

Population Growth and Urban Agriculture in Moundou City (South-west Chad)

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Abstract: *Urban agriculture is not a new phenomenon in the world in general and in Moundou in particular. In this city, it dates back to the colonial period but the agricultural space is pushed back towards the extension zone of the city under the effect of the urban extension. Given the economic situation and population growth, this activity is becoming important. This article aims to demonstrate how the demographic expansion of Moundou city contributes to the development of urban agriculture. The methodological approach was based on surveys and observations in 480 households spread over 13 districts, the use of documents (research work, activity reports), and observation of the streets, the city's expansion zone. The result of this work is that this practice occupies 30.25% of urban land. It is practiced by 58% of the heads of households surveyed. It carries many health risks.*

Keywords: *Extension, Urban agriculture, Public health, Moundou, Chad.*

1. INTRODUCTION

Urban agriculture is a universal fact, the importance of which is relative in different countries (Golhor, 1995:3). In developed countries like Japan, it is protected and encouraged by the government through land tax regulations. In Africa, on the other hand, urban farmers are subject to repressive measures by urban administrators or planners (Freeman, 1991) quoted by (Golhor, 1995: 3). Yet it is a safety valve for low-income households.

In West Africa, urban agriculture plays an important role in achieving national food security objectives on the one hand, and on the other, it meets the food demands in urban areas (Olanrewaju, 1999). The importance of urban agriculture in Bamako is increasing as a result of strong demographic pressure and changes in the population's eating habits (Zallé, 1999) cited by (Olanrewaju, 1999). In the cities of Côte d'Ivoire, urbanization has led to both strong rural migration from the interior and from neighboring countries. This has resulted in unbridled urban spatial expansion marked by undevelopable spaces that are potential agricultural areas (Olahan, 2010). This situation is not dissimilar to other African cities. In Kenya, 20% of household heads are urban farmers in Nairobi, 26% in Mombassa, 30% in Kisumu (Memon and Lee-Smith, 1993).

The case of these cities relates to Moundou city, whose expansion is subject to demographic growth supported by strong immigration (48%) dominated by the rural exodus. These people from rural areas transpose their survival activities so that agriculture is spread in a perceptible and decreasing manner from the urban periphery to the city centre, except for the Baguirmi district, which is largely home to traders, the large market and the banks. In addition, this city has climatic and soil conditions that are favorable to the development of agricultural activities.

It should be noted that the inhabitants of Moundou city before 1923 (birth of the town of Moundou) lived from agriculture. It was not until the arrival of the French colonizers that industry was born and hence the diversity of activities. With the advent of urbanization, agriculture declined in favor of other activities. Thus, the agricultural area is becoming more defined towards the north of the town from the Doumber 1, 2 and 3, Koutou and Bonon districts, towards the east, notably the 15-year-old, Madagascar, Haute ville and Doheri districts, and towards the west in the Kam Gorio, Laba and Belaba districts. These are former rice fields that have disappeared in favor of the city. The

generalization of this activity is favored by the deterioration of the economic situation and the strong demographic growth. Agriculture could meet the growing nutritional needs of this population. The cereal balance sheet in 2012 is in deficit, -464 t in 2012 (ONDR Report 2007 and 2012). It is mainly subsistence farming that lasts for more than six months of the year. Moreover, it is practiced in conditions that are unfavorable to the environment, the urban landscape and public health.

The fields retain soil moisture, providing a breeding ground for insects, especially flies and mosquitoes, and increasing the risk of waterborne diseases. Environmental damage is possible through the use of inputs and insecticides that seep into drinking water sources or the soil. Vegetables can become contaminated and contaminate consumers. The fact that fields are not fenced or fenced with insecticide-treated nets distributed by the National Malaria Control Program exposes households to proximity conflicts and the risk of malaria.

2. METHODOLOGICAL APPROACH

The methodological approach comprises two stages. It concerns the method of data collection and analysis. The collection phase concerns existing data and empirical data that were processed and analyzed. To achieve this, it was necessary to diversify the social science research methods and data collection tools.

2.1. Data Collection

This research is both qualitative and quantitative. The data was collected in a discontinuous manner. The approach taken to address this theme consisted of analyzing existing data and collecting empirical data using previously established collection tools (household survey and field observation forms).

2.1.1. Secondary Sources

Documentary research was fundamental to the design of this article. It consisted of written documents relating to this research theme and available in libraries, documentation centers or on the Internet. These include general works, dissertations and theses, and activity reports.

2.1.2. Primary Sources

The collection of primary data was an essential step in the design of this study. It involved a succession of stages ranging from field observation to data collection by questionnaire. The development of different data collection tools (observation sheet and questionnaire) was necessary in order to carry out these stages.

2.2. Direct Observation in the Field

This is done repeatedly during each visit to Moundou city. In July 2019, it lasted 21 days, i.e. from 8 to 28 July. The second phase takes place from 23 to 30 December of the same year. In 2020, a stay from April to July allowed for a new observation session. The last phase took place from 23 December 2020 to 05 January 2021.

The places observed were the streets, the fronts of houses, the yards of concessions and public establishments (schools, police stations, universities). This phase made it possible to observe the effectiveness of the practice of urban agriculture, the fencing of fields and any threats linked to this activity.

This stage was also useful for taking photographs and topographic surveys which enabled the thematic maps illustrating this document to be drawn. The geographical coordinates taken from the different sites observed are translated into maps. These sites are, among others, the farming areas and households whose heads are farmers.

Thirteen (13) districts were selected for a total of 480 households surveyed. Here, reason was favored over static exercises.

This was achieved through a pilot survey conducted in December 2018 and the exploitation of existing documents. Based on the selection criteria, the neighborhoods were drawn at random for the purpose of this survey. On this basis, data collection tools were designed and administered to households. The aim is to understand how urban expansion has contributed to the development of urban agriculture in Moundou city.

2.3. Data Processing and Analysis

The survey data (qualitative and quantitative) were manually tabulated, recorded and processed in Microsoft Excel 2010. They were coded and grouped into response modes before being analyzed. These results, after processing and analysis, are translated into text, graphs and tables for illustration in the text.

The GPS data was stored in Excel to form the database. They were imported into Arc GIS software and translated into maps with the help of Google Earth, which was used for the delimitation of areas. These maps were transposed into Microsoft Word 2010 to illustrate this work. The analysis of the maps and satellite images allowed the location of the cultivation areas.

2.4. Materials

The Global Positioning System (GPS) was used to collect the geographical coordinates used to produce the maps. Field observation, data collection and interview sheets were useful. Finally, a camera was used to take pictures to illustrate this work.

3. RESULTS

This study on urban extension and agriculture in Moundou city presents three (3) major results.

3.1. Demographic Dynamics in Moundou City

In Chad, the general trend is towards an increase in urban populations (4.77%) to the detriment of rural populations (1.65%) (World Bank, 2007). This is due, on the one hand, to the improvement in living conditions and quality of life and, on the other, to the concentration of administration and services in urban areas.

The demographic growth of Moundou city is linked to its history since the arrival of the French. Their various activities required the contribution of external skills. The presence of these immigrants will lead to an improvement in the living environment, particularly in terms of drinking water, the diversification of edible plants, education and public health. This will have a beneficial effect on natural increase with a decrease in mortality and an increase in fertility (Figure 1).

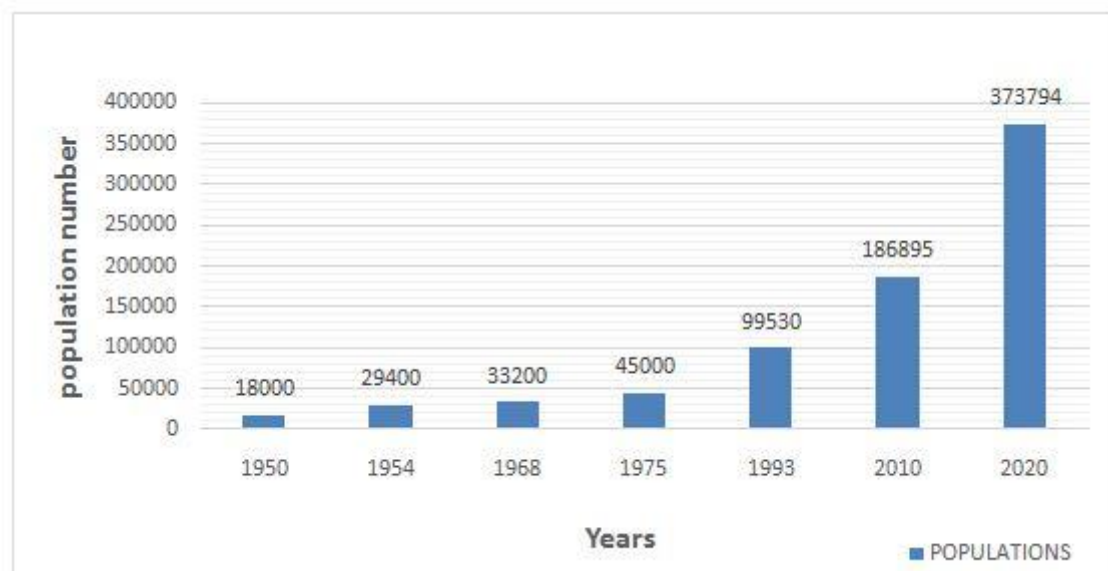


Figure1. Population of Moundou in 2020

Source: INSSSED data, 2010

Figure 1 shows the population projection for Moundou city. According to the results of the latest population and housing census (RGPH 2, 2009), the natural rate of population growth is 3.5% for Moundou city. The last figure in this figure is obtained by applying the natural growth rate. There has been a remarkable growth in the population since 2010. This can be explained by various factors, notably the decentralization of higher education, which has enabled the installation of the University of Moundou, the development of oil activities and the massive arrival of refugees and humanitarians

in the Goré area (Oriental Logone province). Under normal conditions, these populations will double every 19.8 years. Consequently, this population, which was 186,897 inhabitants in 2010, has already reached 373,794 inhabitants at the end of September 2019.

In addition to this natural increase, there is immigration. 48% of these populations were born outside Moundou city, 76% of who come from rural areas.

3.2. Proportion of Households Practicing Agriculture

The practice of agriculture is widespread in Moundou city. More than one in two households is involved in agricultural activities. The field surveys revealed a proportion of 58% of farming households in Moundou city. This proportion varies according to neighborhood (Table 1).

Table1. *Proportion of households engaged in agriculture*

Districts	Agricultural households	Non-agricultural households	Proportion of Agricultural households
Quinze ans	33	17	66%
Tayé	37	3	93%
Guelkoura	29	11	73%
Gueldjem	11	29	27%
Guelbé	14	26	35%
Doyon	19	21	48%
Doumber 3	28	12	70%
Doumber 2	25	15	63%
Doumber 1	32	8	80%
Djarabé	23	17	58%
Bélaba	27	13	61%
Baguirmi	0	30	0%

Source: *Field survey, July 2019*

Table 1 shows the practice of farming households in the neighborhoods surveyed in Moundou city. The absence of this activity in the Baguirmi neighborhood is explained by the fact that this neighborhood is inhabited by Muslims whose main activity is trade. Three districts are dominated by non-agricultural activities. Guelbé is the first district, the core of the town, Gueldjem I is an old district and therefore marked by relative urbanization. Finally, Doyon is the district where the COTONTCHAD factories are located, and is therefore relatively urbanized. In fact, the old, highly urbanized districts are predominantly non-agricultural. On the other hand, in the neighborhoods located in the city's extension zone, households are increasingly practicing this activity.

3.3. Nuisances Related to Agricultural Activities

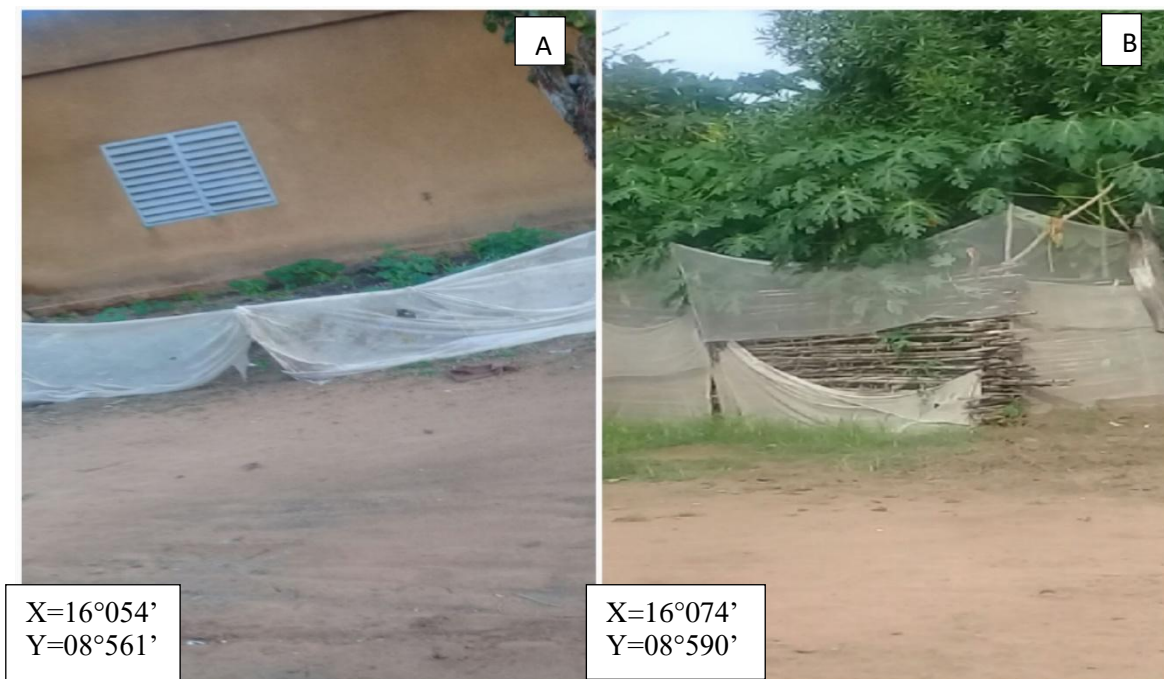
Agriculture as practiced in Moundou constitutes a health or environmental threat due to the inappropriate use of fertilizers, insecticides and other chemicals that can contaminate drinking water sources or the soil. In addition, vegetables that are usually irrigated with surface water of questionable quality pose a health threat to consumers. The aesthetics or urban landscape is also altered as the fields are located in the middle of the city and lack fences or are fenced off with the mosquito nets distributed by the National Malaria Control Program. This is in contradiction with the national malaria control policy (Table 2).

Table2. *Fencing of fields in Moundou city*

Fence Type	Number	Proportions	Observations
Impregnated mosquito net	62	23%	Case fields located in relatively urbanized areas
Living hedge	10	3%	
Dead stems	70	26%	
Without fence	130	48%	Potato or cereal fields located in the city's extension zone

Source: *Field survey, July 2019*

Table 2 shows the methods used by households in Moundou city to fence their fields. It shows that 48% of fields are not fenced, 3% are fenced with live hedges, 26% of households use dead hedges to fence their fields, and 23% are fenced with insecticide-treated nets (Plate 1).



Pictures: Démoundou, July 2019

Plate 1 shows two fields fenced with insecticide-treated nets distributed by the malaria control program. Photo A is taken in the Djarabé district and photo B is taken in the Doumber 1 district. This type of field fencing is found in the relatively urbanized area. Beyond this area, the hut fields have no fences (Plate 2).



Pictures: Démoundou, July 2019

Plate2. Unfenced hut fields

Plate 2 shows the unfenced fields. Photo A is taken in the Bélaba district. Photo B is taken in the Guelkol district. These types of fields located in the city's extension zone attract animals and are a source of proximity conflict.

With the expansion of the city, urban agriculture is practiced intensively in order to efficiently meet the growing food demand of the urban population (Plate 3).



Pictures: *Démoundou, July 2019*

Plate3. *Agriculture in peri-urban areas*

Plate 3 contains photos taken in the Koutou district, the northern extension of the city, showing market gardening fields. These pictures show the traces of a relatively careful work. This makes it possible to obtain a considerable yield.

This activity favors the reproduction of pests such as flies, mosquitoes, earthworms and humidity, which surely have negative effects on public health (Table 3).

Table3. *Nuisances related to agriculture*

Type of nuisance	Households concerned	Proportion
Mosquitoes	130	49%
Flies	16	6%
Earthworms	18	7%.
Moisture	22	8%
Conflicts	11	4%
Flies/Mosquitoes	24	9%
Humidity/Mosquito	24	9%
Mosquitoes/Worms	18	7%.
Conflicts/Flies	3	1%
Moisture/Worms	1	0%

Source: *Field survey, July 2019*

Table 3 presents the nuisances linked to the practice of intra-urban agriculture in Moundou city. These nuisances include the multiplication of mosquitoes, flies and earthworms. The results show that farming favors the production of mosquitoes in 130 households (49%). Twenty-four (24) households reported that this activity promotes the simultaneous production of flies and mosquitoes (9%). A further 24 households reported that it caused mosquito production and maintained soil moisture (9%). Eighteen (18) households said they were affected by mosquitoes and earthworms (7%). A further 18 households believe that agriculture causes earthworms to multiply (7%), 6% of households experience flies. Urban agriculture is partly a source of malaria when the fields favor the multiplication of mosquitoes which are vectors of this disease (Table 4).

Table4. Distribution of nuisances related to farming by neighborhood

Districts	Type of nuisance									
	1	2	3	4	5	6	7	8	9	10
Tayé	14	6	9	1	7					
Guelkoura	10			1	11	9				
Gueljem	8			1	2	2				
Guelbe	8	1	2	3						
Doumber III						9	7	10	2	
Doumber I	21	4		7						
Guelkoura	10			1						
Doyon	13					3	2	1		
Belaba	13			1		4	3	1	1	1
Djarabe	5	5	5	2	3		1	3	4	
Doumber II	15		5	5						
Quinze ans 1 et 2	23									
Total	145	16	21	22	23	27	13	15	7	1

Source: Field survey, July 2019

Legend: 1= Mosquitoes; 2= Flies; 3= Earthworms; 4= Humidity; 5= Conflicts; 6= Flies/Mosquitoes; 7= Humidity/Mosquitoes; 8= Mosquitoes/earthworms; 9= Conflicts/flies; 10= Humidity/earthworms

Table 4 shows the types of nuisance by neighborhood. It can be seen that mosquitoes are the most common nuisance in all neighborhoods. This is due to the presence of greenery which attracts these mosquitoes. This greenery is permanent in some places, but in all cases it lasts at least five (6) months of the year. The second nuisance relates to the humidity of the soil, followed by flies. Moundou's soil is sedimentary and the permanence of the greenery helps to maintain soil moisture. In addition, flies like damp places to develop. Earthworms are only present in the Tayé district. These nuisances result in the proliferation of water-borne diseases such as typhoid fever, malaria and intestinal worms. Agricultural activities give rise to a chain of other activities: shelling, transport or marketing. All these activities clearly generate waste, which is a factor in the proliferation of mosquitoes, flies and earthworms.

3.4. Spatial Distribution of Agricultural Activities in Moundou City

As Moundou is a cosmopolitan city, urban agriculture is not practiced in a uniform manner. It is increasing from the centre or the old, relatively urbanized districts to the new districts on the periphery. Other neighborhoods are free of it (Figure 2).

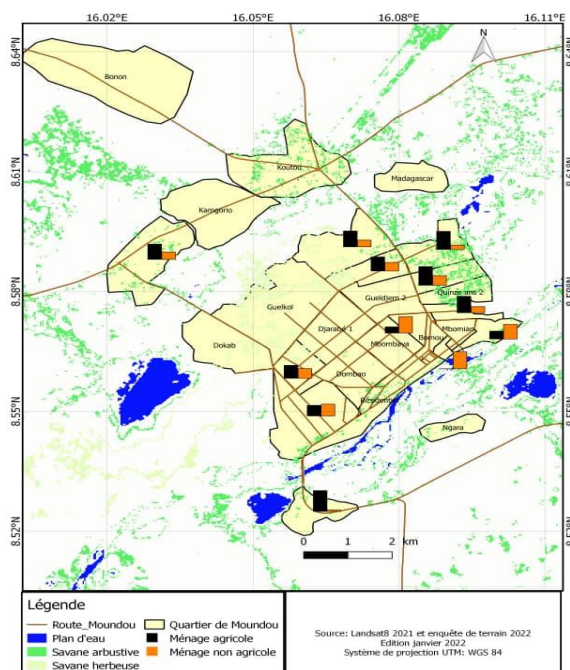


Figure2. Proportion of farmers in the surveyed districts

Figure 2 shows the proportion of farmers in the neighborhoods surveyed. It shows that farming households vary according to neighborhood, and are absent in the Baguirmi neighborhood. The new neighborhoods are sparsely urbanized and contain more farming households than the old ones.

3.4. Agriculture at the Heart of a Spatial Dynamic

The development of agriculture in Moundou city is marked by the expansion of the town both demographically and spatially. Originally, Moundou city (today's Guelbé district) was a town populated by fishermen who made a living from agricultural activities (Figure 2).

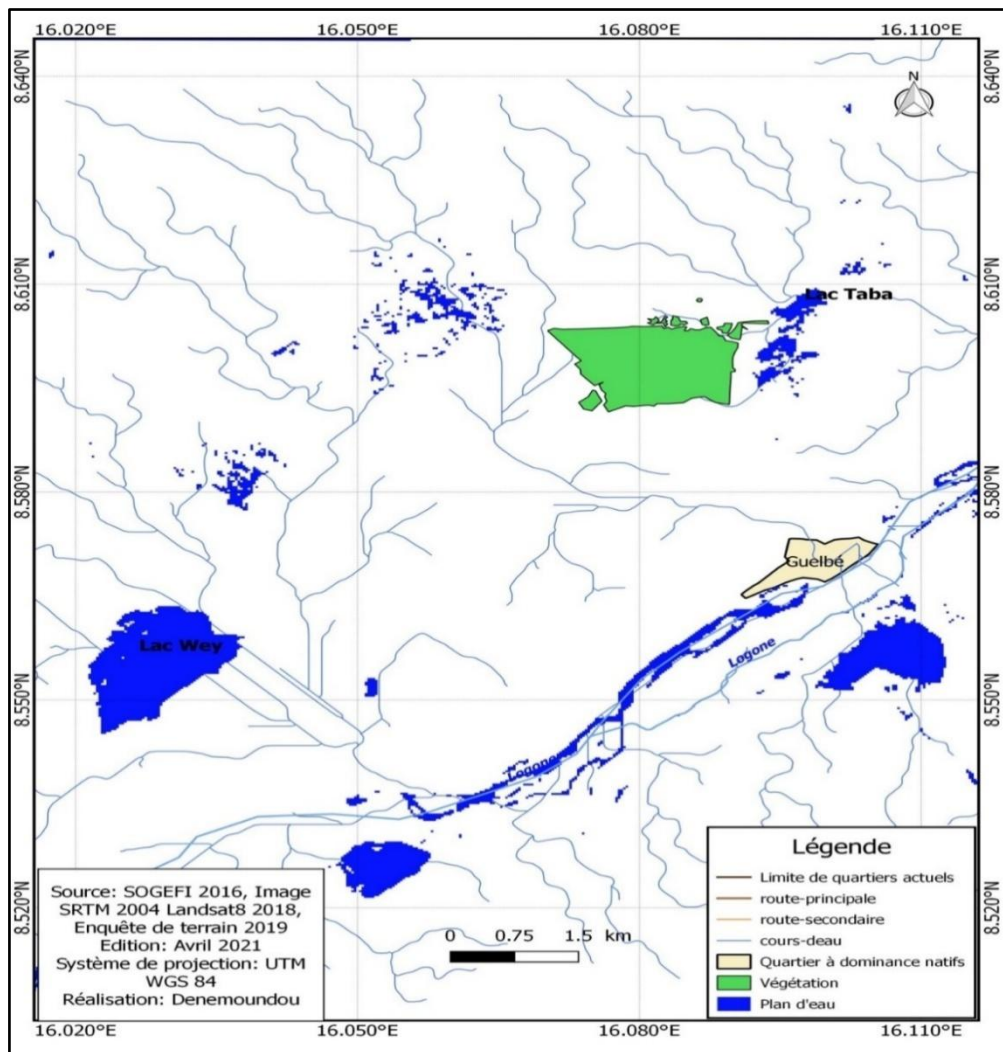


Figure3. Space occupied by Moundou city before 1927 according to Laoukein (2019)

Figure 3 shows the bush (Moundou city), the village occupied by fishermen before the arrival of the French. The Logone River, the two lakes (Wey and Taba) and the core of the town (the present-day Guelbé district) are shown. At that time, agriculture was essential for survival.

Before the 1980s, the peripheral zone of Moundou was occupied by rice fields. These fields extended over the present-day districts of Doumbeur 1, 2 and 3, Quinze ans 1 and 2 to the north and Djarabé to the west. These rice fields were sold to private individuals to be used as housing and have undergone irreversible urban spatial dynamics. Over time, Moundou city ended up swallowing up neighboring villages such as Bélaba, Tayé, Ngara and Bonon.

Thus, agricultural space is receding in favor of the spatial extension of the city. However, urban agriculture is practiced in an oil spill across the city. It is therefore decreasing from the centre to the periphery (Figure 4).

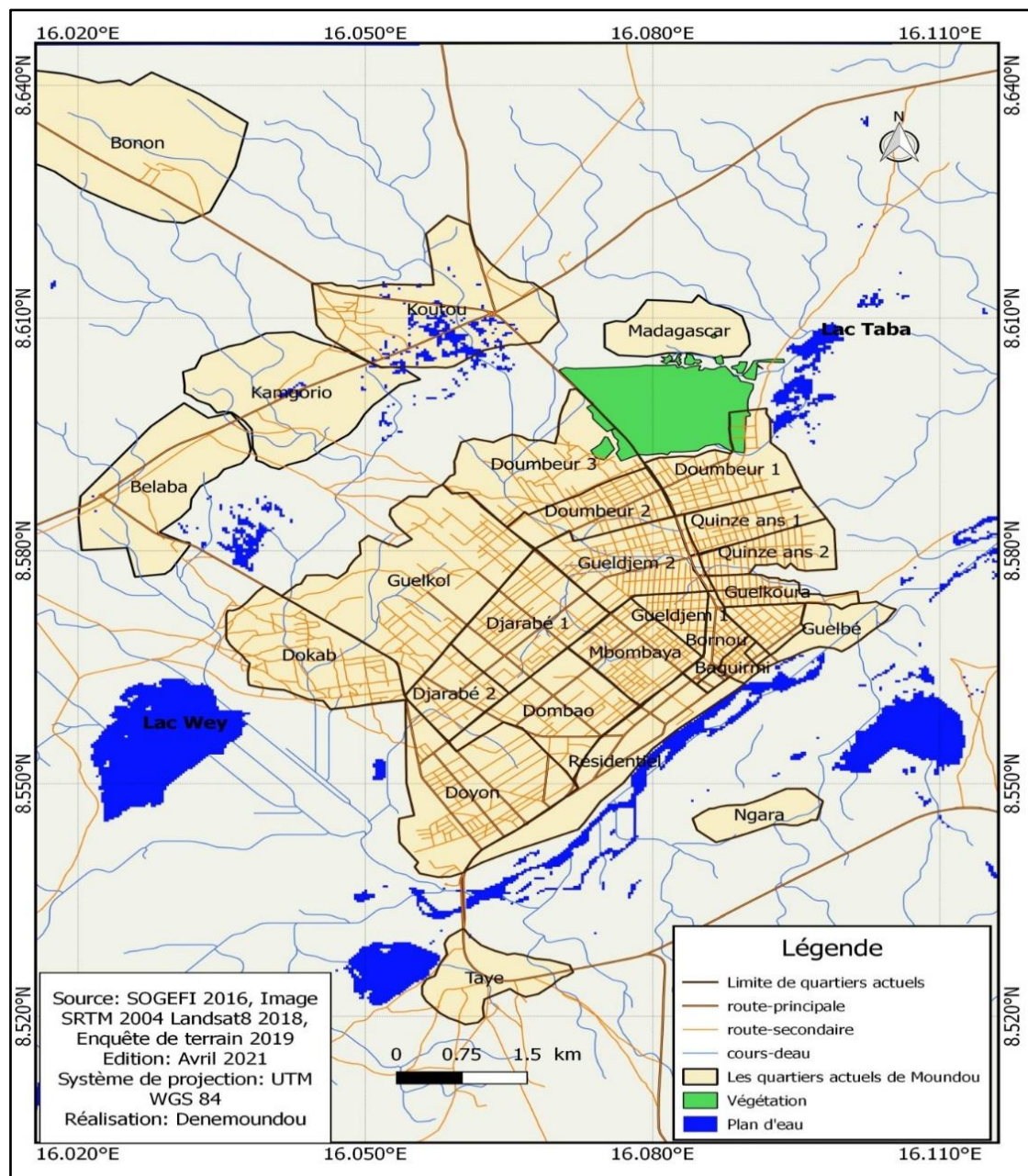


Figure 4. Land use in Moundou city in 2019

Figure 4 shows the city of Moundou in 2019. There is a spatial expansion towards the north and west of the city. This is justified on the one hand by the presence of the university to the north and the Moundou-N'Gaoundéré road to the west, and on the other hand by the fact that these areas are located at a relatively high topography compared to the rest of the city. The villages of Bonon, Madagascar, Kam Gorio and Haute Ville are now an integral part of the urban perimeter.

As the population grows, the nutritional needs of the population are increasing. Due to poverty, households have not hesitated to practice local agriculture to ensure their survival. Moreover, in the new districts (Koutou, Bono, Kam Gorio, Madagascar), agriculture is geared towards profitability. It is therefore the agricultural products from these districts that partly supply the city of Moundou with vegetables or fruit.

In 2021, agricultural land will occupy almost a third of the land in Moundou city (Figure 5).

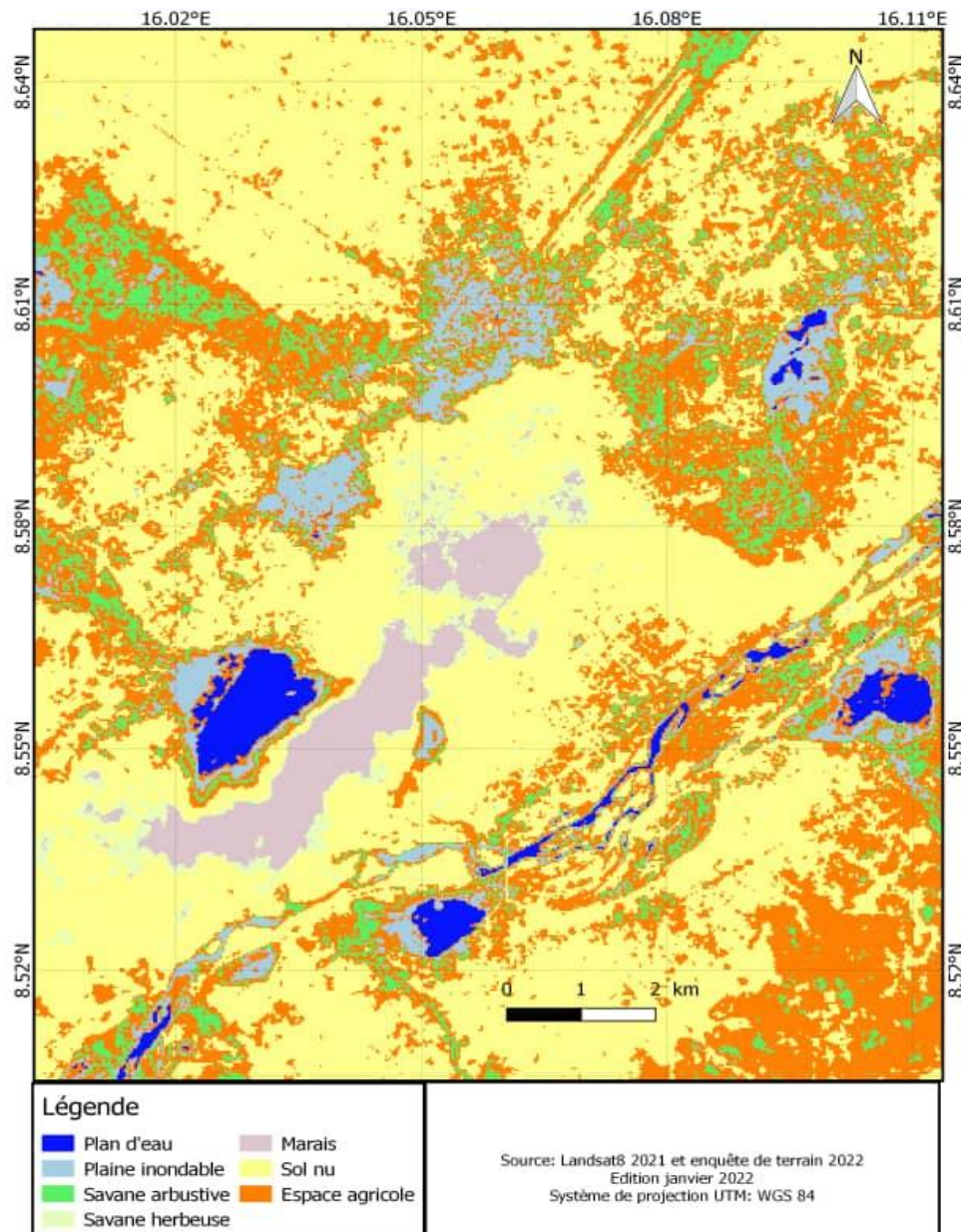


Figure5. Urban agricultural land use in Moundou city in January 2022

Figure 5 presents the space occupied by urban agriculture in Moundou city in 2021. It shows that this activity is practiced in a remarkable way. Few neighborhoods are not concerned.

4. DISCUSSION OF THE RESULTS

This article focuses on the effects of population growth on the development of urban agriculture in Moundou city (South-Western Chad). The aim was to demonstrate how population growth contributes to the development of urban agriculture in Moundou city. This study has its limitations, which include the sampling method (purposive), the inadequacy of the technical tools used to process the data, the absence of the communal documentation centre, and the time spent in the study area.

Despite these limitations, the results show that the immigrant population represents 48%. This result is higher than that obtained by the 2nd General Census of Population and Housing of 2009, which gave a result of 35%. This is explained on the one hand by the relatively high natural growth rate of the immigrant population (3.6% compared to 3.5% for the native population). On the other hand, the population is dynamic, as the census took place in 2009, i.e. 10 years after the present study.

This immigration is dominated by the rural exodus (76%). This is almost double that of Franceville (40%), according to the study carried out in 2002 by Mwanza and Kabamba on immigration to urban

areas. It is more than double that of the cities of Burkina Faso (33%) and 7 times more than the case of the cities of Cote d'Ivoire, according to the survey carried out in 1995 on urban migration in West Africa by the Sahel Institute.

Urban agriculture occupies 58% of households in Moundou city. This figure is close to that of Montreal (42%), reported by Moreno, (2016) in relation to his study of American urban farmers.

Urban agriculture is practiced in a remarkable way in Moundou city as in other cities in Sahelian Africa according to the study carried out by Villien (1988), relating to the city of Bangui and that of Kenyan cities reported by Memon and Lee-Smith (1993).

This information can guide future research and the planning of an urban development project on the basis of knowledge of the situations in the various districts.

5. CONCLUSION

This article aimed to demonstrate the role of population growth on the development of agriculture in Moundou (southwestern Chad). The problem was based on an urban expansion supported by immigration dominated by the rural exodus.

This work, which falls within the field of urban geography, is in line with the current of ecological thought. Population growth in Moundou city and changes in eating habits have contributed to the development of urban agriculture. The way in which agriculture is practised in this city has caused damage to public health, the environment and the urban landscape. However, the products of urban agriculture contribute to the relief of poor households on the one hand, and to the feeding of city dwellers on the other.

Urban agriculture is practiced in 58% of the households surveyed. This means that more than half of the heads of households are farmers. However, the proportion of farmers varies from one neighborhood to another. In addition to households, the urban periphery of Moundou city is occupied by market gardening, which plays an important role in the diet of city dwellers. These gardens contribute to increasing the city's agricultural space.

Given the importance of urban agriculture in Moundou city, it is preferable to practice it with modernization and in respect of the requirements of the urban landscape in order to increase the yield and minimize the sanitary risks. This is in order to maximise its efficiency.

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