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Effects of the Supply Distance of Mineral Fertilizers on Their Consumption in the Mabanda Sector

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Abstract: The availability and accessibility of the sources of agricultural inputs are factors influencing their consumption. This survey study focused on the evaluation of the effects of the supply distance of mineral fertilizers on their consumption in Mabanda sector, Makamba province. It was carried out in two installments, the first one from October 30, 2015 to November 8, 2015 and the second one from June 20 to 25, 2016 on a sample of 50 households spread over all the hills of the Mabanda sector. Data collection was done randomly. Pursuant to the findings of the study, 82.6% of the surveyed households reported that the main cause of decrease in yield is due to the lack of fertilizers and the results indicated that barely 39.2% of the households apply mineral fertilizers. Broadly, the use of mineral fertilizers varied according to the supply distance whereby 17.4 kg/year/household of fertilizer for those who walk less than 75 minutes to reach the source of supply and 2.8 kg/year/household of fertilizer for those who take more than 125 minutes were identified over the course of this study. It is concluded that the supply distance of mineral fertilizers affects their utilization.

Keywords: Distance of supply, mineral fertilizers and farmers.

1. Introduction

Burundian economy is essentially based on agriculture sector with an area of 27,834 km^2, average density of 310 inhabitants / km^2 and a growth rate of 2.4% (ISTEEBU, 2008). The country is ranked, on the one hand, as the second most densely populated region in Africa and on the other hand, amid the 5 poorest countries in the world (EGAE, 2014).

Almost 94% of the population lives in the rural areas with agriculture as their main activity, followed by livestock, and 51% of farmers are women who substantially engage in farming activities than men. Agriculture is practiced in a rudimentary way by approximately 1.2 million of small holder farmers with an average farm size of 0.5 ha per household (MINAGRIE, 2012). According to the aforementioned report, Burundi's agriculture has the fundamental mission of ensuring food security in quantity and quality for all Burundians. In general, agriculture alone provides 53% of GDP and occupies almost 90% of the country's total holdings (ISTEEBU, 2008).

The gross domestic product (GDP) per capita is around $100, the export deficit accumulated during the socio-political crisis from the year of 1990 to 2000, represents 23% of the GDP and the level of poverty remains high in all the provinces of the country (MINAGRIE, 2012). Almost 70% of the population lives below the poverty line (less than $1 / day and per capita) and 85% of households face daily food insecurity (REPUBLIC OF BURUNDI, 2008-2015). The coverage of essential nutrient needs is ensured at 75% for energy, 40% for proteins and 22% for lipids with an insignificant consumption of foodstuffs rich in vitamins and minerals (fruits and vegetables) especially in rural areas (REPUBLIC OF BURUNDI, 2008-2015).

The poor market development of agricultural inputs and distancing supply sources is a major socio-economic handicap for farmers (ADISCO, 2013). Beyond the technological aspects, one should be concerned with political questions aimed at ensuring that farmers obtain the expected benefits from the technologies that they are asked to adopt (Dudal, 2002).

The estimation of using six times more mineral fertilizers than in 1980 in developing countries in order to meet the food demands for the current increase of world population at the end of this century is highly required (FAO, 2000). These fertilizers are likely due to providing an increase of 50% in agricultural production.

In Burundi, the cultivated areas amount to 1,156,118 ha with 34.8% for season A, 36.6% for season B and 28.6% for season C. About 75% of farms have no anti-erosion devices while 48.9% of farm households use organic manure, only 13.9% of farm households use mineral fertilizers and 6.1% use a combination of mineral fertilizers and organic manure. Ultimately, 31.1% of farm households do not use fertilizers (ISTEEBU, 2014), which is considered as vicious circle for decreasing agricultural production following poor soil fertility. This limited number of farmers who does not apply mineral fertilizers may be due to the remoteness of the farmers to reach sources of supply, though no evidenced findings of the previous study. It is for this reason that we have done this work to assess the impact of the supply distance on the use of mineral fertilizers in Mabanda sector. For realizing the objective of this study, we tested the following hypotheses: a) At least 50% of the farmers of Mabanda sector use mineral fertilizers and b) the sources of supply of mineral fertilizers influence their use. The findings of this study will help develop a holistic approaches aiming at increasing the percentages of famers applying mineral fertilizers, which in turn will scale up agricultural production following improved soil fertility.

2. Materials and Methods

2.1 Materials

Mabanda sector, which was the subject of our study, is one of the sectors of Makamba province which extends over the Buragane natural region. It is limited to the north by the sector of Makamba, south by the United Republic of Tanzania, east by the sector of Kibago, west by the sector of Nyanza-Lake, and northwest by the Vugizo sector (Figure 1). It has an area of 294.94 km^2 and Lithosol is the most dominant type of soil in the region (Evrard, 2013). It is in this sector where we carried out a survey which took place in two sections, the first one from October 30, 2015 to November 8, 2015 and the second one from June 20 to 25, 2016.

During our study survey, we used the survey questionnaires which were incorporated in smartphones (androids) to collect information relating to the subject of our study and GPS to take the geographic coordinates of the surveyed households and measure the areas of cultivated plots. In addition, we surveyed 19 census hills with 50 farmers distributed by density. The choice of farmers to be surveyed was realized by taking into account distance (near and far from the road and the source of supply). Beyond this distance criterion, the choice of the respondent was made randomly. According to Danyelie (1973), the sample is considered simple when the individuals forming the sample are all independently taken from each other. Thus, it is thanks to its principle that we took our samples.

2.2 Methods

The proper technique for collecting information was the survey. It was based on observations, interviews and measurements of the cultivated plots. We structured the survey questionnaire in such a way that we could lead the respondent to correctly answer the different questions, without, however, upsetting and interrupting him/her in his/her daily activities. This is why we tested the questionnaire during a pre-survey period to see if we can amend our questionnaires so that they may properly realize the objectives of our study.

The main questions were about how farmers use mineral fertilizers, how they optimize them, sources of supply, sources of information, etc. The questionnaire was structured around five headings: identification of the respondents (geographic location of the households, socio-economy of the households, etc.), identification of the cultivated plot (method of acquisition and presentation, area, different crops, etc.), use of agricultural inputs (history of inputs, types of inputs, optimization of the latter, etc.), sources of supply of agricultural inputs (different markets, shops) and sources of information (radios, associations, etc.). After collecting data in the field, the statistical analysis was done using SPSS version 20.0 software.

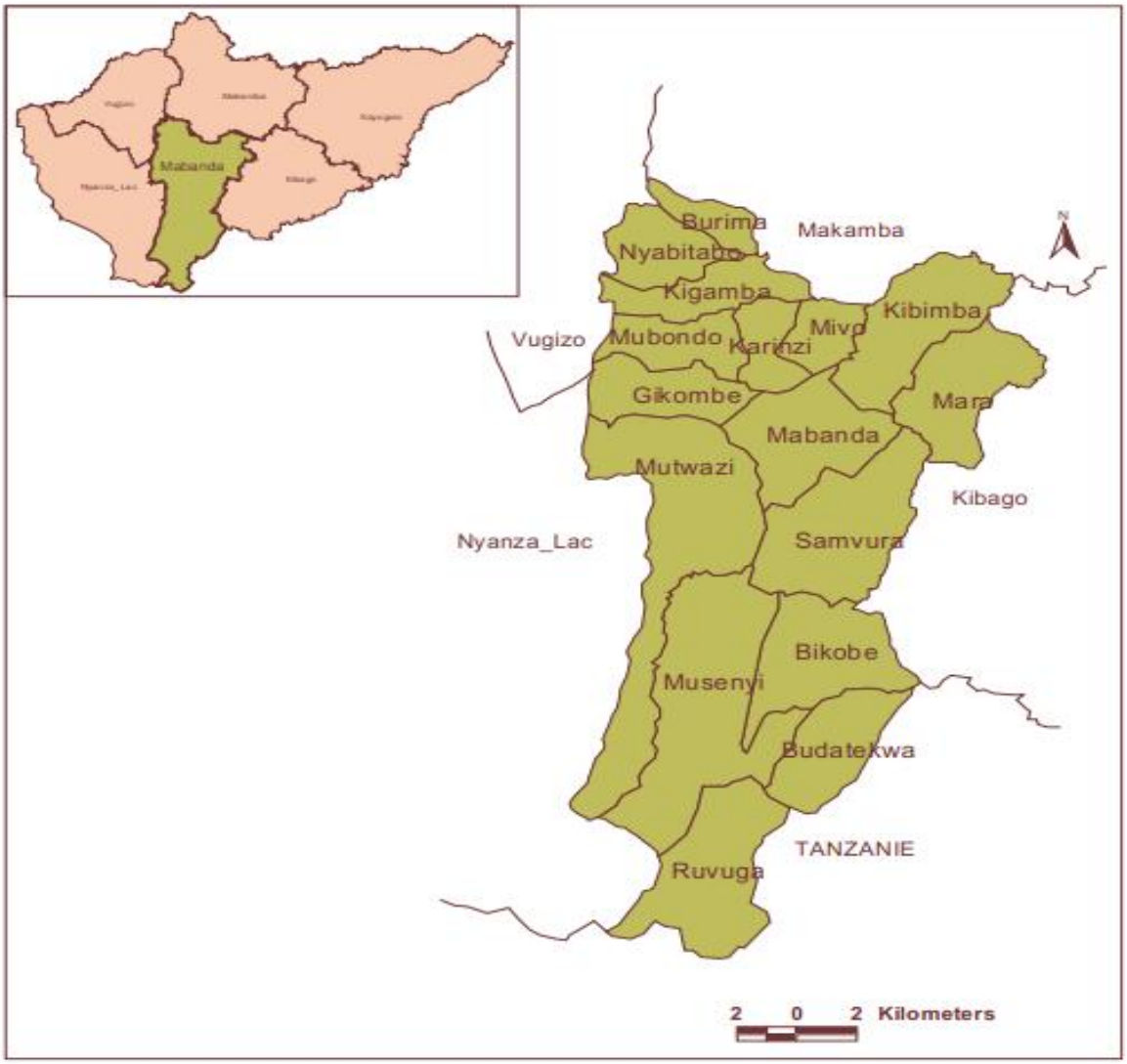

Figure 1. Geographic Map of the study area

3. Results

3.1 Distribution of respondents by census hill

The results from the survey carried out in our study area are presented in Table 1. This table shows that more than 50% of the surveyed households have not used mineral fertilizers.

Table 1: Distribution of respondents by census hill

District	Hills	Number of households per hill	Number surveyed	Those who use chemical fertilizers	Those who do not use chemical fertilizers
Mabanda	Gikombe	3668	2	2	0
	Kibimba	7847	4	2	2
	Mara	4348	2	1	1
	Samvura	4061	2	1	1
	Gikurazo	3737	2	2	0
	Mabanda	8582	5	3	2
	Mutwazi	4797	3	1	2
Kayogoro	Kigamba	2487	2	0	2
	Nyabitabo	2782	2	0	2
	Karinzi	1893	2	0	2
	Burima	3120	2	1	1
	Mabondo	1719	2	0	2
	Mivo	2147	2	1	1
	Bukunda	1428	2	1	1
Gitara	Bikobe	5567	4	0	4
	Budaketwa	5808	4	3	1
	Ruvuga	2304	2	0	2
	Musenyi	3684	2	1	1
	Nyamugari	5217	4	0	4
Total		**75196**	**50**	**19**	**31**

3.2 Different methods of fertilization

Applying chemical fertilizers, green fertilizers, organic manure, lime and compost are the main fertilization methods used by surveyed farmers as shown in Figure 1.

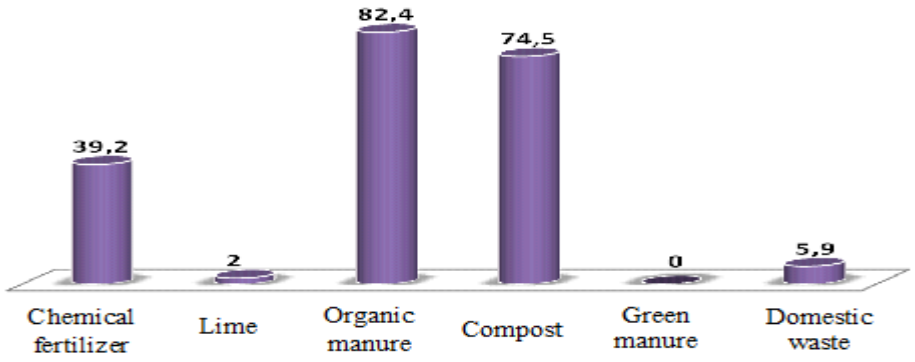

Figure 2: Distribution of different fertilization methods used by households in percentages

Among the different fertilization methods mentioned in Figure 2, organic manuring comes first with 82.4% of the households surveyed; 74.5% of the households produce compost from their domestic waste while 5.9% of households directly apply domestic waste in the fields. 39.2% of the surveyed households use mineral fertilizers in their farming activities. Lime is of paramount importance in ameliorating acidic soil but unfortunately farmers applying lime account for 2% as presented in the Figure 2. Surveyed household responded that none apply green manure during fertilization.

3.3 Time taken to access agricultural inputs

The distance from the road to the household and the distance to reach the place where agricultural inputs are purchased, affects the application of agricultural inputs as shown in Figure 2.

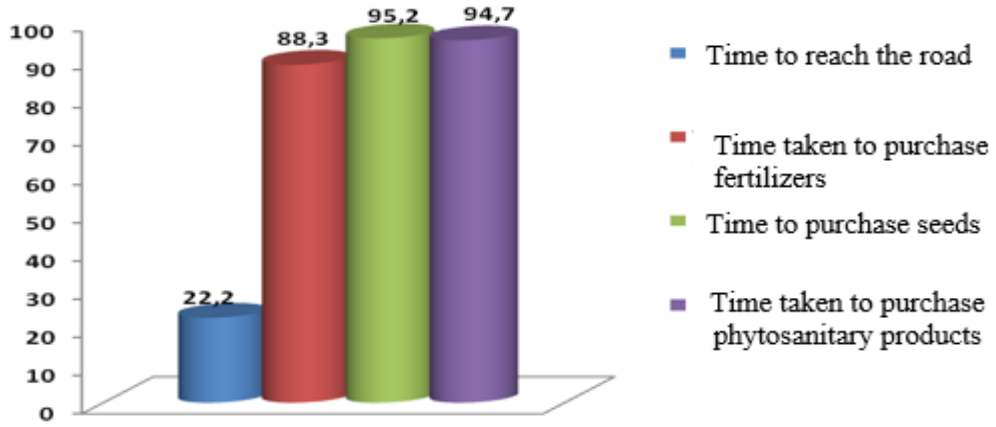

Figure 3: Travel time to access the supply source of agricultural inputs (in minute)

From the figure above, we found that it takes surveyed households almost an hour and a half on average (88.3 minutes) to reach to the point of sale of mineral fertilizers, 95.2 minutes for seeds and 94.7 minutes for phytosanitary products. The average time required to access the route is 22.2 minutes.

3.4 Quantity of fertilizer purchased as a function of time to reach supply sources

The time taken to arrive at the point of the sale of mineral fertilizers is an intrinsic factor influencing the purchased quantity. Figure 4 shows the purchased quantity as a function of the time used to reach the source of supply.

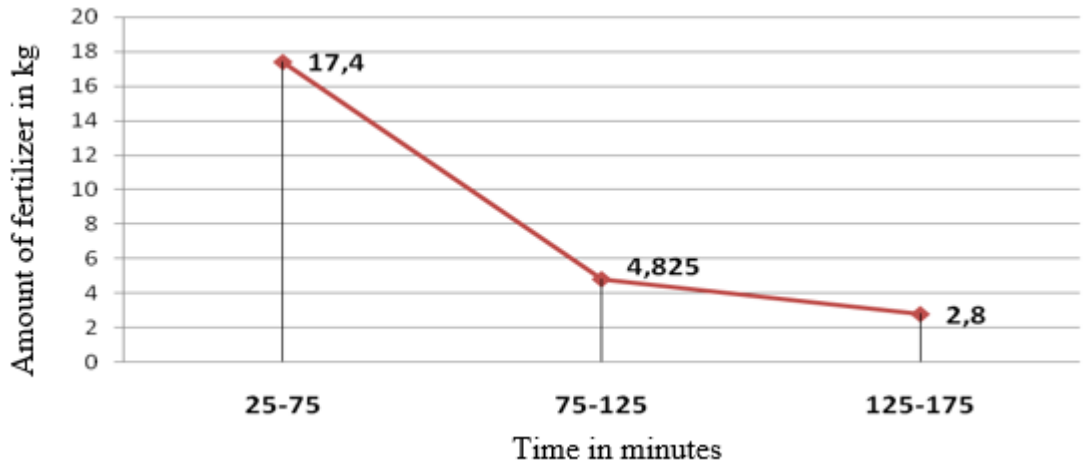

Figure 4: Purchased quantity of fertilizer as a function of distance (in minutes)

Distance is a limiting factor that hinders the use of chemical fertilizers as shown in Figure 3. The closer the farmers are to the sources of supply, the more they use chemical fertilizers. On average in Mabanda conditions, those who make less than 75 minutes (one way) buy an average amount of 17.4 kg of fertilizer per year. As long as farmers move away from sources of supply, the more the use of fertilizers decreases and likely tends towards zero. It was indicated that farmers who walk 125 to 175 minutes to reach the supply sources of mineral fertilizers on average apply 2.8 kg of chemical fertilizers per year. Ultimately, many farmers do not use mineral fertilizers due to the various factors including the remoteness of the supply source of mineral fertilizers.

3.5 Causes of decreasing agricultural yields

The approximately 82.6% of surveyed farmers reported that the main cause of falling yields is lack of mineral fertilizers, followed by heavy rains (58.7%), diseases (43.5%) and the deficit water (32.6%). The other factors are less indicated: strong winds (6.5%), theft (2.2%) as shown in Table 2.

Table 2: Causes of falling yields

Causes of falling yields	% of respondents
Lack of fertilizers	82,6
Drought	32,6
Heavy rain	58,7
Diseases	43,5
Strong winds	6,5
Flight	2,2

4. Discussion

4.1 Quantity of fertilizers purchased as a function of time to reach the source of supply

According to Seward *et al*. (1998), an obvious and necessary condition for farmers to use fertilizers is that they must be available when farmers want to buy and use them. Many farmers in developing countries will buy fertilizers and other inputs only if the market or shop is within a short enough distance to be easily walked (less than 2 km).

The use of chemical fertilizers compared with other fertilizers was low by approximately 39.2% of the households surveyed because in general, when the time required to get to the place of acquisition of agricultural inputs becomes long, the number of people heading to this location for buying agricultural inputs increasingly becomes low (Laurence *et al*. 1990).

According to Randrianarisoa and Minten (2003), the distance plays an important role in the consumption of mineral fertilizers. In their study, it was reported that the number of farmers who traveled an average of more than 60 km to find an agricultural input dealer decreased while those who travelled on average distances of less than 30 km indicated a tremendous use of mineral fertilizers and found in the region with the highest percentages of mineral fertilizer adopters.

Analysis of field data has shown that the consumption of fertilizers is contingent on travelled distance towards supply sources of agricultural inputs due to an increased cost of agricultural inputs following additional cost of inputs, such as cost of transport, etc.. We observed a pronounced difference between the quantities of fertilizers purchased as a function of time. Households who travel a distance of 75 minutes on foot (about 6 km, because a pedestrian makes an average of 5 to 6 km per hour) bought an average of 17.4 kg per year, so those who travel a distance of between 125 and 175 minutes on foot (that is to say between 10.4 and 14.58 km) bought an average of 2.8 kg of fertilizer per year and per household.

5. Conclusion

Given the general profile of Mabanda farmers, we noticed that most of the respondents used the different fertilization methods. Chemical fertilizers come third after organic fertilizers and compost and

they are used by 39.2% of the households surveyed. Thus, the first hypothesis relating to the use of fertilizers is not verified because the rate of use of fertilizers in Mabanda is less than 50%.

The distance to reach the road showed a negative correlation with the use of modern inputs, mainly chemical fertilizers. This means that the further away from the source of supply, the more we observed a decrease in the use of agricultural inputs, especially chemical fertilizers. In this regard, the isolation of farmers compared to places of supply limits agricultural intensification through greater use of chemical fertilizers. Analysis of the results indicated that those who walked less than 75 minutes (one way) used an average of 17.4 kg of mineral fertilizers per year, while those who walked more than 125 minutes bought only 2.8 kg/year of chemical fertilizer on average. We can therefore confirm our second hypothesis that "the sources of supply of chemical fertilizers influence their use by households in Mabanda sector".

6. Recommendations

After being convinced by the farmers that distance is a limiting factor that prevent them from using chemical fertilizers and the approximately 82.6% of surveyed farmers reported that the main cause of falling yields is lack of mineral fertilizers followed by heavy rains (58.7%), diseases (43.5%) and the deficit water (32.6%). Thus, we strongly recommend farmers to adopt massively organic fertilizers to sustain and improve soil health and crop yield via the buildup of soil plant nutrients and organic matter, and thus retain water from heavy rains and suppress disease and pest as well as iron water deficit out. Our Recommendations are based on the proven facts that applying organic fertilizers as soil organic amendments sustain and improve soil quality and crop performance (Negiş et al. 2020; Manirakiza & Şeker 2018; Şeker and Manirakiza 2020; Manirakiza & Şeker 2020).

We also recommend that the government and agricultural stakeholders could bring mineral fertilizers closer to farmers because the results of this study have shown that the distance of supply of mineral fertilizers strongly influences their use.

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