The importance of farms and fertilizers in the Haut-Lomami (Kongo-central) territories of the Democratic Republic of Congo (DRC) was surveyed within the University of Kinshasa. The surveys evaluated the use of fertilizers and their usual chemical and organic types by farmers and small farmers in these territories. The use of fertilizers was low, particularly in the equatorial region and the administrative region of Irumu; the usual practice among farmers is to use these materials to achieve a reliable harvest. In the Irumu domain, the percentage of use of fertilizers was 5.7%. The use of fertilizers may be due to the modernization and development of the Congolese agriculture. The trend in the use of fertilizers is growing in the Democratic Republic of Congo (DRC). However; the use of fertilizers is not yet dominant. 

The University of Paris published a study (Richard 2015) which showed that the use of fertilizers by farmers is prevalent in many regions of the DRC. The use of fertilizers in the territories of the DRC is due to the demand by farmers for fertilizers. The survey conducted in this study followed the same survey done at the University of Mbanza Ngungu. The survey was conducted in the territory of Haut-Lomami, the administrative region of Irumu. The results showed that fertilizers are used to achieve a reliable harvest. The use of fertilizers is not yet dominant in the Democratic Republic of Congo (DRC) and the use of fertilizers is limited to the use of small farmers. The survey conducted in this study followed the same survey done at the University of Mbanza Ngungu.
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Peuvent favoriser l'utilisation des engrais conduisant à des rendements élevés et qui peuvent générer un revenu satisfaisant pour les agriculteurs. 

Mots-clés: Evaluation, engrais, niveau, taux, utilisation

INTRODUCTION

The main role of the agricultural sector is to provide to the society, in sufficient quantity and quality, the basic food products required for a balanced diet (OGUET, 1989). Main employer in the world and livelihood of 40% of the current world population, the agricultural sector has been recognized since the adoption of the Sustainable Development Goals (SDGs) by the United Nations in 2015, as a central element of social and economic progress (SPORE.CTA.INT, 2019). The agriculture therefore should be the basis of both African and Congolese economies. Indeed, the agricultural potential of the DR Congo is unanimously recognized as being considerable: the country has cultivable areas estimated at some 75 million hectares of which less than 10 million hectares are exploited (TECSULT-AECOM, 2009; LEBAILLY et al., 2014). This land availability and the enormous water resources available to the country with the Congo River basin maintain the hope of better food self-sufficiency so required by the Congolese (PEEMANS, 2014). CRUZ et al. (2019) believe, however, that one of the main problems to be solved is to modernize the agri-food system so that it is competitive in national, regional and global markets while offering to young population opportunities for entrepreneurship, improving their living conditions and finding a job. This modernization however requires the use of techniques, inputs, but also equipment adapted to the needs of the sector. Fertilizers are one of the essential elements in improving the productivity of agricultural land, which is often the victim of overexploitation linked to the sedentary way of life led by almost all the agricultural population scattered around the world. Fertilizers provide the crops with the nutrients they need. They increase production and improve the quality of food crops. With fertilizers, you can improve the fertility of poor soils, which are constantly degraded.
All these elements ensure better well-being of the village, the community and the nation (FAO, IFA and IMPHOS; 2003).

These organizations point out that before thinking about applying chemical fertilizers, it is advisable to use all available sources of nutrients: cow dung, pig manure, chicken manure, crop residues, straws and all other organic materials.

The organic fertilizers improve the soil properties, while mineral fertilizers provide plants with the nutrients they need. Thus, organic manure alone is not enough and often it is not available in large quantities to ensure the level of agricultural production expected by the farmer (FAO, IFA and IMPHOS, 2003).

With a growing Congolese population and to avoid malnutrition and famine that threaten the country, farmers should resort to the fertilizers to maintain soil fertility in order to improve crop yields and quality.

The use of green manures can improve soil fertility for crops, apart from other advantages of using plant materials, which can be among other things, the improvement of the sanitary condition of the soil and crops, the stimulation of life in the soil, the improvement and the stabilization of the soil structure, the production of organic matter, and also as sources of nutrients (DUSTIN, 2013).

But, to compensate for the large amounts of nutrients exported by crops and to improve crop growth and yields and quality, the supply of fertilizers is required. However, little information is available regarding the use of fertilizers in DR Congo.

Taking into account this observation, it was necessary to evaluate the level of the use of fertilizers in the Congolese agriculture, in order to appreciate the trend of the modernization of this sector.
The Democratic Republic of Congo (DRC) is administratively organized into 25 provinces and the city of Kinshasa, which has the status of a province. The territories of Aru, Djugu, and Irumu; of Gemena, Kabongo, and Mbanza-Ngungu, located respectively in Ituri, Sud-Ubangi, Haut-Lomami and Kongo-Central provinces, consisted of the areas of the study.

The province of Ituri is situated in the extreme northeast of DRC, on the western slope of Lake Albert and has five territories including the territories of Aru, Djugu and Irumu (OMASOMBO, 2021).

The territory of Aru, with an area of 6,749 km², is situated in the north of the Ituri province and bordered in the north by the Republic of South Sudan, in the east by the Republic of Uganda, in the south by the territories of Djugu and Mahagi in Ituri province and in the west by the territories of Faradje and Watsa in Haut-Uele province.

Its geographic coordinates are 30°10' and 30°90' of East longitude and 2°40' and 3°65' of North latitude. The average altitude is 1,300 meters above sea level. The territory experiences a more or less mild type of subtropical climate, with alternating dry and rainy seasons and an average annual temperature of 25°C. Its vegetation is a steppe savannah in the northeast, grassy in the centre and in the south, and wooded in the west with some forest galleries. There is also a small dense equatorial-type forest in the south-west.

The soils are clay-sandy soils and sandy-clay soils. The population practices agriculture and livestock farming.

The territory of Djugu has an area of 8,740 km². It is bordered in the north by the territories of Aru and Mahagi, in the south by the territories of Irumu and Mambasa, in the west by the territory of Watsa in Haut-Uele province and in the east by Lake Albert. Its geographic coordinates are 1°56′ North latitude and 30°30′ East longitude. Its average altitude is 1,674 m and its climate is tropical humid with alternating dry and wet seasons. The average annual temperature is 18°C. The soils are very fertile sandy-clays. The agriculture and the livestock farming constitute the main socio-economic activities.

Covering an area of 8,183 km² and located in the south-east of the Ituri province, the territory of Irumu is limited in the East by the River Semliki and the Lake Albert, in the west by...
the territory of Mambasa, in the north by the territory of Djugu and in the south by the territory of Beni in the North Kivu province. Its geographic coordinates are $1^\circ 0'0'' - 1^\circ 40'0''$ North latitudes and $29^\circ 20'0'' - 30^\circ 00'0''$ East longitudes. It has a humid tropical climate with alternating rainy and dry seasons. Its average altitude is 935 m and its clay-sandy soils, fertile and rich in humus, favour agricultural activities. Agriculture constitutes the main activity, occupying 80% of the population, while animal rearing occupies 12%. The east and the center are occupied by the savannah with the forest in the south and the west.

The territory of Gemena, covering a total area of 1,148 km², is one of the four territories that make up the province of Sud-Ubangi. It is situated in the north-western part of the former Equateur province and bordered by the territory of Bosobolo in the north, of Budjala in the east and the territories of Kungu and Libenge in the west. It is located between $2^\circ$ and $4^\circ$ North latitude and $18^\circ$ and $20^\circ$ East longitude with an average altitude of 400 m. The climate is equatorial, but of the hot tropical type with little annual variation in temperature. The average temperature is $25^\circ$ C. There are two seasons: one rainy and the other dry. Its vegetation consists of the very dense gallery forest and a savannah dominated by Imperata cylindrica. The soils are sandy-clays which are fertile. The agriculture is the main activity of the population. Food crops (maize; cassava and groundnuts) and a few cash crops (cocoa, coffee and oil palm) constitute the main crops.

The territory of Kabongo, with an area of 20,621 km², is one of the 9 territories that make up the province of Haut-Lomami in the north of Katanga. It is bordered by the territories of Lubao and Kabalo in the north, of Kamina and Bukama in the south, of Manono and Malemba Nkulu in the east and of Kaniama, Ngandajika and Kabinda in the west. The humid tropical climate experienced by the Kabongo territory is characterized by an alternation of two seasons: the dry season and the rainy season. The temperature varies...
La zone de Kabongo est dominée par les savanes, les forêts clairsemées et les forêts semi-closes. Il y a quatre types de sols : sols argileux, sols sableux, sols argilo-sableux et sols sableux. La plus grande partie est couverte de sols sableux et une petite partie est caractérisée par les sols argileux. À part la pêche, la chasse et l'élevage d'animaux, l'agriculture reste l'activité principale de la population. 

Les coordonnées géographiques sont de 06° 20' 00'' à 08° 00' 00'' de latitude du Sud et de 24° 38' 00'' à 26° 25' 00'' de longitude Est avec une altitude moyenne de 1 027 m. La province du Kongo-Central a dix territoires, dont celui de Mbanza-Ngungu. Le territoire de Mbanza-Ngungu, avec une superficie de 8 460 km², est bordé au nord par le fleuve Congo et le territoire de Luozi, au sud par la République d'Angola, à l'est par le río Inkisi et les territoires de Madimba et, à l'ouest, par le territoire de Songololo. Les coordonnées géographiques sont de 05° 00' 00'' à 05° 40' 00'' de latitude du Sud et de 14° 20' 00'' à 15° 20' 00'' de longitude Est. Le territoire bénéficie d'un climat humide tropical avec deux saisons : la saison des pluies et la saison sèche. La température varie entre 28° C et 33° C pendant la saison des pluies et entre 14° C et 29° C pendant la saison sèche. Son altitude varie entre 780 m et 785 m et a un climat frais et humide qui explique la fraîcheur qui règne là et la pratique de certains cotonniers. Son sol riche, majoritairement argileux, est un atout majeur qui rend l'agriculture l'activité principale de la zone (CONGO-AUTREMENT, 2019).
Territories of Aru, Djugu, Gemena, Irumu, Kabongo and Mbanza-Ngungu

Figure 1. Map of the study areas

Material

As material, we used the questionnaire of the pre-survey and that of the survey. This questionnaire was of the closed type.

Methods

To conduct the study, we used descriptive and documentary methods in combination with the techniques of direct observation, interview and questionnaire. These methods and techniques were used to describe the study areas and to collect primary data on the level of use of fertilizers in the selected areas. The sample of the study consisted of the peasant farmers of the territories of Aru, Djugu and Irumu in Ituri; of Gemena in Sud-Ubangi, of Kabongo in Haut-Lomami and of Mbanza-Ngungu in Kongo-Central. A survey by a reasoned choice was carried out by retaining in each selected province, one or a few territories, depending on human and financial resources available, and where agriculture is the main activity of the population. In total,
Cooperating and accessible farmers in the selected territories were subjected to the questions in line with the methods and techniques mentioned above.

Data analysis

The data of the surveys were analyzed using the technique of content analysis. This technique is often used when it comes to exploit a number of data such as responses to a questionnaire, interviews, etc (VALETTE, 2007). The data of the evaluated parameters were expressed in percentages in a standard form of base equal to 100 and presented in the form of graphs to facilitate relative comparisons (KOTHARI, 1985).

RESULTS AND DISCUSSION

Results

The data of the use of fertilizers in the surveyed territories of the DR Congo are presented in figure 2 to 6.

Figure 2. Level of the use of fertilizers in Ituri province

The figure indicates that most of the farmers of the Ituri province do not use fertilizers in their cropping systems, as it can be seen for the territories of Irumu (94.0%), Aru (78.3%) and Djugu (74.7%).

Organic fertilizers are used only by 25.3% of farmers in Djugu, 12.5% in Aru and 6.0% in Irumu. For the chemical fertilizers, a small percentage of Aru farmers (9.2%),...
The use of fertilizers was observed among the respondents. The results can, in decreasing way, be summarized as follows: without fertilizers < organic fertilizers < chemical fertilizers.

![Level of the use of fertilizers](image)

In view of these results, the general tendency is that the majority of Ituri farmers do not or poorly use fertilizers, either chemical or organic. The results can be summarized in decreasing order as follows: chemical fertilizers < organic fertilizers < without fertilizers.

![Level of the use of fertilizers](image)

It emerges from the results in figure 3 that 75.8% of farmers in the territory of Gemena apply organic fertilizers in their farms while the remaining 24.2% do not use fertilizers. The use of chemical fertilizers was not observed among the respondents. These results can, in decreasing way, be summarized as follows: without fertilizers < organic fertilizers.
The results of figure 4 show that 82.1% of farmers in the Kabongo territory in Haut-Lomami province use organic fertilizers in their farming activities against 17.9% who do not apply any fertilizer in their farms to supply nutrients to the crops. As for the territory of Gemena in Sud-Ubangi, the results of the use of fertilizers in this area can be presented in a decreasing way in this order: without fertilizers < organic fertilizers. The results in figure 5 indicate that in the territory of Mbanza-Ngungu, 43.8% of the interviewed farmers do not use any fertilizer, while 31.3% apply organic fertilizers and 25.0% others chemical fertilizers in their farms. As for the province of Ituri, but with different percentages of fertilizer users, the results of Kongo-Central can be presented as follows: chemical fertilizers < organic fertilizers < without fertilizers. We note from figure 2 to 5 that the Congolese agriculture remains a lesser user of fertilizers. In the 6 territories surveyed situated respectively in the North-East, North-West, South and West of DR Congo, it emerges that the peasants farmers of the Irumu territory have...
The highest record of the non-use of fertilizers (94.0%), followed by those of the territories of Aru (78.3%), Djugu (74.7%) in Ituri province; of Mbanza-Ngungu (43.8%) in Kongo-Central, of Gemena in Sud-Ubangi (24.2%) and of Kabongo (17.9%) in Haut-Lomami.

The remaining percentages of farmers surveyed in all these territories use more organic fertilizers with Kabongo territory in the lead (82.1%), followed by those of Gemena (75.8%), Mbanza-Ngungu (31.3%), Djugu (25.3%), Aru (12.5%) and those of Irumu (6.0%).

In general, inorganic fertilizers are not used by Congolese peasant farmers, except by a small percentage in the territories of Mbanza-Ngungu (25.0%) and Aru (9.2%).

Figure 6. Global trend of the use of fertilizers in DR Congo

Based on the results of the study, the general trend of fertilizers use in DR Congo (figure 6) gives the following figures: 55.5% of the farmers do not use fertilizers, 38.8% use organic fertilizers while 5.7% use chemical fertilizers. These results can be summarized in decreasing way as follows: chemical fertilizers < organic fertilizers < without fertilizers.

Discussion

The results of the level of the use of fertilizers in DR Congo showed that more than 55.5% of farmers in the surveyed territories do not apply fertilizers, both chemical and organic to their crops. However, 38.8% of farmers in the territories covered by the study use organic...
fertilizers as source of nutrients to their crops, compared with only 5.7% of them who use mineral fertilizers. KELLY and NASEEM (2009) point out that inorganic and organic fertilizers that are used in sub-Saharan Africa (SSA), are used in very small quantities. The farmers interviewed in some territories, such as those of Kabongo (82.14%) and Gemena (75.83%) use organic fertilizers. The usual practices of peasant farmers (case of Kabongo territory) and the abundant source of plant materials due to the presence of equatorial forest (case of Gemena territory) could justify the interest given to the use of organic fertilizers in these regions.

KELLY and NASEEM (op. cit) also point out that in African agriculture, plant residues and animal wastes have been used to maintain soil fertility. However, most farmers practiced shifting cultivation more than the use of soil amendments to maintain fertility with as a result low crop yields. When the soil fertility declined, farmers opened a new piece of land, allowing previously cultivated land to fallow for 10 to 15 years. The same authors state that currently, the length of fallow rarely exceeds 2 to 3 years, a very short period to restore soil quality. Unfortunately, the decline in the length of fallow is not accompanied by the increase of fertilizers use, either organic or inorganic, to maintain soil quality and crop yields. The very low use of mineral fertilizers, which seems to be a general trend across the country, can be attributed to their unavailability, their high cost on the local market, the ignorance and poor knowledge of their use. This has a negative impact on agricultural production leading to low crop yields. However suggests that before using chemical fertilizers, probably because of their unavailability, high cost and the lack of knowledge of their use by farmers, to use all kinds of organic fertilizers such as cow dung, pig droppings, crop residues, chicken droppings and any other organic material.

DUSTIN (2013) notes that in a country like China, it has long been known that the supply of organic matter was essential in maintaining soil fertility and productivity. The organic matter is also a key factor in the nutrition of cultivated plants and also considered today as one of the most important indicators of soil quality. The supply of organic matter, which contains organic carbon, stimulates soil life as the organic carbon is an important resource for soil
microorganisms. But RANDRIANARISOA and BART MINTEN (2003) point out that the use of chemical fertilizers remains an alternative for increasing agricultural productivity. From an agronomic point of view, the use of compost and manure should not be taken as a perfect substitute of chemical fertilizers, but as a complement, if we want high crop productivity and the maintenance of fertility in major nutrients. According to AFRICAFERTILIZER (2020), substantial use of chemical fertilizers is a prerequisite for successful efforts to improve agricultural productivity and hence the increase of agricultural production and income in Africa. No country in the world has achieved substantial agricultural growth without using them. RANDRIANARISOA and BART MINTEN (2003) also emphasize the profitability of using fertilizers as an investment. A change in the price of fertilizers and/or in the prices of rice, will influence the interest in the use of fertilizers, and thus will cause a change in the rate of adoption of fertilizers. Likewise, the ability of available varieties to respond satisfactorily to fertilizer inputs will increase the motivation of producers to use more fertilizers, as the surplus obtained will be higher. Taking into account the results of the surveys and the above considerations, the combination of the use of organic and chemical fertilizers is suggested while ensuring their quality and quantity, their judicious application, accessibility and profitability. In addition to this suggestion, it is imperative to resort to varieties with high productive potential.

CONCLUSION
The present study on the evaluation of the use of fertilizers was carried out in the territories of Aru, Djugu and Irumu in Ituri; of Gemena in Sud-Ubangi; of Kabongo in Haut-Lomami and of Mbanza-Ngungu in Kongo-Central in DR Congo. The objective of the study was to evaluate the level of the use of fertilizers in the context of Congolese agriculture, in order to appreciate the evolution of the modernization of this sector which is so crucial for the economy of the country. To collect the data on the use or not of the fertilizers by farmers, the descriptive and documentary methods as well as the techniques of direct observation, interview and questionnaire were used. Surveys by a reasoned choice were carried out by retaining in each selected province, one or a few territories, depending on human
In total, 561 cooperating and accessible farmers in the selected territories were subjected to the questions. The results showed that the majority of farmers surveyed (55.5%) do not use any type of fertilizers in their farming practices. However, a relatively high proportion (38.8%) of the interviewed farmers use the organic fertilizers consisted of different organic materials. The rate of their use is particularly high in Kabongo territory in Haut-Lomami, followed by Gemena territory in Sud-Ubangi province.

For the chemical fertilizers, a very low percentage of farmers in the studied territories use them, particularly those in the territories of Mbanza-Ngungu (25.0%) in the province of Kongo-Central and of Aru (9.2%) in the province of Ituri. The temperate climate prevailing in the territory of Mbanza-Ngungu allowing to grow temperate crops and the proximity of the territory of Aru to the Ugandan border through which many manufactured products from Asia and Europe pass may justify the use of chemical fertilizers, although timid, in these regions. But in general, a low percentage (5.5%) of Congolese farmers do not use chemical fertilizers in their cultural practices. The use of fertilizers has therefore not yet reached a threshold that can sufficiently boost Congolese agriculture and promote the enormous potential of its agroecosystems. This forced the country to import basic foodstuffs. Efforts must be made within the framework of agricultural policy in order to highlight the benefits of agricultural inputs and particularly those of fertilizers for Congolese agriculture which has an important development potential in the DRC. However, an evaluation of the quality and quantity of fertilizers according to the needs of the crops grown in the study area is recommended. Also, the use of seeds with high productive potential that can enhance the use of fertilizers leading to high crop yields and which can generate a satisfactory income for farmers can encourage their use in their agricultural practices.
REFERENCES


