

Strategy of Conservation and Protection of Wild Edible Plants Diversity in Burkina Faso

Mamounata BELEM* ***Moumouni NABALOUM***
Josephine YAMEOGO

INERA/DEF, 03 BP 7047 Ouagadougou / BURKINA FASO

** Corresponding author (Sorumlu yazar): e-mail: bmamounata@gmail.com*

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ABSTRACT: *Plant species are divided in cultivated or crops and non-cultivated or spontaneous or wild. Cultivated species are few in Burkina Faso and are mostly recent introduction. Wild species play an important socio-economic role. This paper aims to show the importance of wild edible plants by their used parts, mode of harvest and uses. So, we did this study on the basis of our previous Ethnobotanical surveys in Burkina Faso. Surveys have been made with a list of 135 species met in our previous inventories. The results revealed that spontaneous edible plants can be grouped in shrubs and herbaceous. The over exploitation of the wild edible plants make their protection and preservation necessary in order to achieve greater food security. Management of wild trees involves the identification of constraints and the solutions researching. Popular species such as *Adansonia digitata*, *Bombax costatum*, *Parkia biglobosa*, *Tamarindus indica* and *Vitellaria paradoxa* are subject to mutilation due to bad harvesting, which compromises their renewal. Thus measures must be taken to preserve them and to improve their contribution to food by implementing substantial resources. In these measures, all the actors and structures have to be involved for a good management of wild edible biodiversity.*

Keywords: *Edible wild plants, plants harvesting, mutilation of species, preservation, Burkina Faso.*

INTRODUCTION

Nowadays, with the technical revolution, economic expansion, poverty, conflict and population pressure, the scientific community agree to say that the salvation of mankind goes through conservation and rational use of natural resources. Everything seems to indicate that the current structure of exploitation and consumption of resources are not sustainable and approach natural limits in some areas. In fact, spontaneous flora plays a very important role in the socio-economic

balance of population in development. This flora serves food according to Belem *et al.* (2010) and Yameogo *et al.* (2010).

Walter (2001) in FAO report about NWFP shows that Africa, which has only 16.8% of forest cover worldwide, has been responsible for 56% of the reduction of forest cover between 1990 and 2000. In Africa countries, the edible species are straightly harvested from natural resources (Malaisse, 1997; Belem, 2008). In Burkina Faso, as in other parts of the world, forest resources are purveyors of goods

and services. Populations are deriving their livelihoods, their medication, their energy, their equipment and work income (Belem, 2008). In Burkina Faso, forest resources play a major role in food security, especially in times of wedding for poor households (Lamien *et al.*, 1996).

In addition to the food security aspect, the use of forests products covers a large number of areas and they are the subject of commercial transactions at local, national and even international markets level (Zida, 1990; Belem *et al.*, 1997). These products are obtained by collecting or gathering by women in general. For some species as shown by Sina and Belem (2002) the roles are separated and the woman is relegated to the role of transformative.

Face to this situation of human growing pressure on natural resources, the country reacted in creating national parks and forests in the years 1935, whose the classified forest of Toessin and forest of Mare aux Hippopotames. The Mare aux Hippopotames forest became Biosphere reserve in 1986 (Belem 2008).

Our study, according to Taita (2003) and Belem (2008) proposes some objectives to analyze the conservation strategy for non-wood forest products (NWFP).

Specifically, we propose to identify non timber forests products (NTFPS), to assess the consumed parts and analyze their forms of use by the communities, the mode of consumption and the availability of the products. The method used is a compilation of results from many surveys done about spontaneous species in general, and edible species in particular in the riverine villages of Toessin classified forest and Mare aux Hippopotames, biosphere reserve.

The results have shown that the edible species resources are subject to big destruction. This situation and in addition, the intensification of agriculture, then the non-timber forests products harvesting pose a threat for the biodiversity (Belem, 2008). So, developers have to react. Thus, « elaborate a national strategy and an action plan

for national actors' capacities building » is necessary. These capacities building aim to attend biodiversity conservation and sustainable utilization for spontaneous species in general and for edible species in particular (Sina and Belem, 2002). This fact is necessary for today agriculture and the future one.

MATERIALS AND METHODS

MATERIALS

Study site

Our investigations took place mainly in the riverine villages of Toessin classified forest and Mare aux Hippopotames, biosphere reserve. Mare aux Hippopotames, biosphere reserve is located between 11°30' and 11°45' N then between 04°05' and 04°12' West longitude at Western South of Burkina Faso. Toessin classified forest is located between 12°45' and 12°47' latitude North then between 2°25' and 2°22' West longitude at Western North of Burkina Faso.

Study villages

The choice of the number of selected villages took account of the total number of riverside villages in each forest (Anonymous, 2003). 4 out of 10 riverside villages were chosen in the mare to hippopotames biosphere reserve (Bala, Bossora, Tierako and Sokourani) and 4 villages (Itian, Mesga, Minissia and Toessin), at the classified forest of Toessin according to their accessibility.

METHODS

Data collection

The method is a compilation of results from many surveys done about spontaneous species in general and edible species in particular (Belem, 1993; Belem *et al.*, 1996a; Belem *et al.*, 1996b; Belem *et al.*, 1997; Belem, 2008; Belem *et al.*, 2010).

Those surveys have been done by participatory rural appraisal method (PRA). This method Permitted to list all the useful spontaneous plants met in the riverine villages of Mare aux

Hippopotames Biosphere Reserve and Plateau Central area where Toessin forest is located. With this first list of 175 useful wild species, we did deep enquiries to show the edible one. For that, focus groups, resource persons have been interviewed to identify edible plants characteristics and to identify the actions made or to make for edible species conservation and protection.

Data analysis

All collected data by interview have been analyzed in Excel 2010. Enquiries data analysis allow to state, the Statute of edible species, the wild edible plants organs, the consumption modes, the availability of organs during the year (dry season or wet season), the Statute of Biodiversity conservation and species evolution, the actual Actions for conservation and protection and the proposed Strategy and action.

RESULTS AND DISCUSSION

Edible species statute

Zongo, (2006) in his investigations about food plants in three ecological regions of Burkina Faso, found 3 statutes for edible plants. He has noted about sixty edible Crops species, Protoculture species stayed in parklands or in homes garden and Spontaneous species that grow spontaneously in nature. This last category of plants is the most met, about one hundred and are harvested for their products (Figure 1).

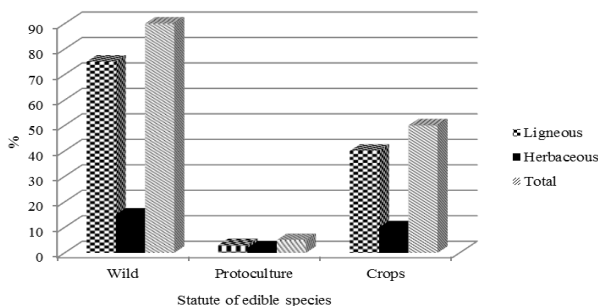


Figure 1. Part of trees and herbs in the edible plants of Burkina Faso.

List of edible species cited

Our previous surveys have noted a total of 175 multipurpose species whose 130 species met in the Biosphere reserve of Mare aux Hippopotames (Belem, 2008), and 45 in the Toessin classified forest (Belem *et al.*, 1997). Among them, 80 species or 46 % are edible plants. Our results are less important than those of Taita (2003) in the central area of the reserve, which has noted 57 food plants representing 78 % of the total of identified plants. Spontaneous edible plants contain Herbs and Trees. Our study noted 56 Ligneous (65 %) as shown in the Table 1 and 24 Herbs (35 %) as shown in the Table 2. This is similar to Zongo (2006) who found 75% of edible wild trees and 25 % of herbs in 3 ecological areas of Burkina Faso.

Spontaneous edible species organs

We noted, like Helmfried (1997) that leaves, roots, stems, flowers, fruits, bulbs, tubers and ash are consumed by populations, either directly or after processing. The 80 identified edible plants are used either raw or in the preparation of sauces, couscous, cakes, like juice drink or like Marmalade.

We noted also that the harvest period varies according to the plants and for the same plant the sought-after parties. For ligneous plants, 59 % are available in dry season, 34 % in wet season and 7 % in all seasons. 92 % of Herbaceous are available in wet season while 8 % are in the dry season. The edible ligneous and herbaceous plants count vegetative and reproductive organs. Vegetative organs of plants are used as food. They are roots, rhizomes, stems and leaves. The reproductive organs are bulbs, tubers, flowers, fruits, grains, almonds and nuts. Reproductive organs intervene more than the vegetative one in food with respectively 75 % and 25 %. This fact shows that edible species are endangers because of problems of renewal (Belem, 2008). Some species have their renewal or reproductive organs which are edible. So a certain competition sets up between species renewal and species consumption. Some protective actions have to be made to avoid the disappearing of species, according to Sina and Belem, (2002).

Table 1. Ligneous food plants.

Species	Family	Eaten parts [□]			Mode of Food	Availability Period
		Le	Fr	Fl		
<i>Acacia macrostachya</i>	Mimosaceae		x		Sauce; Couscous	DS
<i>Adansonia digitata</i>	Bombacaceae	x	x		Sauce, Juice, Boiled	AS
<i>Azelia africana</i>	Caesalpiniaceae	x			Sauce; Couscous	WS
<i>Annona senegalensis</i>	Annonaceae		x	x	Raw; Sauce	WS
<i>Azadiractha indica</i>	Meliaceae		x		Raw	DS
<i>Balanites aegyptiaca</i>	Balanitaceae	x	x	x	Raw; Sauce Couscous	DS
<i>Bombax costatum</i>	Bombacaceae	x		x	Sauce	DS
<i>Borassus aethiopum</i>	Arecaceae		x		Oil, Sauce	DS
<i>Boscia angustifolia</i>	Capparaceae	x	x		Cake; Couscous	DS
<i>Boscia salicifolia</i>	Capparaceae	x	x		Cake; Couscous	DS
<i>Bosia senegalensis</i>	Capparaceae	x	x		Cake; Couscous	DS
<i>Cadabba farinosa</i>	Capparaceae	x	x		Cake; Couscous	DS
<i>Capparis corymbosa</i>	Capparaceae	x	x		Cake ; Couscous	DS
<i>Celtis integrifolia</i>	Ulmaceae	x			Sauce	DS
<i>Ceiba pentandra</i>	Bombacaceae	x	x		Sauce	DS
<i>Combretum micranthum</i>	Combretaceae	x			Boiled	DS
<i>Crateva religiosa</i>	Capparaceae	x			Sauce	DS
<i>Detarium microcapum</i>	Caesalpiniaceae		x		Raw	DS
<i>Diospyros mespiliformis</i>	Ebenaceae		x		Raw	DS
<i>Elaeis guineensis</i>	Arecaceae		x		Oil, Sauce	WS
<i>Ficus capensis</i>	Moraceae		x		Sauce	DS
<i>Ficus ingens</i>	Moraceae		x		Sauce	DS
<i>Ficus sycomorus</i>	Moraceae		x		Raw	DS
<i>Gardenia erubescens</i>	Rubiaceae		x		Raw	DS
<i>Gardenia sokotensis</i>	Rubiaceae		x		Raw	DS
<i>Gardenia ternifolia</i>	Rubiaceae		x		Raw	DS
<i>Grewia bicolor</i>	Tiliaceae		x	x	Raw	DS
<i>Grewia cissoides</i>	Tiliaceae		x		Raw	DS
<i>Lannea acida</i>	Anacardiaceae		x		Raw	WS
<i>Lannea kerstingii</i>	Anacardiaceae		x		Raw	WS
<i>Lannea microcapa</i>	Anacardiaceae		x		Raw	WS
<i>Lannea velutina</i>	Anacardiaceae		x		Raw	WS
<i>Leptadenia hastata</i>	Asclepiadaceae	x			Sauce, Couscous	WS
<i>Maerua angolensis</i>	Capparaceae	x			Couscous	DS
<i>Maerua angolensis</i>	Capparaceae	x			Couscous	DS
<i>Maerua crassifolia</i>	Capparaceae	x			Couscous	DS
<i>Moringa oleifera</i>	Moringaceae	x	x		Sauce, Couscous	AS
<i>Parinari curatelifolia</i>	Chrysobalanaceae	X	x		Sauce	DS
<i>Parkia biglobosa</i>	Mimosaceae		x		Cake, Boiled	WS
<i>Piliostigma reticulatum</i>	Caesalpiniaceae	x			Juice	WS
<i>Piliostigma thonningii</i>	Caesalpiniaceae	x			Juice	WS
<i>Pterocarpus lucens</i>	Fabaceae	x			Sauce	WS
<i>Pterocarpus santalinoides</i>	Fabaceae	x			Sauce	WS
<i>Saba florida</i>	Apocynaceae		x		Juice, Sucettes	WS
<i>Saba senegalensis</i>	Apocynaceae		x		Juice, Sucettes	WS
<i>Sclerocarya birrea</i>	Anacardiaceae		x		Juice; Raw	DS
<i>Spondias mombin</i>	Anacardiaceae	x			Raw	WS
<i>Strychnos innocua</i>	Loganiaceae	x			Couscous	WS
<i>Strychnos spinosa</i>	Loganiaceae	x			Couscous	WS
<i>Tamarindus indica</i>	Caesalpiniaceae	x	x		Juice, boiled	DS
<i>Vernonia amygdalina</i>	Asteraceae	x			Couscous	AS
<i>Vitellaria paradoxa</i>	Sapotaceae		x		Raw; Butter	WS
<i>Vitex chrysocarpa</i>	Verbenaceae		x		Raw	DS
<i>Vitex diversifolia</i>	Verbenaceae	x	x		Sauce; Raw	DS
<i>Vitex doniana</i>	Verbenaceae	x	x		Sauce; Raw	DS
<i>Ximenia americana</i>	Olacaceae		x		Sucettes	DS
<i>Ziziphus mauritiana</i>	Rhamnaceae		x		Sucettes, Cake	DS

□ Eaten parts: Le = Leaves; Fr = Fruits; Fl = Flowers; B = Bulb; Availability: WS = Wet season; DS = Dry season; AS = All season.

Table 2. Herbaceous edible plants.

Species	Family	Eaten parts \square			Mode of Food	Availability Period
		Le	Fr	Fl		
<i>Aeschynomene indica</i>	Fabaceae	x			Sauce	WS
<i>Amaranthus spinosus</i>	Amaranthaceae	x			Sauce	WS
<i>Amaranthus hybridus</i>	Amaranthaceae	x			Sauce	DS
<i>Brachystelma bengeri</i>	Asclepiadaceae			B	Raw	WS
<i>Cassia tora</i>	Caesalpiniaceae	x			Sauce, Couscous	WS
<i>Celosia trigyna</i>	Amaranthaceae	x			Sauce	WS
<i>Ceratoteca sesamoides</i>	Pedaliaceae	x			Sauce	WS
<i>Chrysanthellum americanum</i>	Asteraceae	x			Boiled	WS
<i>Cleome ciliata</i>	Pedaliaceae	x			Sauce	WS
<i>Cleome viscosa</i>	Pedaliaceae	x			Sauce	WS
<i>Commelina diffusa</i>	Commelinaceae	x			Sauce	WS
<i>Corchorus olitorius</i>	Tiliaceae	x			Sauce	WS
<i>Evolvulus alsinoides</i>	Convolvulaceae	x			Sauce	WS
<i>Glossonema boveanum</i>	Asclepidaceae	x			Sauce	WS
<i>Hibiscus asper</i>	Malvaceae	x			Sauce	WS
<i>Hibiscus cannabinus</i>	Malvaceae	x			Sauce	WS
<i>Ipomoea aquatica</i>	Convolvulaceae	x			Sauce	WS
<i>Ipomoea eriocarpa</i>	Convolvulaceae	x			Sauce	WS
<i>Lippia chevalieri</i>	Verbenaceae	x			Boiled	DS
<i>Lippia multiflora</i>	Verbenaceae	x			Boiled	DS
<i>Nymphaea lotus</i>	Nymphaeaceae		x		Raw	WS
<i>Oryza barthii</i>	Poaceae		x		Raw	WS
<i>Tacca leonpetalus</i>	Taccaceae			B	Couscous	WS
<i>Urginea altissima</i>	Liliaceae			B	Raw	WS

\square Eaten parts: Le = Leaves; Fr = Fruits; Fl = Flowers; B = Bulb; Availability: WS = Wet season; DS = Dry season; AS = All season.

Harvest impact on ligneous species biodiversity

Species are rather used commonly by the majority of the population of the region for food or for commercial interest and because source of income (Zida, 1990; Belem *et al.*, 1996b; Lamien and Bayala, 1996) *Adansonia digitata* (leaves and fruits), *Detarium microcarpum* (fruits), *Lannea microcarpa* (fruits), *Parkia biglobosa* (grains, fruits), *Saba senegalensis* (fruits), *Sclerocarya birrea* (almond), *Tamarindus indica* (feuilles, fruits), *Vitellaria paradoxa* (fruits, butter). Due to their resemblance certain species are used to prepare the same kind of sauce. (Helmfrid, 1997). It is the case of *Corchorus* and *Hibiscus* species. Certain species are just used during hunger period: They are *Dioscorea dumetorum* and *Ipomoea eriocarpa* and certain fruits no consumed ordinary like fruits of *Lannea velutina*, *Cola cordifolia* and *Ficus* spp.

Most of the fruity species are relegate to wild category and are brought to home for children. They are *Gardenia erubescens*, *Diospyros mespiliformis*, *Annona senegalensis*, *Adansonia*

digitata and *Ziziphus mauritiana*. *Ziziphus mauritiana* has been improved by greffage, allowing it to give bigger fruits with more pulp and more interesting nutritional characters. Through these observations, we think that many wild species can be improve and domesticated. It is the case of species producing pulp that can be used to make cake, juice and syrup.

According to Belem *et al.* (1996b) one of the ways to combat food insecurity could be the use of the forest food plants that may contribute to food self-sufficiency. The intensive activity period is, in one way, during May and June, at the end of dry season and the beginning of the wet season. At this period, most of the trees are flowering or budding and wear young leaves and stems, and in the second way in September and November, where herbaceous species are in maturity. Wild edible species harvesting have negative impacts. Impacts give a certain status to trees. Three Status have been described by Guigma (2012), Sina and Belem (2002), Belem *et al.* (1997), Lamien and Bayala (1996).



Figure 2. Example of edible fruits.



Figure 3. Example of edible flowers and grains.

There are the sureexploited species, the endangered species and the vulnerable species.

In our plant list we met these three categories of plants as following:

The Sureexploited species: In this category, plants are intensively harvested by their grains, flowers,

roots or fruits for food and also for medicine. We noted: *Parkia biglobosa*, *Annona senegalensis*, *Sarcocephalus latifolia*, *Vitex doniana*.



Figure 4. Example of edible leaves.

The Endangerous species: In this category, plants are intensively harvested for their food, but also for craft, fodder and medicine. So species become more and more scarcer. We can note: *Azelia africana*, *Boscia senegalensis*, *Pterocarpus lucens*.

The Vulnerable species: *Adansonia digitata*, *Bombax costatum*, *Vittelaria paradoxa*, *Detarium microcarpum*, *Lannea microcarpa*, *Sclerocarya birrea*, *Spondias mombin*, *Saba senegalensis*, *Tamarindus indica*. All these species have big importance in food and are sources of income, even at national and international levels. This fact makes them vulnerable.

Strategy for protection and conservation of edible biodiversity the statute of biodiversity conservation and evolution

The overexploitation of the vegetative organs (roots, leaves, bark, wood) cause physiological disorders and lower productivity. We agree with Taita, (2003) to recognize that the use of seeds and

flowers is a threat for species whose regeneration is done by seeds. As a result, all species to various uses and high indices of use deserve particular looks in spontaneous species management strategies (Belem, 2008). The actual actions for conservation and protection of wild edible species are defined in the Table 3. The ministries structures as research centers and institutes and NGOs involved in the biodiversity protection are noted.

Table 3. The actual national actions for biodiversity conservation and protection (Zongo, 2006).

Ministries	Structures
Ministry of Scientific Research	CNRST/ INERA/DPF
	CNRST/ INERA/DPV
	CNRST/ DTA
	UO/SH
Ministry of Environment and Forestry	UO/SVT
	DRECV
	CNSF ENEF
Ministry of Health	Direction of Nutrition
NGOS, National and international level	Tree aid
	CEAS-BF
	Naturama
	Ga Mo Wigna
	AFRS
	ABF
	Catholic Women Association of Banfora
	FONGDJA

The proposed strategy and actions

For the wild edible species management strategies, according to Belem (2008), governments have to identify first the constraints, the applied strategy with its objectives, the approach to be used and the actions to be taken.

The constraints: The three constraints identified are: the big interest for crops species, the lack of money and the climate.

The strategy: The global goal is to insure the conservation and sustainable utilization of edible wild species for human food. Specific objectives are:

- i) identify and know edible wild species for human food,
- ii) insure the protection and the conservation of edible wild species important for human food,

iii) insure sustainable utilization of edible wild species for human food.

The approach: It comprises 3 steps as protection of patrimony, knowledge of the resource and the sustainable utilization of biologic resources.

The actions: The different actions to improve and to have a sustainable management of wild edible species are described in the Table 4. After our surveys, we propose two important actions according to the food species sustainable management and their exploitation.

Table 4. Summary of actions for improvement and sustainable management of wild edible species (Zongo, 2006).

Actions topics	Actions
Affirmation of plant protection interest	Organization Financial and technical Means setting
Actions for the knowledge of plant genetic resources	Surveys Prospection, vouchers collection Genetic studies ; Plants Domestication Seeds Bank (cryoconservation and in vitro trials) Biochemical studies Agronomic studies Physiologic and ecology studies
	Fight against desertification Protection against anarchic harvest Protection against genetic erosion Enhancing the protection Sensibilization of populations Priorisation Arboretum and botanic gardens
	Transformation and storage Commercialization Domestication Genetic improvement

Management of wild edible species

Due to the diversity of wild edible species, an important effort has to be done for their valorization and rational management to reach a food security. Management supposes the identification

of constraints and solutions searching. The much appreciated species as *Adansonia digitata*, *Bombax costatum*, *Parkia biglobosa*, *Tamarindus indica* and *Vitellaria paradoxa* are subject to mutilations, compromising their renewal. Parasitic attacks and bush fires also compromise the production cycle and the regeneration of some species. In general, it is to take care of the mode of spontaneous plants harvesting because it can be a cause of depletion of natural flora.

Improving the exploitation of wild edible species

It is desirable to use better methods of plants harvesting. A regular and rational utilization of wild edible species have an opportunity to reduce our dependence to crops plants. This has the other opportunity to fight the low agricultural yields, being then a form of an adaptation to climate change.

RECOMMANDATIONS

- Give more attention and interest to food species to enable them to play their role as a dietary supplement and as a source of income.
- A special place must be reserved to the structures and peasants associations, associations of women and other rural organizations in any national strategy of development of food species.
- A special attention must be given to the actions needed to ensure the production, processing, packaging, conservation, marketing and distribution of food species.
- A call must be made to all the skills available on the territory: private structures of the State, farming structures, NGOs, laboratories, offices, etc.
- Establish priorities at all levels, based on the national interest after the identification a comprehensive food species.

CONCLUSION

Through this study, we found that the use of forest plants contributes:

- i) to the satisfaction of food needs
- ii) to the variation of the meals and
- iii) to supplement the food ration in times of famine.

Indeed the 80 food species identified show how plants contribute to diversification and to the improvement of the daily rations in rural areas. The study found that plants from picking provide non-wood products that are consumed by people or marketed in the transformed status or not. Usually gathered non timber forest products are eaten on-site (fruits), after firing (flowers, leaves, tubers) or after a long series of transformations. They are exploited by the women and especially children. The role played by women in the development of these products is essential in the process of exploitation of plant resources. Plants bring life substances (carbohydrates, proteins, lipids, vitamins etc.). This qualitative contribution helps to ensure nutritional balance of the man. Due to the diversity of food plants, an effort must be made in the direction of their development and their rational management in order to achieve greater food security. Management requires the identification of constraints and the search for solutions: such popular species *Adansonia digitata*, *Bombax costatum*, *Parkia biglobosa*, *Tamarindus indica* and *Vitellaria paradoxa* are often the subject of mutilation during the harvest of bark, leaves, fruit or flowers, which compromise their regeneration. Parasitic attacks and bush fires also compromise the production cycle and the regeneration of some species. In general, it is to take care of the mode of collection of spontaneous plant because picking can be a cause of depletion of natural flora. Improving the exploitation of these species is therefore desirable.

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