

The Green Structure in Moundou: Between Old Design and Current Expectations

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Abstract: As everywhere in Africa, urbanization of certain regions by colonists respected in the slightest degree the urban standards. They planned green space for a green urban living, and relaxation and to embellish the city. From the creation of these cities to recent times, it was the age of sustainable urban planning and the emergence of the ecological urban planning. In Chad, the same urban public policy was respected until 1970. After that date, new management practices and different types of green spaces appeared, expressed by the illegal occupation of green areas in large cities in Chad. In Moundou, the economic capital city of Chad, the superficies of green spaces communal forest have not change. Those which are there, have been dispossessed for makeshift homes in order to reduce insalubrity and insecurity, whereas 53.74% of respondents believe that the number of green spaces in the urban area if moundoulaise is insufficient and 46.26% who consider them insufficient claim for more green spaces. The objective of this article is to study the evolution of the place the plant in the city from the SPOT scene dated from 2014 and the map of the town of Moundou in 1975. The integration of expectations of citizens in a GIS helped provide a green corridor based on the concept of "biodiversity, accessibility, connectivity," according to the desire of the population of Moundou.

Keywords: Green spaces, old design, Moundou.

INTRODUCTION

In Africa, the place of nature in the city as advocated in Europe [1-3] is challenged by its artificiality and offset the new aspirations of cities. Nature in the city frightens or repels. The shadows created by the green corridors are considered dangerous at night and the areas left fallow come from a lack of work of the service of green spaces in the city. Prejudice is harsh, but realistic and it will still be necessary to make a long process of education to teach citizens the benefits of urban ecology.

Following the example of many towns in Chad, Moundou is located along the river for practical reasons (hydrant, trolley). Moundou enjoys a particularly favorable configuration of this relationship, thanks to the presence of two lakes: Lakes Wey and Taba that frame it. The uniqueness of this site has been recognized by its inhabitants: they don't only speak about the two lakes, but the interior plains they exploit and process every year in rice area.

Created in 1923, the town of Moundou has really experienced real population growth after 1950. The population of the urban center, estimated at

17382 residents in 1953 reached in 1961, the figure of 21 230 [4]. Between the two censuses of 1993 and 2009, the number of Moundou population increased from 93,000 to 187,000 [5]. This population reached slightly 200,000 in 2015. This growth rate of about 2%, compared to those of Moundou rural communities between the same dates (only 1.75%) and an urbanization rate of 23.9%, emphasizes the attractiveness of the economic capital on townships and villages, owing to its proximity for centers recruitment of workers for the oil exploration sites.

In this sensitive population growth, profound changes in the middle of operations was realized in parallel. The growing of market vegetable and citrus fairly new to feed the thousands of workers has sparked intense competition for land and resulted in a massive crumbling situation of urban green spaces. Yet, green spaces permits, according to several authors [6, 7] To "limit the spaces" and with the diversity of landscape that they create, "give a better identity to the sites," reinforce the legibility of the main axes, reduce the visual impact of too heterogeneous built and in varying species "landscapes are created." Green areas are therefore essential elements of urban composition.

Significant efforts are certainly being made by the local authorities, without the recommended solutions have had the desired effect.

Inspired by the concept of "green belt" implementation in some cities of Chad, the article is to identify the natural environment to develop and landscape elements that are strong symbols of identity

of people of Moundou. The proposed green frame rests on the heels ones connectivity concepts, ecological corridor, reservoir of biodiversity, multifunctionality occupying increasingly a prominent place in the discourses and development approaches to local authorities in relation to the expectations of the people of Moundou.

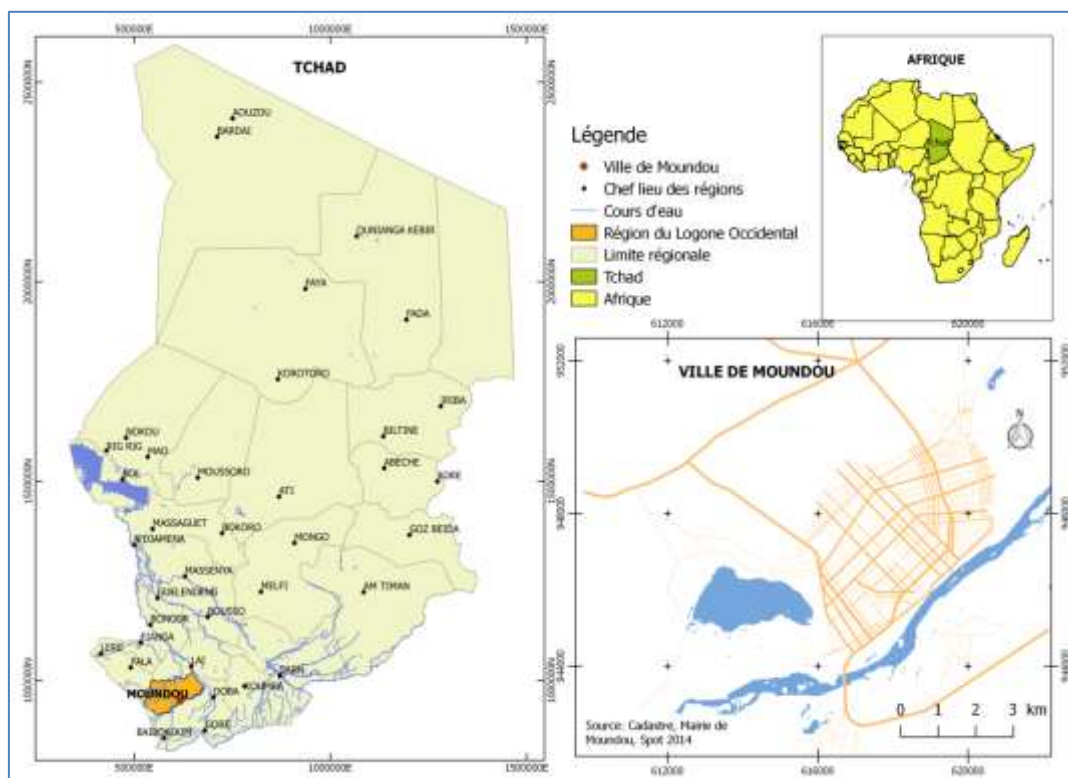


Fig-1: City of Moundou

DATA AND METHODOLOGY

The methodology combined mainly desk research, surveys ground and analysis diachronic image Spot NC-33-V-3 obtained in 2014 and the map of the town of Moundou produced by Cabot [4]. This approach allowed to explore and understand local land dynamics.

To maintain consistency in the spectral response of different plant cover, the image was acquired during the dry period (February 2014). In this sense, it also provides the largest spectral differences among landscape elements [8] including the opposition among the vegetation systems "natural" whose spectral response will differ considerably from "anthropogenic" systems that were then characterized at that time by a near absence of vegetation.

Using the SPOT of course required what is generally called "truths ground", to choose the test areas on which we initiated treatment and to make an objective and accurate assessment of the results of these treatments.

The ground observations were made by following a stratified type of sampling plan [9]. It has relied on all the existing information (map of the town of Moundou produced by Cabot in 1965), an ecological zoning a priori in the region, based on visual interpretation of color compositions [10] and supervised classifications performed on the same data.

The selected classification is supervised (or "supervised classification") under ENVI. Based on our knowledge of the field and on the spectral signature we defined for each pixel of our image its membership class. The algorithm used is the maximum likelihood based on Bayes rule and calculates for each pixel the probability of belonging to one class over another. The pixel is assigned to the class whose membership probability is highest.

- The approach can be summarized in four steps:
- Visual interpretation of satellite images based on both the characteristics of the land cover classes and our knowledge of the field;
 - Selecting a number of drive zones for the desired classes;

- Assessing the reliability of our classification and the test result obtained by the confusion matrix.

The sample which is essentially non-probability composed by the heads of household, Administrative authorities and technical services. Each player has been met in the middle in one or more passages in order to complete the data. Collection concerned 681 people who were interviewed and questioned.

The two chosen reference time present the situation before the socioeconomic transformations of the late 1960s and early 2010, after half a century of changes in land and real liberalization.

RESULTS

The evolution of the built

From 1960 to 2011

Moundou has experienced in recent decades, a very significant population growth. From 30,000 inhabitants in 1964, the number of population in the city grew in at least 30 years to 99,530 people during the census of 1993; that is to say the triple of its initial population. In 2009, its population is 137 251 inhabitants (RGPH2). With a growth rate of 2% per year, the city could expect by 2025, an effective of 180,000. This significant population growth in leads to considerable spatial extension.

Estimated to 1,000 hectares to 1960, the area of the town of Moundou is over 2,200 hectares in 2009 [5]. Strong population growth to which is added the strategic position [1], Print a significant expansion gradient to that city. Indeed, originally made up of three native neighborhoods Bebakor, Guelmi and Nondal, Moundou, was at seventy-three to twenty-four city districts (24) extending over 3,774 hectares [11]. Gradually, Moundou has "swallowed up" the surrounding villages as Ngara and Belaba. With a 114.27 hectare extension dynamic year [11], the trend is far from fading.

The strong momentum experienced by the town of Moundou, earned changing its perimeter several times². These changes have not been made without problems. In May 2008, the review of the urban area was the [2] subject of conflicts of competence between traditional authorities and governments. In December 2010, the city limits were changed by

¹With the presence of a gin and shipping of cotton, an oil mill, soap, breweries Logone, the Manufacture of Cigarettes Chad, Moundou is the economic capital of Chad. Its proximity to Cameroon and the Central African Republic made it a major trade center.

²The scope of Moundou, set by decree no770 / INT / ADG of 20 November 1958 was revised by interministerial decree no238 / PR / PM / MAT / SG / DEL / 07 of 07 January 2007.

extension South side [³] arousing the reaction of traditional populations and authorities. To appease tensions, in February 2011, under the aegis of a ministerial committee, the boundaries were adjusted in concert with the authorities of the two regions (Western Logone Region and Eastern Logone Region) to reflect claims each other; bringing thus the common area today to 8663 hectares or 889 hectares within 10 years. The extension seems to regulate dynamic between the two dates since stabilized at 8.89 hectares per year against 114.27 from 1960 to 2011 [12].

From 2011 to today: the campaign to change the city gates

The immediate vicinity of the town of Moundou has the characteristic of the countryside landscape with rice lowlands, fields of millet and peanut dotted with mango trees, the villages of traditional houses surrounded by a varied vegetation (papaya, various fruit, and lemon hedges) nérés and shea trees whose sharp silhouettes form landmarks often visible from afar.

There are some differences between the north-west, where mangoes are very present, and south-west, where orchards are a greater variety of species, forming a quasi-grove. The largest flood areas offer a more complex landscape, where a more important place is occupied by rainfed crops and irrigated gardening from a quasi-permanent water slide that connects the Wey Lake West to Lake Taba in the East.

Moundou does not have high point from which we have to read the structure of the city, but the opposite bank Ngara can appreciate the skyline and its evolution. The old town grown around a collinear dome at the bank of the Logone. The colonial city was gradually replaced and expanded on the left bank of the Logone, while maintaining a low profile where the trees were very present and a height comparable or even superior to buildings, and from which only administrative buildings in royal stype were built. This figure has been altered, first by removing many trees which ensured its continuity and the more recent emergence of very high suburban buildings. Like those of any city in fast growing segments of Moundou exhibit the blurriness of a changing space, with three extension types:

- Spread by advanced urban front occurs all around the city, heading north, except in the south where it is blocked by the Logone. The front progresses irregularly, according to sideboards and proprietary strategies;
- The linear extension is along the major radial roads (including roads) major presidential projects (weighing and municipal high school) orchards and

³Arrested no3361 / PR / PM / MAT / SG / 2010 of 14 December 2010 on the delimitation of the urban perimeter of the town of Moundou.

habitats along the path towards the Cameroon border, along the eastern bypass governorate, warehouses and garages fences. Along other routes towards N'Djamena, the capital city, there is the alignment of the garages and the university campus which slightly spread beyond regulatory municipal boundary, and

- Urban sprawl is characterized by disordered appearance of buildings or groups in the agricultural area (lots, storage areas) or by the presence of land under construction or during backfilling, sometimes large (tens of hectares) of Doumer 3 in Miscellaneous area.
- However it seems less destabilizing to agriculture: we see little wasteland, agricultural parcels are generally grown to their urbanization at the expense of green belt.

The offer in terms of green spaces from the colonial period to today

From colonial times to the 1970s

The continuity of the green network of the old city moundoulaise takes many forms today. In the city center, continuity lined streets and some plazas and green corridors, forming a network blank is now almost non-existent in the administrative district. In the urban fringe, the discontinuity of the urban stain has not allowed a potential continuity of the green network, because growth of Moundou has provided unconnected open spaces (northern Doumer 2 and 3 towards

Koutou), possible greenways holders if they are preserved. In rural areas, seems that the most planted areas of space are the villages that stretch along main roads (Moundou-Ndéli north and Moundou Larmanaye-west) and some sets of fields planted with mango trees and other fruit trees, which appear as blurry but continuous bands often linked to the villages.

The offer in terms of green spaces in the town of Moundou evolved in two stages. From colonial times to the 1970s, the appearance of urban vegetation showed a heterogeneous distribution of tree types in two groups: one that is well wooded with a concentration of gardens and streets lined with trees in plantations mono-specific; the other, densely built, offering little streets, gardens and tree-lined course. This difference is explained by both historical facts and the current organization of the urban environment is among the administrative center to the periphery. The administrative center and residential areas had benefited from tree planting and maintenance to fight against the wind and erosion of the banks of the Logone River. For the embellishment of the town Kaya Senegalensis (Muray) and Flamboyant were planted along the main arteries; that constitutes quickset of shade (Fig-2). Prices of offices and schools were systematically arranged and planted. Trees (Kaya Senegalensis) intra-urban plantations were the plantations, usually mono-specific, with less exotic.



Fig-2: Kaya Senegalensis relic of the border plantations floor of the colonial era Stereotype: Djangrang, February 2017

It is also noteworthy to notify that the green spaces of that time followed the logic of the periphery Center, a logic that has led to the segmentation of urban space in two blocks (Fig. 2). In the block of administrative districts, green spaces covered places equipped for games, recreation, gardens, walks, ornaments roads and intersections, etc. The colonial administration, through the Parks Department of the

Town Hall, was in charge of its maintenance. In indigenous areas, green areas covered natural forest. Its development and growth more depend on nature. During that time, you could count 3.79 km forested arteries and 95.6 hectares of wooded course completely; which is about 31.92% of the area of the Administrative Area. In neighborhoods of the natives, no green space was planted during that period.

Table-1: Areas of green space from the colonial period to 1975

Neighborhoods	Area (ha)	Area Nature (ha)	%
Administrative district	299.5	95.6	31.92
Native neighborhoods	133.1	0	0.00
Total	432.6	95.6	22,10

Source: Mapping the town of Moundou, Cabot 1965

The regional development plan of that time divided Moundou into two parts: “urbanized” and “non-urbanized” duality; that fact gave a discriminatory character to the city (Fig-2.). The area inhabited by whites (administrative district) included many facilities and amenities. On the aesthetic and urban planning this

neighborhood met the urban standards. In contrast, the eastern part of the city, the least urbanized, involved the construction of unplanned cities in the image of an ancient city. The urban plan has drawn however "a network of wide straight avenues lined with trees intersected itself in a tight grid of streets" [4].

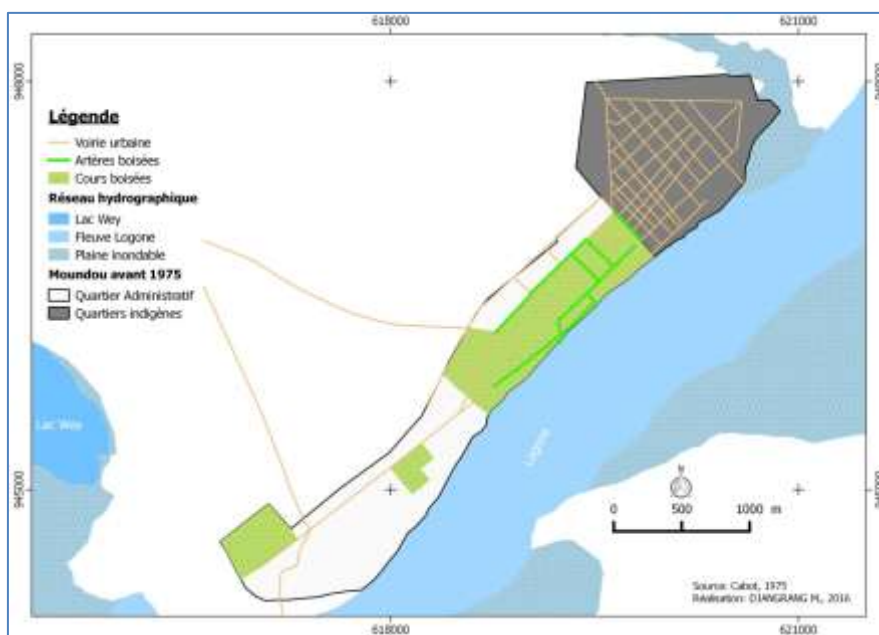


Fig-3: Green areas before 1975

From 1970 to today

After the 1970s, profound structural changes have disrupted administrative management of green spaces that were held by a department under the Ministry of Environment. No directive on the green space policy is advanced by the municipal authorities. In the administrative district where bloomed *Kaya Senegalensis* and flamboyant trees are no longer maintained. Trees, cut very old are never replaced. North of native district that adjoins the "natural forest"; Communal 1973 decision secures a forest park of 482 hectares (communal forest Koutou) (Fig-2) composed of natural essences and mélinahigh rod that the special

interest of providing ornamental and shade for residents of the city of Moundou and against high winds, dust and greenhouse gases. This green space is in a state of neglect. The vegetation is disappearing. Many trees are destroyed or slaughtered as in the Administrative District. The "Koutou communal forest" is invaded by uncontrolled building houses belonging to financially weaker social strata. The analysis of the spot scene acquired in 2014 shows that the communal forest Koutou lost 54 hectares in 41 years is about 1.31 hectare per year. For all of the common, natural parks and plantings are estimated at 1796 hectares. They represent about 20.73% of the municipal area (Fig-3).

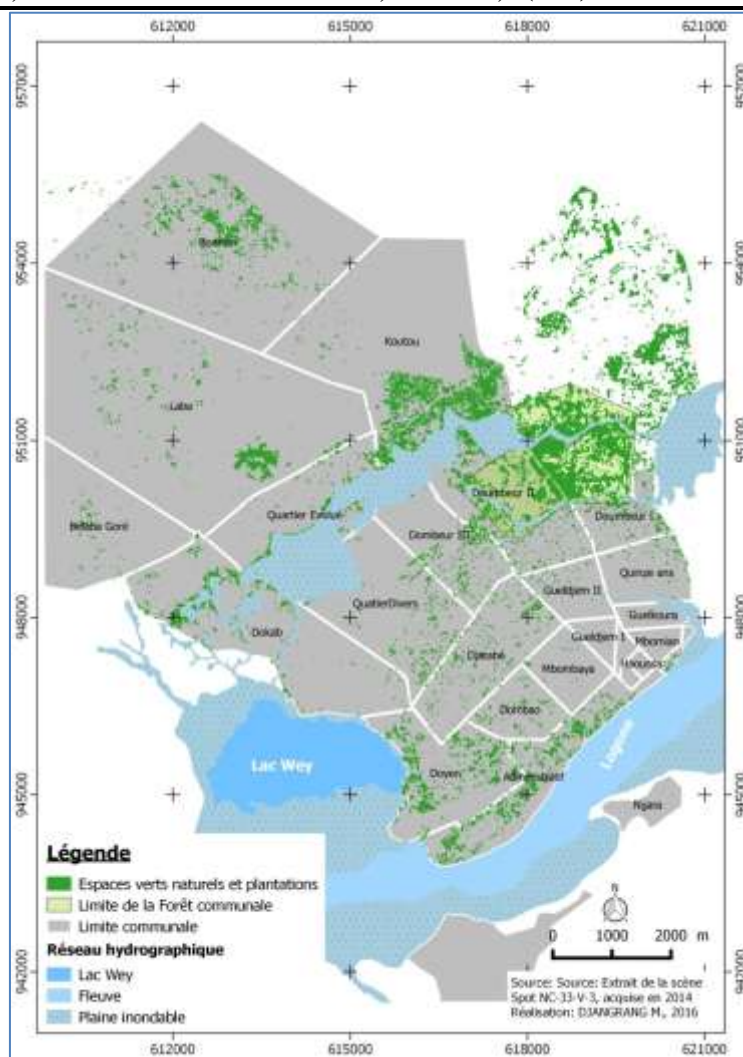


Fig-4: Distribution of natural green areas and plantations

Taking into account the geographical distribution, 95% of woodlands artificialised (orchards) are located at the periphery. The intramural space of the densely populated and mineralized town knows a notorious deficiency or disturbing. Green spaces dating from the colonial period have almost disappeared. Several causes are indexed.

The causes of the destruction of green spaces

The causes of their destruction are legal and economic order.

Legal texts anachronistic

Besides some of them⁴ almost all texts that manage green spaces dating from the colonial era are often anachronistic to the current reality and there is a virtual absence of enforcement. The reading of the law shows that a single legal text often regulates several

⁴ Decree No. 09-904 / PR / PM / MOEHR of August 6, 2009 on the regulation of pollution and nuisance to the environment and Law No. 14 / PR / 98 of 17 August 1998, defining the general principles of the protection of the 'environment.

parts: all kinds of tree-cutting (in natural and artificial green space), management, etc., the direct consequence is that often these texts are superficial. The penalty should be limited in its qualitative and not quantitative description.

Legally and administratively, the management of green spaces recognizes five actors (stakeholders) in Chad because of their participation, namely the Ministry of Public Works and Infrastructure, the Ministry of Urban Development and Housing, the Ministry of environment, town and population.

In terms of the management of green spaces in the town of Moundou, a specialized service attached to the municipality is responsible for the protection of green spaces: it is the green belt and afforestation Service. It should be noted that this service remains today the lame duck; we only see it taking care of the maintenance of roundabouts (Fig-4) and much often of the ornament of the city during the holidays. After these events, parks owe their survival to their ability to adapt to climatic deterioration since the 1950s.



Fig-5: Elephant roundabout, green space abandoned Stereotype: Djangrang 2006

A recurring climatic deterioration

The region is experiencing a North Sudanese climate characterized by annual rainfall of around 819 mm on average, spread almost entirely between June and September. These rains are subject to significant interannual fluctuations in the past five decades (1957-2012) and their rhythm is irregular during the rainy season. But the regularity of rainfall depends on the state of vegetation even more than the soils have a low water holding capacity and are, moreover, not very fertile. Crude mineral salt, unsophisticated erosion, clay

and ferruginous little leached constitute the dominant lobe associations organized along very gentle slopes.

The significant recovery from 1987 to 2005 rainfall noticed in Moundou station, when compared to those years of severe drought from 1972 to 1973 and from 1983 to 1984 (Fig- 5) did not reverse the development of wood of Koutou and plantations curbs of pavements. A millet production within the forest training Koutou essentially self-consumed, it should be added the collection of fuel wood which is the subject of a small business in the markets of the city.

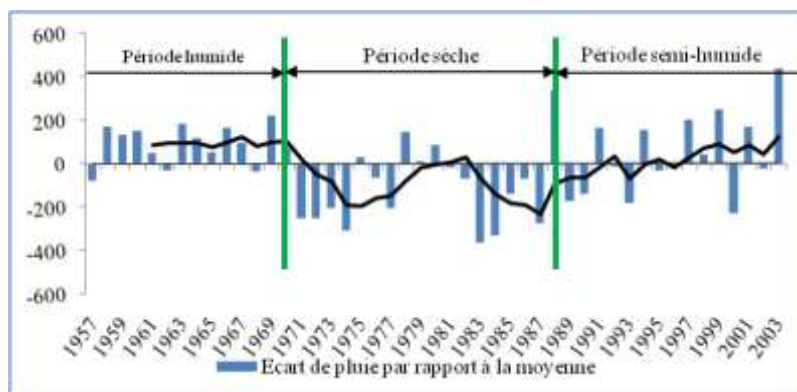


Fig-6: Change in rainfall interannual

Source: DGM, 2014

The expectations of the inhabitants of the town of Moundou

Green spaces are there, but insufficient

Green space, first is for 13.98% of city dwelling green physical space, "a gathering place, reunions or passage, the use of all, a collective living space." For others (86.02%) citizens, it is "a place that belongs to no one, an anonymous place, collective, common, shared, mutual and listen to nature." The general feeling of the people is that green spaces are in short supply. 53.74% of respondents believe that the

number of green spaces in urban moundoulaise is insufficient against 46.26% who are apparently satisfied. Among moundoulais considering that green spaces are too few in number, they are the inhabitants of the town center (Hausa, Bornu, and Dombao Gueldjem1), representing 27.31% of the sample that are more severe: they are 13.21 % to demand more green areas (Table-2); "the green space in the city center should be a multifunctional nature park (cultural, administrative, and recreation) and soften the heat wave in March and April".

Table-2: Opinions expressed

neighborhoods	Number of respondents	opinions expressed			
		inadequate		Enough	
		EFF	%	EFF	%
Bornu	76	57	75.00	19	25.00
Hausa	45	29	64.44	16	35.56
Fifteen	109	37	33.94	72	66.06
Guelkol	68	46	67.65	22	32,35
Doumber 1	98	21	21.43	77	78.57
Various	60	44	73.33	16	26.67
Doumber 3	70	32	45.71	38	54.29
Gueldjem 1	45	34	75.56	11	24.44
Dombao	110	66	60,00	44	40,00
TOTAL	681	366	53.74	315	46.26

Source: Djangrang, Field survey, 2016

The first value recognized by all the inhabitants of the city is the protection against natural hazards (mainly high winds), the hot weather months of March and April, technological risks and nuisances. For them, tree gives shadow and evapotranspiration also contributes to cooling. Green spaces "finally contribute to the setting of dust and micro particles from the leaves," said they.

A green frame for the Moundou Township

Supported by the two lakes as well as open spaces that are wood Doumber 1 Koutou mango orchards and Belaba, the anchoring points of the green

frame should be spread over the entire common but radiating around the city center. The plan proposes to use the term "frame" as opposed to "belt" which refers instead to a ribbon around the center.

From a consideration of territorial assets of the city, the green infrastructure plan proposes to address the challenges facing the municipality in land use planning and development by identifying three main directions: development of sustainable living environments, structuring roads and a protected environment and set value (Fig-6).

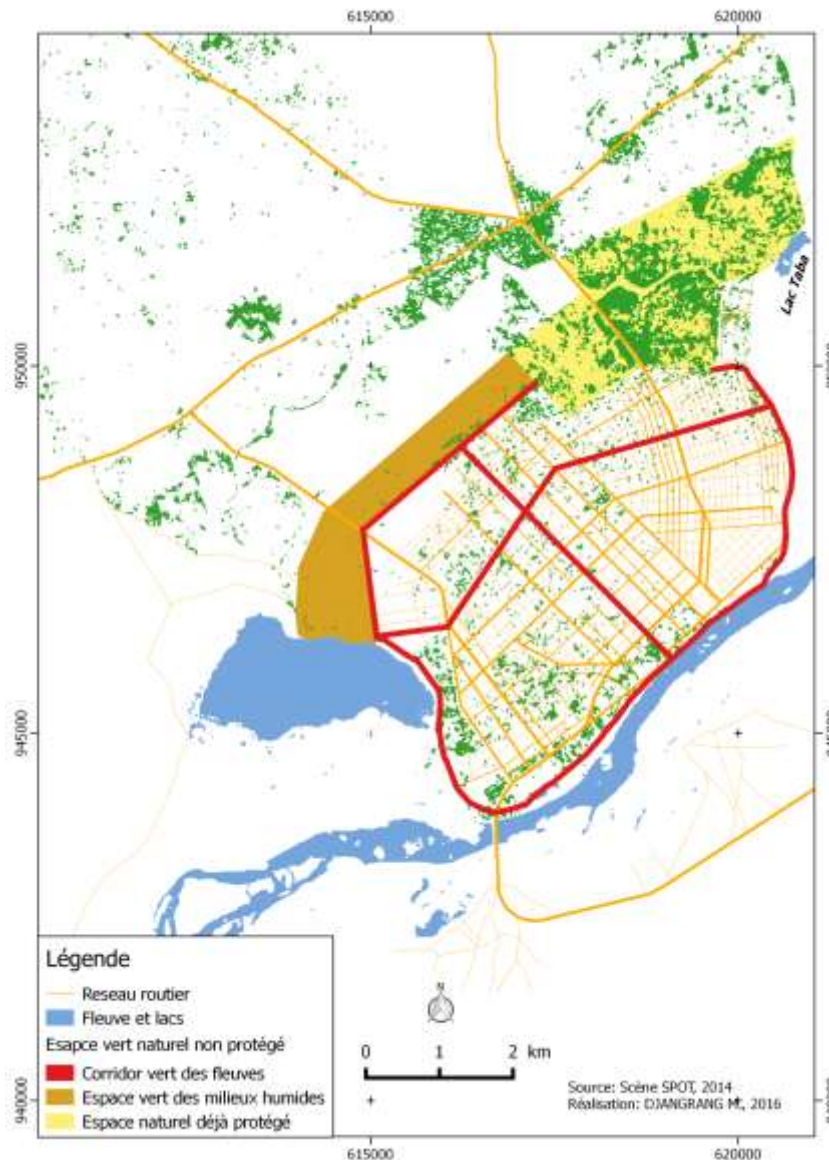


Fig-7: Rearranging the green frame in the township

On the environmental front, the proposal aims to protect 14% of municipal territory, which represents a colossal challenge. More than a year of planning, the requirements of the proposal should be part of the local planning regulations taking into account the protection potential mainly composed of wood of municipal interest and forest corridors relying on principles:

"The reintroduction of nature in the city is not only a health problem. The green areas correspond to a deep need, somehow symbolic securing the freedom of reaction and aggression that the concentration of

human masses in a completely artificial space cannot meet [7].

The green frame multiplies accessible sites near places of residence, and then connects them to facilitate connectivity (Fig-5). Accessible by cycling routes and transit, the frame will allow residents and visitors to benefit from the effects afforded by the practice of not issuing activity of greenhouse gas in the wild. People have planned to add 214.4 ha of woodland and forest corridors and 309.5 ha of wetlands to the 197.3 ha. In total, 1210 hectares have a conservation potential of up to 13.96% of the municipal area (Table-3).

Table-3: Area of green networks

Types d'espace vert	Superficie	
	(ha)	(%)
▪Espace vert des milieux humides	309,5	2,63
▪Espace naturel déjà protégé	197,3	1,68
▪Corridor vert des berges du fleuve et de l'intérieur	214,4	1,82
▪Espace vert naturel non protégé y compris les vergers et les plantations viaires	489,2	4,16
TOTAL	1210	13,96

Based on the concept of "biodiversity, accessibility, connectivity", the development of the green space network with protection and enhancement should enable all sectors of the city to enjoy the river system and natural areas. One is betting that citizens will have access to such wealth, which largely contributes to attractiveness of the town, will become the best guardians.

To implement the proposal and to ensure that tangible results arising from rapidly, the town will have to adopt at its own initiative, the proposal complements the formal regulatory dimension of the actions and the implementation of concrete projects as well as implementation means. Three major projects are targeted either: the bike path and walking between Lake Wey and Lake Taba (14 km), Lake Park and Lake Taba and forest corridor Doumber 1.

The forest corridor from Lake Wey to Lake Taba along the bank of the Logone River is part of an overall concept for the consolidation of the attractions of the town. Because of the potential it represents for the town both recreational plans as heritage tourism, this project will contribute to the implementation of the green frame. In violation with the development plan and the urban plan, the corridor will promote accessibility to both lakes, increasing the visibility of these two lakes, connectivity, recreational and cultural activities within the sector and the extension Dombao the bicycle and pedestrian network sector. These projects provide the foundation for the green network covering more than 1,210 hectares (equivalent to 13.96% of the territory of the commune), contributing to the conservation objectives of the natural environment.

CONCLUSION

From the colonial period to today, the consideration of urban green space has experienced contrasting stages. From the creation of the city in 1970 hygienists concerns led a generation of directors to focus on the plant's contribution to the improvement of urban living. This ideological progress has enabled the implementation of the concessions started with a low fence that demarcates the gardens amidst which the dwelling is visible from the street. During the same period, the study found that indigenous districts formed

a more or less compact rectangular block whose main streets were lined with trees. This urban policy associate with green spaces in general, and urban green spaces in particular, functions and a variety of forms, ranging from "nature artificialized" high aesthetic value to a "wilderness" high ecological value.

From the 1970s, the urban trend least végétaliste will highlight new methods of management and typological choice of specific green areas (urban reserves of biodiversity) without ecological corridors or vegetated parks. The potential of green space acquired during the previous years will be fragmented by a population increasingly large with or without the agreement of the local authorities. The analysis of cartographic and stage spot data showed that the communal forest of Koutou lost about 54 hectares of its original area and intramural almost missing spaces. The reasons given by the inhabitants are structural and cyclical. The anachronism out of legal texts which frames and climatic degradation are indexed.

As in the beautiful old times, the article proposes that urban policy associate with the green spaces of functions and very different forms depending on the socio-cultural and biophysical issues in each area. The planning and management strategies for future green networks as proposed took into account the consistency between these two types of "nature." The actors involved in the implementation of urban green network should focus now on at least two key issues: firstly setting continuity and connectivity of urban green spaces of nearly 1210 hectares or about 14% of the territory as proposed and also the value of services rendered by the plant for the company. Taking as 2011 elections the starting point that brought the municipal institution in the center of the local public space, as a mediator in a complex configuration of power and interests between the public and the private, between the local and national, we assume that the momentum generated by the relationship between the municipality of the town of Moundou and the people around environmental issues will participate in the reconstruction of municipal power relationships at the local level.

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