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Pressures undergone by twenty (20) utility species of the agroforestry parklands in three villages at the rural district of Saaba in the Central Burkina Faso

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The present study aimed to identify the main factors of degradation of the parklands of Saaba commune. Specifically, it aimed to determine the list of adult plants species; characterize the pressures undergone by these species; list the disappearing species. Therefore, floristic inventories were conducted on sixty (60) parklands. Group and individual's interviews were made with the parkland holders. The questionnaires were related to the pressures undergone by the main ligneous species through their uses; the building of private houses and public infrastructures; the species in the process of disappearance. The analyses of variance ANOVA were made with the software JMP. A scoring scale was established to appreciate plants health. The results revealed twenty parkland species belonging to 19 genera and 11 families. The house fields and the bush fields comprise less high densities of ligneous species. Six species were the most cut. The aerial and underground parts of all the species were subject to pressures while the populations of eight of them have been destroyed to build public and private infrastructures. A list of 27 disappearing species during the last 45 years has been identified. There is a real need for an enrichment of agroforestry parklands to maintain woody species diversity in the outskirt of urban areas.

Keywords: Burkina Faso, Agroforestry, Parklands management, Ligneous species, Degradation

INTRODUCTION

Agroforestry parklands creation is perceived as a way of conservation of woody diversity in the agrarian landscapes.The multi-purpose ligneous species beneficial for the men, animals and the environment constitutes in general the priority of the parkland holders (Lawarnou et al., 2010; AECOM-DID/AD10, 2010).

However, this way of conservation of the ligneous species is subject to multiple factors of degradation including natural, anthropic and socio-economic (Abbeg, 2006). These factors can vary from a locality to another. Previous works showed that the pressures undergone by the ligneous species through the climatic factors, the modes of exploitation of the useful parts of the species are the important causes of parkland degradation (Zerbo et al., 2011; Yameogo et al., 2018). To these factors would be added the peri-urban characteristic of this area of study. The rural district of Saaba is a peri-urban commune whose populations maintain socio-economic relationship with the urban district of Ouagadougou. It supplies Ouagadougou with non-wood forest products and wood. Then, because of its statute of peri-urban district, some public and private infrastructures and human habitations have been created increasing the natural resource degradation. Therefore, it is necessary

to assess the impacts of all these factors on the sustainable management of the main useful woody species of the agroforestry parklands.

Thus the present study had as global objective to identify the pressures undergone by the main species of agroforestry parklands in the rural district of Saaba. The specific objectives were to inventory of the twenty main ligneous species of the parklands; to characterize the pressures undergone by the ligneous species through the exploitation of their useful parts; to identify the various pressures consecutive to the installation of public infrastructures and the human habitations.

SITE OF STUDY

The site of study is the rural district of Saaba located at 15 km from Ouagadougou the capital city of Burkina Faso. The villages which sheltered the researches are precisely those of Gampela, Gonsé and Saaba. They are urban neighbouring villages with different characteristics regarding the woody species management. The classified forest of Gonsé, located in Gonsé village, is one of the main providers of woody and non-woody forest products for Ouagadougou. Gampela and Saaba villages are subject to the urban extension of Ouagadougou, to the detriment of the local natural resources. All these factors justified the choice of these three villages for this study. The most widespread soils are tropical ferruginous with variable facies, generally sandy-clay type or gravelly with low agronomic potential. These soils have a higher content of silt and clay in the depressions. They are completely naked places in glacis form locally called “zipélé” (Sampony, 2016). The climate is soudano-sahelian type characterized by two seasons: a dry season from October to May and a rainy season from June to September. The annual average rainfall oscillates between 600 mm and 800 mm (Sampony, 2016). The floristic cover of the district is characterized by a shrubby savanna and gallery forests along the water ways. In a general way, the vegetation is prone to a constant degradation due to the multiple and multiform anthropic pressures.

MATERIAL AND METHODS

Floristic inventories

A total number of sixty (60) parklands have been concerned by the floristic inventories related to the adult trees. In each parkland, a plot of 2500 m^2 (50 m × 50 m) was delimited with a metric ribbon. The plot choice was done in order to get the one which was enough representative and contains consequently the maximum number of the management unit. The diameter at the breast height of the trees was measured with the slide caliper and when this diameter was higher than the capacity of the compass, its circumference was measured with the metric ribbon of 5 m for then calculating its diameter at breast height.

The health condition of the inventoried species

The health condition of the inventoried trees was appreciated with regard to the levels of attacks due to the diseases, the insects, worms and others animals. The levels of cuts, burns by fires, cut for energy requirements, fodder and crafts are also assessed by notations.

THE INTERVIEWS

On one hand, group interviews were carried out during general meetings of villages by using a questionnaire guide. On the other hand, individual interviews were conducted with sixty (60) agroforestry parkland holders, using an individual questionnaire. These interviews aimed to determine the pressures undergone by the useful species through the exploitation of the different parts of the trees, the installations of the public infrastructures and the dwellings in peri-urban area and to draw up the list of the species in the process of disappearance. These last interests were located in a 5 years’ time interval corresponding to the period from which the species considerably regressed in terms of densities in the agrarian landscapes.

DATA MANAGEMENT

The list of the main parkland species resulted from the five dominant species identified in the interviewed farmers’ field. The analyses of variance (ANOVA) were carried out by software “JMP” (Desdevise, 2016). The tests of comparison of the averages values between two parameters were carried out with the threshold of probability 5%.

For the inventoried adult trees, the diameter at chest height is determined by the geometrical formula $C= 2\Pi R$. C = the circumference and R the ray, the diameter D is deduced from R. $D= 2R$.

The frequency (F) of the species is the report of the full number of the individuals of a species (NE) and the full number of the individuals of all the species (NT): $F = NE/NT$.

The average tree densities of the ligneous family in the house fields (CDC), the fields of village (CDV) and the fields of bush (CDB) in the villages of Gampela, Gonsé and Saaba were given according to the inventories.

The following scoring was applied to the health examination of each inventoried adult ligneous: A score 0 = pressure not observed; + = I < 50 %; ++ = 50< I≤75 %; +++ =75 %< I≤100 %. I =rate of inventoried adult ligneous species

RESULTS

The main used ligneous species of the agroforestry parklands

The ligneous densities in the parklands

We observed significant variations between the results of the villages. The tree densities were variable according to the type of the management unit. The village fields and the bush fields recorded higher tree densities while the house fields were particularized by their low densities in all the three villages (Table 1). Statistically, the differences were very highly significant ($p \leq 0.001$) between the three units of management compared one to another: CDB > CDV > CDC.

The main agroforestry parkland species inventoried

A diversity of ligneous species was found in the three types of agroforestry parklands with variable densities. The measured diameters were closely dependent on the morphology of the species and its age according to whether it is adult or young. These twenty main species found on the parklands belonged to 19 genera and 11 families (Table 2). The dominant species whose frequencies were higher or equal to 60% in the bush fields are *Vitellaria paradoxa, Sclerocarya birrea, Lannea microcarpa, Balanites aegyptiaca, Eucalyptus camaldulensis* and *Diospyros mespiliformis.* In the village fields there were *Vitellaria paradoxa, Lannea microcarpa, Terminalia macroptera, Faidherbia albida* and *Diospyros mespiliformis.* In the house fields two species were found with high frequencies which were *Diospyros mespiliformis* and *Lannea microcarpa*. These two last species were also dominant in the CDB and the CDV.

Pressures on the inventoried parkland species

With regard to tree health, low rate of healthy trees and dead trees were recorded i.e. most trees were not healthy: most trees were cut and / or attacked. Indeed, among 20 species, 17 were cut at a rate from 50 to 75% while six (6) were cut to proportions from 75 to 100% (Table 3).

These most cut species were *Vitellaria paradoxa, Azadirachta indica, Terminalia macroptera, Faidherbia albida, Diospyros mespiliformis, Pterocarpus erinaceus*. On most ligneous species, we noted the presence of worms and insects (Figure 1) which attacked the leaves, the stems, the fruits as well as the other parts of the tree. The ligneous species were also prone to the attacks of the parasitic plants of Loranthaceae familly (Figure 2). Tree mortalities were mainly recorded for *Balanites aegyptiaca, Faidherbia albida, Lannea microcarpa, Parkia biglobosa.*

Pressures undergone in the exploitation of the used parts of the ligneous species

The Figure 3 indicates that all the leaves and the wood of the twenty species of parklands were exploited by the rural people for their various needs in particular the energy wood supply. The barks and the roots were also intensely used mainly for the pharmacopeia (Figure 4). The strongest proportions (90 to 100%) were in the uses of the leaves, wood, the barks, the roots and the fruits. That means several species undergo the taking away of all these parts. Taking into account the modes of harvesting which had negative impacts on the tree survival, we perceived how these uses impact negatively the sustainable management of the ligneous species in the parklands. Approximately 50% of the species were exploited for the sap or the resin. The extraction of these substances as well as the other modes of taking away of the useful parts involved wounds prejudicial to the survival of the tree if however precautions are not taken.

Pressures undergone in the installation of the urban infrastructures

The site of the study being an urban outskirt area, public and private infrastructures were gradually created and caused the massive destruction of the vegetation in general and the degradation of the agroforestry parklands in particular (Figure 5). The infrastructures were primarily those of the elementary schools, the health centres, the popular markets, the family and individual homes. Despite the lack of data at the environmental and forestry public offices which quantify the tree destruction, the interviews with the referred people having a good retreat in time were the opportunities to identify the species concerned by the clearings. As Figure 6 indicates it, the species common to the three villages having undergone destruction were *Sclerocarya birrea, Vitellaria paradoxa, Diospyros mespiliformis, Azadirachta indica, Sterculea setigera, Bombax costatum, Ziziphus mauritiana, Balanites aegyptiaca.*

The disappearing species

According to Figure 7, on one hand there is approximately 15 to 20 years the species such as *Vitellaria paradoxa, Acacia seyal, Lannea microcarpa* and *Combretum micranthum* started to disappear. On the other hand the species usually abundant in the fields like *Piliostigma reticulatum* were less present only from the five last years. As for most species in the process of disappearance, it is from the 10 last years that they started disappearing. The enumerated leading causes were the uprootings by the strong winds, wood-cuttings, the overexploitation of the useful parts, chatterings and the cuts for fodder, the bush fires.

Table 1: Ligneous densities per unit of management at Gampela, Gonsé and Saaba

village/Unit of management	CDC ligneous density	CDV ligneous density	CDB ligneous density
Gampèla	07	18	21
Gonsé	10	15	24
Saaba	08	15	20
Average	08	16	22

CDC= House field; CDV= Village field; CDB= Bush field

Table 2: The main preferred agroforestry parkland species, their diameters and frequencies

No	Species	Family	Average diameter (cm)	Frequency		
				CDB	CDV	CDC
01	*Vitellaria paradoxa* C.F. Garrtn.	Sapotaceae	35.48±11.21	0.87	0.68	0.71
02	*Azadirachta indica* A. Juss.	Meliaceae	23.62±12.24	0.48	0.55	0.40
03	*Sclerocary abirrea* (A. Rich.) Hochst.	Anacardiaceae	38.13±09.88	0.83	0.52	0.17
04	*Lannea microcarpa* Eng l. & K. Krause	Anacardiaceae	34.11±05.32	0.65	0.66	0.70
05	*Terminalia macroptera* Guill. & Perr.	Combretaceae	25.44±07.76	0.57	0.70	0.23
06	*Balanites aegyptiaca* (L.) Delile	Zygophyllaceae	27.43±11.05	0.73	0.42	0.34
07	*Parkia biglobosa* (Jacq.) R.Br. ex G.Don	Fabaceae-Mimosoideae	40.73±09.63	0.28	0.57	0.32
08	*Bombax costatum* Pellegr. & Vuill.	Malvaceae	40.22±08.33	0.08	0.25	0.17
09	*Eucalyptus camaldulensis* Dehnh.	Myrtaceae	08.25±04.25	0.72	0.57	0.21
10	*Faidherbia albida* (Delile) A. Chev.	Fabaceae-Mimosoideae	34.57±09.31	0.21	0.67	0.39
11	*Albizia lebbeck* (L.) Benth.	Fabaceae-Mimosoideae	10.14±03.33	0	0	0.32
12	*Diospyros mespiliformis* Hochst. ex A.DC.	Ebenaceae	22.47±07.81	0.89	0.82	0.77
13	*Tamarindus indica* L.	Fabaceae-Caesalpinioideae	39.41±12.20	0.42	0.37	0.23
14	*Anogeissus leiocarpa* (DC.) Guill. & Perr.	Combretaceae	28.46±05.35	0.60	0.37	0.20
15	*Adansonia digitata* L.	Malvaceae	24.87±09.34	0.21	0.30	0.21
16	*Sterculia setigera* Delile	Malvaceae	35.27±05.93	0.39	0.37	0.25
17	*Bauhinia rufescens* Lam.	Fabaceae-Caesalpinioideae	10.02±03.25	0.40	0.34	0.20
18	*Khaya senegalensis* (Desr.) A. Juss.	Meliaceae	33.68±11.07	0.48	0.27	0.16
19	*Lannea velutina* A. Rich.	Anacardiaceae	11.04±03.25	0.35	0.11	0.12
20	*Pterocarpus erinaceus* Poir.	Fabaceae-Faboideae	34.70±07.35	0.52	0.52	0.28

CDC= House field; CDV= Village field; CDB= Bush field

Table 3: Pressures observed on the inventoried ligneous species

N°	Species	Sanitary state		Grazed	Burnt	Cut	Dead
		Healthy	Attacked				
01	*Vitellaria paradoxa*	+	++	0	+	+++	+
02	*Azadirachta indica*	++	+	0	++	+++	+
03	*Sclerocarya birrea*	0	+++	+	+	++	+
04	*Lannea microcarpa*	0	++	+	+	+	+
05	*Terminalia macroptera*	+	++	+	++	+++	0
06	*Balanites aegyptiaca*	0	++	+++	+	++	++
07	*Parkia biglobosa*	0	+++	0	+	++	+
08	*Bombax costatum*	+	+	0	+	++	0
09	*Eucalyptus camaldulensis*	++	+	0	++	++	+
10	*Faidherbia albida*	++	+	+++	+	+++	+
11	*Albizia lebbeck*	+	+	0	+	++	+
12	*Diospyros mespiliformis*	0	+++	+	+	+++	+
13	*Tamarindus indica*	+	++	+	++	+	0
14	*Anogeissus leiocarpus*	+	++	+++	++	++	+
15	*Adansonia digitata*	+	+	++	0	+	0
16	*Sterculia setigera*	+	+	+	+	++	+
17	*Bauhinia rufescens*	+	+	+	+	++	+
18	*Khaya senegalensis*	+	0	0	0	++	+
19	*Lannea velutina*	+	+	++	++	++	0
20	*Pterocarpus erinaceus*	0	++	+	+	+++	+

0=pressure not observed;+=I<50%;++=50<I≤75%;+++ =75%<I≤100%

Figure 1: Worm destroying the leaves of *Piliostigma reticulatum* on Saaba parklands

Figure 2: *Tapinanthus ophiodes* (Sprague) parasitic plants on *Vitellaria paradoxa*

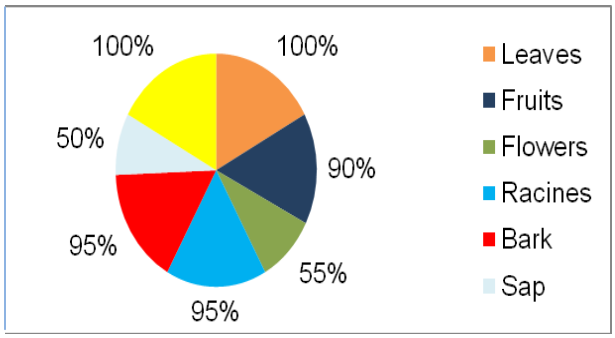

Figure 3: The parts of the species used by the rural people

Figure 4: The bark of *Sclerocarya birrea* cut for medicinal uses

Figure 5: Human habitation built on an agroforestry parkland

DISCUSSION

The results of this work like those of the previous authors confirm that the agroforestry parklands are an operating system of the farms where ligneous species are preserved according to the interests of the farmers (Dya et Duponnois, 2012; Boutaré, 2015). The sustainable management of a woody diversity evokes both a rational use and a compensation of the taking away. The greatest difficulty is related to the rational use when one knows the close link between the man and the plant resources in rural areas in sub-Saharan Africa (Boffa, 2000).

According to the sociocultural practices a certain number of ligneous species are common to the traditional parklands. It is the case of the following species present in the rural district of Saaba: *Vitellaria paradoxa, Parkia biglobosa, Tamarindus indica, Sclerocarya birrea, Balanites aegyptiaca* (Wala et al., 2003). Taking into account the exploitation of the woody and non-woody forest products of these species, the pressures they undergo are observed through the taking away of the useful parts of the trees. This work shows that the useful species were exploited in great proportions at their leaves, wood, barks, roots and fruits. It is obvious that it has negative impacts on the tree survival. That is why it is recommended to the technicians of management of the woody resources to train the producers on the good practices and strategies of the trees useful parts collection. They will have to avoid taking the quantities wanted on only one seedling and close carefully the holes of the root excavation after a rational taking away (Yameogo et al., 2010). In the case of the rural district of Saaba, the over exploitation of the ligneous is supported by the economic relationship maintained by the populations of Ouagadougou and this commune which is identified as a provider of woody and non-woody forest products. In the same way,the examination of the health condition of each inventoried ligneous species reveals that the pressures were both natural and anthropic. Parasitic attacks were visible on several species. In effect the worms and the locusts destroy the reproductive bodies of the plants. They reduce the quality and the viability of the fruits, the pods having to ensure the sustainability of the species through natural regenerations and the direct drillings (Dao *et al.* 2015; Sampony, 2016). The cuts were operated for economic interests such as wood and charcoal commercialization.

Concerning the installation of the infrastructures, the population growth, the urban expansion of Ouagadougou and the will of the authorities to empower the commune led the populations and the authorities to create schools, dispensaries, popular markets. A kind of urbanization is started. The most affluent are the family and individual houses into hard extend. However, some of the activities led to the urbanization were responsible of the ecosystems degradation and particularly the vegetation. Fields comprising the ligneous species were degraded in favor of the infrastructures. The most destruction of the ligneous is observed at school, health and public infrastructures building. They led to the afforestation of considerable areas. A private home

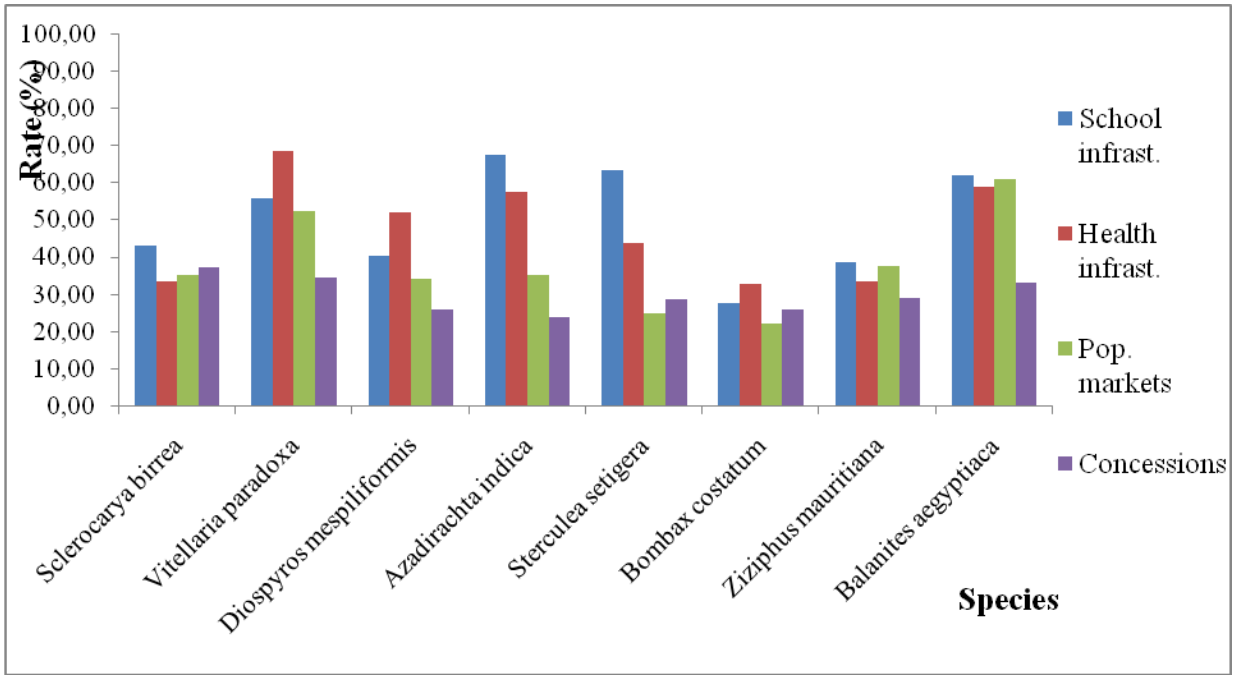

Figure 6: The dominant species in the different infrastructures

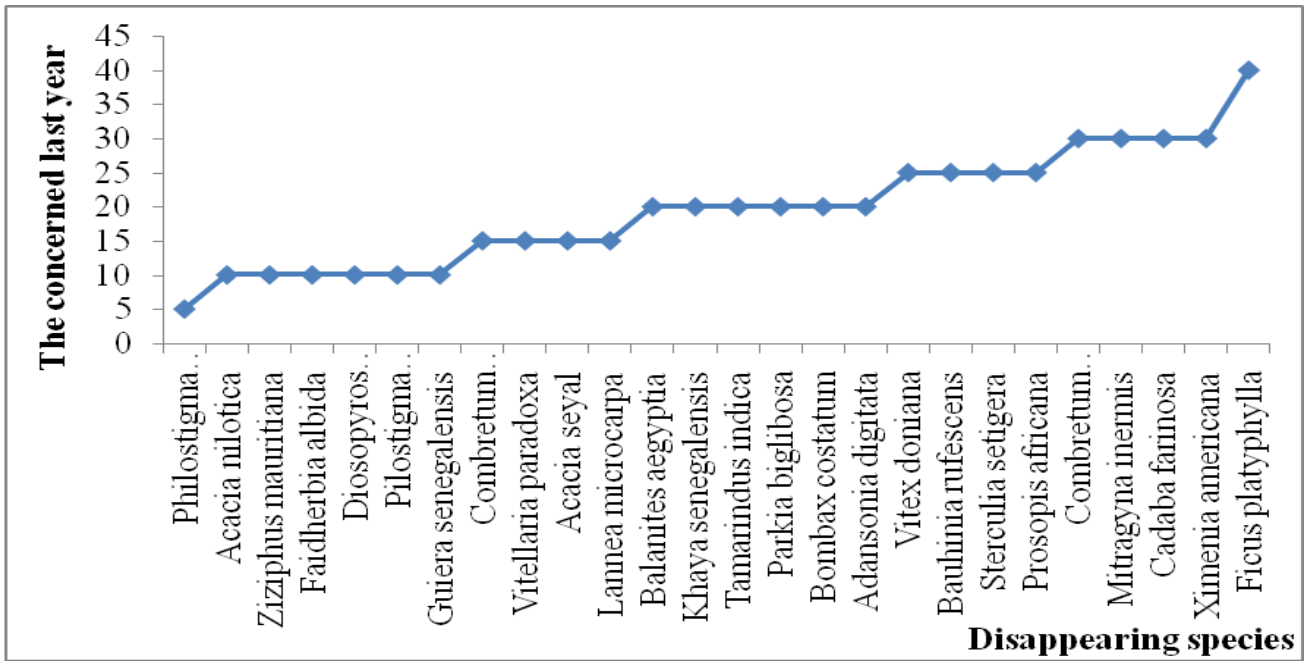

Figure 7: The disappearing species at Gonsé, Gampela and Saaba parklands

building led to the destruction of minor number of trees but it depends on the densities of the houses built. They required also broad areas when a lot of people are interested by the private modern houses, then it's specially recommended by the builders to eliminate the vegetation close to the walls in order to avoid the walls destruction in short terms (CONSEIL-CO, 2015). The consequences of the afforestation are well known. It results in the disappearance of plant and animal species and reduce the ecosystemic advantages for men, animals and the environment. The ecosystem balance and the genetic resources are threatened (Van and Azomahou; 2003).

All the factors of pressures mentioned above were the causes of the disappearance of the species. Indeed, the list of the ligneous species in the process of

disappearance attests that in time the farmers realize the regression of density and the availability of these ligneous species in the agrarian landscapes.

Particularly for the case of Saaba district, because of the extension of the city of Ouagadougou, the urbanization and climatic factor (Yameogo et al., 2018) are to be considered in the ecosystem sustainability activities. Both the communal authorities of Saaba and Ouagadougou; the local population of Saaba; the delegates of the population of Ouagadougou; the technicians and researchers have to develop a sustainable management policy for plant resources. That will be necessary for all peri-urban and rural areas.

CONCLUSION AND RECOMMENDATION

It is important and useful to create the agroforestry parklands but the most important disposition to be taken is to make sustainable management of the parklands components. The ligneous species in the parklands are facing many constraints that we have to take into account in the parklands management. They were conserved for necessary uses and systemic services but they were subject to pressures related to the methods of taking away the useful organs. Some natural and anthropic factors affect also their health conditions while the extension of the urbanization of the urban outskirt area causes damage to the agroforestry ligneous diversity. That's why we strongly recommended a policy of ligneous management for each specific urban outskirt area. The parklands management is generally traditional. Because of the availability of scientific and technical knowledge for parklands management, scientists, technicians and financial partners have to conjugate their efforts to allow farmers adopt the best practices for the best performances of their parklands. We note that the first strategy to adopt is to let farmers choose the interested species and help them produce these plants in their parklands.

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