Different factors influencing fertilizers adoption in agricultural production in Rwanda

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Abstract

Rwanda is facing low agriculture growth rate and this low agricultural growth rate could be attributed to low level of productivity due to various factors of production including land and access to agricultural inputs .The decline of land productivity is caused by over cultivation of the same piece of land continuously without giving it a chance to regenerate its fertility. The use of intensive farming methods to improve yields has gained support from the government. The government of Rwanda has taken various measures to promote fertilizer use like discounting its price, opening up the market to private sector, supporting policies and laws. Despite efforts to promote fertilizer use, adoption of fertilizer by the farmers is remaining low. Our study was to find out the factors that influence adoption of fertilizers, identify the socio-economic characteristics of farmers, and the challenges that farmers face in adoption of fertilizers. A survey was conducted in the eastern part of Rwanda in the year 2018 to investigate the different factors influencing fertilizer adoption by farmers. A sample of 80 people was selected. Where 10 people were face to face interviewed and for 70people questionnaire-interview was used to collect data .a sample was selected randomly and a statistical software SPSS was used to analyze data. The study has shown that fertilizer adoption is influenced by gender, educational level and age of the farmer, land size, land ownership marital status and socio-economic features of the farmers. Extension service was the main factor to influence adoption of fertilizer by the farmers.

Key words: adoption, agriculture, factors, fertilizers, Rwanda

I. INTRODUCTION

Since the mid-1960s, 50-75% of the crop yield increases in non-African developing countries have been attributed to fertilizers (Viyas, 1983) Fertilizer also complements other major inputs and practices e.g.: improved seeds, better water control, proper agricultural practices that have had the greatest impact on yield. Soil nutrient depletion is a common consequence of most African agriculture (Tomislav Hengl, 2017) .The government of Rwanda has put food security among its major national priorities (worldbank, 2016). In this country's context, agricultural intensification must be the main stay of any sustainable agricultural policy. Security of land for large-scale farming; very high demographic growth, persistent food shortages since the 1980s and low level in income generated by other sectors of the national economy make it imperative to use intensive methods for agriculture. This intensification must be aimed at boosting production, productivity and producers' incomes (Cantore, 2010). Fertilizers constitute one of the most important inputs for the agricultural sector (Worldbank, 2013) . The ministry of Agriculture, Livestock Resources attaches primordial importance to the use of agricultural inputs in general, with a special emphasis on fertilizer. In Rwanda, the use of fertilizers falls far short of the norm for East Africa (MINAGRI, JOURNAL, 2009). In a context of an increasing population, seriously diminishing soil fertility, and limited contributions from manure and other organic sources, the solution must be to increase chemical-fertilizer inputs to Rwanda agriculture. To ensure this increase, bottlenecks must be removed all along the marketing and production chain for fertilizer- from importing and marketing to agricultural extension. From 1990s, the Rwanda government removed import taxes on fertilizer imports and gave responsibility for fertilizer marketing to the private sector; and, starting in 2000, a World Bank financed project begun promoting fertilizer imports and marketing. In addition, an important report documenting the profitability of fertilizer use by region and crop has appeared (MINAGRI, JOURNAL, 2009).The Government of Rwanda (GOR) has proposed the following actions and policies aimed at enhancing the use of improved farm inputs:1. Identify the potential for fertilizer use by agro-ecological zones (the most fertilizer responsive crops and varieties and the most effective types of fertilizer for each zone).2. Promote an increased supply (imports) of fertilizer progressively from the current annual average of 4,000 tons to 10,000 tons within five years. 3. Reinforce farmers' technical capacity to use fertilizers through extension programs.4. Reinforce farmers' interest in and access to fertilizers (by improving the credit system, improving markets for high value crops, etc.).5. Create an environment which encourages private sector fertilizer marketing (importation, distribution, etc.) through the reduction of import and sales taxes and improvement in

the physical infrastructure (roads, stores, etc.) to make the business profitable. Agriculture shall be a priority for government budgeting in order to achieve food security and using agriculture for growth and poverty reduction (world bank;2008).the agriculture sector can provide a substitute for welfare system in those countries unable to provide unemployment insurance or other types of social services for retiring workers and employees who lose their jobs during structural change or income shocks .the agricultural sector embodies many activities in which majority of the population can be employed .agriculture gives up the processing ,storing selling, transporting and financing prices giving way to a more complex specialized and integrated process (Davis and Golbeg ;1957; Newman ;1989;Holt and pryor ;1989;FAO; 1997). There is low use of fertilizers, pesticides and other agricultural inputs .this contributes little to long term fertility management .the consumption of fertilizer in Rwanda was estimated at the level of 10.9 kg/ha in 2016 which is lower compared to 19.7 kg/ha 2015 (a reduction of 44.91%) (knoema, 2016) and is lower than that in the region . it has been estimated that the average fertilizer application in sub Saharan Africa is a mere 7kg/ha compared to levels of 200kg of N/ha in most OECD countries.(MINAGRI ;2009).For Rwanda, the average of fertilizer application is 10tons of manure at the second ploughing time, add 250kg of NPK 17, 17, 17 per hectare or 100kg of DAP 18,46,0 at the time of sowing or after emergence, 45 days after sowing, 50 -100kg of urea is applied .in the acidic soil, apply 2.5 tons of lime per hectare (Agenda Agricole, 2010).

II. METHODOLOGY

This study was designed in the form of survey targeting farmers and was about to assess what factors affecting fertilizer adoption in agriculture production .We used a combination of simple random and purposive sampling methods.The study was carried in Nyagatare district, Eastern province, its annual rainfall is around 827mm/an, and Elevation of 1414m, its latitude is: $1^0$18’0.00”S, 30^0 19’30.00’’E, Longitude is: 30.3250m.

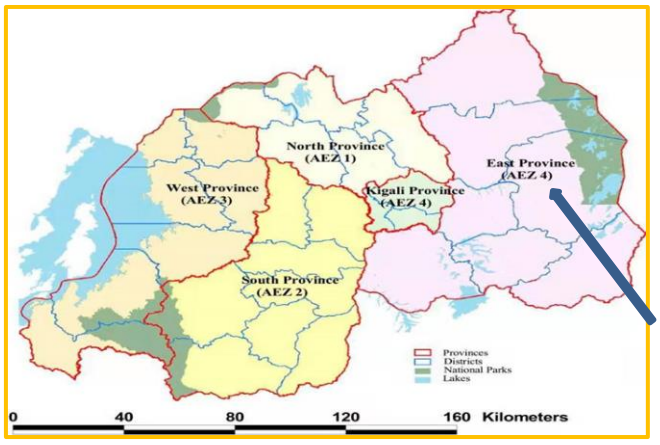

Figure1.Subdivision of the major agro ecological zone in Rwanda (FAO)

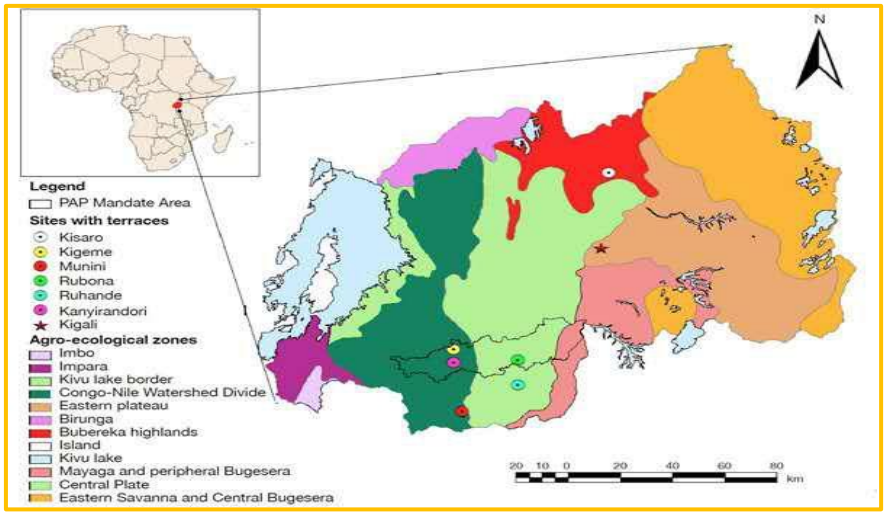

Figure2.Location of Rwanda within Africa (pascal N.rushemuka, 2013)

A questionnaire was prepared and distributed to the interviewers where10 among 80 individuals of the sample were face to face interviewed, and then we used a statistical package for social sciences(SPSS) to analyze.The targeted population in this research was made up with various crops producers. The profiles of the respondent are qualitatively and quantitatively analyzed in the sense that both qualitative and quantitative data are analyzed given that the questionnaire itself comprised both objective and subjective sections .as such objective responses are analyzed quantitatively while descriptive (subjectively) data are analyzed thematically. However, both types of data, because they are corroborative and are responding to the same question, are therefore treated simultaneously.

III. RESULTS

3.1.GENDER OF THE FARMERS

Agricultural activities in Rwanda are performed by both male and female but the degree of involvement varies across crops depending on whether they are cash crops or food crops (Chantal Ingabire, 2018).our study found that the majority of growers was female and counts 60.0% and male counts 40%.The fertilizer use is higher adopted by male than female and this contribute to the low productivity because the big number of farmers (female) doesn't use fertilizers.The survey has shown that the percentage of male growers who use fertilizer is 27.5% while for female growers is 22.5%. A chi-square was used to test a difference in proportion of fertilizer use across male and female farmers. Findings showed that the difference was significant at 5% level of significance.

Table 1.farmers division by their gender (survey 2018)

Gender of respondent

		Frequency	%
Valid	Male	32	40.0
	Female	48	60.0
	Total	80	100.0

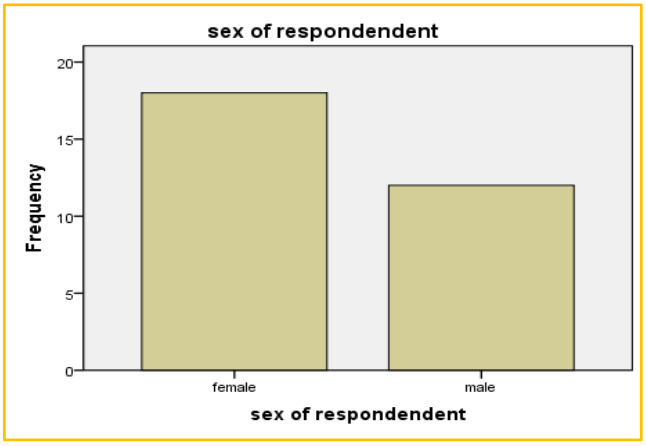

Table 2.relationship between gender and fertilizer use by the farmers (survey 2018)

Gender of respondent and fertilizer use

		Fertilizer use		Total	Chi-square test
		Yes	No		
Gender	male	22(27.5%)	10(12.5%)	32(40%)	0.005
	female	18(22.5%)	30(37.5%)	48(60%)	
Total		40	40	80(100%)	

3.2.AGE GROUP OF THE FARMERS

The age group of the respondents has an important implication on the performance of farming activities by a given family. This is because it influences decisions that a farmer makes in carrying out various operations .it has been documented that young people are more likely to take risks associated with innovation compared to older farmers (Rogers, 1983; Alavalapati etal, 1995; (RA Corner Thomas, 2015).

Table 3.farmers division per age group(survey 2018)

Age group of respondent

		Frequency	%
Valid	20-29 years	18	22.5
	30-39 years	16	20
	40-49 years	35	43.75
	50 years and above	11	13.75
	Total	80	100.0

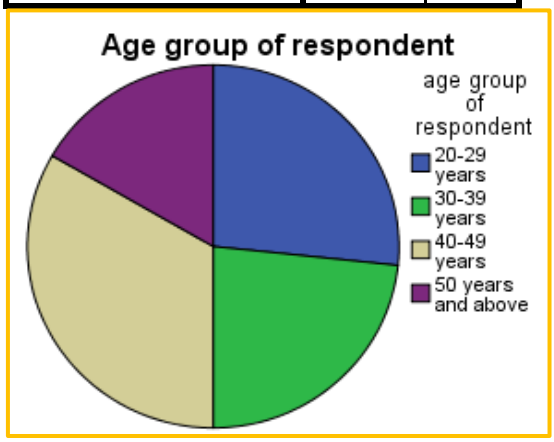

Figure 4.pie chart of farmers division by their age group(survey 2018)

From this study, farmers were categorized into four (4) major age groups of ten years of interval each group; 20-29, 30-39, 40-49 and 50 and above. Youngest growers 20-29, youthful growers 30-39, 40-49 and old farmers 50 and above. Findings have shown that the largest number of respondents fell into the age group of 40-49 that makes up 43.75% of the respondents. It is followed by age group of 20-29 which makes 22.55%, 30-39 makes up 20% and the smallest group is lying between 50 and above which makes 13.75% of the total respondents. A chi-square test was used to test the difference in proportions of fertilizer use across age of respondents have shown that the difference was significant at 5% level of significance.

Table 4.relationship between age group of farmers and fertilizer use (survey 2018)

Age group of respondent and fertilizer use

	Fertilizer use		Total	Chi-square test
	Yes	No		

age group	20-29 years	11(13.75%)	8(10%)	19(23.75%)	0.005
	30-39 years	9(11.25%)	7(8.75%)	16(20%)	
	40-49 years	13(16.25%)	20(25%)	33(41.25%)	
	50 years and above	5(6.25%)	7(8.75%)	12(15%)	
Total		37	43	80(100%)	

3.3.MARTIAL STATUS OF THE FARMERS AND FERTILIZER USE

As shown from the representation below the largest number of respondents is married that makes up 63.75% of the total respondents, 15% of respondents are single, 13.75% widowed and 7.5% are separated .The results indicated that the majority (63.75%) of the growers are married. This means that married people who may engage in the practice of farming for the needs of their families are more than others and are likely to use more fertilizer than widowed, single and separated as it is shown; it makes up 28.75% of the total respondents. A chi-square test was used to test the difference in proportions of fertilizer use across marital status of the respondents. Findings showed that the difference was not significant at 5% level of significance.

Table 5.marital status and fertilizer use by farmers (survey 2018)

marital status of the respondent and fertilizer use

		Frequency	Yes/%	No/%	%
Valid	Single	12	7(8.75%)	5(6.25%)	15
	Married	51	23(28.75 %)	28(35%)	63.75
	widowed	11	4(5%)	7(8.75%)	13.75
	separated	6	2(2.5%)	4(5%)	7.5
	Total	80	36(45%)	44(55%)	100

3.4.EDUCATIONAL LEVEL OF THE FARMERS AND FERTILIZER USE

Educational level of the farmers plays a great role in influencing the level of crop management. Education or literacy enables farmers to seek, obtain and process information on the improved crop management practices or technologies (RA Corner Thomas, 2015).The results showed that 50% of the respondents have a primary level of education .26.25% secondary level of education, 17.5% never attended any formal education program and only 6.25% of the respondents have a university level of education and they all use fertilizers. The level of literacy of farmers in nigeria highly affects agriculture practice (Okpachu, 2014)The higher education level the higher influence on agriculture production (increase local food availability ,farmer income and sustainability of agricultural practice (world, 2010) unfortunately their level of participation is low. Knowledge about agriculture focused on women is very crucial (Gwivaha, 2015) The findings indicate that most of respondents have learnt and this means that farmers have capability to utilize extension advisory information from the government, NGOs or the fellow farmers on the use of improved technologies. A chi-square test was used to test the difference in proportion across level of education of respondent. Findings showed that the difference was not significant at 5% percent level of significance.

Table 6.relationship between education level and fertilizer use by farmers (survey 2018)

Educational level of respondent

		Frequency	yes	no	%
Valid	never attended	14	5(6.25%)	9(11.25%)	17.5
	Primary	40	18(22.5%)	22(27.5%)	50
	Secondary	21	12(15%)	9(11.25%)	26.25
	University	5	5(6.25%)	0	6.25
	Total	80	38	42	100

3.5.SOCIO-ECONOMIC CHARACTERISTIC OF FARMERS

Socio-economic characteristics of the farmers are the major factors that can influence the level of agricultural practices, yield and total income of the farmers.

3.5.1.FARM SIZE

The total amount of agricultural inputs and the cost can depend on farm size.our study showed that most of the farmers who use fertilizer are those who have big farms and those who have the smaller land use fertilizer at low level.We have grouped the size of land of the farmers into three groups; less than 0.5 ha, 0.5-1ha and 1-2ha .from the findings farmers with land size of 0.5-1ha highly use fertilizers and count 50%, farmers with land size of 0.5-1ha count 31.25 % and farmers with land size less than 0.5ha count 18.75%. in china approximately 0.1 ha for each parcel is directly associated to the overuse of agricultural chemicals (Yiyun Wu, 2018) A chi-square test was used to test the difference in proportion of fertilizer use across land size of the respondent. Findings showed that the difference was significant at 5% level of significance.the size of farms should not have been a problem on production if farmers had intensive access on agricultural inputs like fertilizers (Carr, 2015).

Table 7.relationship between land size and fertilizer use by farmers (survey 2018)

		Fertilizer use		Total	Chi-square test
		Yes	No		
land size	< 0.5 ha	6(7.5%)	9(11.25%)	15(18.75%)	0.001
	0.5-1ha	18(22.5%)	22(27.5%)	40(50%)	
	1-2ha	18(22.5%)	7(8.75%)	25(31.25%)	
Total		42(52.5%)	38(47.5%)	80(100%)	

3.5.2.LAND OWNERSHIP

From the findings it has been shown that people who own their lands are those who use fertilizer and count 46.25% of respondents whereas those hire or rent the land are less to use fertilizer and count 10% of the respondents anyone to invest in a part of land wants to make sure that will benefit from the all kinds of efforts and sacrifices, investments of labor, capital ,materials on that land will bring benefit (Lawry, 2015) .A chi-square test was used to test the difference in proportion of fertilizer use across land ownership of respondent. Findings showed that the difference was not significant at 5% level of significance.it is not only the shortage of land that can affect the output of agriculture but the land tenure, lack of proper land ownership and lack of improved agricultural technology can influence as it has revealed in Ethiopia,Namibia,Bangladesh and other sub-Saharan Africa and south Asian countries (Shimelles Tenaw, 2009).

Table 8.relationship between land ownership and fertilizer use by farmers (survey 2018)

Land ownership and fertilizer use

		Fertilizer use		Total	Chi-square test
		Yes	No		
Land ownership	yes	37(46.25%)	15(18.75%)	52(65%)	0.295
	No	8(10%)	20(25%)	28(35%)	
Total		45(56.25%)	35(43.75%)	80(100%)	

3.5.3.SOIL FERTILITY

The fertile soil has many properties such as rich in nutrient necessary for basic plant nutrition, including N, P, and K also contain sufficient minerals element for plant nutrition including sulfur, zinc, boron manganese etc. and also contain soil organic matter improves soil structure and soil moisture retention. Because of over cultivation of piece of land, soil erosion, growth of plant can cause a decline of nutrient, minerals, and soil organic matter within the soil. So in order to retain the fertility of soil, the advises are available for farmers like conservation, tillage, crop rotation and use of legumes, soil cover , crop residues, organic fertilizers like manure and compost, and inorganic fertilizer application (FAO 2006) .The findings showed that 83.75% of the farmers at survey area confirmed that their soils are not enough fertile to sustain high crop productivity while 16.25 % confirmed that their soil is fertile as it is shown in the table above.

Table 9.distribution of respondent views on soil fertility(survey2018)
Soil fertility

		yes	no	Total (%)
Valid	Soil fertility	13(16.25%)	67(83.75%)	80(100)

3.5.4.LOSS OF SOIL FERTILITY

The knowledge of the causes of soil fertility decline is a big step towards formulation of solutions for alleviating the problem. Farmers in this survey area were asked to state ways through which their soils loose fertility. Findings showed in the table 10 below that 46.25% of the respondent answered that the soil lose its fertility because land has been continuously ploughed,35% because of soil erosion while 15% respondents that there are some other different factors lead to loss of soil fertility growing crops,soil erosion and leaching are the main factors of soil nutrients decline.organic matter can mainly lost from the soil through continuous cropping with crop debris removal or burning and frequent tillage (government, 2017) . Most agriculture activities on sloping landscapes increase the potential for soil erosion and it requires long time to recover the eroded land (Al-Kaisi, 2002).According to this survey, fertilizer application has to be taken into consideration as one way to regenerate soil fertility.

Table 10.respondents view on the ways through which soil fertility declines

Loss of soil fertility

		frequency	%
Valid	continuously ploughed	37	46.25

	Soil erosion	28	35
	Others	15	18.75

3.5.5.MEASURES TO IMPROVE SOIL FERTILITY

Different measures can be taken to regain the fertility of the soil; some of them are use of different fertilizer (organic and inorganic fertilizer), crop rotation and others. In this survey farmers were asked about what measure they use to improve their soil fertility. Findings showed that 47.5% of the respondents do not use farm yard manure to improve soil fertility, 13.75% of the respondent use crop rotation, 17.5% of the respondent don't use any method and the smallest number of respondent which count 8.75% use chemical fertilizers.measures like crop rotation,choice of adapted crop varieties,legume cover crops,tillage,weed control can improve soil fertility but additional of other inputs like fertilizers is also needed (Martens, 2004).

Table 10.respondents view on the ways through which soil fertility declines

Measures taken to improve soil fertility

		Frequency	%	Total %
Valid	use of farm yard manure	38	47.5	
	crop rotation	11	13.75	
	use of chemical fertilizer	7	8.75	
	None	14	17.5	
	Total	80		100.0

3.5.6.FERTILIZER ACCESSBILITY

Fertilizer accessibility is the major factor in fertilizer application. Many farmers do not use fertilizer because is difficulty for them to access on it.

Findings presented in the table 12 above showed that the majority of farmers do not access on fertilizer easily and count 83.3% of the total respondent while 16.7% of respondent are only ones who responded that it is easy for them to access on fertilizer.

Table 12.respondents view on fertilizers accessibility (survey 2018)

Fertilizer accessibility by respondent

		Frequency	%	Cumulative %
Valid	easy	23	16.7	
	difficult	57	83.3	
	neutral	80		100.0

3.5.7.WAYS TO OBTAIN FERTILIZERS

The government of Rwanda has developed a policy to give a loan of fertilizer to the farmers in order to ease them to access on fertilizer and to attract farmers to adopt chemical fertilizer use because the fertilizer that we use are imported but remain of high price. The farmers are supposed to pay back fertilizers after selling what they harvested. The government is encouraging farmers to make cooperatives where access on fertilizer may be easy for them. (MINAGRI2005). The size of Rwanda's fertilizer market is now more attractive to the private sector to ensure the efficiency accessibility (reduced capital, delivery ,storage and lower the cost to the

smallholder farmers) the government also developed programs to increase awareness and credit for farmers in partnership with private sector players and donors then it can as importer and distributer (Minagri, 2012).Findings shown in the table 13 above showed that the majority of the respondents which make 43.75% do not have any way to obtain fertilizer (do not use fertilizer), 13.75% of respondents obtain fertilizer through purchasing and 16.25% of the respondents obtain fertilizer by loan from government. This shows that the fertilizer adoption is still low.

Table 13.distribution of respondent views on ways to obtain fertilizer (survey 2018).

		Frequency	%	Cumulative %
Valid	purchase	11	13.75	13.75
	Loan	34	16.25	16.25
	None	35	43.75	43.75
	Total	80		100.0

3.5.8.EXTENSION SERVICE

Extension services are the flow of information from the extension agent to the farmers . The ministry of agriculture is the major source of agricultural information (extension services). Therefore it is hypothesized that contact with extension workers will increase farmer's likelihood of adopting new technologies like fertilizer application. Good extension programs and contacts with producers are the key aspect in technology dissemination and adoption (Danso-Abbeam G. , 2018).During our survey, the farmers were asked to state the number of times they receive or they meet with extension agent in a given period. Findings were presented in table 14 above and showed that the majority of farmers who received the extension services use fertilizers and count 27.5% and those who do not receive extension services their level of fertilizer use is low and count 15%. 16.25% they don't receive extension services but they can use fertilizer while the big number 57.5% of the farmers don't get extension services and doesn't use fertilizers. A chi-square test was used to test the difference in proportion of fertilizer use across extension services. Findings showed that the difference was not significant at 5% level of significance.

Table 14.relationship between extension service and fertilizer application (survey 2018)

Extension services and fertilizer use

		Fertilizer use		Total	Chi-square test
		yes	no		
Extension services	yes	22(27.5%)	12(15%)	34(42.5%)	0.002
	no	13(16.25%)	33(41.25%)	46(57.5%)	
Total		35(43.75%)	45(56.25%)	80(100%)	

3.6.MAJOR CHALLENGES TO THE FERTILIZER USE BY FARMERS

Many of the respondents said that fertilizer is very expensive that is why they do not use fertilizers and those are counting 46.25% of the total respondents, 30% represent those who said that they do not use fertilizer because of limited knowledge on fertilizer use and application and 23.75% of respondents said that they do not use fertilizer because fertilizer is not readily available. High cost of investment ,inadequate physical infrastructure,insufficiency storage facilities,limited funding by the government and private sectors low income of farmers to purchase agricultural inputs and lack of awareness by farmers on better farming methods are the major challenges to the agriculture in africa and rwanda (Ipar, 2009).

Table 15.Major challenges in fertilizer use by farmers(survey 2018)

the major challenges in fertilizer use by farmers

		Frequency	%
Valid	very expensive	37	46.25
	limited knowledge	24	30
	not readily available	19	23.75
	Total	80	100.0

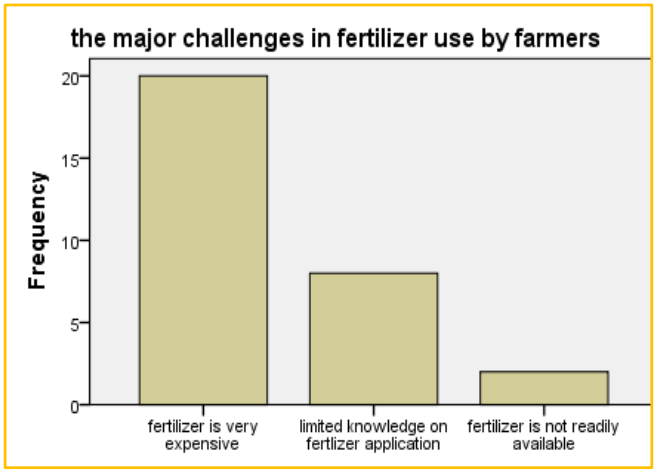

Figure 2.major challenges in fertilizer use by farmers(survey 2018)

IV. CONCLUSION, DISCUSSION AND RECOMMENDATION

4.1. CONCLUSION AND DISCUSSION

Findings showed that factors such as age, farm size, educational level, marital status were not significant at 5% level of significance. Gender (sex), extension services and farm size were significant at 5% level of significance. Extension services were shown to be an important source of knowledge for farmers that significantly influenced adoption of fertilizer application through teaching farmers. (Tilley, 2018) Without fertilizers nature struggles to replenish the nutrients in the soil (Amy Quinton, 2018)currently there is no short cut for substantial increases in production without using either organic or inorganic fertilizers. Gender was shown a great contribution in fertilizer adoption by farmers .male farmers are the ones with high adoption rate while females are late adopters .the fact that a big number of farmers is female is still a challenge for fertilizer adoption. it has revealed that men are highly mobile and dominate some public spaces where they can access knowledge and information easier than women who use to stay at home. (Netsayi N.Mudege, 2017)There is a scarcity in cultivated land in survey area and this was shown a great influence in fertilizer adoption .farmers with big land are those who use fertilizer and those with smallest land (less than 0.5ha) use less fertilizer. The factor that most of the farmers have small land was still a challenge for adoption of fertilizer.The effect of farm size has been variously found to be positive (Mc Namara, Wetzstein, and Douce, 1991; Abara and Singh, 1993; Feder, Just and Zilberman, 1985; Fernandez-Cornejo, 1996; Kasenge, 1998), negative (Yaron,D,Dinar,A and Voet,H., 1992)or even neutral to adoption (Mugisa-Mutetikka,M.,A.F.Opio.,M.A.Ugen.,P.Tukamuhabwa.,B.S.Kayiwa,C.Niringiye and E.Kikoba., 2000).Farm size affect adoption cost, risks perceptions, human capital, credit constraints, labor requirements, tenure arrangement and more. (Yu Sheng, 2016) With small farms, it has been argued that large fixed cost become a constraint to technology adoption, (Abara and Signh,1993) especially if the technology requires substantial amount of initial set up cost, so-called “lumpy technology”. In relation to lumpy technology, Feder, Just and Zilberman, 1985) .further noted that only larger farms will adopt these innovations. With some technologies the speed of adoption is different for small and large scale farmers.

4.1.1.COST OF TECHNOLOGY

The decision to adopt is often an investment decision. And as Caswell et al, (2001) note, this decision presents a shift in farmers' investment options. Therefore adoption can be expected to be dependent on cost of a technology and on whether farmers possess the required resources. Technologies that are capital intensive are only affordable by wealthier farmers (El Oster and Morehart; 1999) and hence the adoption of such technologies is limited to larger farmers who have the wealth (Khanna, 2001).In addition, changes that cost little are adopted more quickly than those requiring large expenditures hence both extent and rate of adoption may be dependent on the cost of a technology. Economic theory suggests that a reduction in price of a good or services can result in more of being demanded.

4.1.2.AGE OF ADOPTER

Age is another factor thought to affect adoption the possibility of fertilizer adoption is decreasing as the age of farmers increases where young farmers are more likely to adopt new technologies than elder ones (Berihun Kassa Hailu, 2014) .age is said to be a primary latent characteristic in adoption decisions. However there is contention on direction of the effect of age on adoption .age was found to positively influence adoption of sorghum in Burkina Faso (Adesiina,Akinwumi A.and Jojo Baidu-Forson, 1995).The effect is thought to stem from accumulated knowledge and experience of farming systems obtained from years of observation and experimenting with various technologies .in addition ,since adoption pay –offs occur over a long period of time while costs occur in the earlier phases ,age of the farmer can have a profound effect on technology adoption .Older farmers, perhaps because of investing several years in a particular practice may not want to jeopardize it by trying out a completely new method.In addition, farmers perception that technology development and the subsequent benefits, require a lot of time to realize cab reduce their interest in the new technology because of farmers' advanced age and the possibility of not living long enough to enjoy it (Cawell et al., 2001; Khanna, 2001).Furthermore, elderly farmers often have different goals other than income maximization; in which case, they will not be expected to adopt a technology do so at a slow pace because of their tendency to adapt less quickly to a new phenomenon (Tjornhom, 1995).

4.1.3.EDUCATION LEVEL

Studies that have sought to establish the effect of education on adoption in most cases relate it to years of formal schooling (Tjornhom, 1995, Feder and Slade, 1984). Generally education is thought to create a favorable mental attitude for the acceptance of new practices especially of information intensive and management intensive practices (Waller et al .1998; Caswell et al., 2001).educated farmers are believed to acquire ,analyze and evaluate information on different agricultural inputs and markets (Berihun Kassa Hailu, 2014).

4.1.4.GENDER CONCERNS

Gender issues in agricultural production and technology adoption have been investigated for a long time .most show mixed evidence regarding the different roles men and women play in technology adoption.in the most recent studies (Doss,Cheryl R.Michael L.Morris, 2001)in their study on factors influencing improved bean technology adoption in Ghana, and over field and Fleming 2001.Study in Nigeria showed that the most farmers who adopted cassava processing technology where male and married (Udensi, 2017).Since adoption of a practice is guided by the utility expected from it, the effort put into adopting it is reflective of this anticipated utility. It might then be expected that the relative roles women and men play in both "effort and adoption are similar, hence suggesting that males and females adopt practices equally.

4.2.RECOMMENDATION

Factors such age, sex, family size, educational level, farm size and extension services may enhance or limit the adoption and diffusion process of the new technologies. To develop a realistic adoption of agricultural technologies in the area as well as the whole country, these factors have to be taken into consideration. Especially extension services should be increased. The children must attend schools that teach the courses of agriculture in order to top up the extension officers who will be in charge of delivering services about agricultural technologies. Furthermore extension unit of the state ministry of agriculture should be strengthened to educate farmers more about fertilizer usage. There is no way found to increase land size but arable land can be increased through proper habitation (Imidugudu), land consolidation for land use efficiency and soil erosion control. In survey area individual farmers were asked and it has shown that their level of fertilizer adoption was low. Therefore farmers should work in groups (cooperatives) because the information flow is easy for people in group rather than individual person. Further research is needed to assess if the contribution of culture and religious aspects on how farmers consider chemical fertilizers and other advanced agricultural inputs.

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