

Original Research Article

Inventory of food melliferous plants threatened to disappearance in Togo

ABSTRACT

Ethnobotanical surveys conducted between 2006 and 2008 at several locations in Togo, with selected with the assistance of local authorities resource persons have established a list of endangered food plants compared to their operating manner. This list crossed with that obtained after pollinic analysis conducted between 2009 and 2014 on honey sampled directly in beekeeping areas or outlets, has noted that about 24 % of food plants of the Togolese bee flora are threatened with extinction.

Divided into 43 genres, these endangered species inventoried can be grouped into 24 families most at risk are the Malvaceae, the Anacardiaceae, the Fabaceae and the Annonaceae. These food honey plants can be divided into two classes: wild plants and crops. Their bodies' majority routinely used are the fruits and leaves. In general, nectar plants are the most represented.

Keywords: Togo, ethnobotanical survey, pollinic analysis; food melliferous plants; threat.

1. INTRODUCTION

Melliferous plants are plants whose flowers provide bee colonies to a contribution in nectar and / or pollen for honey production. Besides their beekeeping interest or their potential exploitable resource by bees, some of these plants are full of other assets in the broader nutrition of populations. These plants are called food melliferous plants. Apart from their diversity, food plants are very important in nutrition, health and household food security in the world [1].

These food melliferous plants have many virtues in various fields that contribute to the proper development and sustainable environmental management. Unfortunately, faced with perpetual environmental, economic, socio-cultural and cultural, many food plants once valued for consumption, are neglected, underutilized and endangered [2].

The objective of this work is to inventory these food melliferous species that are endangered and evaluate it over all melliferous species currently identified in Togo and that partially constitute the national melliferous flora.

2. METHODOLOGICAL APPROACHES

2.1. Data collection

This study is based on the work of ethnobotanical surveys carried out between 2006 and 2008 [3, 4, 5]. In all, 280 communities were surveyed. They include 38 cultural groups, some of which majority and everywhere in the country and other minority located in an area or even a single village [6]. The number of ethnocultural groups varies from one locality to another. Also, the samples within an ethnocultural group were based on the importance of the geographical distribution of that group in the country.

In these localities, the chosen people, often with the assistance of local authorities (Leaders of Village Development Committees and agricultural groups, the farmers of the Third Age , etc), are all social strata: men, women, heads of households, young and old, rich and poor, farmers, agro-pastoralists and people engaged in an activity other than agriculture, etc. These respondents were in groups of 2-70 individuals with an average size of 11 people.

Furthermore, it is important to note that the methodology consisted of the use of sampling in both strata and cluster. Five ecological zones of the country [7, 8] were considered as the first level of stratification. Within these areas, different cultural groups are considered to be a second level of stratification. In ethnocultural groups, localities representative -such clusters- are chosen at random [9, 10].

Data collection was carried out with the support of a multidisciplinary team at the Laboratory of Botany and Plant Ecology between 2006 and 2008 by ethnobotanical surveys. Semi-structured interviews coupled with direct observations at home, in the fields and market places were organized [9, 10]. The survey was conducted using an interview guide previously established and tested on a small sample.

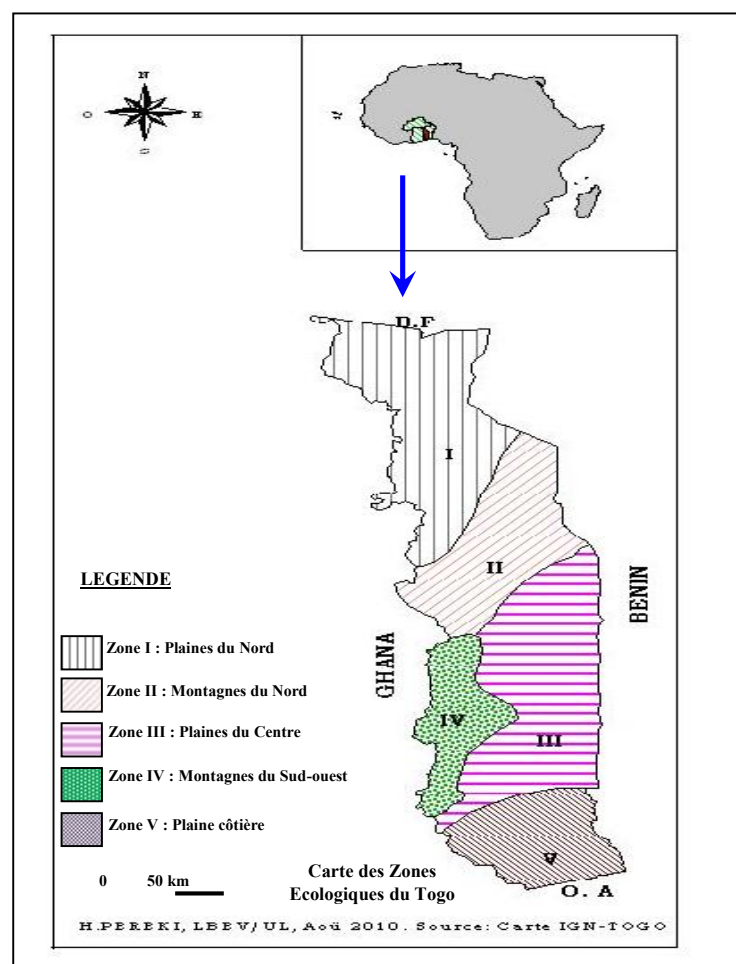
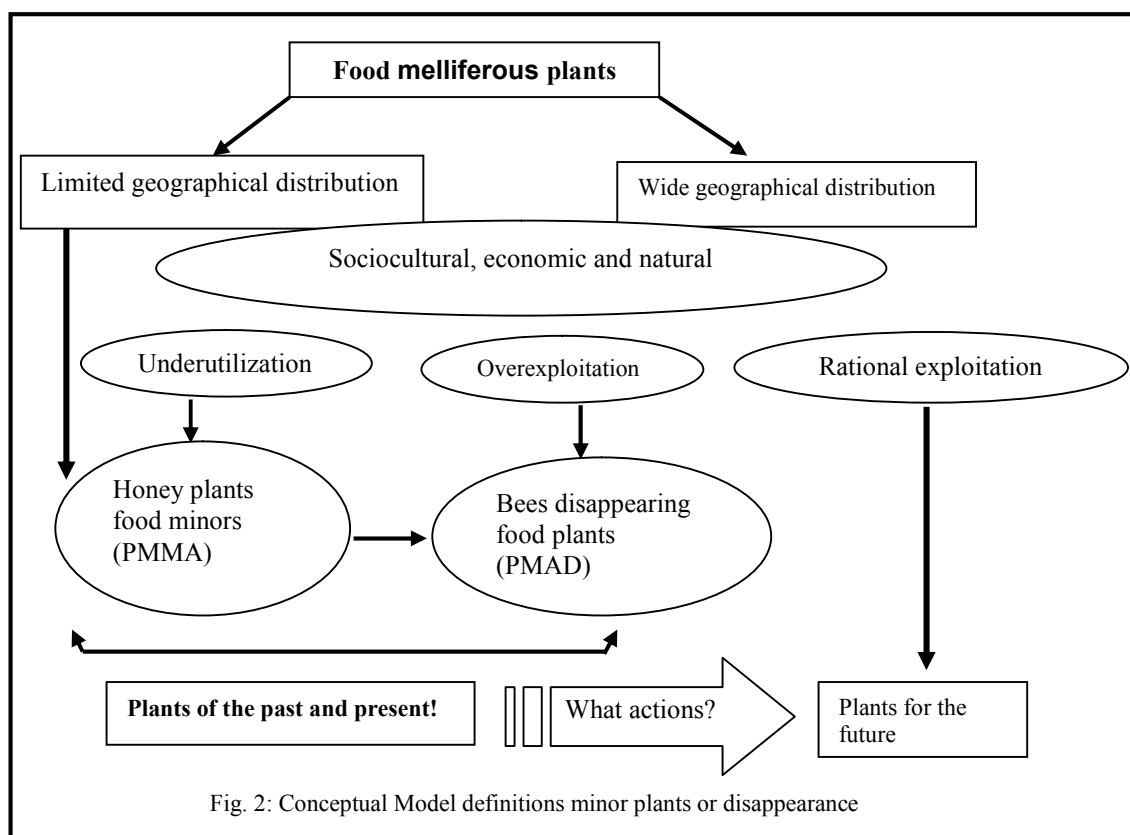


Fig. 1. Map of Ecological Zones of Togo
(source: Koudégnan & al. (2014))

Most species encountered were determined directly in the field. Those which are difficult to identify are sampled and put in a herbarium for identification in the laboratory following certain nomenclatures [8, 11, 12, 13, 14, 15, 16]. Pictures of the plants were taken on the ground for the purpose of identification and illustration. Pretreatment of all species inventoried and named allowed drawing two broad categories of species:

- Food melliferous crops or spontaneous (wild) minor plants; this category is rarely used or underutilized food plants [2, 17] and food plants reduced original geographical distribution ;
- Food melliferous spontaneous or cultivated plants threatened with extinction.

In general, food melliferous plants endangered include both minor but not overused food melliferous plants and minor ones (Fig. 2).



(Source: extract of Akpavi S. & al. (2006))

2.2. Pollen analysis

Twenty millimeters of honey were collected and acetolysed [18] to remove sugars, proteins, waxes and pectocellulosic membranes, etc. For each sample of honey, about 20 microliters of the pellet obtained after centrifugation at 3000 rpm trs / min $\pm$ 100 for 10 minutes with a centrifuge type "juan c 3 12" are mounted between slips and coverslips for microscopic observation. The observations are performed using a light microscope biloculaire "Nikon Eclipse ci" to 400x and 1000x magnifications kind. Each prepared slip is then fully explored and the counts are progressively on the horizontal lines of a periphery to another to inventory all their palynological population.

Determinations are made at the specific level, genre or family. But in this case study, we limited pollen tax identified to species level..

176 3. RESULTS AND DISCUSSION

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178 3.1. Results

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180 3.1.1. Diversity of food honey plants threatened to disappearance

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182 The intersection of the results of investigations and pollen analysis [3, 4, 5, 19, 20] are
183 helped us to identify on the whole 45 food melliferous plants endangered (PMAD) in Togo;
184 averaging 24 % of total honey plants currently constituting the Togolese melliferous flora.
185 These species identified, which fall into 43 genres, belonging to 24 families.

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187 3.1.1.1. Distribution of melliferous families according to their specific composition

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189 Depending on their species composition threats, these families can be divided into four
190 groups (Fig. 3a):

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192 ➤ The group of highly threatened families consisting of Malvaceae (33.33 %) and
193 Anacardiaceae (20.83 % each);

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195 ➤ The group of moderately threatened families constituted by Fabaceae and
196 Annonaceae (12.5 % each);

197

198 ➤ The group of threatened families formed by Amaranthaceae , Arecaceae , Moraceae
199 , Rubiaceae , Rutaceae and Sapindaceae (8.33 % each);

200

201 ➤ The group of low risk families consisting Caricaceae , Commelinaceae ,
202 Convolvulaceae , Cyperaceae , Droseraceae , Gentianaceae , Irvingiaceae ,
203 Meliaceae , Myrtaceae , Olacaceae , Portulacaceae , Sapotaceae , Solanaceae ,
204 Zygophyllaceae (4.16 % each).

205

206 Figure 3 below reflects the distribution of families according to the number of threatened
207 species assessed as a percentage.

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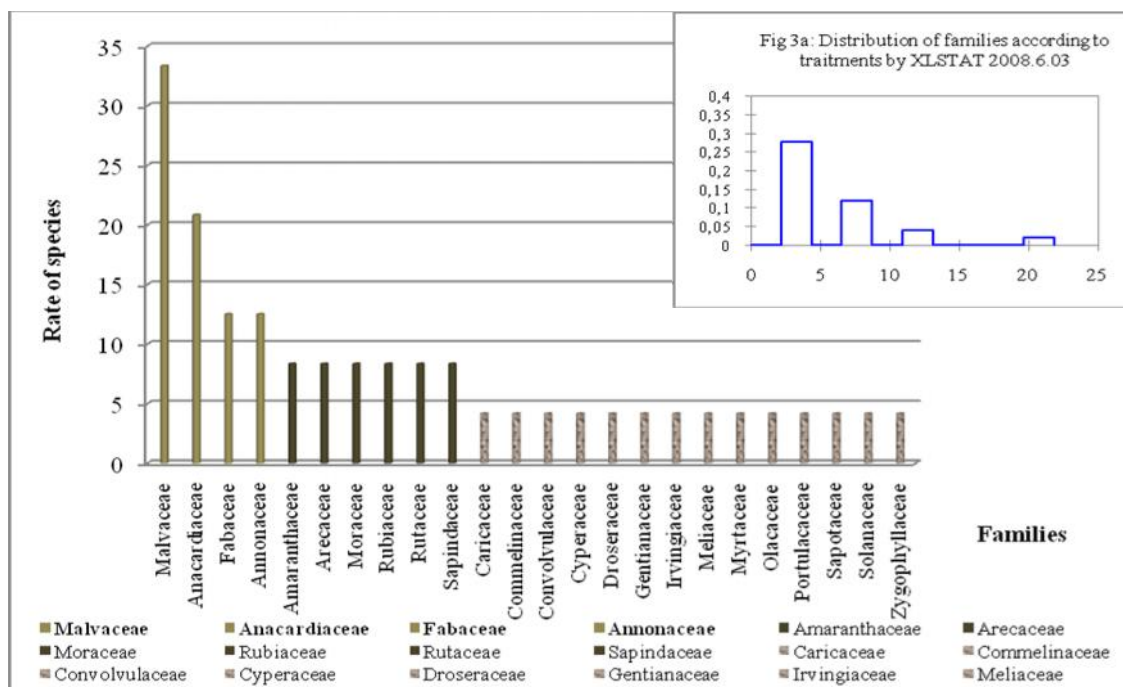
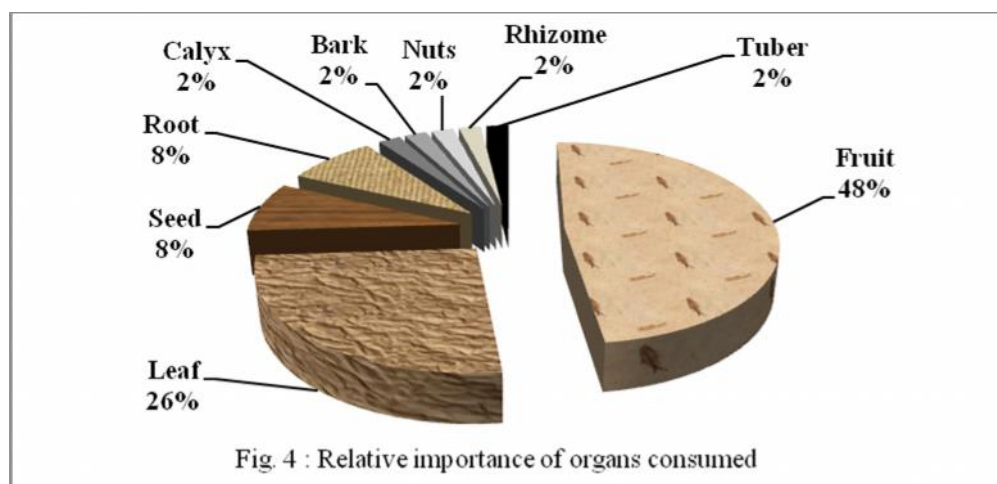


Fig. 3: Relative importance of melliferous families threatened
(Classification according to APG II, 2003)

3.1.1.2. Distribution of food melliferous plants threatened according to organ consumed

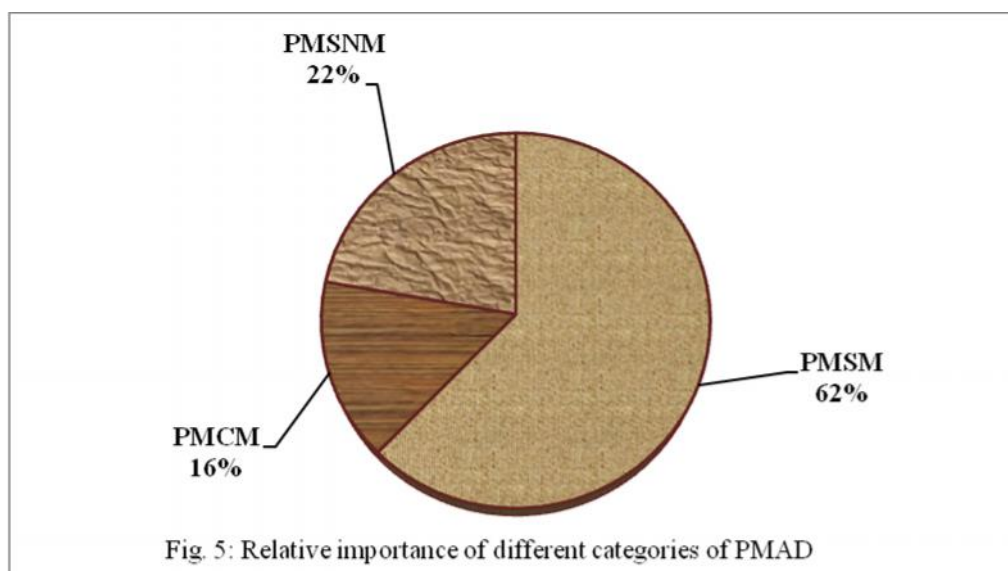
In terms of the various organs used, fruit plants are most dominant (47%); those dominant medium consist of leaf of plants (27%) and weakly dominant gather seed plants, root plants, calyx plants, bark plants, nut plants, rhizome plants and tubers plants (8-3%).



3.1.1.3. Distribution of food melliferous species threatened according to categories of plants

Food melliferous plants endangered consist of

- Spontaneous minor melliferous plants (62 %): *Amaranthus spinosus* L. *Annona senegalensis* Pers, *Balanites aegyptica* (L.) Del., *Blighia sapida* C. König, *Bombax costatum* Pellegr. & Villet, *Borassus aethiopum* Mart., *Ceiba pentandra* (L.) Gaertn, *Cola millenii* K. Schum, *Dialium guineense* Willd., *Diospyros mespiliformis* Hochst. ex A. DC., *sycomorus Ficus* L., *Grewia carpinifolia* Juss., *Hexalobus monopetalus* (A. Rich.) Engl. & Diels, *Ipomoea mauritiana* Jacq., *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., *Lannea acida* A. Rich., *Nauclea latifolia* Sm., *Parkia clappertoniana* Keay, *Paullinia pinnata* L., *Sclerocarya birrea* (A. Rich.) Hochst, *Spondias mombin* L., *Strychnos spinosa* Lam., *Talinum triangulare* (Jacq.) Willd., *Tamarindus indica* L., *Uvaria chamae* P. Beauv., *Vitellaria paradoxa* CF Gaertner *Ximenia americana* L. and *Zanthoxylum zanthoxylloides* (Lam.) Zepernick & Timler.
- Crops minor melliferous plants (16 %). *Anacardium occidentale* L., *Carica papaya* L., *Corchorus olitorius* L., *Cyperus esculentus* L., *Elaeis guineensis* Jacq , *Psidium guajava* L. and *Solanum aethiopicum* L.
- Spontaneous non-minor melliferous plants (22 %): *Afraegle paniculata* (Schum. & Thonn) Engl, *Antiaris africana* Lesch, *Celosia argentea* L., *Commelina benghalensis* L., *Corchorus fascicularis* Lam, *Corchorus tridens* L., *Khaya senegalensis* (Desr.) A. Juss., *Mangifera indica* L., *Mitragyna inermis* (Willd.) Kuntze and *Sterculia tragacantha* Lindl.



3.1.1.4. Distribution of food melliferous species threatened according to nutrients foraged by bees

Different plants are identified differently foraging. Overall, the nectariferous plants are the most important, followed by nectariferous-polleniferous plants, then after polleniferous plants (Figure 6).

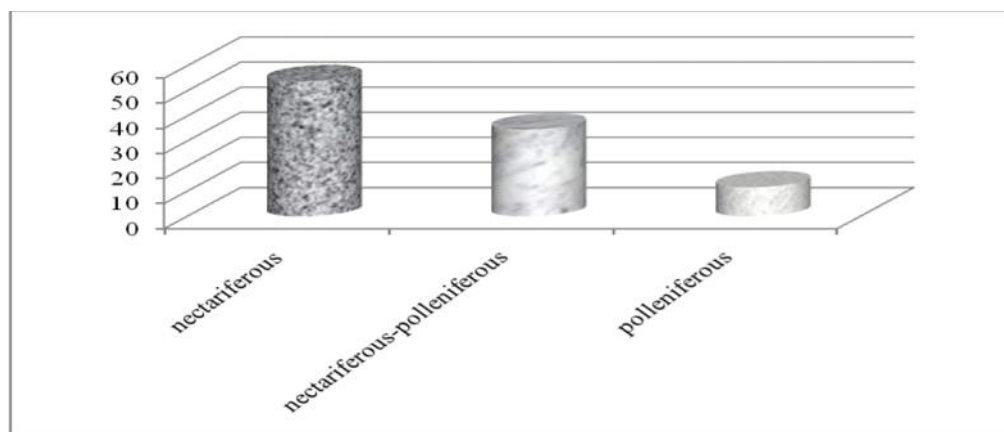


Fig. 6: Relative importance of nutrients PMAD foraged by bees

3.1.2. Causes of threats to food crops in Togo

Availability, consumption and sustainability of food melliferous plants are influenced by a combination of factors that work synergistically. These causes, which vary from one locality to another and from one ethnocultural group to another, include: the destruction of natural ecosystems by advancing agricultural and urban fronts and uncontrolled bush fires, the soil and climatic conditions unsuitable, sociocultural considerations, the degradation of good neighborly relations, the disruption of family structures, social discrimination against the use of plants to certain categories of people, the cultural shift schedule, changes in eating habits, competition from new varieties, the lure of the exotic, the specific characteristics of plants, reduction of agricultural land, the influence of rainfall and low crop yields .

All these different causes listed above can be divided into four main areas [3, 4, 5] as shown in Figure 7 below.

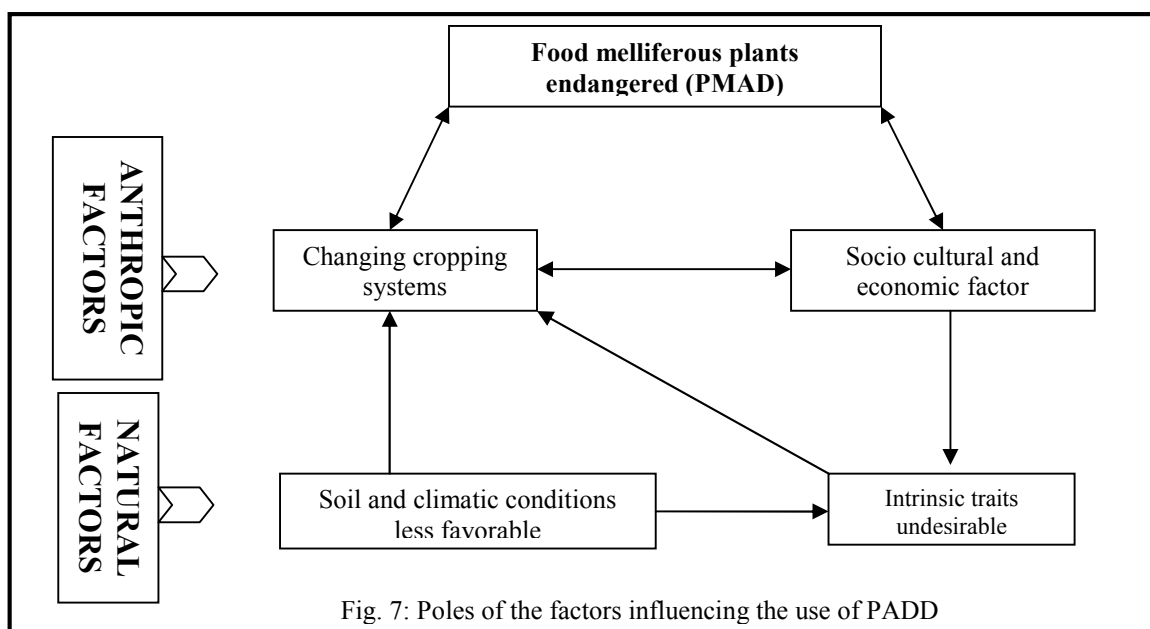


Fig. 7: Poles of the factors influencing the use of PADD

When soil conditions and climates are more conducive to certain cultures, they are abandoned and changing the structure of cropping systems. Changing cropping systems can also be linked to socio-cultural and economic factors favoring or prohibiting the use of certain plants. Each of these centers is, in a different way, threats to the availability and consumption of plants.

This correlation between the factors influencing the availability, use and sustainability of PMAD is more related to the spatial distribution of cultural groups and their size. Indeed, the widespread a people is, more it is in touch with all the socio- traditional natural and economic conditions prevailing in all agro -climatic zones of the country. This remains true even if the number of people's representatives in these areas is not large.

3.2. Discussion

The 45 melliferous species identified as endangered, represent 24% of the national melliferous flora which currently covers about more than 2% of the Togolese flora, according the studies carried out [19, 20]. Taking into account all of endangered food plants inventoried [3] this number represent 32.85 %. What remains important not to overlook, given the importance of these plants in the survival of living beings, or generally in the conservation and sustainable management of ecosystems.

The classification of these food melliferous plants endangered (PMAD) in different categories (spontaneous minor and minor cultivated plants) is an important preliminary in the management of local resources [21]. Melliferous crop plants identified in this study are all minor. Minor crops are those less cultivated and / or consumed in favor of other introduced species [3]. Similarly, other authors confirmed this assertion [2, 18, 22, 23] stating that as these plants become less and less available food recipes populations. For melliferous species threatened qualified as spontaneous minor, that represent 62 %, the work [3, 8, 24, 25] showed that these are plants that either have a low representation in the territory , or are under consumed and neglected , and therefore under these conditions less attention of consumers. According to World Union for the nature, it states that degradation of natural habitat reducing the occurrence of plants is a key factor in their disappearance [26].

This study emphasizes that taking into account the bodies consumed by the number of species, the fruit are most at risk (48 %) followed by plant leaves (26 %). This confirms the results obtained by Akpavi, which reports that fruit and wild vegetables are an important part of the minor or endangered plants [3, 4, 5]. Another works have stated that the fruit and wild vegetables have strong implications in food recipes of West Africans population especially during food crises [27, 28, 29].

The majority of these threatened species include plants that need bees for honey production: nectariferous plants. Honey, being completely made with nectar, a sweet substance in the flowers, the disappearance of these species has a significant effect on the rate of production of this food; a very useful food for bees themselves and humans. Moreover, this threat of extinction will have direct effects on plant and animal ecosystems. As bees being Hymenoptera animals playing an important role in pollinating flowering plants , so the multiplication of plants, the disappearance of their nutrient supply sources (nectar , pollen , resins, ...) lead their reduction or their total extinction. It follows then that the threat of extinction of these plants is in turn a threat of destruction of the whole environment; which is very worrying.

Moreover, the various causes related to threats of extinction food melliferous species above are of two kinds: natural and anthropic causes.

The natural order of threats that affect the availability and consumption of food plants in Togo are related to environmental degradation, change in cropping systems, some intrinsic characteristics of plants and factors sociocultural and economic [3]. The phenomenon of degradation and human impacts of ecosystems leads to land saturation and a mining farmland [30]. Complementing this statement certain authors explain that the lack of agricultural land forces farmers to intensify cropping systems and operate rigorous choice, thus excluding often the seeds of food crops to low value [31, 32].

Another works showed that influences linked the marginalization and the loss of many food plants are anthropic order or contemporary social phenomena such as changes in eating habits, social disparities, individualized behavior, migration populations and the disruption of family structures [3, 33, 34]. The work of FAO indicates that changes in eating habits can lead to a complete disappearance of menus, a total or partial modification of components menu [35]. These changes are in response to a multitude of internal and external factors interact, including food supply, culture and education, lifestyle, socioeconomic level and styles or dietary patterns [36, 37].

4. CONCLUSION

From this study, it appears that 45 species of melliferous and food interest were targeted endangered in Togo. These species, which represent approximately 24 % of the national melliferous flora, correspond to 43 genres and belong to 24 families. These melliferous families were divided into four groups based on their composition in food plants endangered: the highly threatened families, families moderately threatened endangered families and families' low risk. Overall, the fruit are the most dominant plants followed leaf plants. The majority of these plants are represented by the nectariferous plants.

In addition, food melliferous species identified were grouped into three categories: spontaneous minor melliferous plants, crops melliferous plants and spontaneous non-minor melliferous plants.

The causes which are the basis of the disappearance of food melliferous plants in Togo are generally natural and human-induced order and can be divided into four areas intrinsically linked: the soil and climatic conditions, changes in cropping systems, sociocultural and economic factors and intrinsic traits undesirable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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513

514 **DEFINITIONS, ACRONYMS, ABBREVIATIONS**

515

516 - Fig.: figure;

517 - &: and;

518 - Trs: tours;

519 - Min: minute;

520 - PMAD: Food melliferous plants endangered [In French];

521 - PMSM: Spontaneous minor melliferous plants [In French];

522 - PMCM: Crops minor melliferous plants [In French];

523 - PMSNM: Spontaneous non-minor melliferous plants [In French].

524