Pak. J. Bot., 44(4): 1177-1184, 2012.

USES AND MANAGEMENT OF *XIMENIA AMERICANA, OLACACEAE* IN SEMI-ARID EAST SHEWA, ETHIOPIA

DEBELA HUNDE FEYSSA[1*], JESSE T. NJOKA[2a], ZEMEDE ASFAW[3] AND M.M.NYANGITO[2b]

[1]*Department of Natural Resource Management, College of Agriculture & Veterinary Medicine, Jimma University, Ethiopia*
[2a],[2b] *Department of Land Resources & Agricultural Technology, College of Agriculture & Veterinary Sciences, University of Nairobi, Kenya*
[3]*Department of Biology, College of Natural Sciences, Addis Ababa University, Ethiopia*
[*]*Corresponding author e-mail: feyssahunde@yahoo.com,*

Abstract

Wild edible plants are crucial resources with multipurpose uses and indigenous people have ethnobotanical knowledge of their use and management. *Ximenia americana* L., is among the preferred multipurpose use wild edible plants (WEPs). These uses and managements were inadequately documented. Ethnobotanical studies can explore the uses and management of this species and associated indigenous knowledge (IK). Ethnobotanical and socioeconomic studies were carried out in Fantalle (Galcha, Qobbo, Dheebiti) and Boosat (Xadacha, Trii Bireti and Diglau Tiyo) districts in Ethiopia. The main data collection methods used were, field inspection by guided walks, focus group discussions with 14 key informants taken from transhumance pastoralists and settled framers of the two districts, and systematic field observations along six transects. Indigenous people have explained 7 major uses of *X.americana* (Food, medicine, fuel wood and others). Food value was the highest. Ten major threat factors have affected the species, of which agricultural expansion ranked highest. All (100%) indicated that there was no domestication of the species indicating that people collect the fruits from the wild. The indigenous people have knowledge of the use and management of *X.americana*. The fruits were used for food while roots and other pats of the species were used for medicine and source of income. However, because of overexploitation, the species became rare in the study area. This can lead to erosion of associated indigenous knowledge on the use and management of *X.americana.* Its multipurpose uses can contribute to livelihood of semiarid people and calls for urgent rehabilitation by closure of the natural habitat by complementing with domestication of the species.

Introduction

Many wild plants have economic, medicinal and forage values in addition to preserving cultural heritages and maintaining ecological balance by providing various ecosystem services. Indigenous people have knowledge of the use and management of *X. americana* named HUDHA in Oromo language (the language of people of the study area). Overharvesting can threat the species. Without management intervention it may lead to the extinction of a species and loss of associated indigenous knowledge on use and management. Ethnobotanical works by (Bahiru, 2010) and (Yohanis, 2009) have given inadequate account of the use and management of *X. americana* . They included in the list of plants dealt without giving the specific uses and management of *X.amricana*. (Balaemie & Kebebew, 2006) have given general ethnobotany of wild edible plants of southern Ethiopia in (1250–1500m) range and Guinand and Lemessa (2000) have given guiding recommendation to focus on wild edible plants use for food security. Hence, most of the studies were not focused on specific uses and management of the species. Thus, saving the species, documenting and preserving indigenous knowledge is essential and timely (Alam & Ali, 2010). Ethnobotanical studies become essential components of botany; this is evident from recent studies (Ajaib *et al*., 2010). The importance of ethnobotanical studies of local uses of medicinal plants were also given due emphasis by Ali (2011).

The natural vegetation of the study area is largely woodlands and scrub vegetation rocky outcrops (dominated by rocks). It is declining due to the ever increasing threat on the plant resources and their ecosystems and overexploitation (Anon., 2009). Understanding the dynamics and taking conservation actions needs to be based on ethnobotanical studies among others. Ethnobotanical studies are essential for rehabilitation and managing the species that require urgent action, in this case *X. americana*.

Description of the study species: The study species *Ximenia americana* L., belongs to family *Olacaceae*, commonly known as wild plum, blue sour plum and tallow nut. It is spreading or, less often, scrambling spiny shrub or small tree up to 6 m, commonly less than 4 m. Branches normally arching down often armed with straight spines. Leaves are simple, alternate or clustered on spur shoots with rounded and slightly notched; broadly tapering base or rounded and occasionally softly haired. Small greenish white, fragrant flowers, born on short shoots (Maundu *et al*., 1999) and greenish-cream, scented and 5-10 mm long; in small, branched inflorescences (Sacande & Vautier, 2006). Fruits, up to 3 cm long, oval, shiny. Light green, turning yellow, orange or red on ripening. The fruit is yellow-red edible drupe which is oval, approximately 2.5cm in diameter and contains one large endospermic seed within its green pulp containing a small embryo near a thin testa. They have up to 60% oil content. Seedling morphology is variable, when young the leaves are densely hairy, but become smooth and shiny with growth (Maundu *et al*., 1999; Sacande & Vautier, 2006).

Global distribution of *Ximenia americana*: Globally, *X. americana* is widespread throughout the tropics in Africa, India and South East Asia to Australia, New Zealand, Pacific Islands, West Indies, Central and South America. It is a plant of diverse habitats in semi-arid bushland, in many types of dry woodland, sandy open woodland and dry hilly areas and coastal bushlands (0-2000 m) (Maundu *et al*., 1999). It is frequently found on coastal dunes, along water courses and on stony slopes. It occurs at altitudes up to 2000m.a.s.l. and where rainfall exceeds 500mm per year. It grows on many soil types; however, often on poor

and dry (Sacande & Vautier, 20067; Anon., 2010).Grow in Ethiopia's Flora 500-2100(2450) m (Vollesen, 1989) which is relatively narrow altitudinal range. It may have contributed to the vulnerability of the species.

In east Shewa *X. americana* were assumed to have multipurpose uses for humans, livestock, wild life and for environmental services. Therefore, ethnobotanical study of the *X.americana* is basic for documenting the uses and management. As in other parts of Ethiopia, wild edible plants such as *X. americana* and the associated indigenous knowledge of the use and management are vital for improving the livelihoods of transhumance and settled farmers of east Shewa. Hence, the main objectives of this study were, to identify and document multipurpose uses and management practices of *X. americana* by local people of semi arid east Shewa of Ethiopia and identify the threats to the species in the study area.

Materials and Methods

Study area: The study was conducted in the semi- arid part of east Shewa Zone in Fantalle and Boosat districts located between 7°12'-9°14'N latitudes and 38°57'-39°32'E longitudes in the northern part of Great East African Rifty Valley in Ethiopia (Fig. 1). The altitude ranges from 900 1450 m for 90% of the districts with peaks of 2247 m and 2007 m for mountains of Boosat Guddo and Fantalle Guddo (Anon., 2009).The vegetation of the area lies in the broad vegetation category of the Somalia-Maasi center of endemism described by (White, 1983) and described as acacia woodland vegetation by (Demessew & Friis, 2009). The climate of the area is hot with erratic, variable rainfall. The highest mean annual rain fall of semi arid east Shewa was 171.05 mm and lowest is 23.04 mm. The highest mean monthly rainfall 243.11(July and August) and the lowest mean monthly rainfall is, 5.78 mm November. The main rainy season was from June to September known as 'Kiremt' and low rainfall from February to May known as 'Belg". The highest mean maximum temperature is 36.73° C in June and the lowest (31.24°C) in December. Mean annual rainfall was 952.799 and 511.6 for Welenchiti (Boosat) and Metahara (Fantalle) respectively. Economic activities of the area are mostly livestock production but people in Boosat generally practice mixed agriculture; consisting of livestock and crop production. Vegetation of the area is a habitat of diversity of plants including many wild edible plants species. However, it is declining due to anthropogenic factors. This has affected both natural resources and the food security of people living in semi arid east Shewa.

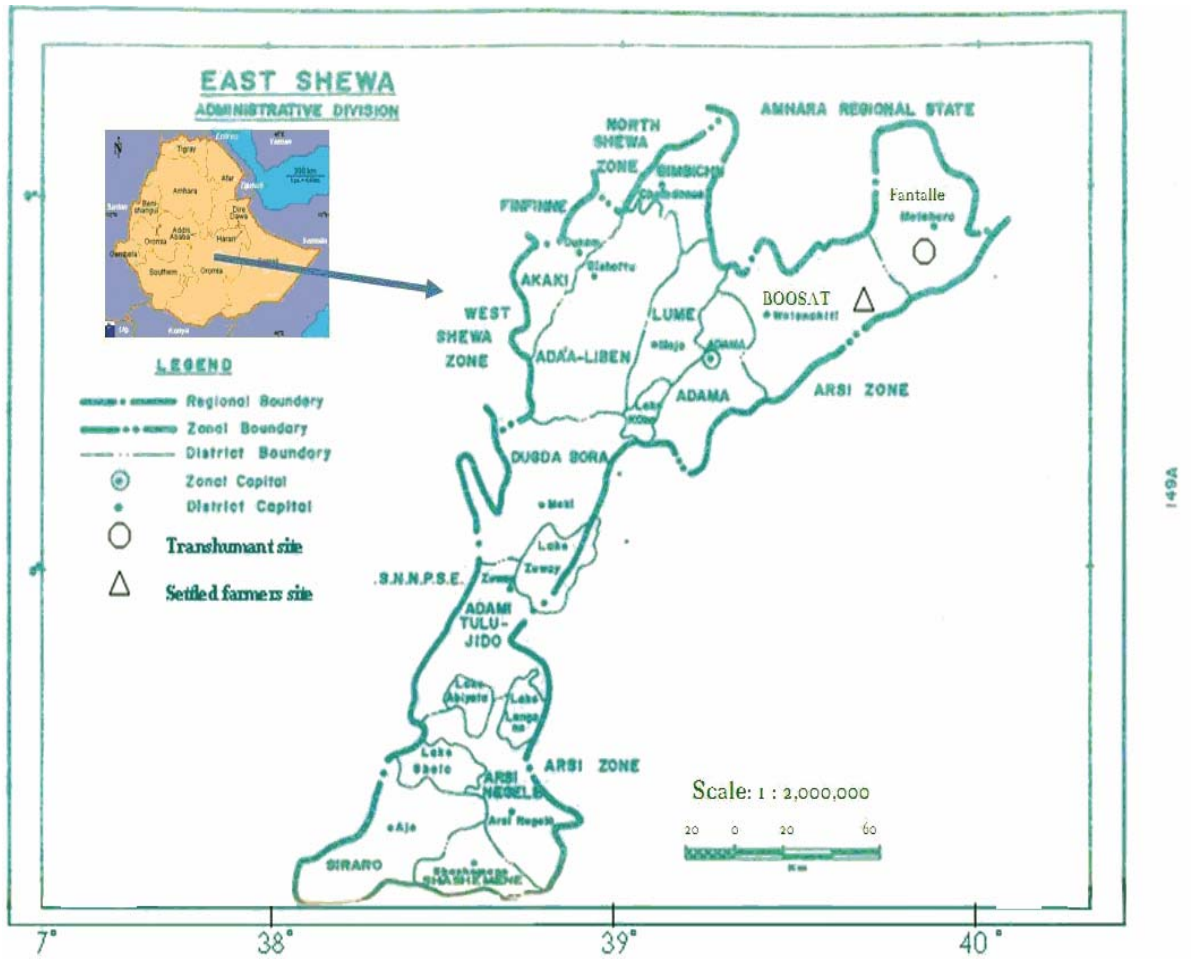

Fig. 1. Map of the study area showing Fantalle and Boosat Districts of East Shewa. Ethiopia.

Methods: Ethnobotanical study was conducted between October, 2009 and April 2010 in Fantalle (Galcha, Qobbo, Dheebiti) and Boosat (Xadacha, Trii Bireeti and Diglau Tiyo) districts (Weredas) were selected to study multipurpose uses, management practices and threats to *X. americana*. Galcha and Xadacha are administrative units next to districts (weredas) in this case study sites.

Ethnobotanical data collection: Following reconnaissance study of the study sites, ethnobotanical data on multipurpose uses, management and threat to the species were collected using methods which included: semi structured interview of 120 (30 household heads from each study site) randomly selected, guided field inspection and key informants discussions (Martin, 1995).To identify the species, field observations along six transects laid in two districts and 6 study sites of Fantalle and Boosat were conducted (Martin, 1995; Cotton, 1996; Balaemie & Kebebew, 2006). To identify and rank the threats to the species, focus group discussions (FGD) were made with 14 transhumance pastoralists and settled farmers selected from each study sites with the help of development workers and community leaders (Cotton, 1996).The information on multipurpose uses, management and threats factors identified by FGD were presented to local residents of transhumance and settled framers from the study sites to verify community consensus. Population data was obtained from 1994 census data and constructed (Anon., 1999).

Voucher specimen collection and identification: Six transects of 5 km length were laid based on altitudes and variation in vegetation in two districts, 3 in each districts at 500 m interval and 30 km interval between two districts (Cook & Stunbbendieck, 1986) to explore the availability/abundance of *X. americana*. Identification of the species, field data and voucher specimen collection were employed through observations and discussions with key informants. Information on plant use and management were collected by semi-structured interview of randomly selected household heads focused to identify use history of abundance of species. Fruit yield was estimated by focus group discussion with key informants. In this case average quantity was used to estimate yield at wild condition. Four markets in the two districts were surveyed and the prices per 10 g of *X. americana* fruits were recorded and average price was used for reporting.

Data analysis: Data analysis was done following standard ethnobotanical methods (Martin, 1995; Cotton, 1996). The data obtained through field observations, focus group discussions and semi-structured interviews were summarized in frequencies, percentiles. Data from FGD were narrated. Fruit yield were averaged in kg per tree per year. Preferences of people were ranked for 10 major uses based on values given by key informants. Values of threat factors given in matrix by key informants were summed and ranked. Perceptions of people on species abundance were coded and entered in Excel spread sheet facility; percentages and Chai-square were calculated using SPSS software version 16. Linear regression analysis was carried out to show the trend in population density of the study area. Included in were projections for 2010 -2013 years to show short term future trends.

Results

Plant identification and voucher specimen collection: Plant specimen was collected in duplicates, dried and processed. Proper identification has been done using Floras, a taxonomist and deposited in National Herbarium, Addis Ababa, University, and College of Natural Science, Ethiopia.

Distribution and habitat in the study area: Field inventory by guided transect walks in the study districts of east Shewa, Ethiopia revealed that *X. americana* was mainly found in *Acacia* woodland, sandy and rocky hilly slopes. *X. americana* is very rarely found along flooded plains and along water courses because of human and livestock pressure. Elderly key informants explained that about two decades back *X. americana* was widely distributed along road sides and in the nearby *Acacia-Balanities* woodlands. Few years back, the species was rarely found only in rocky slopes, secluded and protected areas. This was verified by laying 6 transects of 5 km length, 3 in each district. No living specimen of *X. americana* was found in the transects except in Xadacha study site where a plant was encountered (Fig. 2). But elderly key informants explained that the species was used to exist in these areas before the expansion of commercial charcoal production and encroachment of forests by agriculture and settlements.

Uses of *X. americana*

Medicinal uses in the study area: Focus group discussion with local people had shown that, *X.americana* has diverse food and medicinal uses for both human beings and livestock. Crushed bark is used for treatment of hepatitis and malaria. Boiled and filtered pieces of bark in a tea glass were served for treatment of malaria. For infected wound, dried bark was crushed, powdered and applied on wound both for livestock and humans. If livestock was sick showing bloody urine symptoms, pounded green leaves mixed with one liter cold water was used to treat the disease in animals.

It is also used for treatment of cobra's attack (type of snake poisoning in humans) and a fresh or dried stem, boiled in water was served as a drink to treat cobra's bite and the residue is applied to the wound to hasten poison healing in the study area. Bark was chewed to treat swelling of the pancreas (Table 1).

Food and other economic values of *X. Americana*: About 95.83% of informants attested that *Ximenia americana* was a communal property. People collect and use from the wild. At average age of 15 and above local people start collecting the fruits for use with no gender difference. Average total use values given by key informants' for top seven uses is 31.47 out of 35 points (Table 2). The total average yield per tree per year obtained through key informants' interview is 50.33 kg wet fruits. This was used give an estimated monetary value equivalent to 2516.50 ETB (Ethiopian Birr) (50.33x50 ETB) or 186.41 USD (US Dollars) per year. This money can be used to cover various households' needs; it can buy food, utensils, medicine and improve livelihoods if there is no pre and post harvest loss.

Fig. 2. *Ximenia americana* L., identified at Xadacha study site in acacia vegetation; picture corresponding author November 23, 2009.

Table 1. Multiple uses and services of *X. americana* in the study area (0=no use, 1= least valued, 5= highest value), 14 key informants involved per study sites and average values were taken for each.

WEP spp.	Food			H. medicine			L. medicine			Fodder			E. services			Fuel wood			Construction		
Boosat sites	TB	XA	DT	TB	XA	DT	TB	XA	DT	TB	XA	DT	TB	XA	DT	TB	XA	DT	TB	XA	DT
Value	5	5	5	5	5	3	2	2	3	2	4	5	5	4	3	2	2	3	2	2	3
Fentalle sites	Ga	Qo	De	Ga	Qo	De	Ga	Qo	De	Ga	Qo	De	Ga	Qo	De	Ga	Qo	De	Ga	Qo	De
Values	5	5	5	5	5	4	5	5	4	5	5	5	5	5	5	5	1	5	5	5	5
Pooled average		5			4.5			3.5			4.33			4.5			3			3.67	

Table legend = H. medicine & L medicine = human & livestock medicine respectively, E. services = environmental services: TB = Trii biretti; XA= xadacha; DT= Digalu tiyo; Ga= galcha; Qo= Qobo; De= Dheebiti

Table 2. Rank across the study sites for food value of *X. Americana*.

Districts	Study site	Total score
Boosat	Tri Bireti	66
	Xadacha	66
	Digalu Tiyo	65
Fantalle	Galcha	63
	Qobo	63
	Dheebiti	62
Average food values of two districts		64.17

Settled farmers gave higher food values for the species than transhumance informants (Table 2). This might be related to the food habits of settled farmers which include great mix of plant materials than transhumant that relatively depends more on livestock products.

Key informants explained that, the mature wood was strong and durable and used for making cooking sticks of local stew, porridge and for other household items. It is also used for making local spoons, handles of knives, sickles, sticks and hafts of the spears in study area, east Shewa. The oil in the seeds was used traditionally to soften leather.

Major factors threatening *X. americana* in the study area: Key informants ranking matrix values out of 70 for the threatening factors to *X. amricana* revealed that agricultural expansion stood first 64 (10.05%), adverse climate change second 63.50 (9.97%) and poverty third 57.33 (9%) (Table 3). The pressures being led by agricultural expansion to marginal lands have resulted in rarity of the species due to habitat destruction. Key informants explained that in early years it was commonly used for medicine and the fruit as food. It was also collected and sold in plenty in the markets and households generated income from its sell to buy other food items and utensils. Hence, the rarity of *X. americana* is attributed largely to anthropogenic factors and exacerbated by climatic change. Five of them are direct and six are indirect causes of degradation and their impact relatively varied across (Table 3). Linear regression analysis has shown the high rate of increase in population density from 74.99 to133.14 ($Y=3.0281x-5964.8$, $R^2=0.9943$) and51.33 to 90.36 ($Y=2.0479x-4033$; $R^2=0.9962$) persons per km^2 within 2 decades for Boosat and Fantalle respectively since 1994 (Fig. 3).

Table 3. Factors Contributing to degradation of *X. americana* in the study districts (value for informant(R) is an average response of 6 persons (values are scale 0-5,0=no impact, 5=highest impact).

Causes	Informants														Total score	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14		
Human population pressure **	4.17	3.67	3.83	4.17	4.00	3.67	3.33	4.00	4.00	4.17	3.50	4.17	4.17	3.67	54.50	6th
Land use changes*	3.83	3.83	3.17	3.00	3.33	3.83	3.67	3.00	3.33	3.50	4.00	2.67	2.33	3.67	47.17	7 th
Poverty/hunger **	4.83	4.83	4.00	4.33	3.83	3.17	4.17	3.83	4.33	3.67	4.17	3.50	4.50	4.17	57.33	3rd
Tribal conflicts *	3.33	2.83	2.50	2.33	3.17	2.50	2.83	3.00	3.00	2.67	2.17	2.50	3.33	3.00	39.17	10 th
Adverse climate change **	4.17	4.50	4.83	4.50	4.33	4.67	4.50	4.83	4.33	4.50	4.17	4.67	4.50	5.00	63.50	2nd
Overexploitation of resources*	4.17	4.00	4.17	4.17	3.67	4.17	4.33	4.17	4.33	4.17	3.83	4.33	3.50	4.00	57.00	4 th
Restriction of mobility**	4.00	3.67	2.83	3.17	2.67	3.00	3.00	3.17	2.67	2.67	3.00	2.50	3.33	2.83	42.50	9 th
Lack of alternative**	4.00	4.17	3.83	3.83	4.67	4.50	3.83	4.33	3.83	3.67	3.83	3.00	4.00	3.50	55.00	5 th
High livestock population *	3.50	3.00	3.50	3.33	4.00	3.17	3.17	2.83	2.83	3.50	3.17	2.67	3.00	3.00	44.67	8 th
Expansion of agriculture*	4.17	4.67	4.83	3.83	4.67	5.00	5.00	5.00	4.83	4.17	4.33	4.50	4.50	4.50	64.00	1st
Total															**636.51**	

*= Direct causes of degradation, **= Indirect causes of degradation

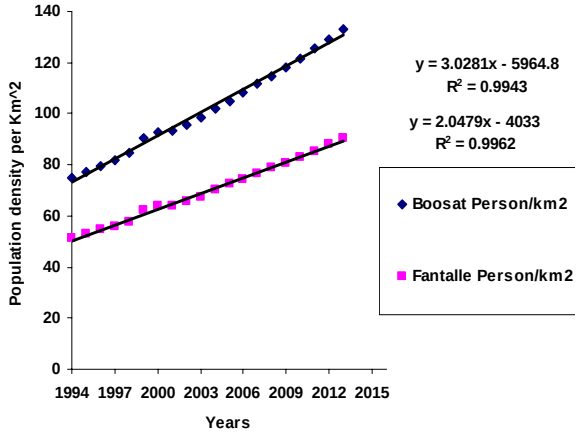

Fig 3. Trend in population density Boosat and Fantalle over two decades.

Impact of over harvesting on *X. americana*: In the six transects laid in two districts no adult and no seedling *X. americana* individuals were observed where the species was reported to be abundant in early times by local people. Key informants explained that, the natural regeneration capacity of *X. americana* was good. But as the distribution is restricted and forest resources become rare. Wild animals such as Grivet monkey (*Cercopithecus aethiops)* known as *QAMALE* in Oromo language and Olive baboon *(Papio anubis)* known as *DALJESSA* in Oromo language .These primates are most common pest of crops in Ethiopia. They eat the pulp and the seed fruit together. Local people call it "KESSA CACABSANI NYATU" means they eat by heavy crashing of the inner seed. This has impacted the germination capacity of the seed. The uses of root and bark for medicine have grave consequence on the species. Hence, overharvesting and adverse climate changes are likely to accelerate the decline of the species in natural habitats. From key informants noted that people were forgetting about *X. amricana* as the plant is not currently found near their reach to use either for food, medicine and other multipurpose uses. This was a threat to the associated indigenous knowledge of the use and management of the species. This has been confirmed by researchers' discussion with key informant and field inspection.

Local adaptation of the species: Seasonal observation of the rare plant has revealed that *Ximenia americana* has drought resistant characteristics. In the study area flowering takes place at beginning of the main rainy season and produces fruits towards the end of June and continues until October. Elderly key informants explained that in good rain years the second flowering takes place from mid March to April and gives fruits in May and continues to September. This has been confirmed by seasonal observation made by researchers. *Ximenia americana* produces fruits in short and main rain seasons. Hence, *X. americana* can be good source of food and multiple uses for humans and animals.

Perception of local people on current status of *X. americana*: Field inventory of *X. americana* clearly showed that *.X. americana* was found only around stony hill sides of mountains of Boosat Guddo, Fantalle Guddo, and Halam and in and around Awash National Park within the study districts. About 59% of respondents asserted that the species was abundant in the local vegetation, road sides and easily accessible to collect the fruits. About 40.8% of them responded that, they do not remember the real history, but they know that elderly people were telling the species was abundant in the past.

About 60% of respondents had responded that the species has declined and 40% of them haven't shown their position indicating that they were not aware of what has happened. Key informants explained that, local people were unable to get fruits of the species from nearby vegetation. Chai-square analysis has shown significant variation (p=0.04) of perception of local people on current status of the species (Table 4). Respondents in Boosat district strongly agreed the decline in status of the species.

This indicated the need for conservation and domestication of *X.americana* which have multipurpose uses for people to improve their livelihoods. Some of the options viable include: 1) sustaining multipurpose uses of *X. americana,* 2) rehabilitating, improving the ecosystem and enhancing its services, 3) enhance resilience of people to climate change adaptation by promoting indigenous knowledge of people, diversify food sources and biocultural heritage (cultural values and practices attached to the species and its habitats).

Table 4. Perception of local people on current status of *X. americana* compared to twenty years ago (N=120).

Status	Responses for current status by district		Total	Responses for status 20 yeas ago by district		
	Boosat	Fantalle		Boosat	Fantalle	Total
Abundant	0(0%)	0(0%)	0(0%)	41(34.2%)	30(25.0%)	71(59.2%)
Declining	42(35%)	30(25.0%)	71(60%)	19(15.8%)	30(25.0%)	49(40.8%)
Not responded	18(15%)	30(25.0%)	49(40%)	0(0%)	0(0%)	0(0%)
Total	**60(50.0%)**	**60(50.0%)**	**120(100.0%)**	**60(50.0%)**	**60(50.0%)**	**120(100.0%)**

Significant at 5% probability level ($p = 0.04$, $\chi = 5.00$) for the perception of current status and for 20 years ago $p = 0.063$, $\chi = 0.063$

Discussion

Distribution of *X. americana* in the study area: Interview and focus group discussions in the study area have revealed that *X.americana* was found in majority of the study areas in early times. Currently, the distribution is narrowed to inaccessible rocky hills, near protected areas because of anthropogenic threats caused by population pressure. The species is distributed in *Acacia* woodland, *Acacia-Balanites* woodland, *Combretum-Terminalia* wooded grasslands in all regions of Ethiopia (Vollesen, 1989). However, the species is under wide scale threat (Tamene *et al*., 2009).

The major threats to the biodiversity of Ethiopia were overharvesting, invasive species and conversion of natural vegetation to farmland degrading habitats leading to fragmentation with concurrent loss. The root causes were poverty, lack of alternative viable livelihoods, population pressure and inadequate awareness of the threats and possible solutions (Anon., 2009). These all have an overlap with factors affecting distribution and abundance of *X. americana.* The species is rarely observed in human influenced vegetation. By inference, and field observations and interview data, *X. americana* was threatened locally in the study area. The causes of threat identified by present study were categorized as direct and indirect (Table 3). Hence, rehabilitation of the species and sustaining its uses needs management of the habitats by controlling the threatening factors. Shinwari & Qaiser (2011) and Ajaib *et al*., (2010) indicated the need for more efforts on conservation and sustainable use of medicinal plants with scientific confirmation of indigenous knowledge, value addition to raw material and address policy issues to large scale cultivation and conservation.

Medicinal and multipurpose uses of *X. americana*: *Ximenia americana* has multiple uses to humans as food and medicine. It is also applied in leather making similar to the in the study area, and in other areas of Ethiopia. The oil from the seeds was used as a cosmetic and skin ointment. The edible fruit was made into a type of beer, and the pulp is used as a preservative and to make jellies. Bark, roots and leaves are used to treat ailments such as leprosy, fever, headaches, ulcers and skin complaints. Communities in Kenya used the roots and bark in a more diversified ways for human food, medicine and livestock forage (Maundu *et al*., 1999).The multi-use of the species has locally threatened the species. An infusion of the leaves was used as an eye wash, and also for toothache and constipation (Abbink, 1993). The stone of this plant is used by the Suri people, southern Ethiopia for extracting oily substance which is applied to skin cuts also used after bone surgery to prevent infections. Women also use the pressed oil as a contraceptive and Shinasha people in Benshangul Gumuz northwestern Region, Ethiopia used it medicinally for hepatitis, kidney problem and abdominal pain (Desissa & Binggeli, 2002) similar use to the present study area. In Asia, the young leaves are cooked as a vegetable. However, the leaves also contain cyanide and need to be thoroughly cooked, and should not be eaten in large amounts (Wikipedia, 2010). Scarcity rank done in Shinasha area ranked it the second most scarce plant when needed to treat diseases by six traditional medicine practitioners from the local people (Desissa & Binggeli, 2002).

Ximenia oil is beneficial because of its content of saturated and monounsaturated fatty acids (about 99%), which makes it, stable to oxidation and experiments have shown that the oil is useful for dry skin prone to early senescence and it was helpful to improve the functionary of the sebaceous tissues. Apart from that it also contains unsaturated fatty acids and has an exceptional nutritional value to nourish the skin while moisturizing, softening and revitalizing the skin (Sallamander, 2010).

Preferences for *X. americana*: Pair wise ranking by key informants resulted 36 out of 50 points for *X. americana* food value being 4.5 out of 5 points. Hence, it was among the preferred wild edible plants of east Shewa. Similarly it was preferred third in taste and quality among 5 wild edible plants according to results of pair wise comparison made at Cheffa wetlands, Wello, Ethiopia (Tamene *et al*., 2009). The species has also been rated as rare in the surrounding vegetation of Cheffa wetlands due to deforestation, charcoal making, fuel wood collection and agricultural expansion. This is additional evidence showing the threat to *X. americana* both in semiarid and wetland ecosystems of Ethiopia calls for urgent conservation measures.

The reasons for its being preferred over other species include its attractive and strong yellowish-red to brownish-orange and fine-textured regular heartwood. The wood is very hard, heavy and durable, and is used for tool handles. The timber usage is limited due to the thinness of the stem. The wood is also used as fuel wood. In east Shewa, the mature wood is used to make local spoons, handles of knife, sickle because of its hard and beautiful wood. As a shortage of wood continues to be serious its use for charcoal production together with other shrubs and trees has also increased in the study area.

Storage of fruits of *Ximenia americana*: In the study area people do not store fruits of *X. americana*. There is no appropriate technology in the study area to store the fruits. If kept in a closed container it decomposes and ferments. Local people of east Shewa were observed keeping fruits in open containers to prevent spoilage. This has helped them to keep fruits for about 15 days. Indigenous people indicated that there is problem of storing. The storage needs low temperature and moisture content and as cold as possible. However, people of the study area faced problems of storing due to high temperature. There is no local technology for processing fruits except that people locally make juices and soups at homes when they gather fruits. Hence the fruits were mostly used as table fruits raw.

Threat to *Ximenia americana*: *Ximenia americana* a locally threatened food and multipurpose plant in east Shewa due to: 1) over-harvesting for food, medicine and other uses. Informants indicated that root and bark were used for medicine. The use of root and bark were detrimental to the plant's continuity as it affects vascular system of the plant 2) Fuel wood, commercial charcoal production, construction material, over browsing by camels and goats has threatened the species and the habitats.

In east and central Africa overgrazing 50% and agricultural activities 14% contributed for resource degradation (Marcoux, 2010). The level of degradation was classified strong 11%. Deforestation (removal of wood cover for domestic use) was identified among major causes of degradation. The resultant effect was water erosion 74% and wind erosion 26%. The resultant effect of all these is habitat fragmentation and loss with consequent impact on precipitation b of the region. Hence, there exists link between species existence, its habitat and human activities. An increase in population density of study area indicated increased demand for natural resource including high value species such *X. americana.* Therefore, it indicated that people have been vulnerable to food insecurity due to declining ecosystem services as evidenced by this species. Hence, the species is a priority wild edible plant to be considered in dryland agroforestry conservation to save the species from extinction and for sustainable use. Local management practices alone can not save the species unless further sustainable measures are complemented.

Conclusions

In spite of the multipurpose use of *X. americana* it is locally vulnerable from a number of resource degradation factors. Unless the situation is reversed by collective effort it will face extinction in the near future particularly from the rate of deforestation, selective removal and indiscriminate degradation of local habitat. Expanding deforestation for agriculture, increased settlements are threatening *X.amreicana.* Hence, conserving the species with concurrent domestication is an option to sustain it and its multipurpose uses. One ways to start the process could be the use of indigenous conservation practices, such as traditional dryland agroforestry, live fencing, and enhancing closure of pasture land known as KALO in Oromo language. Support local people with appropriate extension services and technology to properly use the species. This system should be made profitable to local people through linkage to market opportunities and transformation of their produce to value added fruit products under sound policy environment.

Acknowledgments

We appreciate and thank people of Fantalle and Boosat districts, Ethiopia who gave adequate information for the research and facilitated the field work. The full financial support of RUFORUM-Rokefeler and Association of African Universities (AAU) are thankfully appreciated**.** Unreserved support and contributions of University of Nairobi, CAVS, LARMAT, Kenya and Jimma University, College of agriculture and Veterinary Medicine, Ethiopia for hosting and providing logistic, technical and managerial supports are acknowledged.

References

Abbink, J .1993. 'Me'en medicinal, ritual and other plants: a contribution to Southwest Ethiopian ethnobotany', *Journal of Ethiopian Studies*, 26(2): 1-21.

Ajaib, M., Z. Khan, N. Khan and M. Wahab. 2010. Ethnobotanical Studies On Useful Shrubs Of District Kotli, Azad Jammu & Kashmir, Pakistan *Pak. J. Bot*., 42(3): 1407-1415.

Alam, J. and S.L. Ali. 2010. Conservation Status of *Androsace Russellii* Y. Nasir: A Critically Endangered Species in Gilgit District, Pakistan, *Pak. J. Bot*., 42(3): 1381-1393.

Ali, S.I. 2011. Medicinal Plants Collection and Taxonomic Identification. *Pak. J. Bot*., 43: 11-13.

Anonymous. 1999. *The 1994 Population and Housing Census of Ethiopia. Results at Country Level.* Office of the Population and Housing census Commission, Volume II Analytical Report.

Anonymous. 2009. Ethiopia's 4th Country Report, to the Convention on Biological Diversity (CBD), November, 2009. Institute of Biodiversity Conservation, Addis Ababa, Ethiopia 2009, pp. 374.

Anonymous. 2009. Socioeconomic Profile of Boost District. District Finance & Economic Development Office (BDFED), Pp, 1-61.

Anonymous. 2010. (World Agroforestry Centre). *Ximenia americana*. Tree species reference and selection guide, Agroforestry Data Base, *http://www.worldagroforestry.org*, (Accessed 26 April, 2010).

Bahiru, T, Z. Asfaw and D. Sebsebe. 2010. Variation of indigenous botanical knowledge versus social characteristics between the afar and oromo nations in and around the Semi Arid Awash National Park. *Ethiopian Journal of Agricultural Science and Technology*, 2(1): 1-13.

Balemie, K. and F. Kebebew. 2006. Ethnobotanical Study of Wild Edible Plants in Derashe and Kucha Districts, South Ethiopia. *Journal of Ethnobotany and Ethnomedicine*, 2(53): 1-9.

Cook ,C.W. Stubbendieck, J.1986. Range Research: Basic Problem and Techniques . *Society for Range mangement*, Denver Colorado 80204, P 317.

Cotton, C.M. 1996. *Ethnobotany: Principles and applications*. Chichester, New York John Wiley and Sons Ltd.

Demessew, S. and I. Friis. 2009. Natural Vegetation of the Flora area. IN: Flora of Ethiopia and Eritrea. Vol. 8. General part and Index to Vol. 1-7. pp. 27-32, (Eds.): I. Hedberg, I. Friis and E. Persson. National Herbarium, Biology Department,

Science Faculty, Addis Ababa, University, Addis Ababa and Department of Systematic Botany, Uppsala University, Uppsala, Sweden .

Desissa, D. and P. Binggeli. 2002. Uses and conservation status of medicinal pants used bytheShinashaPeople**.**EWNHS, http://members.multimania.co.uk/ethiopianplants/shinasha. html (Accessed 16 January, 2010).

Guinand, Y. and D. Lemessa. 2000. Wild-food Plants in Southern Ethiopia: Reflections on the role of 'famine-foods' at a time of drought. University of Pennsylvania - African Studies Centre.

Marcoux, A. 2010. Population Change Natural Resources Environment Linkages in East and Central. *Sustainable Development department FAO* .Africahttp://www.fao.org/sd/wpdirect/WPan0021.htm (Accessed 29 July, 2010) 1998.

Martin, G.J. 1995. Ethnobotany: *a methods manual*. London, UK: Chapman and Hall.

Maundu, P.M., G.W. Nugugi and C.H.S. Kabuye. 1999. Traditional Food Plants of Kenya. Kenya Resources Centre for Indigenous Knowledge. National Museums of Kenya, Nairobi.

Sacande, M. and H. Vautier. 2006. *Ximenia americana.* Seed Leaf Let No**112**, April 2006 *Millennium Seed Bank Project*, Kew. Forest & landscape, Denmark. www.Kew.org/Msbp (Accessed 27 April, 2010).

Sallamander, C. 2010. Ximeniaoil. Esoteric Oils CC, Sallamander Concepts (Pty) Ltd 1998-2010. (http://www.essentialoils.co.za.htm, (accessed on 22 April, 2010).

Shinwari, Z.K. and M. Qaiser. 2011. Efforts on conservation and sustainable use of medicinal plants of Pakistan, *Pak. J. Bot*., 43: 5-10.

Tamene, B., T. Bekele and E. Kelbessa. 2009. An Ethnobotanical study of the Semi-wetland Vegetation of Cheffa .*Consortium for Integration of Population, Health, and Environment, Ethiopia Publications*. http:// www.phe-ethiopia.org, pp, 1-15, accessed Dec, 4, 2009).

Vollsen, K.1989. Olacaceae. In: *Flora of Ethiopia*, Vol. 3: 356-357, (Eds.): I. Hedberg and S. Edwards. National Herbarium, Biology Department, Science Faculty, Addis Ababa, University, Addis Ababa and Department of Systematic Botany, Uppsala University, Uppsala, Sweden.

White, F. 1983. *The Vegetation of Africa: A Descniptive Memoir to Accompany the* UNESCO/AETFAT/UNSO Vegetation of Africa, pp. 44-117. UNESCO, Botanic Institute, BIBL, UPPSALA.

Wikipedia. 2010.*Ximenia americana.* http://en.wikipedia.org. *Ximenia americana* (accessed 20 February, 2010).

Yohanis, T. 2009. Woody Plant Species Diversity Analysis and Documentation of Invasive Alien Species in Awash national Park. Addis Ababa University, 2009, pp, 79.

(Received for publication 26 August 2010)