

Research Article

Farmer's Knowledge on Utilization of Chemical Fertilizers as Soil Fertility Enhancement Option in Ruhumuro Sub-County, Bushenyi District

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Abstract

The study focused on assessing the farmer's knowledge on utilization of chemical fertilizers as soil fertility enhancement option in Ruhumuro sub-county, Bushenyi district. It was limited to; establishing the local farmers' knowledge on the use of chemical fertilizers, investigating the factors that influence farmers' decisions to utilize chemical fertilizers and establishing the benefits that local farmers achieve from utilizing chemical fertilizers. The study employed a cross-sectional research design and primary data was collected from 200 respondents. the data was analyzed using SPSS version 22.0. The study concluded that farmers had local knowledge on use of chemical fertilizers where they revealed that, fertilizer use is influenced by on agro-climatic conditions and farm characteristics at ($p=.027$), profitability is the principal incentive to adopt fertilizer use at ($p=.021$), fertilizer use ensure high productivity and yields at ($p=.003$). The decisions on fertilizer use has mainly considered credit access and price at ($p=.026$) Fertilizer use alter the soil properties at $p= (.029)$. Fertilizer applied to farmers' crops do not provide optimal economic returns to farmers as ($p=.312$) as non-significant. The study also concluded that there were factors that influence the farmers' decisions to utilize chemical fertilizers. Such as; ownership of land ($p=.022$), labour avialability ($p=.024$), Cost of the fertilizers ($p=.004$) and un-availability of credit services/financial institutions offering services ($p=.028$). Non-significant factors included; farming experience and level of education ($p=.427$, $p=.369$). The study concluded that there were benefits that local farmers achieve from utilizing chemical fertilizers. Such as; Restoration of soil fertility ($\chi^2 = 3.002$, $p=0.021$), Sustainable food production ($\chi^2 = 2.441$, $p=0.001$), Income security ($\chi^2 = 0.871$, $p= 0.010$), Improvement of crop yields ($\chi^2 = 3.123$, $p=0.023$) and Contribute to greenhouse effect ($\chi^2 = 4.211$, $p=0.141$) which was not significant. The study recommends that, there is a need for policymakers and agricultural stakeholders to consider the social, economic, and environmental implications of the widespread use of chemical fertilizers. Constant extension training services on chemical fertilizer use should be done to help farmers use the recommended dosage of fertilizers to avoid environmental degradation due to lack of adequate knowledge on fertilizer utilization. Government should undertake legal reforms to recognize and protect the rights of vulnerable groups to own and use land. They should also put in place mechanisms to ensure that the law is enforced.

Keywords

Knowledge, Chemical Fertilizer, Soil Fertility, Bushenyi District

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1. Introduction

The increase in global population has put environmental threats, on food security and safety at a critical challenge [5, 21]. This has drifted the world agricultural system to be more dependent on chemical fertilizers in order to sustain food supply [7]. The use of chemical fertilizers has risen above 150kg/ha in Asia and Europe [14] with little or no considerations on food safety. This is a call for concern as to the risk factor associated to the use of chemical fertilizers in food crop production [9].

In Africa, over eighty percent (80%) of the nation's food crops are produce by small scale farmers who form the majority of the farming population [5]. They are also referred to as the main feeders of the nation increasing population [22], which is expected to reach some 30 million by 2030 [22]. This implies the number of small-scale farmers is bound to increase, leading to increase in the demand for land. This is placing local soils under pressure in order to produce more food to match home consumption and the ready market [16]. Although more people are venturing into farming activities, low levels of better seeds, fertilizers, and technologies, such as irrigation, but with greater use efficiency and less environmental impact, including fewer greenhouse gas emissions per unit output inputs and inadequate government subsidies are some of the major drawbacks to sustainable crop production in Africa countries [6].

In Sub-Saharan Africa, about sixty percent (60%) of the economically active population works in the agricultural sector [22]. Over eighty-five percent (85%) of the rural population continues to rely on agriculture for their survival [22]. The differences between actual and potential food production are believed to be wide, especially in sub-Saharan agricultural systems where large portions of the land are still under subsistence farming [5]. The present level of chemical fertilizer use in Cameroon stands at 7 to 10 kg/ha, which is still considered very low relative to the above 150kg/ha of other countries in Asia and Europe [12]. This could lead to serious health problems, attributed to inadequate or no knowledge on the use and application of chemical fertilizer in the region and beyond. Future scenarios may be worst if appropriate measures are not considered at this stage [12, 17]). Unavailability of chemical fertilizers affects its usage and food safety [7, 18].

In Uganda, Sustainable Land Management in agriculture is not prioritized, particularly through government policies [19]. Farmers tend to rely on chemical fertilizers as the first choice to improve soil fertility, particularly in high input agriculture experienced in horticultural sector and plantation farming [11]. Knowledge on sustainable land management practices and its utilization in Uganda is limited probably due to lack of land management policy [2]. The increasing population pressure and subsequent land fragmentations had necessitated intensive land use practices by farmers in Ruhumuro sub-county Bushenyi district. This has led farmers to shift from

use of organic fertilizers to chemical fertilizers to improve on their yields but with limited information on the right procedures of using chemical fertilizers which has resulted into adverse health hazards to farmers [2]. This research therefore, was intended to bridge the gap of local farmers' knowledge on Chemical fertilizer usage.

2. Statement of the Problem

Chemical fertilizers are commonly used to enhance soil nutrients to increase agricultural yields [23]. Although using chemical fertilizers provides significant benefits to society, it can be harmful if heavily and improperly used [15, 17]. In general, chemical fertilizers consist of the principal nutrient's essential for plant growth such as nitrogen, phosphorous, and potassium (NPK). Although chemical fertilizer consumption has grown continually over the years, majority of the farmers lack clear information on handling and applying fertilizers hence they end up mishandling them, which results into health hazards [19, 20]. In Ruhumuro sub-county Bushenyi district, majority of the farmers who use chemical fertilizers lack protective gears and do not follow major recommended procedures while applying fertilizers and has resulted into adverse health effects hence affecting the lives of people. Similarly, chemical fertilizers are sold in agri-input shops which are majorly allocated in town than in rural areas and this limits small scale farmers to access these fertilizers since it may require some extra transport costs and time to acquire such fertilizers from a recognized agro-input shops. It was from this basis that research was conducted to assess farmers' knowledge, access to and use of Chemical fertilizers.

The investment in the new supportive technologies such as; streamer nozzles, strip tillage equipment and variable rate applicators, and the availability of markets have not yet yielded many results as anticipated. This implies the technology advances generated through research have not yet translated into increased output productivity and in variably increased the use of chemical fertilizer [1, 3]. This requires that all factor inputs be efficiently and effectively utilized to bridge the gap between actual and potential outputs. Literature available in Uganda shows that research has been done on use of fertilizer but limited to chemical fertilizer handling. However, none of these studies had considered farmers' knowledge on utilisation of chemical fertilizers as soil fertility enhancement option in Ruhumuro sub-county Bushenyi district. This study, therefore, aimed at filling the existing gap.

3. Research Objectives

The general objective of the study was to; assess farmers' knowledge on the utilization of Chemical fertilizers in

Ruhumuro sub-county Bushenyi district. The specific objectives were to; establish the local farmers' knowledge on the use of chemical fertilizers, investigate the factors that influence farmers' decisions to utilize Chemical fertilizers and establish the benefits that local farmers achieve from utilizing chemical fertilizers.

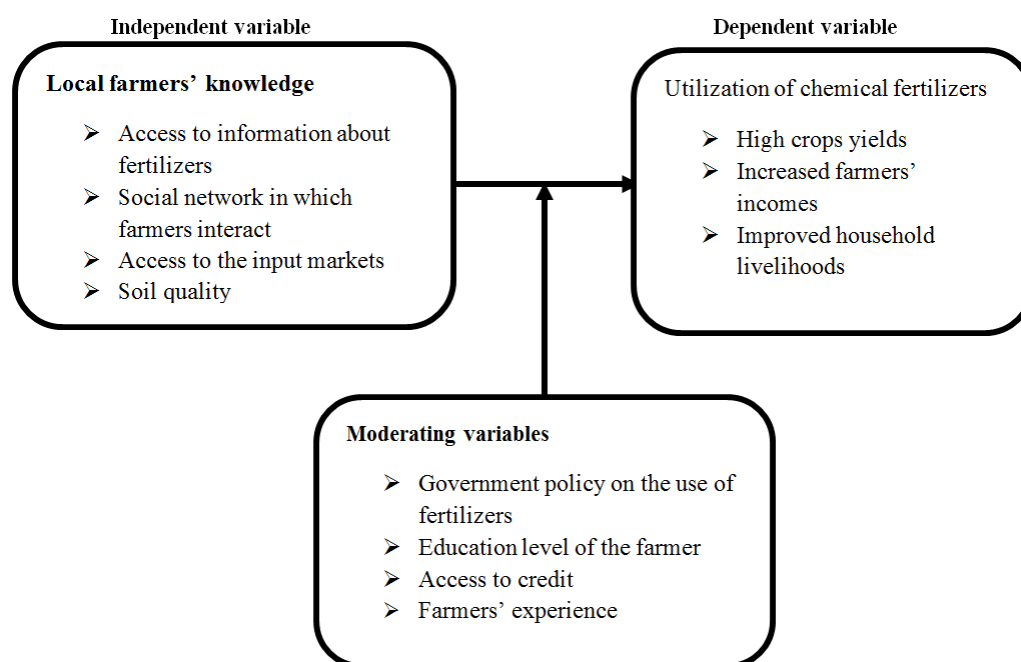
4. Justification of the Study

With increasing global population and environmental threats, ensuring soil fertility enhancement and safety is a critical challenge [5]. This has drifted the world agricultural system to be more dependent on chemical fertilizers in order to sustain food supply [7]. Limited lands for cultivation and inability of farmers to obtain farm inputs and subsidies have pushed farmers to engage in unsustainable practices like slash and burn farming and the excess use of pesticides and chemical fertilizers in order to scale up production in most countries of Sub-Saharan Africa [10, 11]. Although present level of chemical fertilizer use in Uganda stands at 7 to 10 kg/ha, this is still considered very low relative to the above 150kg/ha of other countries in Asia and Europe [14]. This

could lead to serious health problems, attributed to inadequate or no knowledge on the use and application of chemical fertilizer in the region and beyond. Future scenarios may be worst if appropriate measures are not considered at this stage [12]. The use of agro-ecological farm inputs such as chemical fertilizers, natural nutrient cycling techniques, conservation agriculture and machines to scale up production is hindered by ignorance and limited access of farmers to farm inputs (Gizaki et al., 2015).

5. Conceptual Framework

A conceptual framework is defined as a coherent set of concepts, beliefs, values, propositions, assumptions, hypotheses, and principles [24]. A conceptual framework is an analytical tool with several variations and contexts. It is used to make conceptual distinctions and organize ideas. Strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply. It maps out the actions required in the course of the study given his previous knowledge of other researchers' point of view and his observations on the subject of independent variable chemical fertilizer utilization.



Source: Researcher's own construct, 2020

Figure 1. Conceptual framework.

6. Materials and Methods

The study employed cross sectional research design. It involved both qualitative and quantitative approaches of obtaining data. According to [24] maintains that qualitative and

quantitative studies most of the time are employed to in order to capture all data types from the responses. The researcher also intended to use qualitative and quantitative studies because the survey involved the investigation of experiences, events, actions, norms and values from the perspective of those being studied.

The study was conducted in Ruhumuro sub-county

Bushenyi district. Bushenyi District is bordered by Rubirizi District to the northwest, Buhweju District to the northeast, Sheema District to the east, Mitooma District to the south and Rukungiri District to the west. The largest town in the district, Ishaka, is located 75 kilometres (47 mi), by road, northwest of Mbarara, the largest city in the sub-region. The coordinates of the district are: 00 32S, 30 11E.

The study targeted a population of farmers who used chemical fertilizers, extension workers and other community stakeholders.

The sample size was determined using formula by [25] as follows:

$$n = \frac{z^2 pq}{d^2}$$

Therefore the study used 200 respondents

The study a two-stage sampling procedure in selecting farmers; stage one (1) deal with site selection where two (2) parishes were purposively selected based on the prevalence of fertilizer usage. The same criterion for selecting parishes was used to select two villages from each parish as the study sites. Stage two dealt with the selection of farmers in villages where simple random sampling was applied to select 50 farmers per village in each parish. A total of 200 farmers were purposively selected to participate in the semi-structured interviews. Farmers were selected because they were the ones practicing soil enhancement practices (applying chemical fertilizers) to improve on their yields.

Data for the study was obtained from both primary and secondary sources. Under primary source, emphasis was put on the collection of data directly from field surveys via the administration of questionnaire, interviews. Under secondary source the researcher used published and documented sources which will include; documents comprising research works, textbooks, magazines, journals, office records/statistics and the internet. Primary data was collected from farmers, local council leaders and sub county agriculture extension workers. Primary data provided reliable and accurate first-hand information relevant to the current study.

The study used questionnaires and interview guide to collect primary data. Questionnaires were self-administered to farmers who directly participated in agriculture and use fertilizers. Questionnaires were structured and semi-structured in nature with both open and closed questions to capture quantitative responses from respondents. Interview guides were meant to capture information from key informants who were extension agents and community stakeholders.

The quality of the data was maintained by pre-testing the instruments to ensure that they were valid and reliable as this was done by then scrutinizing the instruments by the supervisor to ensure that the terms used were precisely defined and properly understood. The supervisor ensured that correct variables relevant to the study were included in the questionnaire.

The data analysis started after data collection process and continued more systematically after returning from the

fieldwork. This involved the process of bringing order, structure and meaning to the mass collected data. It also involved uncovering underlying structures extracting important variables, detecting any anomalies and testing any underlying assumptions. The Quantitative data from questionnaires was cleaned to eliminate errors, coded and entered into a computer. The coded data was entered and analyzed using the Statistical Package for Social Scientists (SPSS version 22.0). After data processing, it was presented in tables for easy interpretation. The researcher then analyzed data using qualitative and quantitative methods where by frequencies and percentages was generated for easy data analysis. Qualitative data was obtained from interviews and organized into concepts and themes for in-depth understanding of the phenomena.

The ethical clearance was obtained from Bishop Stuart University through Research Ethical committee. Due to sensitivity of some information to be collected, the researcher held a moral obligation to treat the information with utmost propriety. Some respondents were reluctant to disclose some information, the researcher assured them confidentiality of the information given and were told how the report was purely academic/examination purpose. The researcher was obliged to avail a copy of the completed project to the respondents upon their request.

The study was limited by financial difficulties in carrying out the research. This was in terms of transport to the area of the study, typesetting, printing, photocopying and binding research work. However, the researcher endeavored to solicit financial assistance from brothers, sisters and friends. The study was also limited by inadequate time to carry out the study. The study was costly in terms of transport and lunch for the researcher. However, the researcher endeavoured to solicit for help from friends and relatives for funds that helped him to complete the study.

7. Study Results

Respondents during survey were asked their sex, responses were captured and presented in figure 2 below;

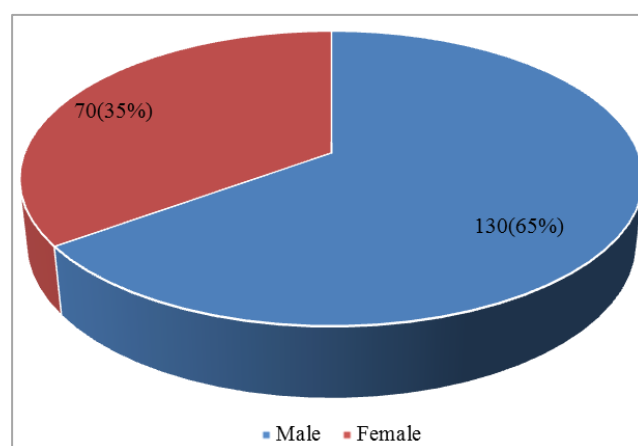


Figure 1. Sex of respondents.

As shown in figure 2 above, 65% of the respondents were males and 35% were female. The dominance of males in the study meant that activities done during fertilizer application are too hectic which could not be done by majority of females.

Respondents during survey were asked their age, responses were captured, analyzed and presented in figure 3;

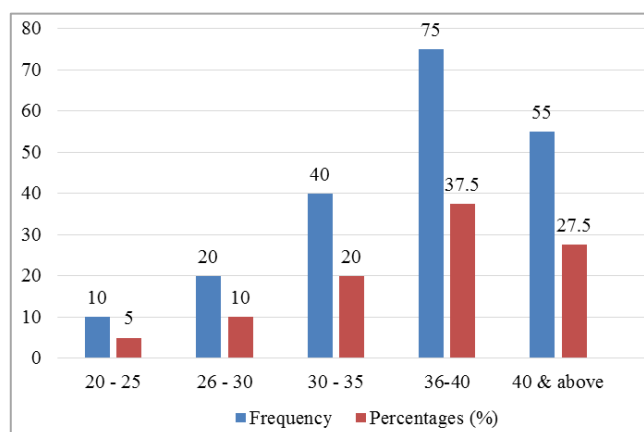


Figure 2. Age group of respondents.

Majority 37.5% revealed 36-40, 27% revealed 40 and above, 20% revealed 30-35, 10% revealed 26-30 and 5% revealed 20-25. The results implied that respondents who were more involved in the study were still in productive age group which meant that they were able to handle cumbersome activities to improve on their crop production.

Respondents were also asked their marital status, responses were also captured and presented in figure 4 below;

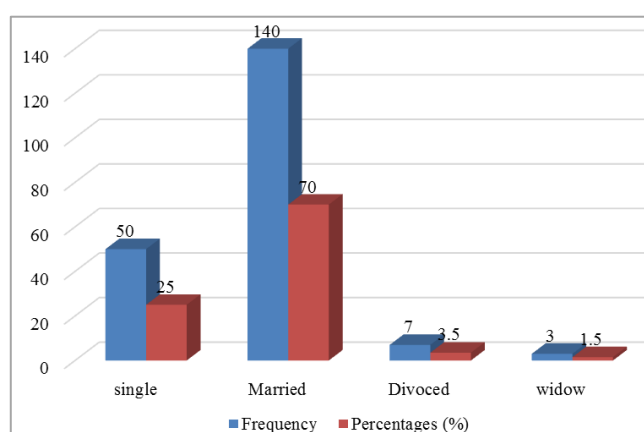


Figure 3. Marital status.

According to the findings in figure 4 above, it was revealed that 70% of respondents were married, 25% were single, 3.5% had divorced and 1.5% were widowed. The result showed that the proportion of married household heads

was higher among utilizers compared to the non-utilizers implying that respondents who are the heads as a result of being married are more likely to adopt chemical fertilizer use. This consistency increases farmers' concern for household welfare, thus increasing farmer participation in the preparation and utilization of chemical fertilizers.

Respondents were also questioned to mention their level of education as presented in figure 5;

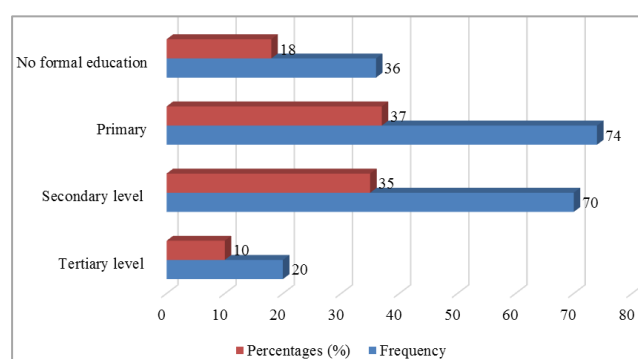


Figure 4. Education level of respondents.

The study results revealed that majority had completed primary level and this was reported by 37%, followed by 35% who revealed to have completed secondary level, 18% had no formal education and the least number of respondents 10% had only finished tertiary level of education.

This might be because educated farmers are more knowledgeable about chemical fertilizer use and the benefits of using it to boost land fertility. Furthermore, the lack of knowledge related to the use of chemical fertilizers in terms of compost preparation was another constraint to farmers. This implied that low skills related to the preparation and use of chemical fertilizer could limit its use, as farmers may face difficulty during fertilizer application. Respondents were further asked on the type of fertilizer commonly used in the area; responses were given, analyzed and presented in the figure 6 below;

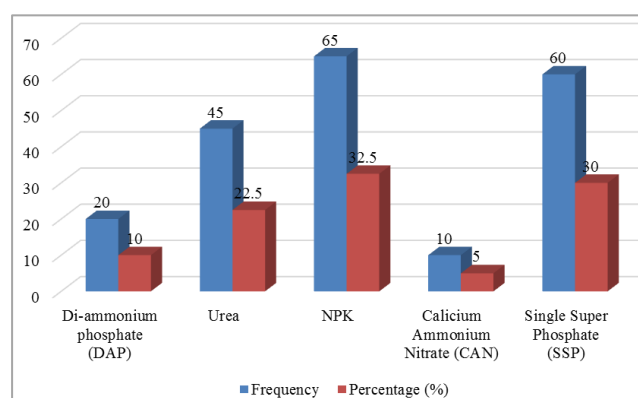


Figure 5. The type of chemical fertilizer used in Ruhumuro Sub-county.

The study results revealed that majority of respondents 32.5% use Nitrogen, Phosphorus and Potassium (NPK), followed by 30% who used SSP, 22.5% revealed use of Urea, 10% revealed use of DAP and 5% revealed use of CAN. Majority of respondents reported that the nitrogen in NPK fertilizer is usefully for helping plants to growth leaves. Phosphorus, by contrast, helps to produce healthy flowers, buds, roots, and fruits. Potassium is used by plants to help sustain overall plant health. The study results revealed that

NPK was the most commonly used fertilizer among farmers in Ruhumuro sub-county. The results implied that use of NPK speeded up the growth of leafy vegetables like spinach, and enhanced leaf quality since certain fertilizer contains chlorophyll component which gives green color to a crop or plant.

Respondents were also asked the common method of fertilizer application used in the study area, responses were captured and are indicated in [table 1](#) below;

Table 1. Common method of fertilizer application used in the study area.

Response	Frequency	Percentage	Cumulative percentage
Use of irrigation water	48	24	24
Foliar spray	04	02	26
Broad casting	78	39	65
Placement method	70	35	100
Total	200	100	

Source data: field data, 2023

The study results revealed that majority of respondents 39% revealed use of broad casting, followed by 35% who revealed use of placement methods, followed by 24% who revealed applying fertilizer through irrigation water and the least number of respondents who revealed use of foliar spray during chemical fertilizer application as this was reported by 2%. Respondents further reported that fertilizer broadcasting is less effective than other methods and that farmers customarily use fertilizer broadcasting, as it is a convenient and less time-consuming practice and partly improves soil fertility. The results implied that the most commonly used broad casting method tend to exhibit lower fertilizer use efficiency compared to other methods, farmers revealed that it covers the expansive areas swiftly and cost effective among farmers unlike other methods.

Respondents were also asked to mention their source of fertilizers used in the gardens, responses were also captured and presented in the [table 2](#) below;

Table 2. Source of fertilizers.

Response	Frequency	Percentage	Cumulative percentage
NGO's	05	2.5	2.5
Fellow farmers	42	21	23.5

Response	Frequency	Percentage	Cumulative percentage
OWC	120	60	83.5
Input suppliers	25	12.5	96
Cooperatives	08	04	100
Total	200	100	

The study results in [table 2](#) revealed that majority of respondents 60% get fertilizers from Operation Wealth Creation (OWC), 21% revealed getting fertilizers from fellow farmers, 12.5% revealed getting it from input suppliers, 4% revealed agricultural cooperatives as their source of fertilizers they use during crop production and 2.5% of the respondents revealed NGO's as their source of fertilizers. The study results implied that majority of farmers used to wait for Operation Wealth Creation to supply them fertilizers at a least cost compared to other sources of fertilizers and this had helped farmers to efficiently utilize fertilizers to improve soil fertility and crop growth. Farmers would wait for OWC because fertilizers used to be supplied to them at subsidized/affordable cost.

Respondents, however were questioned on who offered training on use of chemical fertilizers to them, responses are also indicated in [table 3](#) below;

Table 3. Who provided training on use of chemical fertilizers to them?

Response	Frequency	Percentage	Cumulative percentage
Extension workers	100	50	50
Fellow farmers	60	30	80
Media platforms	05	2.5	82.5
Input suppliers	20	10	92.5
Cooperative officials	15	7.5	100
Total	200	100	

The study results revealed that majority of the respondents 50% revealed that they received training services on chemical fertilizer use through extension workers, 30% revealed training through fellow farmers, 10% revealed training through input suppliers and 7.5% revealed that they received training through agricultural cooperative officials. The re-

sults implied that majority of farmers received training from their fellow farmers due to cheap and easy accessibility as well as getting access to training at their convenient time.

Respondents were asked their local knowledge on use of chemical fertilizers, responses were captured analyzed and presented in table 4 below;

Table 4. Regression output on local knowledge on use of chemical fertilizers.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	18.812	1.763		9.905	.000
Fertilizer use is influenced by on agro-climatic conditions and farm characteristics	2.027	1.033	.138	1.772	.027
Profitability is the principal incentive to adopt fertilizer use	3.011	1.002	.149	2.678	.021
Fertilizers are basically used in high commercial crops like tea and coffee	-.068	.051	-.114	-.741	.312
Fertilizer use ensure high productivity and yields	3.045	1.164	.200	-2.128	.003
Fertilizer applied to farmers' crops do not provide optimal economic returns to farmers	-.183	.021	-.123	-.710	.311
The decisions on fertilizer use has mainly considered credit access and price	2.102	1.048	.177	1.896	.026
Fertilizer use alter the soil properties	2.228	1.187	.146	1.092	.029

Some of the statements were found to be statistically significant and others were non-significant. The significant statements included; Fertilizer use is influenced by on agro-climatic conditions and farm characteristics was significant at ($p=.027$). This had a significant influence on farmer's knowledge to fertilizer use by 2 chances. Profitability is the principal incentive to adopt fertilizer use at ($p=.021$), with 3 increased chances of developing enough knowledge on fertilizer use. Fertilizer use ensure high productivity and yields at

($p=.003$), with 3.045 chances. The decisions on fertilizer use has mainly considered credit access and price at ($p=.026$) by 3 increased chances of developing more knowledge on fertilizer use. Fertilizer use alter the soil properties at $p= (.029)$ with 2 chances of developing more knowledge on fertilizer use. Non-significant statements include; Fertilizer applied to farmers' crops do not provide optimal economic returns to farmers and fertilizers are basically used in high commercial crops like tea and coffee ($p=.312$). This implied that local

farmers knowledge had a statistical significant relationship with use of chemical fertilizers.

Table 5. Regression Model Summary on local farmer's knowledge on use of chemical fertilizers.

Model Summary				
Model	R	R Square	Adjusted R Square	Standard error of the estimate
1	.674 ^a	0.448	0.454	0.75592
Predictors				
Dependent variable: banana production				

The R which is the coefficient of correlation, 67.4% shows that there is a strong relationship between the dependent and independent variables. Since this is a positive relationship which suggests that an increase in the independent variables will lead to an increase in use of fertilizers which was measured using yield per acre. The coefficient of determination shows that 44.8% of the individual independent variables can

be used to predict the knowledge on use of chemical fertilizers because they are good predictors of the model. The adjusted R square is 45.4% implied that the proportion of the dependent variable explained by the independent variables combined in the regression equation determined the positive relationship between variables.

Table 6. Regression output on the factors that influence the farmers' decisions to utilize chemical fertilizers.

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
(Constant)	15.211	0.735			7.512	.000
Ownership of land	2.010	1.123	.121		1.512	.022
Labour availability	1.025	1.201	.158		2.792	.024
1 Farming experience	-.056	.070	-.126		-.796	.427
Cost of the fertilizers	4.066	1.152	.201		-2.273	.004
Level of education	-.193	.214	-.134		-.900	.369
Un-availability of credit services	2.216	1.199	.166		1.083	.028

Regression results on factors that influence the farmers' decision to utilize Chemical fertilizers in Table 6 above. Among the six hypothesized factors, four were found to be statistically significant. These included; Ownership of land ($p=.022$), labour availability ($p=.024$), Cost of the fertilizers ($p=.004$) and un-availability of credit services/financial institutions offering services ($p=.028$). Non-significant factors included; farming experience and level of education ($p=.427$, $p=.369$). The results implied that majority of the factors had a significant influence on farmer's decision to use chemical fertilizers.

Respondents were further questioned during survey for how long have they been using chemical fertilizers in farming, responses were captured and indicated in the figure 7 below;

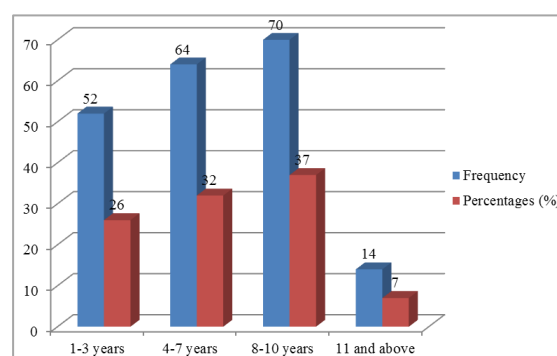


Figure 6. How long have they been using chemical fertilizers in farming.

The study results revealed that majority of respondents 35% had spent 8-10 years using chemical fertilizers in farming, followed by 32% who revealed 4-7 years, 26% revealed 1-3 years, 7% revealed 11 years above. Majority of respondents reported 8-10 years which implied that this would quickly adopt the use of chemical fertilizers because they already know the realized benefits of applying it unlike farmers with few years. This further improves the farmer's knowledge on use of chemical fertilizers. The results implied that the more the years spent in farming, the greater the knowledge farmers had in utilizing chemical fertilizers.

Respondents were asked whether they recorded changes in income before using chemical fertilizers, responses were captured, analyzed and presented in figure 8;

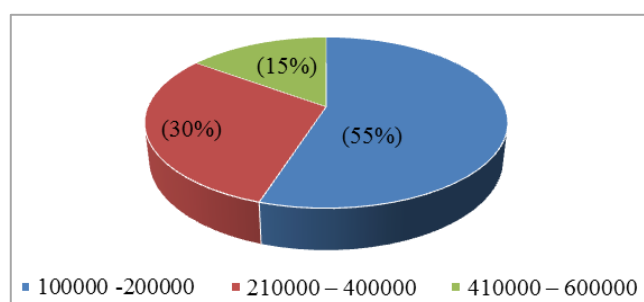


Figure 7. Income before chemical fertilizer use.

The study results revealed that majority of the respondents revealed slight change in income before fertilizer use; 55% revealed 100,000-200,000, followed by 210,000-400,000, 4100,00-600,000. The study results implied that production without fertilizer use give rise to slight change in income.

Respondents were further asked their change in income after using chemical fertilizers; responses were captured and presented in figure 9;

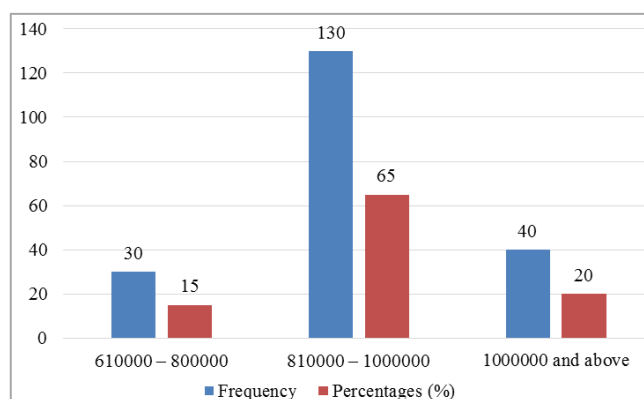


Figure 8. Income after chemical fertilizer use.

The study results revealed that majority of the respondents 65% mentioned 810,000-1000,000, followed by 1000,000

and above and finally the least number of respondents 15% revealed 610,000-800,000. The study results implied that use of chemical fertilizers in farming yield a drastic change in income.

Respondents were asked the benefits realized from using chemical fertilizers; responses were captured, analyzed and presented in table 7 below.

Table 7. Regression output on benefit achieved through utilization of chemical fertilizers.

Benefits	Chi-square (χ^2)	Df	Asymp. Sig. (p<0.05)
Restoration of soil fertility	3.002	2	0.021
Sustainable food production	2.441	3	0.001
Income security	0.871	2	0.010
Improvement of crop yields	3.123	2	0.023
Contribute to greenhouse effect	4.211	1	0.141

It is therefore safe to conclude that farmer's knowledge on chemical fertilizer use had a great influence on production basing on benefits presented in the table 7. The chi-square results are given below;

Restoration of soil fertility ($\chi^2 = 3.002$, $p=0.021$), Sustainable food production ($\chi^2 = 2.441$, $p=0.001$), Income security ($\chi^2 = 0.871$, $p= 0.010$), Improvement of crop yields ($\chi^2 = 3.123$, $p=0.023$) and Contribute to greenhouse effect ($\chi^2 = 4.211$, $p=0.141$) which was not significant.

8. Discussion of Results

The study results revealed that fertilizer use ensures high productivity and yields at ($p=.003$). According to regression output, farmers with adequate knowledge on chemical fertilizer use had 3.045 chances of improving their yields as this was attributed to soil fertility replenishment. Respondents further revealed that crop fields where chemical fertilizers were used, had higher yields than fields where chemical fertilizers were not used. This finding disagrees with [20] who noted that fertilizer is not only scarce but also information related to its use and the potential increases in productivity that it could bring about are unknown, thereby reducing the incentive for its use by farmers.

Fertilizer applied to farmers' crops do not provide optimal economic returns to farmers ($p=.312$) as this was not significant. Respondents further reported that that adoption of chemical fertilizer use would not bring optimal economic returns since the average yields from such small portions of land would not cover up all the costs involved in the man-

agement of different enterprises. This is why farmers normally opt to use organic fertilizers due to their easy accessibility. This can be compared with Jönsson, *et al.*, [10] who pointed out that the use of fertilizers is not always profitable. Firstly, it is an expensive investment, which means increased costs. Secondly, if it is not handled properly, fertilizers will have a negative impact on the nature and can be harmful for both animals and human's health when not used carefully.

The study results established that fertilizer use is influenced by agro-climatic conditions and farm characteristics at ($p=.027$). This had a significant influence on farmer's knowledge to fertilizer use by 2 chances. Fertilizers can be used in different agro climatic zones depending on the level of nitrogen flush hence some farmers lack knowledge on which type of fertilizers should be applied in the soil to improve on its fertility. This finding is consistent with Benson *et al.*, [3] who pointed out that in most agro-ecological zones, extension workers recommend the use of organic manure and/or triple super phosphate (TSP), calcium phosphate (CAP) or rock phosphate, but not di-ammonium phosphate (DAP), which is soil acidifying being nitrogenous.

The study findings indicated that ownership of land (rights to own and use land) was among the significant farm-based factors that influenced farmer's decision utilize chemical fertilizer since the p -value was less than 0.05 (0.022). Insecure land rights can discourage farmers from investing in their land or making long-term improvements, including the use of chemical fertilizers. This finding can be compared with [8] who in their study reported that 'assurance effect' of secure land tenure provides a guarantee to farmers to invest in both short and long-term soil management practices because it eliminates threats of appropriation.

The study findings also revealed that labour availability influences farmers' decisions to utilize chemical fertilizers at significant level of ($p=.024$). Respondents further reported that farm labor is a major production cost in agriculture and that lack of sufficient labor on the farm is theorized to impede the use of various soil fertility management practices. The study finding is consistent with [13] who explained that in many developing countries, families continue to provide the bulk of farm labor for most farm operations because many households cannot afford to hire wage laborers. This implies that the lack of family labor coupled with family liquidity constraints to hiring labor greatly affect the adoption of soil fertility enhancement technologies/practices.

The study findings further revealed that farming experience affects farmers decision to utilize chemical fertilizers though not significant at ($p=.427$). Respondents further explained that as a farmer grows older, (s)he has generally been exposed to more ideas, information and production practices thereby being more efficient and accurate in judgment of expected benefits. This finding is in line with Emana *et al.*, [4] who found out those farmers' experiences positively influence adoption soil conservation practices. However, other meta-analyses on the same parameter have found quite in-

conclusive results and found out that experience in farming was not significantly related to adoption of fertilizer use, thus calling for further studies.

The study discovered that there benefits that local farmers achieve from utilizing chemical fertilizers in Ruhumuro Sub-county, Bushenyi district; the study findings established that restoration of soil fertility was realized from utilizing chemical fertilizers at ($\chi^2 = 3.002$, $p=0.021$). Farmers reported that an important prerequisite to produce high quality crops, with good growth, is to add nutrition. When growing crops on the same plot year after year it is necessary to add extra nutrients to the soil to restore the nutrient level. The study finding is consistent with Morris, *et al.*, [15] who revealed that fertilizers contain nutrients for plants and is used to strengthen and maintain the soil's ability to improve the fertility. The same authors explained that Fertilizers often include phosphorus, potassium and nitrogen, which are three nutrients that help to restore the soil fertility.

The study results revealed that sustainable food production has always been achieved by farming households through use of chemical fertilizers. This finding can be compared with Emana *et al.*, [4] who reported that increase in consumption of fertilizers has largely been responsible for bringing about a progressive improvement in the production of food grains in the country. The green revolution would have remained a dream only, but, for increasing use of fertilizers. Unstinted efforts by all stake holders like farmers, and industries supplying various inputs and government as well as its agencies during the last three decades have helped in achieving the goal of self-sufficiency in food grains production.

The study findings also revealed that improvement of crop yields is also realized due to fertilizer utilization. The study finding is in line with [14] who confirmed that agricultural growth achieved over the past decade was through land area expansion as opposed to yield increases per unit area of land. MoFA report also revealed that to achieve a sustained growth in agricultural productivity among smallholder farmers; the application of appropriate agro inputs cannot be under-estimated.

9. Conclusion

The study concluded that farmers had local knowledge on use of chemical fertilizers where they revealed that, fertilizer use is influenced by on agro-climatic conditions and farm characteristics at ($p=.027$), profitability is the principal incentive to adopt fertilizer use at ($p=.021$), fertilizer use ensure high productivity and yields at ($p=.003$). The decisions on fertilizer use has mainly considered credit access and price at ($p=.026$) Fertilizer use alter the soil properties at $p=$ (.029). Fertilizer applied to farmers' crops do not provide optimal economic returns to farmers as ($p=.312$) as non-significant statement.

The study also concluded that there were factors that in-

fluence the farmers' decisions to utilize chemical fertilizers in Ruhumuro sub-county, Bushenyi district. Such as; ownership of land ($p=0.022$), labour availability ($p=0.024$), Cost of the fertilizers ($p=0.004$) and un-availability of credit services/financial institutions offering services ($p=0.028$). Non-significant factors included; farming experience and level of education ($p=0.427$, $p=0.369$).

The study concluded that there were benefits that local farmers achieve from utilizing chemical fertilizers in Ruhumuro Sub-county, Bushenyi district. Such as; Restoration of soil fertility ($\chi^2 = 3.002$, $p=0.021$), Sustainable food production ($\chi^2 = 2.441$, $p=0.001$), Income security ($\chi^2 = 0.871$, $p=0.010$), Improvement of crop yields ($\chi^2 = 3.123$, $p=0.023$) and Contribute to greenhouse effect ($\chi^2 = 4.211$, $p=0.141$) which was not significant.

10. Study Recommendations

There is a need to reduce the cost of chemical fertilizers and farmers be supplied with fertilizers at subsidized cost. This will make these inputs more affordable and accessible to farmers in Ruhumuro sub-county, Bushenyi district. There is a need for policymakers and agricultural stakeholders to consider the social, economic, and environmental implications of the widespread use of chemical fertilizers. This could include the development of policies and regulations to promote the sustainable use of chemical fertilizers, as well as the promotion of alternative approaches such as agroforestry and organic farming.

Constant extension training services on chemical fertilizer use should be done to help farmers use the recommended dosage of fertilizers to avoid environmental degradation due to lack of adequate knowledge on fertilizer utilization. Government should undertake legal reforms to recognize and protect the rights of vulnerable groups to own and use land. They should also put in place mechanisms to ensure that the law is enforced.

Abbreviations

CAP	Calcium Phosphate
DAP	Di-Ammonium Phosphate
Kg/ha	Kilogram Per Hectare
MoFA	Ministry of Finance and Agriculture
NGOs	Non-Governmental Organizations
NPK	Nitrogen, Phosphorous, and Potassium
SPSS	Statistical Package for Social Scientists
SSP	Single Super Phosphate
TSP	Triple Super Phosphate

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Conflicts of Interest

The authors declare no conflicts of interest.

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