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*Full Length Research Paper*

# Coexistence of human and hyena and associated impacts in Haramaya district of Eastern Ethiopia

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**Coexistence of human and hyena, associated impacts, and feeding habit was studied in Haramaya district of Eastern Ethiopia from October, 2011 to December, 2013. A total of 110 households from four sub-districts (Tinike, Finkile, Kerensa and Bocheke) were selected randomly for interview. The questionnaire was designed to assess various parameters including eliciting information on the knowledge of local people about spotted hyena in the area, identify the habitat that were disturbed by human activities, number of domestic animals owned and its management and number of livestock lost, incidences of human attack and death, and susceptible domestic animal species to predation by hyenas for the past 10 years. The household's survey result showed that 1578 domestic animals were lost due to predation for the past 10 years. The economic cost of livestock lost due to predation from hyena was about US$ 7527.8 per year. Scat analysis used to study diet of spotted hyena showed that the prey from domestic origin were dominating except for dikdik (*Madoqua saltiana*), klipspringer (*Oreotragus oreotragus*) and porcupine (*Hystrix cristata*), which were observed from Kerensa sub-district. Sheep was considerably more preferable prey among domestic animals and constituted 37.4%, followed by 35.4% goats and 10.47% dogs. Improvements of livestock management system and west disposal practices can substantially reduce human-hyena conflicts and loss of livestock.**

**Key words:** Human-Hyena conflicts, Haramaya district, predation, spotted hyena.

## INTRODUCTION

Globally, many large carnivores are found at low abundances, with large territories of conflict with humans (Croes et al., 2011; Yirga et al., 2012). In Africa, the acceptance level of local people towards large carnivores is very low and they believe that retaliatory killing after livestock attack is acceptable. Therefore, large carnivores avoid themselves from populated villages and urban areas (Croes et al., 2011). Conflicts between human and wildlife populations are emerging as a major conservation issue worldwide. Crop raiders including elephants, many primates, several bird species, and rodents can diminish or destroy the farmers' food and cash crops. The loss that conflict can cause has gain a considerable attention for the past ten years, particularly, conflict between carnivores and people (Sillero-Zubiri and Laurenson, 2001; Macdonald and Sillero-Zubiri, 2002). In Africa, very

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few researches were conducted to demonstrate conflict between human and hyenas as well as associated impact. This is particularly true in case of Eastern Ethiopia where human and hyena coexist in a higher density.

Spotted hyaenas (*Crocuta crocuta*) are the most common among all large carnivores, found all over sub-Saharan Africa, including tropical forests, alpine areas and true deserts (Yalden et al., 1996; Mills and Harvey, 2001; Gade, 2006). The species is commonly seen as hunter of domestic animals. Moreover, spotted hyena is also known to attack and kill humans, particularly at the time of disease outbreaks (Kingdon, 1977; Hofer, 2002; Gade, 2006). In Africa, the total population of *C. crocuta* is estimated to be about 27,000 and 47,000 (Mills and Hofer, 1998). Most of the population are found in Tanzania of the Serengeti ecosystem (Kruuk, 1966; Schaller, 1972; Ray et al., 2005) and South Africa of the Kruger National Park (Ray et al., 2005). The abundance, distribution and population structure of spotted hyena in South African region are stable, whereas in other region of Africa (East, Central and West Africa) many populations are considered to be declining (Hofer and Mills, 1998; Ray et al., 2005). The main reasons for decline of spotted hyena distribution and populations in the area is because of the habitat degradation, poison, low number of natural pray, and persecution and disease. These factors make spotted hyenas dependent on the continued existence of conservation areas (Mills and Hofer, 1998).

In Ethiopia, the great dependence of a large proportion of the human population for their survival on the agriculture, coupled with the presence of large numbers of livestock led to sources of conflict between people and wildlife. Human population growth coupled with expansion of agriculture resulted in habitat degradation through the loss of vegetation cover of the country. Therefore, the natural forest areas of the region are overexploited. In eastern part of Ethiopia, humans have coexisted with high abundance spotted hyenas. This species is one of the few large carnivores found in the area that survive in the habitats with dense human populations. The natural habitat available in the area for natural prey base for carnivores is degraded and fragmented. Therefore, existence of spotted hyena as other large carnivores mostly relies on the predation of livestock and domestic waste disposal. In El Kere and Bare of South Eastern Ethiopia, 50 people were attacked by hyena in the year 1998/1999, of which majority of them (35 0ut of 55) were children. In the same year at Fedis which is located at 30 km from Harer city, hyena killed 3 people and injured 3 others (Sapa-AFP, 1999). After a year, in 2000 in the northern part of Somalia Region, 4 people died because of hyena. In 2005/2006, hyenas killed 11 people and more than 40 were wounded in the same region (IRIN, 2000; Somalil and Times, 2006).

However, studies dealing with human hyena conflict and addressing problems associated with the conflict in the region were unknown. The impact of human-hyena conflict in relation to livestock loss, its economic impact for the livelihood of the local peoples, problem associated with the death of peoples and feeding habit and preference of spotted hyena are poorly known, not yet quantified and documented. Domestic animal owners are challenged by losses of their animals from spotted hyena. Therefore, assessing human hyena conflict and quantifying associated impacts are fundamental to implement appropriate conflict mitigation techniques so as to minimize domestic animal loss and to safe guard the conservation of the species. In this paper the actual proportion of domestic animal predation by spotted hyena, was determined; the economic losses of livestock depredation associated with human hyena conflict over the past ten years were quantified; asses human attack; identify vulnerable animal species to spotted hyena predation and quantify the feeding habit of spotted hyena in Haramaya distract, Eastern Ethiopia.

## MATERIALS AND METHODS

### Location of the study area

This study was conduct in Haramaya district (Tinike, Finkile, Kerensa and Bocheke sub-district), which is located in Eastern Hararge Zone of Oromia, Eastern Ethiopia. The district covers 52,163 hectares. The altitude of the area ranged between 1600 and 2100 m above sea level (asl). The climate of the district is tropical, with two rainfall peaks; first from June to September, which is the long rainy season and a short rainy season from February to May. The annual rainfall is between 118 and 866 mm. The dry seasons of the area are December to January and June to August; the latter being more severe and longer. The temperature ranges from 9 to 24°C (DMoA, 1999). According to the 2006 population census (CSA, 2007), the total human population of the district was 166,597 of which 18,582 are urban living and 148,015 are rural population. 71,205 cattle, 15,294 sheep, 28,990 goats, 11,755 donkey and 250 camels are found in the district (Figure 1).

### Preliminary study

A preliminary survey was conducted in August, 2011. During this survey, all the available and relevant data on the area (climate, topography and the habitats modified by the impact of human interference) were gathered. Different vegetation types, representative habitat sites and the place where the local people live and keep their livestock were observed.

### Data collection

The method of data collection mainly includes household questionnaire, focus group discussions, field observations and participatory rural appraisal (PRA). This data collection dealt with 110 respondents selected randomly in four sub-districts (Tinike, n = 35; Finkile, n = 23, Bocheke, n= 28 and Kerensa, n = 24). Respondents were asked questions related to history of human hyena conflict, coexistence of spotted hyena and human and associated problems, particularly the loss of domestic animals and

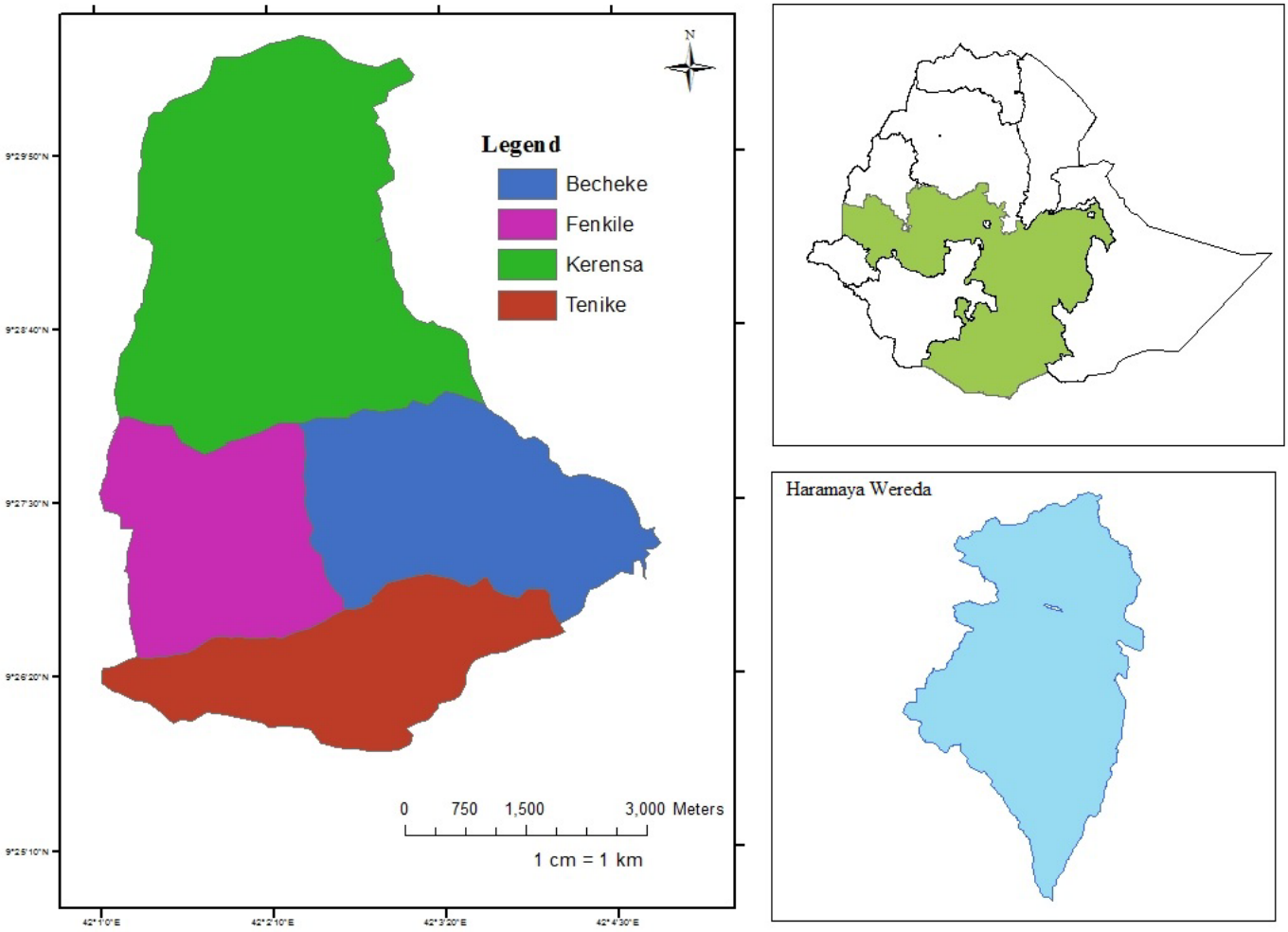


**Figure 1.** Map of the study area.

the number of people that died because of hyena and its economic impact from 2003 to 2012. The economic impact as a result of domestic animal loss due to predation of spotted hyena was estimated based on the record of species, age, number and sex of domestic animals losses for the past ten years. The current average market prices of the species of different categories of domestic animals by age and sex were obtained from buyers and sellers and averaged, then converted to US$ at the average exchange rate of the time of the study. The secondary data were collected from district Agricultural Office and Animal Veterinary Center.

### Feeding habit and preferences

Feeding habit of spotted hyena was characterized using Scat Analysis. 85 spotted hyena drops were obtained from four sub-districts: Tinike, n = 22; Finkile, n = 19; Bocheke, n= 16; and Kerensa, n = 28. Samples were preserved in 5 to 10% formalin solution in individual plastic bottle and brought to the Animal Physiology Laboratory of Haramaya University for examination. Samples were washed by distilled water for proper identification, and then hairs were extracted from washed sample and observed under a microscope, the comparison was done using hair in our reference collection to analyze prey species composition. Reference collection was prepared from hair of all domestic animals, human and selected wild species found in the study area. Style, form, length and color of the hair were used to identify the hair of the prey using a microscope.

## RESULTS

### Production system

Dominant mode of production in the district was small mixing farming of livestock and crop production. Sorghum (*Sorghum bicolor*) and maize (*Zea mays*) are the most commonly cultivated cereal crops in the district. Agricultural production business is supported by cultivation of vegetables through both rain fed and irrigation. Chat (*Catha edulis*), is the most commonly grown as source of cash crop. In some extent, they also planted coffee as a cash crop. Animal production is also importance source of income in the district; however, livestock production mainly cattle production is dominated

**Table 1.** Number of domestic animals lost and estimates of economic cost by spotted hyena in Tinike, Finkile, Bocheke and Kerensa sub-districts (n = 110), Eastern Ethiopia.

| Species | Depredation | Percentage | USD |
|---|---|---|---|
| Cattle | 98 | 6.25 | 25257.73 |
| Sheep | 590 | 37.4 | 24329.90 |
| Donkey | 33 | 2.08 | 1020.62 |
| Goat | 559 | 35.4 | 23051.55 |
| Chicken | 133 | 8.4 | 342.78 |
| Dog | 165 | 10.47 | 1275.77 |
| Cat | 0 | 0 | 0 |
| Camel | 0 | 0 | 0 |
| Mule | 0 | 0 | 0 |
| Horse | 0 | 0 | 0 |
| Total | 1578 | 100% | 75278.35 |

by traditional, and communal grazing with coarse pasture and crop-residue.

**Livestock feeding management**

Cattle, sheep, donkey and goats are the common livestock in the district. The grazing system is dominated by grazed on natural pastureland in the care of herdsmen, who are usually children except fattening animals. All groups of domestic animals usually graze together on communal grazing land except the fattening animals. Overgrazing or over stocking is commonly seen in the district due to shortage of communal grazing area available for livestock resulting from increasing human population and intensive cropping. Animals grazed in the grazing land up to 9 h, grazing time rarely exceeds this hours. Animals remain around the backyard until 9 am and are moved to the grazing fields. The grazing animals stay in communal grazing area until 6:00 pm local time. The animals move a distance 0.5 to 2 .0 km from the farmers' residence to the grazing area. In dry season, there is shortage of feed for animals, the leaves of indigenous fodder trees serve as a feed for livestock.

**Livestock housing**

During day time, all animals stay outside and then during the night they are kept in housing. In relation to the housing type, the house is divided in to three parts, one is for keeping the animals, one part for the farmer and his family, and the last one for a kitchen.

**Wildlife in the district**

The respondents listed 4 wild mammals that occur in the study area. Spotted hyena (*C. crocuta*), kdik (*Madoqua saltiana*), klipspringer (*Oreotragus oreotragus*) and porcupine (*Hystrix cristata*) were known to all respondents.

**Domestic animal loss**

Farmers reared different type of livestock. Respondents claimed that spotted hyena came to the village and attacked their domestic animals. Spotted hyena killed 1578 domestic animals for the past ten years in the district, of which 3337.4% (n=590)] were sheep and 34.4% (n=559) were goat (Table 1). The annual monetary loss was US$ 75278.35 (Table 1). The loss of domestic animals per house-hold per annum was 14.34 domestic animals with the economic loss of US$ 68.43, which is about 0.57% of the average annual income of individual households of the district. The economic loss of cattle and sheep, because of hyena accounted for a loss of US$ 25257.73 (33.55%) and 24329.90 (32.3%), respectively (Table 1).

**Domestic animals species vulnerable to predation of spotted hyena**

Among domestic animals, sheep were more significantly taken by hyena predation, accounting for about 37.4%, followed by goats (35.4%) and dog (10. 47%) (Table 2). Among domestic animals existing in the district, two species have been reported as the most susceptible species to predation of spotted hyena (Table 2).

**Human attacks**

Twenty four human attacks (eighteen males and six female) were recorded during the survey. In 2010 to 2012, twelve peoples were killed because of hyena, of

**Table 2.** Domestic animal species ranking based on their vulnerability to predation of spotted hyena in Haramaya district (Tinike, Finkile, Bocheke and Kerensa sub-districts, n = 110), Eastern Ethiopia.

| Species | Respondents | Rank | Percentage (frequency) |
|---|---|---|---|
| Sheep | 85 | 1 | 37.4 |
| Goat | 68 | 2 | 35.4 |
| Dog | 32 | 3 | 10.47 |
| Chicken | 24 | 4 | 6.25 |
| Cattle | 11 | 5 | 2.08 |
| Donkey | 7 | - | - |
| Cat | 0 | - | - |
| Camel | 0 | - | - |
| Mule | 0 | - | - |
| Horse | 0 | - | - |

**Table 3.** Feeding habit and analysis of spotted hyena in four sub-districts (Tinike, Finkile, Kerensa and Bocheke) of the Haramaya district.

| Prey species | Count | Relative frequency (%) |
|---|---|---|
| Poultry | 32 | 29.1 |
| Goat | 5 | 4.55 |
| Donkey | 4 | 3.64 |
| Sheep | 2 | 1.82 |
| Cat | 11 | 10.00 |
| Dik dik | 21 | 19.10 |
| Dog | 19 | 17.27 |
| Cattle | 4 | 3.64 |
| Porcupine | 1 | 0.91 |
| Unidentified | 11 | 10.00 |
| Total | 110 | 100 |

which 58.3% (n=7) were children below the age of twelve. 50% of human attack was made when they go to toilet during evening, whereas the rest of them occurred when people sleep outdoors at night and move from one village to the other during night. The others attacked by hyena, when they gave support for others during a hyena attack, or when hyenas enter into homestead to attack livestock or human. The result showed that most of (98%) of the attack were occurred at night.

### Diet analysis

The feeding analysis of spotted hyenas result showed that prey of domestic origin dominated the feeding type. Dikdik (*M. saltiana*), klipspringer (*O. oreotragus*) and porcupine (*H. cristata*) were observed from scat of Kerensa sub-district (Table 3). A significant difference was observed in the frequency occurrence of hair among species ($P < 0.05$), but there is no significant difference between sub-districts. Goat, sheep, cattle, chicken and donkey were the commonly observed species of domestic animals in the feed analyzed.

## DISCUSSION

Agriculture was the main activity of the people around in the district. Farmers reared different types of livestock such as cattle, sheep, goat and pack animals. Respondents claimed that spotted hyena came to the village and attacked their domestic animals. The result of the study showed the losses of 1587 domestic animals because of existence of hyena over the past ten years (Table 1). Human coexist with many large carnivores in several parts of Africa (O'Connell-Rodwell et al. 2000). However, one of the main reasons for many carnivores changing their diets is impoverishment of prey populations, due to their hunting competence (Woodroffe et al., 2005; Kolowski and Holekamp, 2006). For instance Polisar et al. (2003) in Venezuela of Hato Pinero cattle ranch, the very high number of livestock loss have been recorded in this area, but the area is known by its low abundance and diversity (Polisar et al., 2003). The

respondent pointed out that hyena found around in the district often preyed on livestock, causing economic loss to farmers. Compared to studies conducted in other area, the economic loss caused by predation of hyena in the study area is significantly low (Holmern et al., 2007; Kissui, 2008; Yirga and Bauer, 2010). In this study, the economic loss was 0.57%, whereas Holmern et al. (2007) and Kissui (2008) found 19% of yearly monetary loss households in other area (Holmern et al., 2007; Kissui, 2008). However, this variation might be because of the variation in relation with the country's living standard.

In Haramaya district, the natural vegetation was degraded, because of land for human settlement, farming and grazing, cutting of forest for charcoal or fire wood production and other development projects. This has resulted in the deterioration of wildlife habitat and vegetation cover in the area and depletion of the natural prey species. Therefore, diet of hyena was predominantly dependent on domestic origin, because the habitat where hyenas live support inadequate food resources, however for survival, hyenas require 3.8 to 4.0 kg of food per day (Henschel and Tilson, 1988). Therefore, in the area where the abundance of wild prey is very low, domestic animals serves as prey buffer (Litvaitis, 2000; De Iongh et al., 2004; Abay et al., 2011) and starts to attack peoples and their domestic animals. This result proved that spotted hyenas and human can exist together in the area, because hyena is dependent on anthropogenic food in his diet. The population of hyena is very high; therefore, domestic waste and predation of domestic animals are sources of food and can substantially support the existence of a viable spotted hyena population in the district.

The present killing of domestic animals is the major cause of conflict between human wildlife conflicts in the district. Frank (1998) and Ogada et al. (2003) also confirmed livestock loss by wildlife as a cause for human wildlife conflict (Frank, 1998; Ogada et al., 2003). Wildlife is accountable for the loss of 3% of livestock per year (Jackson and Nowell, 1996). This study revealed that loss of domestic animals because of coexistence of human and spotted hyena is a great economic concern for the poor farmers whose economy is dependent on agriculture in Eastern Ethiopia. Studies analyzing human wildlife conflict in many part of the world showed that the rate of tolerance among local communities toward predators mostly depends on the degree of predation on their domestic animals (Kolowski and Holekamp, 2006; Holmern et al., 2007).

Between 2011 and 2012, 24 people were attacked by spotted hyena. The study showed that 50% of the incidence happened during the dark when they go to toilet, while the rest was induced when people sleep outdoors at night or travel from one village to the other or from one house to the other house predominantly during night or dark time. This is because of the fact that the species are nighttime predators, probably due to their better night vision relative to their prey which is domestic animals (Bertram, 1979). The results are also supported by other studies elsewhere. For instance, a boy was attacked by a spotted hyena when he was sleeping in Northern Kenya (Flying Doctors Society of Africa, 2002). Kruuk (1972) reported the attack of sleeping peoples by spotted hyena in Malawai. In our investigation, majority (75%) of the people that faced a problem with spotted hyena were males. This is due to the fact that males are involved to support human or domestic animals when hyena bites them rather than women or children to protect victims. However this finding obtained during the present study is inconsistent with other records from Tanzania. Kruuk (1972) recorded that spotted hyena attacked 60 people in Tanzania, among which majority of them were women and children. However, the number of humans that died or got injured by spotted hyena occurred rarely and did not occur regularly. Even though the number of people affected or died by hyena was low, its impact with regard to the local people perception was large.

## Conflict of Interests

The authors have not declared any conflict of interests.

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# Medicinal plants used and the perception of plant endangerment by the traditional medicine practitioners of Nasarawa State, Nigeria: A pilot study

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**The growing role of traditional medicine practice in the health care delivery system of most countries of the world cannot be over emphasized. Needless to say, more than 90% of the remedies used by the practitioners of traditional medicine are medicinal plant based. The growing demand for these plants for medicinal use and the subsequent unsustainable harvesting, livestock browsing and infrastructural development has led to the endangerment of some of the species. A pilot study was conducted to document the medicinal plants used by traditional medicine practitioners (TMPs) and those they perceived to be scarce or endangered in Nasarawa State, Nigeria. Sixty TMPs were interviewed orally with the use of structured questionnaire. A total number of 120 medicinal plant species were identified from the 158 specimens surveyed for treatment of various ailments. Forty eight percent of the respondents did not agree that wild collection of medicinal plants without replacement can increase extinction risk of such plants. Of the medicinal plants mentioned by the TMPs to be scarce, only 33 were identified taxonomically and 75% of them are trees, while 3% are herbs. The study reveals the urgent need for raising of awareness level of the TMPs on plant endangerment, training on good collection practice, sustainable collection, and as well as sensitization on sustainable biodiversity conservation practice.**

**Key words:** Nasarawa State, medicinal plants, biodiversity conservation, Traditional Medicine Practitioners (TMPs).

## INTRODUCTION

Majority of the African population regularly consults both orthodox and African traditional healing systems. WHO estimates that 60% of the people in sub-Saharan Africa use traditional medicine to alleviate their spiritual, psycho-social and physical problems (WHO, 2001). Statistics have shown that in sub-Saharan Africa, it is estimated that one western-trained physician treats about 40,000 patients while one traditional healer treats about 400

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patients (Hoggle, 1990; Mbereko and Mahlatini, 2014). This implies that there are many traditional healers serving a large portion of the population. Despite enormous advances in conventional medicines, the use of traditional medicines is encouraged, partly because some conventional drugs have failed to prove effective, have serious side effects, or cannot cure certain new illnesses (WHO, 1978; Hamayun et al., 2006; Khan et al., 2007; Sofowora, 2008; Wachtel-Galor and Benzie, 2011). The World Bank in recognition of the vital roles of medicinal plants in community sustenance and development has put up a strong case for the use of herbal in healthcare delivery. The identified vital roles include medicinal, ecological, income generation, cultural, social and religious roles (Mburu, 2005).

Today, the people that hold indigenous knowledge on the uses of plants are the older generation and the traditional healers. These traditional medicine practitioners (TMPs) at the rural community level are usually farmers, hunters, fishermen, timber workers, among others, and they are predominantly male, usually above 50 years old (Shaheen et al., 2014; Ibrahim et al., 2007). Transfer of knowledge and skills of the practice are mainly through family inheritance, and only very few practitioners developed their skill through apprenticeship. Majority of the TMPs lack formal education, however, some educated persons are developing interest in the profession. While the numbers of these TMPs are decimating mainly due to old and age death, there is relatively low knowledge turnover and practice by the younger generation that has become more mobile due to civilization (Ibrahim et al., 2007; Kunle, 2009; Kassam et al., 2011). In addition, there is rapid disappearance of genuine traditional herbalists and decline in authentic knowledge of traditional treatment (Lindsay and Hepper, 1978; Kassam et al., 2011), thus raising concerns for the extinction of indigenous traditional medicine knowledge. Furthermore, secrecy, superstition and lack of adequate records on the use of herbal medicines may have led to the loss of many invaluable heritages in herbal medicine.

Furthermore, high population pressure, which has led to high demand for medicinal plants and intensive land use for agricultural and livestock expansion, pose great danger to the very existence of our plant diversity. To preserve the traditional knowledge of plant use or our biodiversity generally, and to be able to suggest ways for their conservation, it is important to have data on medicinal plants that still exist, where to find them and their uses. Several ethnobotanical surveys have been carried out in Nigeria (Gill and Akinwunmi, 1986; Odugbemi et al., 2007; Lawal et al., 2009; Soladoye et al., 2010; Ene and Atawodi, 2012; Kunle et al., 2013). These surveys were usually focused on a community sector and addressed the documentation of the uses of medicinal plants and materials and the traditional healing practices of the rural population.

There is need, therefore, not only to carry out ethnobotanical research and documenting healing methods, but also to encourage propagation and conservation of herbal plants among the local people. This study aimed at undertaking a pilot study to identify, document and evaluate the local abundance of the medicinal plants used by the TMPs in Nasarawa State, North Central Nigeria.

**Figure 1.** Map of Nigeria showing Nasarawa State.

## MATERIALS AND METHODS

### Study site and study population

Nasarawa State (Figure 1) lies between 8.5333° N, 8.3000° E with a land mass of 27,118 km$^2$ and located in the Savannah belt of Nigeria. It has a climate typical of the tropical zone. The population of the state as at 2006 was put at 2 million people (Report of Nigeria's National Population Commission on the 2006 Census, 2007). The state is made up of about 300 ethnic, sub-ethnic and cultural groups each with a distinct heritage. Nasarawa State has a well-organized Traditional Medicine Practitioners Association (NAMTMP) which made access to and collaboration with them for the study easy and well-coordinated. The activities of NAMTMP in the state are closely monitored by the State Ministry of Health. The people of Nasarawa State still retain most of their indigenous ways of life, including farming and traditional medicinal practice, despite the high rate of urbanization of their towns, especially those close to Federal Capital city.

### Questionnaire and prior-informed consent (PIC) form

Structured questionnaire and informed consent form were designed for the study. The questionnaire included questions designed to gather data on the study area and field sites, socio-demographic characteristics of the TMPs, ethnobotanical survey of the plants used as medicines, as well as plant conservation awareness and methods used by the TMPs.

### Preliminary familiarization visit, data collection and analysis

Reconnaissance visits were made to the study site, during which


**Figure 2.** Cross section of TMPs during Lafia interview section in Nasarawa State.

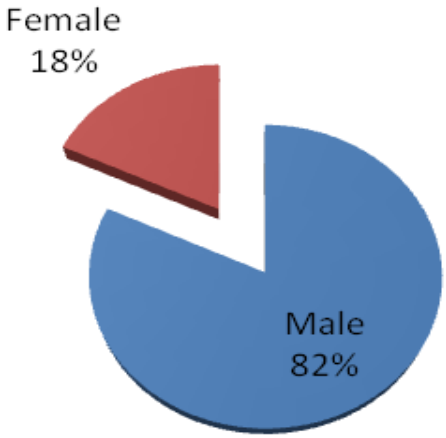


**Figure 3.** Sex distribution of Respondent TMPs of Nasarawa State.

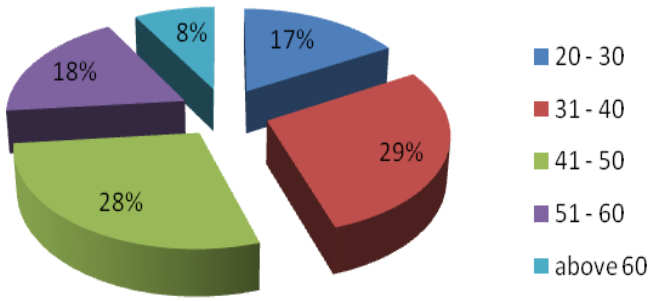


**Figure 4.** Age group of Respondent TMPs of Nasarawa State.

approval for the questionnaire administration was obtained from NANTMP, and 60 TMPs to be administered the questionnaires were randomly selected, including 30 TMPs each from Lafia and Keffi.

The questionnaires were administered to the selected TMPs using a focal group discussion method (Figure 2). This was done after their written consent was obtained, while the questions were explained to them with the aid of experienced interpreters to Hausa and other local languages. Collected data were analyzed using descriptive statistics such as percentages and frequency and expressed in charts.

## RESULTS AND DISCUSSION

### Socio-demographic characteristics of the TMPs

The socio-demographic structure of TMPs in Nasarawa State as observed in this study is similar to those reported in other parts of Nigeria and Africa. This study noted that majority of the holders of indigenous knowledge were males and above 31 years old which corroborate with earlier findings (Ibrahim et al., 2007; Lawal et al., 2009; Shaheen et al., 2014) (Figure 3 and 4).

On the practitioners' level of education, majority of the respondents, 33% (20), had no formal education and this was always the trend in most surveys (Ibrahim et al., 2007; Shaheen et al., 2014). The 5% of the respondents observed to have post-secondary education showed that the people with high educational qualification were beginning to have interest in the practice (Figure 5).

The length of training and practice of the respondents also showed different patterns. Majority of the respondents, 39 and 25% had been practicing for over 11 years. Those that had been practicing for over 40 years were about 8% (Figure 6). Majority of the respondents (77%) did not respond to the number of years they spent training as apprentice practitioners, this might be as a result of the fact that many claimed that they inherited the practice from their parents. About 24% (17 and 7%) responded positively to training period and gave number of years spent training (Figure 7). The training or source of knowledge were also very diverse with the majority of about 82% (49) accounting for family source (Figure 8);

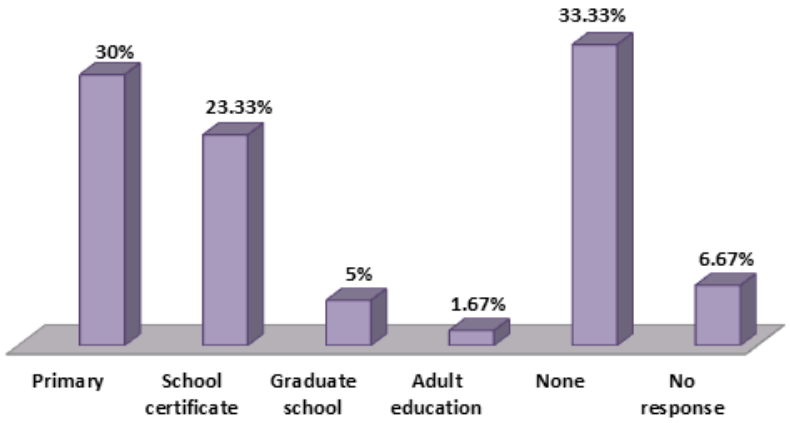


**Figure 5.** Level of education of Respondent TMPs of Nasarawa State.

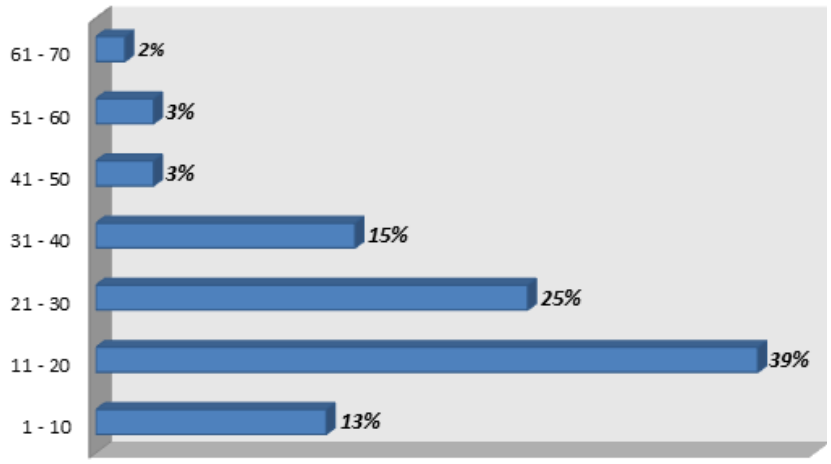


**Figure 6.** Length of practice by Respondents TMPs of Nasarawa State.

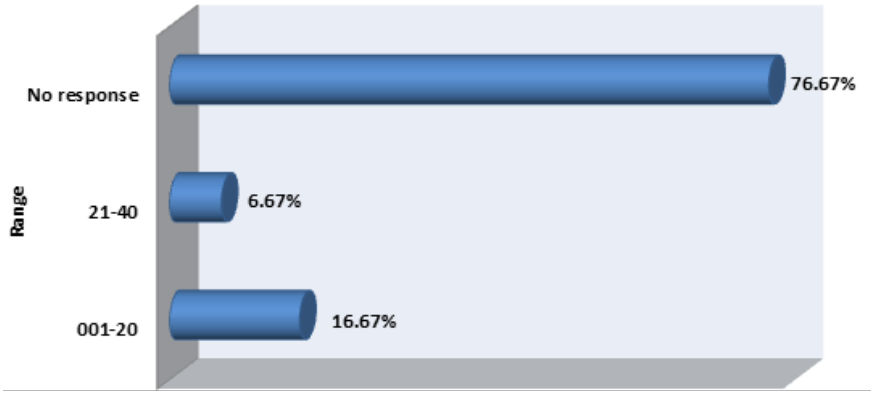


**Figure 7.** Years of trainingby the TMPs of Nasarawa State.

this correspond with most documentation or common knowledge on source of indigenous knowledge by the locals or TMPs, which are mostly said to be inherited from the family (Ryan, 1998; Ndubani and Hojer, 1999;

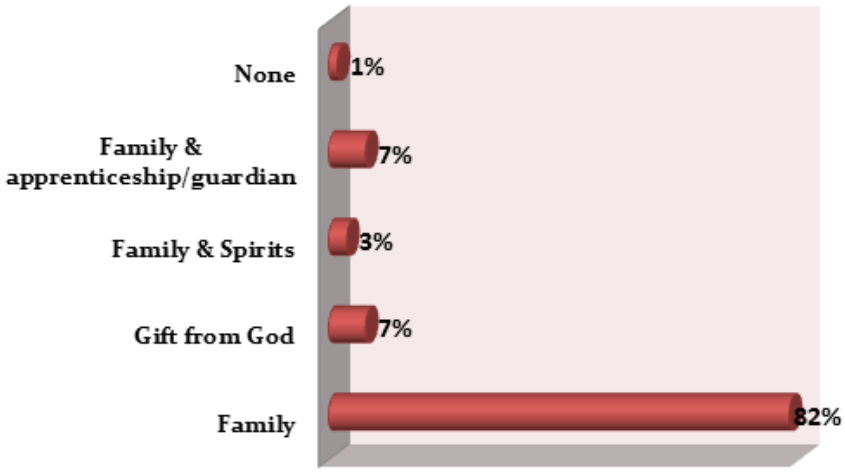


**Figure 8.** Source of acquiring traditional medicine knowledgeby the TMPs of Nasarawa State.

Atawodi et al., 2002).

**Medicinal plants used as medicines by the TMPs**

A total of 158 specimens were documented comprising 120 identified species in 50 families and 38 unidentified specimens for treatments of various ailments are shown in Table 1. They were used either singly or in combination with other plants and/or additives in form of infusion, decoction, and tincture or even in powdered form. Some of the ailments treated were typhoid fever, snake bite, infertility, cancer, stomach ache, convulsion, mental illness, dysentery, pile, hypertension, measles, etc. The highest numbers of species are found in the family Fabaceae with twenty three species, followed by Euphorbiaceae and Rubiaceae each with seven species, while the least representation of one species each were found in twenty eight families (Table 1). This trend is also observed in the work of Ibrahim et al. (2010) in a study carried out in Sabo-Wuse in Niger State and Soladoye et al. (2010) where the highest number species of medicinal plants are found in the family Fabaceae. The species that were mentioned most by the TMPs for treatment of ailments is the parasitic plant of *Tapinanthus globiferus* and *Agelanthus dodoneifolius* followed by *Olax subscoipoides* (Table 1). *A. dodneifolius* have been documented to be used for treatment of several diseases which includes hypertension, diabetes and cancer among others (Burkil, 1995; Traore, 2000; Deeni and Sadiq, 2002; Olapade, 2002).

**Plant conservation awareness**

The survey analysis showed about 40% of the TMPs were aware that continuous collection of plants without replacement could increase extinction risk of the medicinal plants, while 48% did not agree that wild collection of medicinal plants can threaten them (Figure 9). Furthermore, about 42% of the TMPs have either fully developed medicinal plant garden in form of small farms, gardens or plantations or acquired land for medicinal plant cultivation, but are yet to start (Figures 10 and 11), while the high percentage of those who did not respond to the question on effort made in cultivation correspond to TMPs who believed that plants would always be in the wild and therefore did not need to propagate them. The notion by the majority of the TMPs that the plants would always be in the wild showed the level of unawareness of loss of biodiveristy as it regards the rate at which plant biodiversity are being depleted. On the other hand, it might be that the plants used by some of the TMPs were still readily available in their localities. It is also possible that Nasarawa State has not experienced massive deforestation as a result of infrastructure development, thus biodiversity are yet to be adversely affected. This might not be the case in the near future due to the State's proximity to the Federal Capital Territory. It is therefore imperative to create awareness on preserving the plant biodiversity and sustainable collection of medicinal plants. The TMPs should also be trained on the different methods of conservation, especially cultivation of their medicinal plants which would also help them in quality control and assurance.

A total number of 33 plant species were reportedly cultivated by the TMPs, spread across 16 familes with trees of the highest percentage (Table 1 and Figure 12). The trees cultivated by the TMPs were noted to be easily propagated and fast growing trees, such as *Moringa oleifera, Carica papaya* and trees that serve dual purposes as food and medicine as in *Anacardium occidentale* (Cashew), *Citrus* species (orange family), *Magnifera indica* (Mango), *Carica papaya* (Pawpaw) and

**Table 1.** List of medicinal plants used by TMPs of Nasarawa State for treatment of ailments.

| Family | Scientific names | Local names | Plant part used | Ethnomedical uses | No. of times mentioned | Cultivated species by TMPs | Scarce medicinal plants |
|---|---|---|---|---|---|---|---|
| Amaryllidaceae | *Crinum spp.* | Gadeli | - | - | 1 | - | - |
| Anacardiaceae | *Anacardium occidentale* | Yazawa | - | - | 1 | Y | Sc |
| Anacardiaceae | *Heeria insignis* | Kekasheshe | Root/leaves | - | 2 | Y | - |
| Anacardiaceae | *Mangifera indica* | Mangoro (Hausa) | Leaves, S/bark | Constipation | 2 | Y | - |
| Anacardiaceae | *Sclerocarya birrea* | Danya | ,, | Various infections | 1 | - | - |
| Annonaceae | *Annona senegalensis* | Gwandandaji | Leaves, roots, S/bark | Cancer, pile | 3 | Y | Sc |
| Apocynaceae | *Saba florida* | Kuranga | Whole plant | Ring worms | 1 | - | - |
| Araceae | *Pistia stratiotes* | Kaunuwa | Whole plant | Mental illness | 1 | - | - |
| Asclepiadaceae | *Calotropis procera* | Tufafia (Hausa) | Roots | Gonorrhea, spiritual diseases | 2 | - | - |
| Asteraceae/compositae | *Dicoma tomentosa* | Daudamaharba | - | - | 1 | - | - |
| Asteraceae/Compositae | *Vernonia amygdalina* | Bitter leaf | - | - | 1 | - | - |
| Asteraceae/Compositae | *Centaurea perrottetii* | Tsandandaji | - | Cancer | 1 | - | - |
| Bignoniaceae | *Kigelia africana* | Rahaina | - | - | 1 | Y | - |
| Bombacaceae | *Adansonia digitata*<br>*Bombax buonopozense*<br>*Ceiba pentandra* | Kuka (Hausa) | S/bark, leaves | Immune booster, sickle cell anaemia, constipation, ulcer | 2 | - | sc |
| Bombacaceae | *Boswellia dalzielli* | Gurjia; Kurya (Hausa) | Bark | Ulcer | 2 | - | - |
| Bombacaceae | *Commiphora africana* | Silk tree (English) | - | - | 1 | - | - |
| Burseraceae | *Boscia senegalensis* | Arrarabi | S/bark | Fever; internal heat | 4 | - | - |
| Burseraceae | *Carica papaya* | Dashi | Stem bark | - | 2 | - | - |
| Capparaceae | *Maytenus senegalensis* | Amza | Roots | - | 1 | | - |
| Caricaceae | *Parinari spp* | Gwandagida | Leaves | Hypertension | 1 | Y | - |
| Celastraceae | *Cochlospermum sp* | Kurunkushiya (Hausa) | Bark | - | 1 | - | - |
| Chrysobalanaceae | *Anogeissus leiocarpus* | Rura | - | Body weakness | 1 | - | - |
| Cochlospermaceae | *Combretum micranthum* | Zunzuna | - | Convulsion | 1 | - | - |
| Combrateceae | *Combretum glutinosum* | Marke (Hausa) | Stem bark, root | - | 3 | - | Sc |
| Combretaceae | *Guiera senegalensis* | Geza (Hausa) | - | - | 1 | - | Sc |
| Combretaceae | *Terminalia avicennioides.* | Taurania | - | - | 1 | - | Sc |
| Combretaceae | *Bryophyllum pinnatum* | Sabara | Leaves | - | 2 | Y | Sc |
| Combretaceae | *Cucurbita maxima* | Baushe (Hausa) | Bark/Root/Leaves | - | 2 | Y | Sc |
| Crassulaceae | *Cyperus tonkinensis* | - | - | - | 1 | Y | - |
| Cucurbitaceae | *Diospyros mespiliformis* | Kabewa | Leaves | - | 1 | - | - |
| Cyperaceae | *Crinum spp.* | Kajiji | - | - | 1 | - | - |
| Ebenaceae | *Anacardium occidentale* | Kaiwa / Kanya | Roots | Mental illness | 1 | - | - |

**Table 1.** Contd.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Euphorbiaceae | *Acalypha spp.* | - | - | - | 1 | Y | - |
| Euphorbiaceae | *Chrozophora senegalensis* | Damagi (Hausa) | Bark, whole plant | For babies | 3 | - | - |
| Euphorbiaceae | *Hymenocardia acida*<br>*Jatropha curcas* | Janyaro | Leaves, root | Infectious diseases (leaves); induce labour (root) | 2 | Y | Sc |
| Euphorbiaceae | *Securinega virosa*<br>*Uapaca guineensis* | Bini da zugu; Chindezugu; Cin da zuga | Leaves, stem, roots | Labour, induces breast milk | 3 | - | - |
| Euphorbiaceae | *Chrozophora senegalensis*<br>*Bauhinia rufescens* | Tso (Hausa) | Leaves | - | 1 | - | Sc |
| Euphorbiaceae | *Cassia singuena* | Kababbago | Leaves | - | 1 | - | - |
| Euphorbiaceae | *Cassia tora* | Damagi | Whole plant | - | 1 | - | - |
| Fabaceae:Caesalpinioideae | *Daniellia oliveri* | Tsatsagi | - | - | 1 | - | - |
| Fabaceae:Caesalpinioideae | *Detarium senegalense* | Ruhu (Hausa) Runhu | - | - | 2 | - | Sc |
| Fabaceae:Caesalpinioideae | *Isoberlinia doka* | Tafasa | Whole plant | - | 1 | - | - |
| Fabaceae:Caesalpinioideae | *Piliogstima thonningii* | Kadaura, Maje | Bark/Leaves | Immune booster, stomach ache, breast cancer, sickle cell anemia. | 3 | Y | Sc |
| Fabaceae:Caesalpinioideae | *Senna sp* | Taura | Stem, leaves | Polio;diarrhoea | 3 | Y | sc |
| Fabaceae:Caesalpinioideae | *Tamarindus indica*<br>*Afzelia africana* | Doka | Stem, leaves | - | 1 | - | - |
| Fabaceae:Caesalpinioideae | *Acacia albida*<br>*Amblygonocarpus andogensis* | Kalgo (Hausa) | Leaves, root, seeds | Children convulsion, dysentery (leaves), stomach ache (root), spiritual diseases, pains in the body (seeds) | 4 | Y | Sc |
| Fabaceae:Caesalpinioideae | *Entada africana* | Raidore | Roots | - | 1 | - | - |
| Fabaceae:Caesalpinioideae | *Mimosa pigra* | Tsarmiya (Hausa) | Bark/Leaves | - | 1 | Y | Sc |
| Fabaeae:Caesalpinioideae | *Parkia biglobosa* | Kawo (Hausa) | Leaves/S/bark | Ulcer, body pains | 1 | - | Sc |
| Fabaceae:Mimosoideae | *Prosopis africana* | Gawu (Hausa) | - | - | 2 | Y | Sc |
| Fabaceae:Mimosoideae | *Abrus precatorius* | Sandanmayu | - | - | 1 | - | - |
| Fabaceae:Mimosoideae | *Erythrina senegalensis* | Tatwasa | - | Child birth/Labour | 2 | Y | Sc |
| Fabaceae:Mimosoideae | *Indigofera spp* | Kadeji | - | - | 1 | Y | - |
| Fabaceae:Mimosoideae | *Pterocarpus erinaceus* | Daurowa , dorowa | Leaves/Bark | Pile in children, appetizer | 2 | | Sc |
| Fabaceae:Mimosoideae | *Swartzia madagascariensis* | Kirya | Bark/Root/Leaves | - | 2 | | Sc |
| Fabaceae:Papilionoideae | *Acalypha spp.* | Idonzakara | - | - | 1 | Y | - |
| Fabaceaee:Papilionoideae | *Chrozophora senegalensis* | Mingirya | - | - | 1 | - | - |
| Fabaceaee:Papilionoideae | *Hymenocardia acida* | Kaikayi ; Baba (Eggon) | Leaves | Fever | 2 | - | - |
| Fabaceae:Papilionoideae | *Jatropha curcas* | Madobia, Shagini | Leaves | Constipation | 2 | - | Sc |
| Fabaceae:Papilionoideae | *Securinega virosa* | Bayama | - | - | 1 | - | - |

**Table 1.** Contd.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fabaceae:Papilionoideae | *Ostryoderris stuhlmanii* | Majinachiya | - | - | 1 | - | - |
| Fabaceae:Papilionoideae | *Phaseolus vulgaris* | Beans | Seed powder | - | 1 | - | - |
| Graminae/Poaceae | *Oryza sativa* | Jatau | | - | 1 | - | - |
| Graminae/Poaceae | *Pennisetum glaucum* | Wuyanbigimin | - | Impotence | 1 | - | - |
| Labiatae | *Hyptis suaveolens* | Maganizono | - | Mental illness | 1 | - | - |
| Labiatae | *Ocimum gratissimum* | Basil | - | - | 1 | - | - |
| Labiatae | *Ocimum basilicum* | Doddaya /Tagida | - | Cough | 1 | - | - |
| Lauraceae | *Cassytha filiformis* | Rumfangada | - | Chest problem | 1 | - | - |
| Liliaceae (Allicaceae) | *Allium cepa* | Onion | bulb | - | 1 | Y | - |
| Liliaceae (Allicaceae) | *Allium sativa* | Garlic | ,, | - | 1 | Y | - |
| Liliaceae (Aloaceae) | *Aloe vera* | Moda | Leaves | - | 1 | Y | - |
| Liliaceae (Asparagaceae) | *Asparagus africanus* | Kayanbera | - | - | 1 | Y | - |
| Loganiaceae | *Anthocleista vogelii* | Kwari | - | Infertility | 1 | - | - |
| Loranthaceae | *Agelanthus dodonefolius*<br>*Tapinanthus globiferus* | Kauche on (kargo, dorowa, maji, madachi, itatuwa, sabara) | Whole plant | - | 8 | - | - |
| Loranthaceae | *sida acuta*<br>*Urena lobata* | Kauche on (kargo, dorowa, maji, madachi, itatuwa, sabara) | Whole plant | - | 8 | - | - |
| Malvaceae | *Azadirachta indica*<br>*Khaya senegalensis* | Kalkashinkwado | Whole plant | Veneral diseases | 1 | - | - |
| Malvaceae | *Pseudocedrela kotschyi* | Kafimallam | - | - | 1 | - | - |
| Meliaceae | *Ficus platyphylla* | Dogonyaro, neem | - | - | 2 | Y | - |
| Meliaceae | *Ficus spp* | Madachi (Hausa), mahogany | Bark | Stomach disturbance | 2 | Y | Sc |
| Meliaceae | *Ficus sur* | Tuna | Stem | - | 1 | - | - |
| Moraceae | *Ficus sycomorus*<br>*Moringa oleifera* | Gamji (Hausa) | Leaves/S/bark | Body pains, fertility, spiritual disease, cell anaemia; pile, spiritual disease. | 3 | - | - |
| Moraceae | *Musa paradisiaca*<br>*Musa sapientum.* | Baure | Leaves | Infertility, stomach ache | 1 | - | - |
| Moraceae | *Eucalyptus spp.* | Baurekiyashi | S/bark | Rheumatism | 1 | - | |
| Moraceae | *Psidium guajava* | Baure (Hausa) | Whole plant | Swollen body | 1 | - | |
| Moringaceae | *Lophira alata* | Zogale | Leaves, roots | Fever, typhoid | 1 | Y | Sc |
| Musaceae | *Ostryoderris stuhlmanii* | Plantain | - | - | 1 | - | - |
| Musaceae | *Phaseolus vulgaris* | Banana | Trunk | Measles | 1 | Y | - |
| Myrtaceae | *Oryza sativa* | Sanda l | - | - | 1 | Y | - |
| Myrtaceae | *Pennisetum glaucum* | Gwaiba | Leaves | Pile | 1 | - | - |
| Ochnaceae | *Hyptis suaveolens* | Kujeme | Leaves | - | 1 | - | - |

**Table 1.** Contd.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Olacaceae | *Olax subscorpioidea* | Gwano (Hausa) | Leaves, stem bark, roots | - | 5 | Y | Sc |
| Olacaceae | *Ximenia americana* | Tsada (Hausa) | Bark/Root | - | 1 | - | - |
| Palmaceae | *Elaeis guneense* | Palm tree | Roots | - | 1 | - | - |
| Pedaliaceae | *Sesamum indicum* | Ridi | Seeds | For healthy babies | 1 | - | - |
| Pedaliaceae | *Sesamum spp.* | Kalkashi | Leaves | - | 1 | - | - |
| Polygalaceae | *Securidaca longepedunculata* | Sanya; Uwarmagunguna | Stem, leaves and roots | Mental illness | 4 | Y | Sc |
| Rhamnaceae | *Ziziphus murtaniaca* | Magarya | | | 1 | - | Sc |
| Rhamnaceae | *Ziziphus spina cristi* | Kurna | | | 1 | - | Sc |
| Rosaceae | *Malus domestica* | Apple tree | - | - | 1 | - | - |
| Rubiaceae | *Crossopteryx febrifuga* | Kashinawaki (Hausa) | Bark/Root | - | 1 | - | Sc |
| Rubiaceae | *Fadogia ancylantha* | Bakingagau | Roots | - | 1 | - | - |
| Rubiaceae | *Fadogia agrestis* | Bakinganye | - | - | 1 | - | - |
| Rubiaceae | *Feretia apodanthera* | Kurukuru (Hausa) | Bark/Root | - | 1 | - | - |
| Rubiaceae | *Gardenia erubescens* | Gaude | Tender leaves and roots | - | 1 | - | - |
| Rubiaceae | *Mitracarpus scaber* | Gogamasu (Hausa) | Whole plant | - | 1 | - | Sc |
| Rubiaceae | *Nauclea Latifolia* | Tufashiya | Stem and leaves | Ring worms and fever | 2 | - | Sc |
| Rutaceae | *Citrus limon* | Lemon | - | - | 1 | Y | - |
| Rutaceae | *Citrus sinensis* | Orange | - | - | 2 | Y | - |
| Sapindaceae | *Paullinia pinnata* | Hanubijary | Leaves | Menstruation problem, pains | 3 | - | |
| Sapotaceae | *Vitellaria paradoxa* | Kadeyan, kadai | - | - | 2 | - | Sc |
| Solanaceae | *Solanum esculentum* | Tomatoes | Fruits | Night blindness | 1 | - | - |
| Solanaceae | *Physalis angustifolia* | Matsarmama | Whole plant | - | 1 | - | - |
| Solanaceae | *Solanum spp.* | Kautankura | - | - | 1 | - | - |
| Solanaceae | *Solanum sp* | Gardili (Eggon) | - | Snake bites, weakness of body | 1 | - | - |
| Sterculiaceae | *Sterculia setigera* | Kukuki | Leaves | Stomach ache, body pains. | 2 | Y | Sc |
| Tiliaceae | *Grewia mollis* | Danrgaza | - | Teething | 1 | - | - |
| Verbenaceae | *Lippia multiflora* | Angontaki | Leaves | Chest pains | 1 | - | - |
| Verbenaceae | *Starchytapheta spp.* | - | - | Impotence | 1 | - | - |
| Verbenaceae | *Vitex doniana* | Dunya | S/bark | Leprosy | 2 | - | - |
| Vitaceae | *Cissus spp* | Yakuwanfatake | - | - | 1 | - | - |
| | Unidentified | Gbandibo (Eggon) | - | - | 1 | - | - |
| | Unidentified | Iri (Eggon) | - | Typhoid fever | 1 | - | - |
| | Unidentified | Sandanayu (Hausa) | - | Filaria fever | 1 | - | - |
| | Unidentified | Ruche (Hausa) | - | - | 1 | - | - |
| | Unidentified | Fada (hausa) | Seeds | - | 1 | - | - |
| | Unidentified | Muburiki (hausa) | Leaves | Infertility | 1 | - | - |
| | Unidentified | Gabonkare (hausa) | - | Cancer | 1 | - | - |

**Table 1.** Contd.

| | | | | |
|---|---|---|---|---|
| Unidentified | Yahutu (hausa) | - | Dysentery | 1 |
| Unidentified | Mafida (hausa) | - | Child birth/labour | 1 |
| Unidentified | Pageli (Fulani) | - | Malaria, stomach ache, ulcer | 1 |
| Unidentified | Idakudulhi (Fulani) | - | Cancer | 1 |
| Unidentified | Dirbidi (Fulani) | - | Skin diseases | 1 |
| Unidentified | Gerorihi (Fulani) | - | Birth control | 1 |
| Unidentified | Adekehi (Fulani) | - | - | 1 |
| Unidentified | Chapbuli (Fulani) | - | - | 1 |
| Unidentified | Kojodi (Fulani) | - | - | 1 |
| Unidentified | Jasmi (Fulani) | - | - | 1 |
| Unidentified | Nelbi (Fulani) | - | - | 1 |
| Unidentified | Alali (Fulani) | - | - | 1 |
| Unidentified | Gora (hausa) | Leaves | - | 1 |
| Unidentified | Palwaya | Leaves | - | 1 |
| Unidentified | Sandanmallamai (hausa) | Bark/Leaves | - | 1 |
| Unidentified | Tshukutshuku (hausa) | Root/Leaves | - | 1 |
| Unidentified | Tsintsiya (hausa) | Bark | - | 1 |
| Unidentified | Sinferu | - | - | 1 |
| Unidentified | Sasagi (Hausa) | - | - | 1 |
| Unidentified | Rumba (Hausa) | - | - | 1 |
| Unidentified | Wurishi (Hausa) | - | - | 1 |
| Unidentified | Bakingayin (Hausa) | Leaves | Miscarriage, infertility | 1 |
| Unidentified | Lokodaban | - | - | 1 |
| Unidentified | Susajaki (hausa) | Leaves | Cancer | 1 |
| Unidentified | Hurushi (hausa) | - | - | 1 |
| Unidentified | Ogunacher (Igala) | - | - | 1 |
| Unidentified | Korikoshia (hausa) | - | Pile | 1 |
| Unidentified | Ayangwankaya (hausa) | - | Children problem, teething, etc. | 1 |
| Unidentified | Warshi (hausa) | Roots | - | 1 |
| Unidentified | Dokarafi (hausa) | Roots | - | 1 |
| Unidentified | Giri (hausa) | Whole plant | - | 1 |

- : Not disclosed; Y: Yes cultivated; Sc: Scarce.

many others (Table 1). Thirty-two species in 16 families were plants that used to be locally abundant but are gradually becoming scarce of which 75% are trees (Table 1 and Figure 13). The TMPs noted that they have to go distances or buy these scarce plants from medicinal plant sellers. Ibrahim et al. (2010) reported that medicinal plants sold by herb sellers are mainly forest species and other species not easily accessible

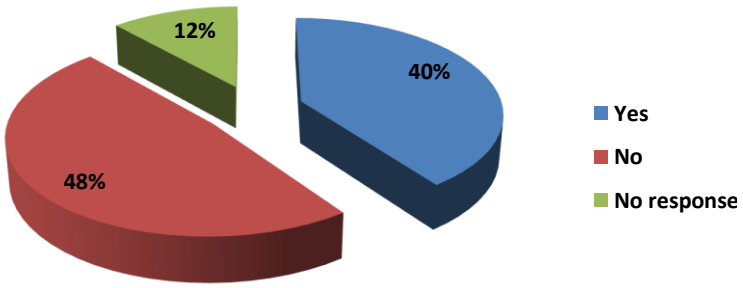


**Figure 9.** Level of awareness of depletion of plant biodiveristy by the TMPs of Nasarawa State.

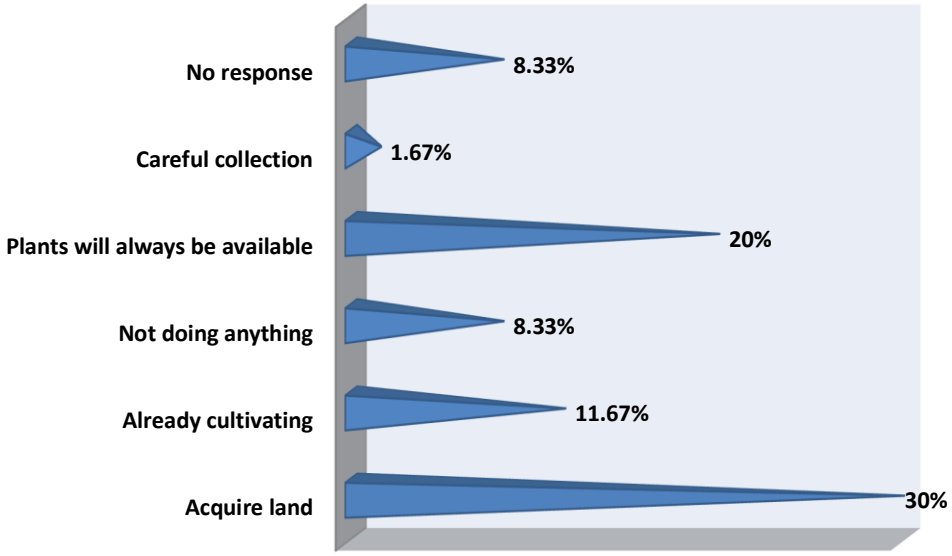


**Figure 10.** Percentage of Respondents TMPs involved in plant conservation in Nasarawa State.

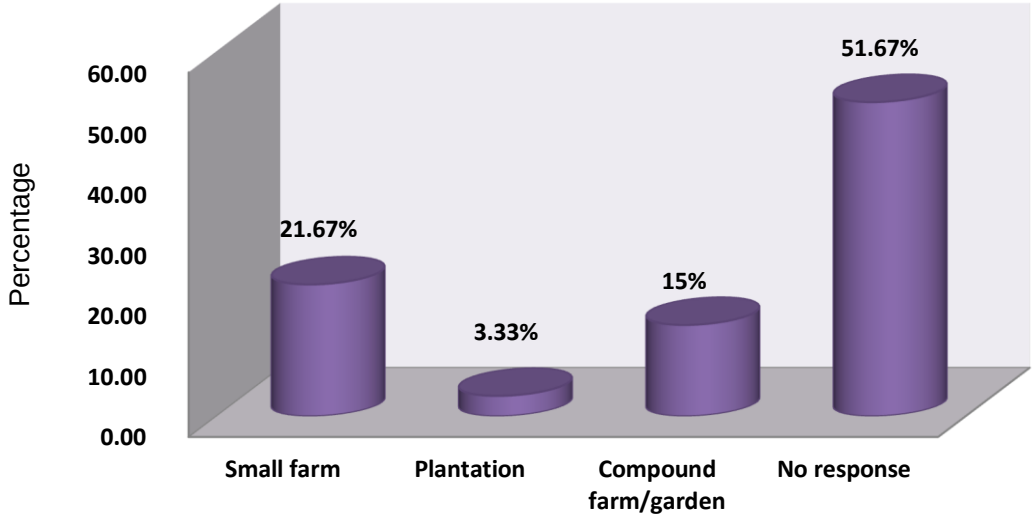


**Figure 11.** Scale of cultivation of medicinal plantsby the TMPs of Nasarawa State.

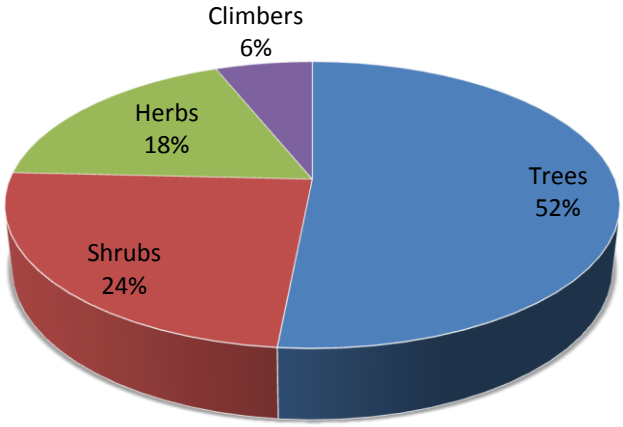


**Figure 12.** Percentage plant Habit of cultivated medicinal plants by the TMPs of Nasarawa State.

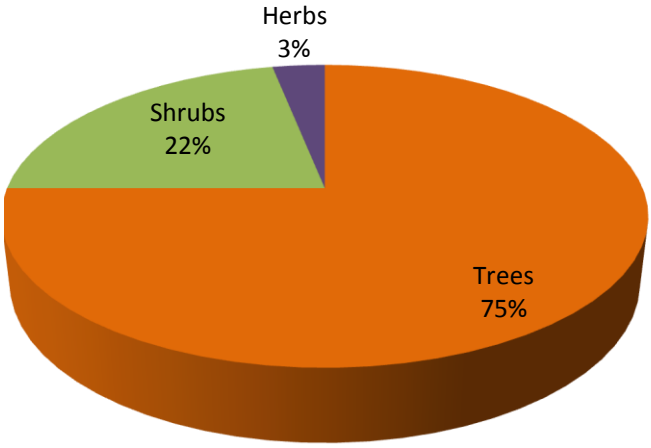


**Figure 13.** Percentage plant Habit of medicinal plants not easily accessible scarce to the TMPs of Nasarawa State.

to the TMPs in their locality. Therefore, it is quite expected that a large amount of medicinal plants not easily accessible by TMPs of Nasarawa state are trees. The depletion of this species may mostly likely be as a result of infrastructural development. More so, most trees are perennial and cannot be easily regenerated like herbs. Herbs which are mostly annual will most likely regenerate annually during rainy season, and trees that are cut down without any replacement are lost forever making it difficult for the TMPs to access them. This necessitated going far into the forest for species that were previously at close proximity to them. The only herb documented to be scarce in this study is *Mitracarpus scaber*. *M. scaber* is a weed of abandoned farmland or uncultivated piece of land (Hutchinson and Dalziel, 1954; Burkill, 1995) and as more land area are being converted for urbanization and agricultural purposes, the populations of this species may be decimated.

## Conclusion

Large numbers of plant species were documented for the treatment of various ailments which might be a lead for drug discovery for treatment of those ailments. Very few educated persons are beginning to take interest in the profession due to the growing awareness and this trend should be encouraged as the country works towards achieving MDG goal with regards to healthcare and poverty alleviation. The study also revealed that majority of the TMPs in Nasarawa State was not aware of sustainable use and biodiversity conservation of medicinal plants. Very few of the TMPs who were aware of endangerment were involved in one form of plant conservation or the other; hence, there is need to raise awareness through grass roots sensitization on biodiversity conservation and sustainable use of medicinal plants and also training in simple form of plant conservation to ensure sustainability and quality control of their medicinal plant products. Further study will be undertaken to identify the very large number of unidentified plants specimen from this study which will eventually add to the compendium of local names and scientific names of plants in Nigeria. It is recommended that similar studies be conducted in other states and ecological zones of the country to enable a country-wide solution approach.

## Conflict of Interests

The authors have not declared any conflict on interests.

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