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USE AND MANAGEMENT OF MEDICINAL PLANTS AMONG THE MOBA IN THE PREFECTURE OF TONE IN TOGO

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Abstract

Background and research objectives: Finding sustainable management options for the local communities that depend on medicinal plants is crucial in the face of human pressure on these plants. This study contributes to the sustainable management of medecinal plants in Togo. It aims to censusing medecinal plants and pathologies and identify the endogenous sustainable management strategies for medicinal plants in the Moba ethnic group of Togo. Methods: Data was collected through semi-structured ethnobotanical individual interviews with 50 traditional healers, recorded on a Microsoft Excel 10 spreadsheet and processed with the Sphinx5V software and the Microsoft Excel 10 table. Results: 166 medicinal plants were reported in the treatment of 91 pathologies dominated by dysmenorrhoea, stomachache, wounds, general and chronic asthenia, and infantile umbilical hernia. The most represented botanical families were: the Poaceae (12), the Combretaceae (10), and the Euphorbiaceae (10), Caesalpiniaceae (8), and Mimosaceae (7). The most important species according to the Species Importance Value Index (IVIsp) are: *Vitellaria paradoxa* (159.59), *Parkia biglobosa* (145.94), *Securidaca longipedunculata* (145.12), *Diospyros mespiliformis* (133.51), *Annona senegalensis* (123.88), *Khaya senegalensis* (110.52), *Cymbopogon proximus* (106.88), *Cymbopogon giganteus* (102.03), *Zanthozylum zanthoxyloides* (99.005). The most used plant parts are roots (18.6 %), leaves (17.85 %), bark of the trunk (16.66 %), the whole plant (14.28 %) and the fruits (12.30 %). Endogenous management strategies for medicinal plants include in situ protection in fields, reforestation, and respect for totemic trees, groves and sacred forests.

Keywords: ethnobotany, medicinal plant, phytotherapy, sustainable management, prefecture of Tone, Togo.

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1. Introduction

For centuries, man has always used plants to satisfy its basic needs (food, health care, etc.). The use of plants for medicinal purposes is one of the most important. Estimates suggest that nearly 80 %

of the population of West African and African populations rely on traditional herbal medicine [1, 2]. Phytomedicine is significantly more common in rural areas than in urban areas. Firstly, healthcare structures are less developed in rural areas and in most cases inaccessible or absent [3]. Furthermore, despite the advent of generic medicines, many treatments remain financially inaccessible to economically disadvantaged rural populations [1, 4–6]; as well as superstitions and religious beliefs. In most cases, traditional medicine is practiced by a person who is commonly referred to a traditional healer. The practitioner is the inheritor of the science, either by heredity or training [1].

Traditional medicine has been the subject of several ethnobotanical studies in Africa and particularly in Togo. The basic objectives have been the inventory and the various therapeutic uses of medicinal plants [1, 3, 7, 8]. Several other studies have been devoted to the development and sustainable management of medicinal plants in Togo [6, 9–16]; and this by biological screening in the laboratory using animal models. This has proven to be a reliable and highly conclusive approach to discovering of new drugs [2]. All these studies highlighted that knowledge of plant use depends on botanical families, ethnic groups, beliefs, age and spatial parameters [17, 18].

Despite these numerous studies, information on the phytotherapeutic knowledge of the Moba of the Tone prefecture remains less known. Information on the management methods of medicinal species is also incomplete. The lack of scientific information on endogenous knowledge of plants is not conducive to helping to improve of traditional health practices or to improving sustainable management systems for the natural environment. Certain inappropriate ways of using plant organs, combined with high demand and agricultural expansion, have become real challenges for biodiversity conservation [5]. These anthropogenic threats cause many species many species to become rare or even disappear [19–21]. This situation also due to the collapse of traditional African structures for biodiversity conservation [22, 23].

This study contributes to the management of medicinal plants in Togo. More specifically, it aims to:

1. Characterize medicinal plants used by traditional healers in health care.
2. Identify the pathologies treated.
3. Highlight endogenous strategies for the management of medicinal plants in the Moba etrhnic group of Togo.

2. Materials and methods

2. 1. Study area

The prefecture of Tone is located in the extreme north of Togo (**Fig. 1**). Administratively, the prefecture is divided into 18 cantons and 383 villages. The climate is tropical Sudanese with dry to thorny savannah vegetation and combretaceae [24]. The region is characterized by a long dry season with an average annual rainfall of 1,000 mm.

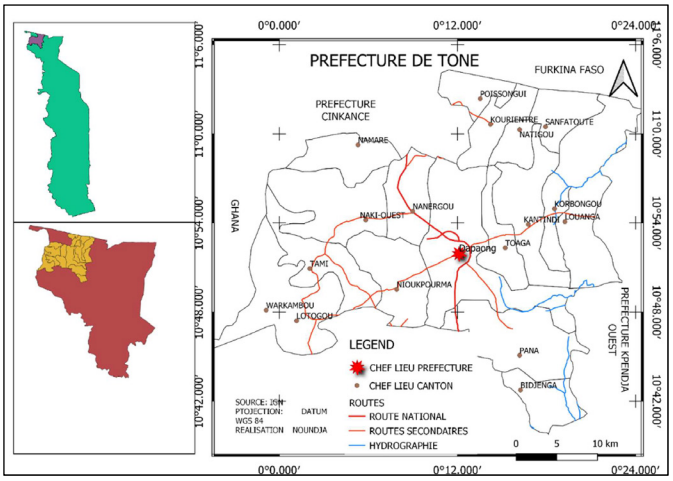

Fig. 1. Location the prefecture of Tone in the region of Savannahs in Togo

2. 2. Sampling design

Prior to the fieldwork, a permission was obtained from the Prefect of Tone. The Prefet approved the study. He also provided an authorization document. This authorisation was necessary to reassure the Prefectural Office of Traditional Healers. This office helped to identify traditional healers (TH) to be interviewed.

A stratified random sampling method was used based on three (3) inclusion criteria. These are: to be a Moba Traditional Healer (TH) residing in the Tone Prefecture, to have a notorious reputation recognized by the Prefectural THs Office or to be legally certified and finally to voluntarily agree to participate in the interviews. On the basis of these criteria, the sample considered was made up of 50 TH Moba distributed throughout the prefecture. Globally, 27 villages in the 18 cantons of the Tone prefecture were considered. This sample consists of 42 men (84 %) and eight women (16 %). Almost 60 % of the THs are over 60 years old.

2. 3. Collection of data

The fieldwork was conducted from December 2019 to February 2020. Ethnobotanical surveys in the form of semi-structured individual interviews [1, 5]. The information sought concerned: the socio-demographic data of the respondent, the origin of the therapeutic knowledge, the medicinal plants used, the plant parts used, the method of preparation and administration of the recipes, the pathologies frequently treated and the management strategies of the medicinal plants used.

The identification of plants reported carried out by comparing the samples collected with the specimens of the herbarium of the University of Lomé and with the data available online from PROTA (Plant Resources of Tropical Africa). The nomenclature used in this study is that of the analytical flora of Benin [25].

2. 4. Data processing

The field data were recorded on a Microsoft Excel 2010 spreadsheet and processed using Sphinx5V software and Microsoft Excel 2010. Data processing consisted of calculating several parameters: the frequency (Frsp), the reported use of each plant (RUsp), the plant part value (PPV), the species use value (UVsp), the species use diversity (UDIsp), and the species importance use value index (IUVIsp) [8, 18]. This treatment also allowed discrimination of local plant management strategies. The calculated parameters and indices are:

– the frequency of mention (*Fr*) of a species which corresponds to the ratio between the number of respondents (*n*) who mentioned the species and the total number of respondents (*N*):

$$Fr = \frac{n \times 100}{N},$$

n – numbers of respondents reporting the species and *N* – total number of respondents.

The maximum value (100 %) was reached when all respondents reported the species;

– RU_{sp} corresponds to the sum of citations per plant part of the species:

$$RU_{sp} = \sum PPV.$$

UV_{sp} corresponds to the ratio of RU_{sp} and the sum of the number of citations of all the species (ΣRU_{spi});

– the species with the highest value is the one with the most recognized use:

$$VU_{sp} = \frac{NU_{sp}}{\sum NU_{spi}}.$$

– UDI_{sp} is the ratio of the number of specific uses of a target species to that of the species with the maximum number of specific uses. The specific use is the use described by the respondents. This index highlights the relationship between a medicinal plant and the variety of pathologies that require its use.

– $IUVI_{sp}$ is the sum of the citation frequency (Fr_{sp}), the use value of the species (VU_{sp}) and the diversity use index of the species (ID_{sp}):

$$IVI_{sp} = Fr_{sp} + UDI_{sp} + VU_{sp}.$$

The $IUVI_{sp}$ was chosen to highlight the most useful medicinal plants based on the common use knowledge of the respondents, the diversity of the plant parts used and the diversity of the specific uses in which it is involved [8]. The pathologies were grouped into 14 classes of pathologies adapted from [5].

3. Results

3. 1. Diversity of medicinal plants in use by Moba TH

A total of 166 medicinal plants used by the Moba TH of the Tone prefecture of in Togo have been identified. These species are divided into 120 genera and 58 families. The most represented families are mainly Poaceae (12 species), Combretaceae and Euphorbiaceae (10 species each), Leguminosae-Caesalpinoideae (8 Species), Leguminosae-Mimosoideae and Leguminosae-Papilionoideae (7 species each) and Rubiaceae (6 species). The most reported plants were: S*ecuridaca longipedunculata* (60 %), *Vitellaria paradoxa* (56 %), *Cymbopogon giganteus* (50 %), *Parkia biglobosa* (48 %), *Cymbopogon proximus* (A. Rich.), *Annona senegalensis* (46 %), *Pennisetum americanum* (44 %).

On the basis of *IUVIsp*, the best known and most used plants in traditional therapy in the Moba environment are *V. paradoxa* (159.59), *P. biglobosa* (145.94), *S. longipedunculata* (145.12), *D. mespiliformis* (133.51), *A. senegalensis* (123.88), *K. senegalensis* (110.52). Plants of medium importance are: *C. proximus* (106.88), *C. giganteus* (102.03), *Z. zanthoxyloides* (99.005), *P. americanum* (98.28), *P. guineense* (94.69), *H. monopetalus* (**Table 1**).

Table 1

List of the most important species in traditional therapy

Species	Frsp	VUSp	IDUSsp	IVISsp
Vitellaria paradoxa C.F.Gaertn. ssp. *paradoxa*	56	3.60	100.00	159.60
Parkia biglobosa (Jacq.) R.Br. Ex G.Don	48	2.49	95.45	145.95
Securidaca longipedunculata Fresen.	60	3.31	81.82	145.12
Diospyros mespiliformis Hochst. Exa.De.	40	2.61	90.91	133.52
Annona senegalensis Pers.	44	2.61	77.27	123.88
Stereospermum kunthianum Cham.	32	1.91	77.27	111.19
Khaya senegalensis (Desr.) A.Juss.	36	1.80	72.73	110.53
Cymbopogon proximus (A.Rich.)	46	1.80	59.09	106.89
Cymbopogon giganteus (Hochst.) Chiov.	50	2.03	50.00	102.03
Zanthoxylum zanthoxyloides (Lam.) Zepern. & Timler	38	1.91	59.09	99.01
Pennisetum americanum (L.) Leeke subsp. *Americanum*	42	1.74	54.55	98.29
Tamarindus indica L.	28	1.80	68.18	97.98
Piper guineense Schumach. & Thonn.	38	2.15	54.55	94.69
Anogeissus leiocarpa (DC.) Guill. & Perr.	28	1.39	63.64	93.03

The **Table 1** shows the details of the most important plant species according to their citation frequency, their specific use value, their index of diversity of specific use and their index of specific importance.

Among the species listed, *V. paradoxa* is the plant that intervenes in the treatment of the greatest number of pathologies (22 diseases). It is followed by *P. biglobosa* which was mentioned in the treatment of 21 pathologies and species such as *D. mespiliformis, S. longipedunculata* and *A. senegalensis* which were reported in the treatment of 20, 18, 17 pathologies respectivily.

Some species are specific to the treatment of a particular pathology. They can be used on their own or in combination with other plants. For example, *Allium sativum* L. is used only for the dressing

of skin wounds while the *Lantana camara* L. is used alone in a decoction for gonococcal disease. Still other plants, although used specifically for a single pathology, are, on the other hand, associated with several others. This is the case of *Cissus doeringii* in combination with other plants for the treatment of diarrhoea, or *Zizyphus mauritiana* Lam. used for the treatment of urogenital disorders also in combination with *Aframomum melegueta*, *Blighia sapida*, *Calotropis procera* and *Carissa edulis.*

3. 2. Plant parts use importance

Thirteen different types of plant organs are used in the development of different drug recipes. These are: leaves, roots, foliate stems, trunk bark, seeds, bulbs or tubers, fruits, and the whole plant. The most reported plant parts were mainly roots (18.6 %), leaves (17.85 %), bark 16.66 %, whole plant 14.28 % and fruits (12.30 %) (**Fig. 2**).

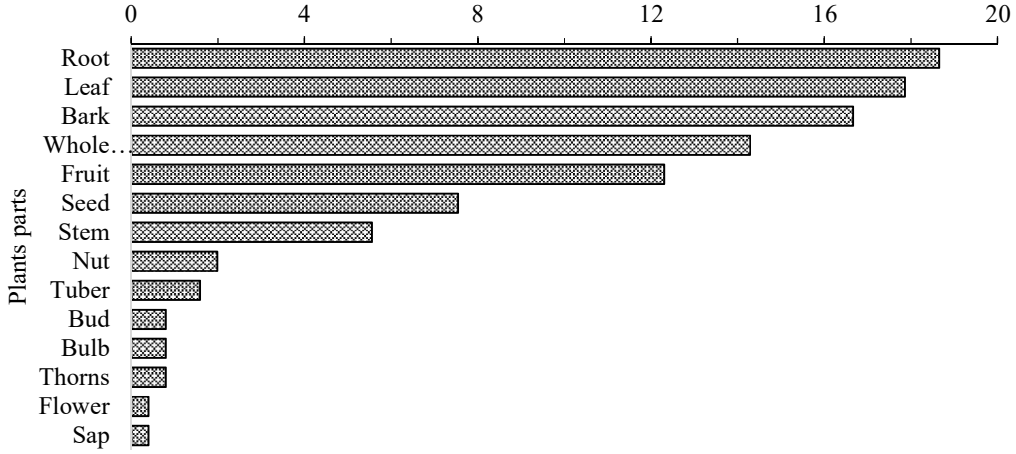

Fig. 2. Plant organs used in recipes

The **Fig. 2** shows the different plant organs used by practitioners of traditional medicine. All organs are used from root to leaf through bark, sap and fruit.

3. 3. Modes of preparation of medicinal recipes

There are more than 164 recipes for the treatment of various diseases. These are divided into six categories according to the method of preparation (**Fig. 3**). The main ones decoction (29.2 %), powder (21.95 %), calcination (18.29 %), infusion (14.63 %) and trituration (9.76 %). Almost all of these recipes are actually a combination of several plants for the treatment of a single disease.

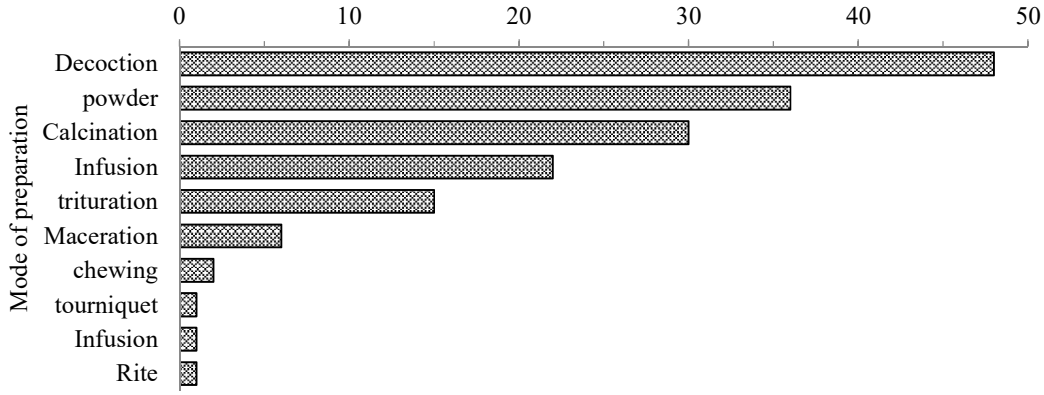

Fig. 3. Medication recipe preparation method

The **Fig. 3** shows the different forms of use of plant organs in order of importance of citation or in order of frequency.

3. 4. Routes of administration

The different medicinal recipes are administered orally 26.08 %, by bathing (22.82 %) and intimate cleansing, by skin massage (13.58 %), by washing wounds, by poultice, by the anal route (purging), by fumigation and by inhalation of vapours (**Fig. 4**). Decoction and maceration are used either as drinks or in bathing, in personal hygiene or for washing wounds. Similarly, the powders of dried or calcined organs are both taken orally or for massage and poultices.

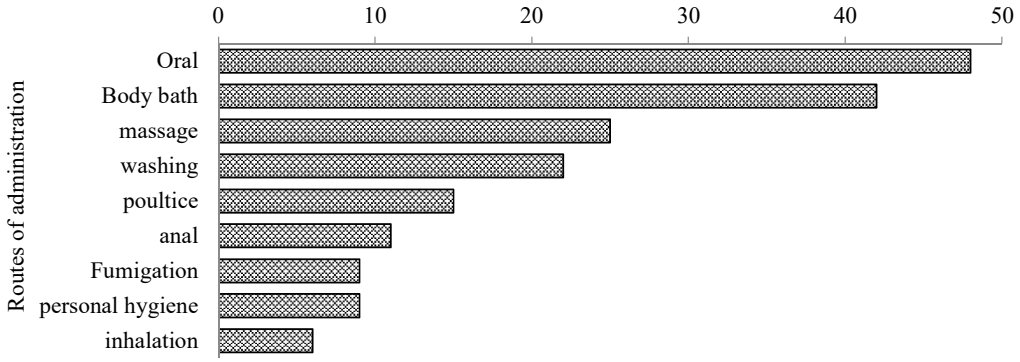

Fig. 4. Routes of administration of the different drug recipes

3. 5. Pathologies treated by traditional healers

A total of 91 pathologies were identified (**Fig. 5**). The most reported diseases were dysmenorrhoea (62 %) and stomach aches (62 %), skin wounds (38 %), general and chronic asthenia and infantile umbilical hernia which are also cited each with a relative frequency of 36 %. Then came malaria and dysentery, with 32 % and 30 % respectively, haemorrhoids and chest pain, both 28 % and finally the least common of diseases were least common of the diseases were anal ulcers mentioned by more than 24 % of PMTs.

The pathologies were grouped into 14 different pathology groups (**Fig. 5**). These are wounds (Wo), musculo-skeletal disorders (MUS), digestive and parasitic disorders (DP), cutaneous and subcutaneous disorders (CSC), poisoning (Po), pregnancy disorders – childbirth (PDC), nutritional disorders (Nut), mental disorders (Men), genitourinary disorders (GU), ophthalmo-otolaryngological disorders (OO), cardio-respiratory disorders (CR), envenomization disorders (Env), supernatural disorders (SNT) and physiological (Phys).

More than 85 species are reported for the treatment of internal physiological disorders, 71 for genito-urinary disorders, 69 for digestive and parasitic disorders.

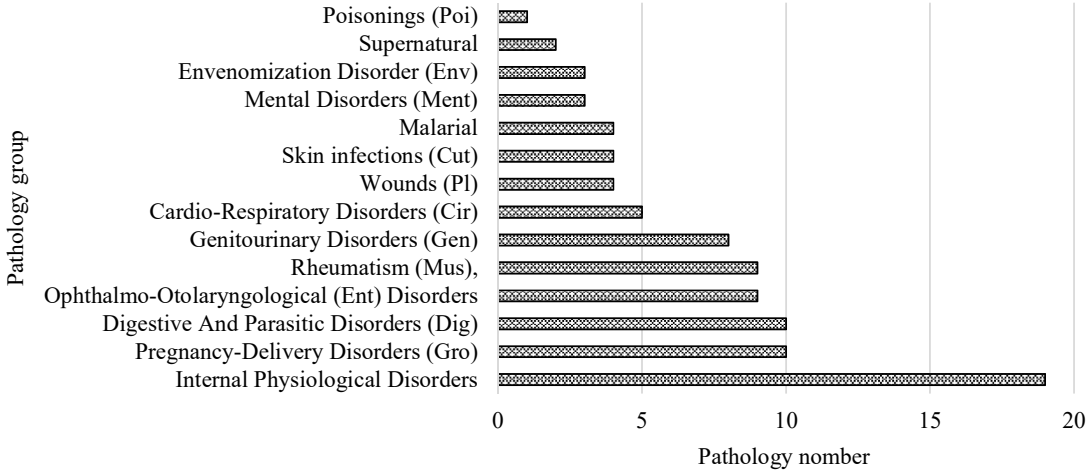

Fig. 5. Distribution of the different categories of pathologies

The **Fig. 5** shows the different categories of human pathologies treated among Moba practitioners in the prefecture of Tone. These groups of pathologies are ordered as a function of their specific frequency of citation.

3. 6. Threats to the conservation of medicinal plants

More than fifty-six (56) plants are listed as being rare or disappeared in several localities. By locality, we have in order of priority, *S. longipedunculata* disappeared in 80 % of localities. Then *C. edulis, H. monopetalus, U. chamae, C. proximus* in respectively 56 %, 36 %, 26 % and 24 % of the localities.

The abuse or unreasonable withdrawals of plant parts imposed by the marketing is the most reported threats (44 %). It is followed by agricultural expansion, almost 29.4 % (**Fig. 6**). Ploughing uproots young seedlings. Wildfire is also incriminated (9.5 %). There are other causes, although they are under-represented: demography, climate change and non-compliance with customs.

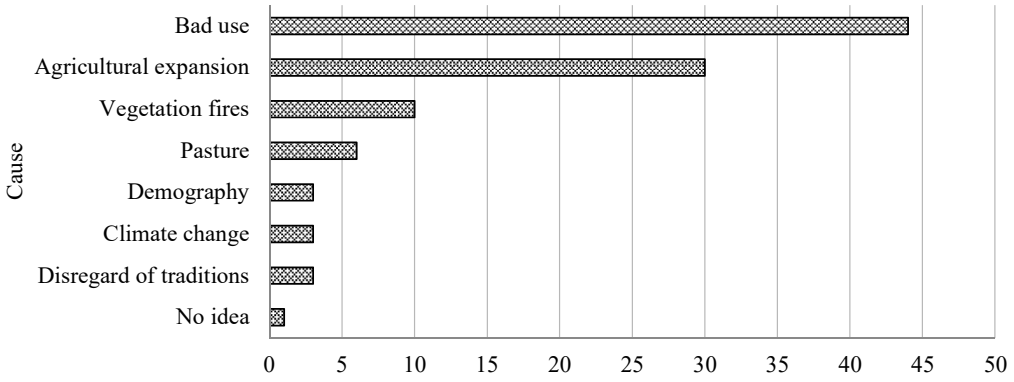

Fig. 6. Distribution of the main causes of plant scarcity

The people of tone prefecture report seven main causes of plant scarcity in their localities. These different causes are mostly related to changes in men's diets and lifestyles.

3. 7. Local strategies for managing and conserving medicinal plants

Almost all of the THs have initiated private or collective actions for the conservation and management of medicinal plants. Approximativily 54 % of THs carried out in-situ plants protection in croplands. The most reported plants are: *K. senegalensis, C. edulis, A. africana, X. americana, V. simplicifolia, H. monopetalus, C. proximus, C. proximus*. About 20 % of the others have choosen to plant medicinal plants. For *K. senegalensis*, seedlings are produced in nurseries. Spontaneous seedlings are taken from the natural environment and replanted in home gardens, houses, fields and other protected areas for species for which the nursery technique is not sufficiently well-known (*P. africana, Z. zanthoxyloides, C. edulis, D. mespiliformis)*

Totem trees are still owned and respected by (50 %) have. These totemic trees are mainly *D. mespiliformis* (41.7 %), *S. setigera.* (13.9 %), *P. africana, A. digitata, T. indica* and *Combretum* molle. Alongside totemic trees, there are also sacred groves and forests. It is forbidden to exploit the species that make up these sacred places. Maintaining these customs is a form of biodiversity protection. As a result of the loss of traditional customs and practices, the areas and species they inhabit are being degraded.

The creation of a protected area for the cultivation and conservation of medicinal plants was strongly desired by more than 38 % of respondents. Others (30 %) would rather have seedlings to plant in their plots. A proportion of 26 % of THs would like financial support to drill boreholes in order to ensure irrigation and also to errect barriers against animals.

4. Discussion

4. 1. Diversity of medicinal plants

Among the Moba of the Tone prefecture in Togo, more than 166 plants belonging to 120 genera and 58 families have been reported for the treatment of human diseases. This diversity is higher

than that of [24]. The latter study reported 87 species used only for female infertility diseases at the scale of the Savannahs' region of Togo. This difference is due to the specificity of this study. In this study 66 species were reported for urogenital diseases. In the southern part of Togo, a similar study reported 106 species [25, 26] and 127 species used in maternal healthcare in the Maritime region [3]. [27] reported 54 medicinal plants in the markets of Bamako (Mali). The differences would be explained by the topics addressed but also the ecological and cultural differences prevailing in the study areas [18].

Many medicinal plants uses reported in thie study have similar uses in other regions of Togo, Burkina Faso and neighboring countries. *A. senegalensis* is reported in the present study as a multipurpose plant also reported in the treatment of infertility and sexual weakness [28], as an antitussive [26] in the south of Togo and as an anti-venom [29] in the Central region of Togo. The bark of *Adansonia digitata* is used to treat wounds and sores while the fruit is used elsewhere as a galactogen or to treat asthenia and anaemia [3, 29, 30]. Species such as *A. djanolensis, U. chamae* are used by the Dozo Sénoufo people in Burkina Faso [31]. *S. latifolius* is also used by the Goins of Burkina Faso. Indeed, even if knowledge varies between community groups, it is also strongly linked to the availability of the species in the areas in the area [2, 8, 32].

The most represented families are mainly Poaceae, followed by Combretaceae and Euphorbiaceae. The dominance of Poaceae and Combretaceae is a characteristic of Sudanese savannahs (Aubréville, 1950). It highlights the floristic characteristics of the study area as reported by several floristic studies in the Savannahs' region of Togo [22, 33]. The same botanical families have been reported in Burkina Faso [34] where more than 50 % of the species belong to four families: Leguminosae-Caesalpinoideae (14 %), Leguminosae-Mimosoideae (14 %), Combretaceae (13 %) and Anacardiaceae (9 %). This situation would be due to belonging to the same phytogeographical band.

4. 2. Uses of plant parts and vulnerabilities of medicinal plants

The most commonly reported plant parts by THs in the Tone Prefecture were roots, leaves and barks. The exploitation of roots seriously affects the sustainability of plants [2, 5]. Several species were identified as threatned have also been reported as victims of uprooting (*A. senegalensis, S. longepedunculata*) and excessive bark removal (*P. biglobosa, X. americana*), leading to their rarefaction in San, in Burkina Faso [5]. [27] also identified six species including *M. inermis, Afrormosia laxiflora, P. biglobosa, Pteleopsis suberosa* and *T. indica* which are truly threatened in their biotope due to their overexploitation. This is justified by the fact that the removal of roots and barks affects the survival and development of plants. It would be wiser to use the leaves which sometimes contain the same active ingredients and whose removal less impact on the plants [35]. [36] showed that leaves of *K. senegalensis* contain three times more iron than the the same amount of bark which is the most commonly used in the treatment of anaemia/malaria.

The predominance of roots as the most used plant parts is a similar to the findings of [24] in the region. This predominance of the use of roots and bark is not the case in the south of the country where rather the leaves are more likely to be used [3, 29]. Still other earlier works reported the high use of the leaves rather than the root [5]. For these authors, the high use of leaves can be explained by the easy access to this plant part or the availability of leaves throughout the year, unlike in savannah areas that are often affected by wildfire [31]. This can also be explained by the recent awareness of the impact of leaves harvesting on plant survival [35].

4. 3. Method of preparation and administration

Among the 10 recipe preparation methods, the decoction, powder, calcination, infusion and trituration were the most reported. These results are very similar to several studies [2, 27, 31, 32] that found that the decoction to be the most common preparation method. These results would at least reflect the importance of the local population's beliefs in the decoction method, which seems more appropriate for disinfecting the plant and warming the body. Decoction makes it possible to collect the most active ingredients and reduces or eliminates the toxic effect of certain recipes [2]. It is also the fastest way to obtain the most active ingredients in record time for oral ingestion, body bathing or inhalation of vapours. As for it, there are more recipes for infusion than for decoction and maceration.

4. 4. Biodiversity management strategies

In the Tone prefecture, THs are aware of the scarcity and the disappearance of some very important medicinal plants in their localities. More than 56 medicinal plants reported as endangered are *S. longipedunculata, C. edulis*, *U. chamae*, *C. proximus, C. giganteus* et *H. monopetalus. S. longipedunculata*. Several local medicinal plant are managed. These are totemics, sacred groves and forests, and seedlings management in farmlands. Individual and community initiatives, especially plant domestication through field protection were also been noted among Burkinabe THs [34]. Totemic species are mostly species with very slow growth and regeneration. This often ancestral knowledge has largely favoured the conservation of biodiversity and the protection of natural resources. The totemic plants and sacred grove as a form of ancestral biodiversity conservation strategies is widespread in the study area [22, 37]. The dynamics of religious spirituality, in particular imported religions, which has desacralised the customary rules that are confused with idolatrous practices.

5. Conclusions

This study has highlighted the central place of traditional medicine in the health system of the Moba community in the Tone prefecture. The medicinal plants diversity was estimated at 166 plants divided into 120 genera and 60 botanical families. These plants are used in the treatment of 91 pathologies grouped into 14 different pathology groups. However, some of these plants are victims of overexploitation. For their sustainable management, traditional strategies are being developed. However, many of them are still confronted in their implementation by various disturbances, mainly of an anthropological order, such as ploughing livestock farming, still affect the implementation of many of them. Some medicinal plants have simply disappeared. These findings indicate that floristic inventories are necessary for understanding local medicinal plants' conservation status and for strengthening effective local biodiversity management strategies.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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Data availability

The data will be made available on reasonable request.

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