# Indigenous Knowledge and Consumer's Perspectives of Stinging Nettle (Urtica Simensis) in the Central and Southeastern Highlands of Oromia Regional States of Ethiopia

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**Research**

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# Abstract

**Background:** Wild plants are essential for increased dietary diversity; for food and nutritional security and as herbal remedies. Stinging nettle, *Urtica species*, is one of the 20 widely consumed wild plants with cultural importance index ranging from 0.5-1.26 CI in different countries**.** As in previously conducted wild plants ethnobotanical studies in Ethiopia, the present study reported for the first time the indigenous knowledge and consumer's perspectives of stinging nettle (*Urtica simensis*) in the central and southeastern highlands of Oromia regional states of Ethiopia.

**Methods:** Data was collected through informed consent semi-structured interviews, questionnaires, key informant discussions, focus group discussions and tour-guided field observation in 13 districts of three zones (Arsi, Bale and North Shewa) of Oromia regional state, Ethiopia.

**Results:** The local people gather, where women carries 69.2% of the responsibilities for collecting and cooking, stinging nettle in winter and spring season almost from everywhere with higher preference for road sides followed by homestead boundaries, waste land, field boundaries and agroforestry in order of importance. The factors limiting harvesting, consumption and marketing of stinging nettles could be ranked as cultural barriers (63.1%) > lack of knowledge (26.9%) > stinginess (10%). According to key informants, the local people who gather and cook stinging nettle are commonly referred as the poor and they call stinging nettle crop as a poor man crop. Interestingly, covering hands with cloths and wearing plastic bags were traditional manipulations practiced by the local community to protect themselves from stinging hairs thereby avoiding stinging sensation and collect the young and tender shoots from the plant. The highest use-value indices of stinging nettle plant was in North Shewa zone (UVc = 0.93), followed by Arsi zone (UVc = 0.9), and Bale zone (UVc = 0.63). Its central role in North Shewa (FL = 51.7%) and Arsi zone (FL = 50 %) is as a source of both food and fodder, where as in Bale zone (FL = 33.3%) is as a source of food only. In the study areas stinging nettle sauce is prepared by boiling young nettle leaves and roasted barley powder and then cooled sauce is served with injera.

**Conclusions:** There exists biological security to livelihood of the people in the study areas by consuming stinging nettle to cope up times of food shortage. This result shed light on further research and a needs to popularize, awareness creation, the potential for domestication, value addition and processing for food and nutritional security and wellbeing of consumers.


# Background

The current population of more than 110 million people in Ethiopia is expected to double by 2050 (Population Reference Bureau, 2019). An estimated five million people are suffering from lack of vitamins and essential minerals, of which 80% are children. Most rural people in developing countries rely on wild resources, the diversity of wild species provides a variety of family diets and leads to household nutrition and food security. However, studies reported that older generations fail to disseminate traditional knowledge on the food and medicinal value of wild plants to the younger generation causing a decrease

in traditional knowledge and the use of biodiversity (Quinlan and Quinlan, 2007; Ong, Mojiun and Milow, 2011; Sousa et al., 2012; Saynes-vásquez et al., 2016; Wiryono, Japriyanto and Erniwati, 2017; Suwardi et al., 2019). Many recent studies indicate that wild plants have an underexploited potential to contribute to food security, nutrition, health, income generation and environmental services(González, García-Barriuso and Amich, 2010; Ranjan, Jamir and Ozukum, 2013; Çakir, 2017; Suwardi et al., 2019; Yesil and Inal, 2019; Miskoska-milevska, Stamatoska and Jordanovska, 2020; Prakash et al., 2020; Alemneh, 2020; Demir, 2020; Hançer et al., 2020; Hassen, 2021; Al-Fatimi, 2021; Katrahalli and Siddeshwari, 2021; Kumar, 2021; Purba and Silalahi, 2021; Woldemariam, Demissew and Asfaw, 2021; Woldemedhin, Lulekal and Bekele, 2021; Ding et al., 2021; Golait, Auti and Laware, 2021; Agarwal and Chandra, 2021).

Utilization of wild plants are essential for increased dietary diversity; for nutritional security and as herbal remedies. Recent studies on the basis of the cultural importance index to determine the cultural significance of these wild edible plants, stinging nettle is among the 20 widely consumed with cultural importance index ranging from 0.5–1.26 CI (Mohammed S. Ali-Shtayeh et al., 2008; González, García-Barriuso and Amich, 2010; Çakir, 2017; Yesil and Inal, 2019; Ding et al., 2021; Hassen, 2021). For example, Hançer et al. (2020) reported that Urtica represent the greatest number of taxa of the 41 genera and *Urtica dioica* and *Urtica urens* are most culturally important species and frequently used as cooked vegetable in Biga, Turkey. Stinging nettle can provide an open-access source of food and nutrition, especially to vulnerable groups such as the poor, malnourished children. Nettles have also been found to improve household food security both under normal circumstances as well as during periods of crop scarcity and in rural as well as urban contexts.

A wide range of studies reported that Urtica spp. (*U. dioica, U. urens, Urtica simensis, U. membranifolia*) are frequently consumed as cooked leafy vegetable and use as herbal Medicine in different countries of the world (González, García-Barriuso and Amich, 2010; Ranjan, Jamir and Ozukum, 2013; Çakir, 2017; Suwardi et al., 2019; Yesil and Inal, 2019; Miskoska-milevska, Stamatoska and Jordanovska, 2020; Prakash et al., 2020; Alemneh, 2020; Demir, 2020; Hançer et al., 2020; Hassen, 2021; Al-Fatimi, 2021; Katrahalli and Siddeshwari, 2021; Kumar, 2021; Purba and Silalahi, 2021; Woldemariam, Demissew and Asfaw, 2021; Woldemedhin, Lulekal and Bekele, 2021; Ding et al., 2021; Golait, Auti and Laware, 2021; Agarwal and Chandra, 2021).

*Urtica simensis* is endemic to Ethiopia and have been known for a long time as medicinal and food plants (Kavalali, 2003). Asfaw and Tadesse (2001) studied prospects for sustainable use and development of wild food plants in Ethiopia. The authors reported that *U. simensis*, locally known as Samma, is widely available in the highlands of Ethiopia and leafy shoots are harvested for consumption. The plant grows around the highlands of Ethiopia, specifically in the North and South Gondar, North and South Wello, North Shewa, Wag Hamra, Tigray region, highland of Sidama zone in Southern region and Arsi zone of Oromia region at 1500–3500 meter above sea level (Erenso and Maryo, 2014; Andualem, 2016). In the traditional health care system of Ethiopia, “Samma” is used for the treatment of diabetes mellitus and various other ailments (Tsegaye, Urga and Asres, 2009). Roberts (2011) described that

stinging nettle, is not just a weed but it is a well-respected and valuable healing food or medicinal plant due to its high neutraceutical value.

Although, a number of ethnobotanical studies have previously reported on wild edible plants in various regions of Ethiopia (Kefalew, Asfaw and Kelbessa, 2015; Regassa, Kelbessa and Asfaw, 2015; Seyoum et al., 2015; Tebkew, 2015; Ashagre, Asfaw and Kelbessa, 2016; Berihun and Molla, 2017; Tebkew et al., 2018; Alemneh, 2020; Dejene et al., 2020; Woldemariam, Demissew and Asfaw, 2021; Woldemedhin, Lulekal and Bekele, 2021; Hassen, 2021), no ethnobotanical studies have previously been reported on *Urtica simensis* from highlands of Ethiopia. Additionally, recent studies mainly reported on the analysis of morphological and molecular genetic diversity of *U. simensis* (Abdulkadir and Kusolwa, 2020) and nutritional profile, chemical composition, polyphenols and antioxidant activity of *U simensis* leaves (Assefa, Haki and AddisDemoz, 2013; Andualem, 2016; Keflie et al., 2017; Seifu et al., 2017; Ayalew et al., 2019; Bayba et al., 2020) from different regions of Ethiopia. To recommend and popularize stinging nettle as contributing to an improved diet; enhance conservation and management practices and popularize consumption of stinging nettle for improved nutrition and healthy diet, traditional knowledge about diversity and consumer perspective is essential. Therefore, this study was conducted to identify indigenous knowledge and consumer's perspectives of stinging nettle (*U. simensis*) using informed consent semi-structured interviews, questionnaires, key informant discussions, focus group discussions and tour-guided field observation in 18 districts of three zones (Arsi, Bale and North Shewa) of Oromia regional state, Ethiopia.

As in previously conducted ethnobotanical studies in Ethiopia, the present study reported for the first time the indigenous knowledge and consumer's perspectives of stinging nettle (*U. simensis*) in the central and southeastern of Oromia regional states of Ethiopia, thus highlighting the importance of ethnobotanical recording to avoid the loss of cultural knowledge about stinging nettles "Samma, local name".

# Methods

# Study area

The study was conducted in the highlands of central, southeastern and eastern part of Oromia regional states of Ethiopia. The study on indigenous knowledge and consumer's perspectives of stinging nettle (*Urtica simensis*) was conducted in Debre Libanos, Degem, Gerar Jarso, Jida, Gerbe guracha, Sululta, Wuchale and Yaya Gulele districts located between 9°05'N latitudes and 38°74'E longitudes with an elevation of 1551metres-3010 meters above sea level in the central part of Ethiopia; Arsi zone in Aseko, Degeluna Tijo, Inkolo Wabe, Jeju, Limu Bilbilo, Robe, and Tiyo districts located between 7°93' N latitudes and 39°65'E longitudes with an elevation of 2430 meters above sea level in the southeastern part of Ethiopia; and Bale zone in Dinsho, Goba and Sinana districts located between 6°76' N latitudes and 40°31'E longitudes with an elevation of 2,492 metres-3207 meters above sea level in the southeastern part of Ethiopia (Fig. 1).

The climate of the area is temperate type climate with mean annual rainfall of 410–820 mm the study areas experience moderate temperature, (mean temperature of the coolest month is less than (18 ºC) and ample precipitation (1200-2000mm)" (Aynalem, 2021). The areas generally practice mixed agriculture consisting of livestock and crop production. The sites were selected because of the expected existence of diverse indigenous knowledge on stinging nettle.

A reconnaissance survey was conducted to produce a specific description of the study sites. After selecting the study sites, discussions were carried out with the respective responsible government officials. The discussions were conducted after clear explanation on the objectives, planned activities and duration of the research. Rural kebeles (villages) were then selected that met the selection criteria. Formal letters were written to selected rural kebeles by the responsible district offices and the researchers were introduced with kebele administrative officials and community elders by district officials. It was essential to maintain contact with the local people while studies were conducted.

This procedure satisfied local customs and official ethical guidelines on carrying out indigenous knowledge and consumer's perspectives of stinging nettle (*U. simensis*) research. Government bodies and local community members have fully consented and facilitated the work.

# Data collection

Thirteen districts were randomly selected from the three zones of Oromia regional states of Ethiopia on the basis of availability of stinging nettles, topography and difference in lifestyles. Knowledgeable key informants and focus group discussants were identified in each study site with the help of development workers and community leaders.

The first step in the fieldwork was selecting 2-3villages/kebeles to represent respective district. Key informants were used to distinguish in each district different social, cultural and ecological zones, which form the bases for selecting participating villages.

A sample population was selected using the village registrar. Ethnobotanical data collection was done by interviewing 130 informants who were drawn from randomly selected households. A semi-structured questionnaire, as described by Montagne (1997) was employed and ethno-botanical information in indigenous knowledge and consumer's perspectives of stinging nettle (*U. simensis*) was gathered through semi-structured interview of the randomly selected rural households in the eighteen districts. The semi-structured interviews were performed based on the following questions:

1. The semi-structured interviews were performed based on the following questions:
2. How frequently do you gather stinging nettles?
3. Please mention the months (seasons) in which stinging nettles are most available?
4. From where do you get stinging nettles?
5. Please mention the various uses and services of stinging nettles?
6. [illegible]llect stinging nettles?

7. Who is responsible to collect and prepare stinging nettles in the household?
8. Do you think there are factors that limit harvesting and consumption of stinging nettles?
9. How do you compare farm cultivated crops and stinging nettles (taste, palatability and availability )

The second step, complementary data was collected through key informant discussions, focus group discussions and tour-guided field observation (Montagne, 1997). Members of the focus groups was carefully selected to include both male and female community members, and from varying socio-economic and age groups. Information on how often they use, its improvement and conservation, preservation methods, how they value it, traditional or legend related to it, short comings in its utilization, interest to produce it, time and purpose of consumption and if you use stinging nettle “Samma” as family food source, enumerate the method of preparation, were recorded.

# Use-value citation index

The use-value (UVc) citation index, which is useful for evaluating the relative importance of stinging nettle plant in different zones based on its cited uses, was calculated as described by (de Albuquerque et al., 2007) using the following formula:

$$UV_c = \frac{\sum U_{is}}{N}$$

Where $U_{is}$ is the sum of the total number of all individual use citation reports in a given study area/zone, divided by the total number of informants (N).

# Fidelity level

The fidelity level (FL) percent measure was used to identify the central role of stinging nettle plant in a given study zone. The FL was defined as the ratio of between the total number of informants that independently cited a specific use (Nt) of the plant and the total number of informants (N) that cited the species for any use (Friedman et al., 1986):

$$FL\% = \frac{N_t}{N} X100$$

# Data analyses

Data collected from semi-structured interviews were quantitatively analyzed by SPSS version16 and summarized into frequency tables in percentages. Principal Component Analysis (PCA) in XLSTAT 2020 (AddinSoft™ SARL, Paris, FRANCE) was conducted on the observations or variables table to show a visual interpretation of differences in indigenous knowledge and consumer’s perspectives of stinging nettles in North Shewa, Bale and Arsi zones of Oromia regional states of Ethiopia. PCA plots give visual information of data for easier understanding of overall differences or similarities in indigenous knowledge among districts and zones.

# Results

## The various uses of stinging nettles

This study was an account of the traditional knowledge and use of stinging nettle by local people in the high lands of Ethiopia. Majority of the people in the study area use stinging nettle both for human and livestock while in Bale zone the local people preferred stinging nettle more for human consumption (Table 1). The local community uses stinging nettle as a source of food, feed and herbal medicine while most local people also regarded it as unwanted plant. The results data reflects the strong relationship between the local peoples and the valuable knowledge of the uses of samma as potential sources for traditional food, feed and medicine. Rural communities in the high lands of Ethiopia continue to collect and consume stinging nettle as a food source.

Table 1
The various uses of stinging nettles in the three zones of Oromia regional state, Ethiopia

| Uses | Zones | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | North Shewa | | Arsi | | Bale | | | |
| | Count | % WD | Count | % WD | Count | % WD | Count | % WD |
| Food only | 14 | 23.3 | 7 | 17.5 | 10 | 33.3 | 31 | 23.8 |
| Food and fodder | 31 | 51.7 | 20 | 50.0 | 8 | 26.7 | 59 | 45.4 |
| Herbal medicine | 5 | 8.3 | 5 | 12.5 | 0 | 0.0 | 10 | 7.7 |
| Fodder only | 6 | 10.0 | 3 | 7.5 | 1 | 3.3 | 10 | 7.7 |
| Unwanted plant | 4 | 6.7 | 5 | 12.5 | 11 | 36.7 | 20 | 15.4 |
| Total | 60 | 100 | 40 | 100 | 30 | 100 | 130 | 100 |
| WD: within districts | | | | | | | | |

## Fidelity level analysis

Fidelity level (FL) analyses enable evaluation of the central role of the stinging nettle plant in a study site; this is particularly useful when considering the varies use citations of the plant. For example, in North Shewa zone, stinging nettle plant has a wider range of utilities, was cited for use 56 times with a Use-value citation index (UVc) of 0.93 (Fig. 2, Fig. 4). While it has cited uses for as a source of food only, food and fodder, herbal medicine and fodder only, its central role (FL = 51.7%) is as a source of both food and fodder. In Bale zone, on the other hand, have a narrow range of utilities, with a low UVc of 0.63 and FL values. For example, its highest FL value is 33.3% (for human consumption only), followed by as a source of food and fodder (26.7%), and livestock feed only (3.3%). In Arsi zone, the plant has a use value, UVc, of [illegible] (FL = 50%) or Human consumption only (17.5%).

# Use-value citation analysis

Use-value citation indices were determined for all cited uses of the plant. This analysis enables determination of the overall rank of the uses of the plant by informants, allowing for a comparative analysis at the rank of individual zones. The zone with the highest use-value indices for stinging nettle plant was North Shewa zone (UVc = 0.93), followed by Arsi zone (UVc = 0.9), and Bale zone (UVc = 0.63) (Fig. 3, Fig. 4). Notably, the plant has UVc = 0.85 distributed across the different zones. Comparison of use value indices at the zone level revealed that North Shewa zone, and Arsi zone had the highest average use-values, though this analysis is limited by disparate numbers of representative districts within each zones.

# Preferences for habitats to collect stinging nettles

Cross tabulation analysis of interview administered to 130 informants indicated that stinging nettle were available throughout all habitats and local people gather stinging nettle almost from everywhere with higher preference for road sides followed by homestead boundaries (Table 2). The local people indicated that stinging nettle survive and perform well almost everywhere from marginal areas to fertile soil without any agricultural input and cultivation requirement. The results can be an indicator of the potential of stinging nettle to be integrated into the farming system.

Table 2
Preferences for habitats to collect stinging nettles in three zones of Oromia regional state, Ethiopia

| Habitats | Zones | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | North Shewa | | Arsi | | Bale | | Total | |
| | Count | % WD | Count | % WD | Count | % WD | Count | % WD |
| Homestead boundaries | 12 | 20 | 12 | 30 | 8 | 26.7 | 32 | 24.6 |
| Agroforestry | 5 | 8.3 | 3 | 7.5 | 8 | 26.7 | 16 | 12.3 |
| Road sides | 24 | 40 | 6 | 15 | 7 | 23.3 | 37 | 28.5 |
| Field boundaries | 3 | 5 | 9 | 22.5 | 5 | 16.7 | 17 | 13.1 |
| Waste land | 16 | 27 | 10 | 25 | 2 | 6.7 | 28 | 21.5 |
| Total | 60 | 100 | 40 | 100 | 30 | 100 | 130 | 100 |
| WD: within districts | | | | | | | | |

# Economic status and frequency of gathering stinging nettle

Poor local people frequently gather stinging nettle over those who have reasonable income and rich (Table 3). Key informants during the focus group discussion explained that, gathering and consumption

of stinging nettle is linked to the economic standard. According to informants, the local people who gather and cook stinging nettle are commonly referred as the poor and they call stinging nettle crop as a poor man crop. This could indicates a needs of further policy and local level awareness creation to really value wild edible plants and improve their uses and enhance their conservation for sustainable utilization

Table 3
Economic status of the households on frequency of gathering stinging nettles in Oromia regional state, Ethiopia

| Frequently of gathering | Economic status of the households | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Rich | | Have reasonable income | | Poor | | | |
| | Count | % WD | Count | % WD | Count | % WD | Count | % WD |
| Seasonally | 2 | 40 | 23 | 76.7 | 79 | 83.2 | 104 | 80 |
| Annually | 3 | 60 | 7 | 23.3 | 16 | 16.8 | 26 | 20 |
| Total | 5 | 100 | 30 | 100 | 95 | 100 | 130 | 100 |
| WD: within districts | | | | | | | | |

# Seasonal availability of stinging nettle

Stinging nettle is adapted to specific seasons of the year. Informants explained that there is clearly defined seasonal availability of stinging nettle. Stinging nettle give new flushes of growth during dry months of December to February (winter) and shortly after small rains of March to May (Spring), seasons when other farm vegetables are not in the field indicated that gather and use stinging nettle in winter and while about 54% use takes place during spring seasons (Table 4).

Table 4
The months (seasons) in which stinging nettle are most available and consumed in three zones of oromia regional state, Ethiopia

| Seasons | Zones | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | North Shewa | | Arsi | | Bale | | | |
| | Count | % WD | Count | % WD | Count | % WD | Count | % WD |
| Spring | 30 | 50 | 30 | 75 | 10 | 33.3 | 70 | 53.8 |
| Winter | 30 | 50 | 10 | 25 | 20 | 66.7 | 60 | 46.2 |
| Total | 60 | 100 | 40 | 100 | 30 | 100 | 130 | 100 |
| WD: within districts | | | | | | | | |

# Consumable parts and traditional manipulation practices to collect stinging nettle

# Consumable parts

Local people explained that they use young shoots to prepare local sauces and the roots for their medicinal value (Table 5). Focus group discussions and participatory observations indicated that leaves of stinging nettle were used for human consumption while fresh and dried whole stinging nettle plant was used for animal feed or as a fodder. Respondents also indicated that stinging nettles based food preparation utilize spare time for collection with no or minimum attention and management for the plants in the wild.

From informants' response and field inspection people of the study area used various traditional methods of collecting stinging nettle for protecting themselves from the stinginess. Covering hands with cloths and wearing plastics were traditional manipulations practiced to collect stinging nettle leaves (Table 5). The most commonly used manipulation of stinging nettle gathering was covering hands with cloths to collect young shoots. The implication is that communities probably use sustainable techniques.

Table 5
Consumable parts and traditional manipulation practices to collect stinging nettle for human food in three zones of Oromia regional state, Ethiopia

| | Zones | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | North Shewa | | Arsi | | Bale | | | |
| | Count | % WD | Count | % WD | Count | % WD | Count | % WD |
| Consumable parts | | | | | | | | |
| Root | 2 | 3.3 | 7 | 17.5 | 4 | 13.3 | 13 | 10 |
| Young leaves | 58 | 96.7 | 33 | 82.5 | 26 | 86.7 | 117 | 90 |
| Total | 60 | 100 | 40 | 100 | 30 | 100 | 130 | 100 |
| Traditional manipulations' for collecting | | | | | | | | |
| Covering hands with cloths | 41 | 68.3 | 32 | 80 | 17 | 56.7 | 90 | 69.2 |
| Wearing plastics | 19 | 31.7 | 8 | 20 | 13 | 43.3 | 40 | 30.8 |
| Total | 60 | 100 | 40 | 100 | 30 | 100 | 130 | 100 |
| WD: within districts | | | | | | | | |

# Traditional methods of preparing stinging nettle for human

Table 6 presents Traditional methods of preparing stinging nettle for human consumption in three zones of Oromia regional state, Ethiopia. In the study areas stinging nettle sauce is prepared by boiling young nettle leaves and roasted barley powder and then cooled sauce is served with injera. Focus group discussions and interaction made with households has shown that, stinging nettle can contribute to people's livelihood and food security.

Table 6
Traditional methods of preparing stinging nettle for human consumption in three zones of Oromia regional state, Ethiopia

| Steps | Activities |
|---|---|
| 1st | Harvesting young shoots from the field wearing thick cloths to prevent stinging ness of the leaves |
| 2nd | Mashing the leaves on traditionally made sieve from grass |
| 3rd | Boiling the leaves in plenty of water in clay pots |
| 4th | After 5–10 minutes of boiling, separating the leaves from the liquids and they discard used water |
| 5th | Mixing partly cooked leaves with specially prepared barely flour (hulled, slightly roasted and milled barely grains) and recooking for 15 minutes |
| 6th | The mixture will be cooled down overnight |
| 7th | Consumed next day with injera (traditionally made fermented teff and or sorghum/maize dough made into thin bread) |

# Analysis of Gender to collect and prepare stinging nettle

Table 7 shows analysis of gender to collect and prepare stinging nettle in three zones of Oromia regional state, Ethiopia. According to key informants' response, all household members participate in collecting and preparing stinging nettle for home consumption; however, women carries 69.2% of responsibilities for collecting, preparing and serving the family food.

Table 7
Analysis of gender to collect and prepare stinging nettle in three zones of Oromia regional state, Ethiopia

| | | Zones | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | North Shewa | | Arsi | | Bale | | | |
| | | Count | % WD | Count | % WD | Count | % WD | Count | % WD |
| Respondents status | Male | 25 | 41.7 | 15 | 37.5 | 10 | 33.3 | 50 | 38.5 |
| | Female | 35 | 58.3 | 25 | 62.5 | 20 | 66.7 | 80 | 61.5 |
| Who is responsible to collect? | Husband | 5 | 8.3 | 2 | 5 | 2 | 6.7 | 9 | 6.9 |
| | Wife | 35 | 58.3 | 34 | 85 | 15 | 50 | 84 | 64.6 |
| | Girls | 20 | 33.3 | 4 | 10 | 13 | 43.3 | 37 | 28.5 |
| Who is responsible to prepare? | Wife | 46 | 76.7 | 32 | 80 | 21 | 70 | 99 | 76.2 |
| | Girls | 14 | 23.3 | 8 | 20 | 9 | 30 | 31 | 23.8 |

WD: within districts

# People's perception and factors limiting harvesting and consumption of stinging nettles

Table 8 presents people's perception and factors limiting harvesting and consumption of stinging nettles in three zones of Oromia regional state, Ethiopia. The local people indicated that stinging nettles based sauces are highly palatable (89.2%) and flavorful (69.2%) compared to farm cultivated vegetables. A focus group discussion with key informants and local people's confirmed the palatability and flavor richness of nettle based sauces. For example, persons who even lost appetite to consume other foodstuff can enjoy eating of nettle based dishes with no hesitation, they even have also the desire to eat more main meal served with nettle sauce than other commonly consumed vegetables. In the study areas the community use freshly harvested stinging nettles for human consumption whereas as they use dried root, rhizomes, shoots and stems of the plant as a fodder (94.6%). Stinging nettles are not domesticated or cultivated in the study areas. Respondents explained that, no formal conservation and marketing activities were practiced. People collect stinging nettles from their settlements. The factors limiting harvesting, consumption and marketing of stinging nettles could be ranked as cultural barriers (63.1%) > lack of knowledge (26.9%) > stinginess (10%).

Table 8
People's perception and factors limiting harvesting and consumption of stinging nettles in three zones of Oromia regional state, Ethiopia

| | | Zones | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | North Shewa | | Arsi | | Bale | | | |
| | | Count | %WD | Count | %WD | Count | %WD | Count | %WD |
| How do you compare its taste compared to cultivated vegetables | Flavorful | 44 | 73.3 | 24 | 60 | 22 | 73.3 | 90 | 69.2 |
| | Acceptable flavor | 16 | 26.7 | 16 | 40 | 8 | 26.7 | 40 | 30.8 |
| Preservation for human consumption | Use freshly harvested | 60 | 100 | 40 | 100 | 30 | 100 | 130 | 100 |
| Preservation for animal feed | Feed fresh | 0 | 0 | 2 | 5 | 5 | 16.7 | 7 | 5.4 |
| | Feed Dried | 60 | 100 | 38 | 95 | 25 | 83.3 | 123 | 94.6 |
| How do you compare its palatability compared to cultivated vegetables | High palatability | 51 | 85 | 38 | 95 | 27 | 90 | 116 | 89.2 |
| | Moderate palatability | 9 | 15 | 2 | 5 | 3 | 10 | 14 | 10.8 |
| Availability in marginal areas and dry season | Higher | 60 | 100 | 40 | 100 | 30 | 100 | 130 | 100 |
| How long it requires to fetch from the first harvest? | 2 weeks | 34 | 56.7 | 26 | 65 | 3 | 10 | 63 | 48.5 |
| | 3 weeks | 26 | 43.3 | 14 | 35 | 20 | 66.7 | 60 | 46.2 |
| | 1 month | 0 | 0 | 0 | 0 | 7 | 23.3 | 7 | 5.4 |
| Any attempt for domestication or conservation? | No | 60 | 100 | 40 | 100 | 30 | 100 | 130 | 100 |
| Could it be gathered and sold in markets? | Yes | 4 | 6.7 | 0 | 0 | 0 | 0 | 4 | 3.1 |
| | No | 56 | 93.3 | 40 | 100 | 30 | 100 | 126 | 96.9 |
| Factors limiting its harvesting | Stinginess | 5 | 8.3 | 5 | 12.5 | 3 | 10 | 13 | 10 |

| | | Zones | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | North Shewa | | Arsi | | Bale | | | |
| | | Count | %WD | Count | %WD | Count | %WD | Count | %WD |
| and consumption? | Cultural barrier | 40 | 66.7 | 25 | 62.5 | 17 | 56.7 | 82 | 63.1 |
| | Lack of knowledge | 15 | 25 | 10 | 25 | 10 | 33.3 | 35 | 26.9 |
| WD: within districts | | | | | | | | | |

Figure 4 presents a summarised view of where the first principal components (F1 (63.64 %) and F2 (36.36 %) explained 100 % of the total variability in indigenous knowledge and consumer's perspectives of stinging nettles in North Shewa, Bale and Arsi zones of Oromia regional states of Ethiopia. For example, the PCA chart clearly shows cultural barrier as the major factors limiting harvesting and consumption of stinging nettles in North Shewa, followed by Arsi and Bale zones, respectively. The first principal component (F1) clearly shows lack of knowledge in Bale > Arsi > North Shewa and stinginess in Arsi > Bale > North Shewa were ranked as the main factors limiting harvesting and consumption of stinging nettles.

## Discussion

# The various uses of stinging nettles

The local community uses stinging nettle as a source of food, feed and herbal medicine while most local people also regarded it as unwanted plant. A number of recent ethnobotanical studies on uses of wild plants by local communities' in different areas of the world showed that local people harvest and used edible wild plants for food, fence, fuel, fodder, medicine and furniture (Thapa, Dhakal and Chaudhary, 2014; Suwardi et al., 2019; Purba and Silalahi, 2021; Woldemariam, Demissew and Asfaw, 2021; Woldemedhin, Lulekal and Bekele, 2021). For example, Miskoska-milevska, Stamatoska and Jordanovska (2020) investigated the traditional uses of wild edible plants in the Republic of North Macedonia. The authors indicated varies uses of *U. dioica* L. for preparation of infusion (leaves, roots, shoots, and seeds), dried leaves as spic, cooked as vegetable and medicinal purposes. Alemneh (2020) reported that *Urtica simensis* reserved only in home gardens and most commonly used species for live fence. (Al-Fatimi (2021)indicated that the use of wild plants are linked to food shortage, nutritional values and local cultural tradition. Many ethnobotanical studies of the wild edible plants contributed immensely in saving people during famine, drought and war in different developing and developed world countries (Addis, Urga and Dikasso, 2005; Abbasi et al., 2013).

The highest use-value indices of stinging nettle plant was in North Shewa zone (UVc = 0.93), followed by Arsi zone (UVc = 0.9), and Bale zone (UVc = 0.63). Its central role in North Shewa (FL = 51.7%) and Arsi [illegible] where as in Bale zone (FL = 33.3%) is as a source

of food only. A number of comparative studies on the use-value index of wild plants showed that stinging nettle, *Urtica spp.*, belongs to among the top 20 species with high preference for consumption with cultural importance index ranging from 0.5–1.26 CI (Mohammed S. Ali-Shtayeh et al., 2008; González, García-Barriuso and Amich, 2010; Çakir, 2017; Yesil and Inal, 2019; Ding et al., 2021; Hassen, 2021). For example, (Hassen, 2021) reported that from a total of 66 locally available wild plants, *U. simensis* belongs to the top five which have high preference for consumption in North Wollo, Ethiopia. In Turkey, stinging nettle is among the 20 widely consumed with cultural importance index (1.26 CI) of 154 wild plant taxa of Iğdır Province (Çakir, 2017). Recently, Ding et al. (2021) reported that stinging nettle, Urticaceae, have the highest cultural importance value next to Rosaceae from the total of 84 species of wild edible plants used by Chenthang Sherpa People, belonging to 62 genera in 40 families. Mohammed S. Ali-Shtayeh et al. (2008) studied traditional knowledge of wild edible plants used in Palestine. Stinging nettle is one of the top 20 widely consumed and with the highest mean cultural importance values in all five areas of Palestine. This could indicate that samma can be domesticated and grown as alternative crops in the future's agriculture and broadly used in human nutrition.

# Preferences for habitats to collect stinging nettles

The local people indicated that stinging nettles survive and perform well almost everywhere from marginal areas to fertile soil without any agricultural input and cultivation requirement. The results can be an indicator of the potential of stinging nettle to be integrated into the farming system, for rehabilitation of degraded lands, serve as organic compost, and enhance productivity of the area on top of their role in diversification of human diet. Studies reported that stinging nettle is mostly found in farmlands, grazing lands, roadsides, forests and home gardens, plentiful near houses and can be harvested whenever there is a need (Assefa, Haki and AddisDemoz, 2013; Alemayehu, Asfaw and Kelbessa, 2015; Kefalew, Asfaw and Kelbessa, 2015; Alemneh, 2020; Gebrezgabiher, Kalayou and Sahle, 2020). For example, (Prakash et al., 2020) studied the diversity, distribution and indigenous uses of wild edible plants used by the tribal community in Pangi valley, Chamba of Himachal Pradesh, North- Western Himalaya. The authors reported that stinging nettles, *U. dioica*, grows very well in shady moist, dry, degraded and rocky habitats.. Afolayan and Jimoh (2009) reported that wild plants besides the natural attributes of resistance against diseases, they are more adaptive to harsh environments and grown less intensively.

The results also provide a baseline for potential domestication action of stinging nettle to sustain their conservation and utilization. Vohland and Wydra (2011) addressed issues on the role of on-farm conservation of underutilized crops in the wake of climate change as complementary measure to ex situ.

# Economic status and frequency of gathering stinging nettle

According to informants, the local people who gather and cook stinging nettle are commonly referred as the poor and they call stinging nettle crop as a poor man crop. This could indicates a needs of further policy and local level awareness creation to really value stinging nettle plants and improve their uses and enhance their conservation for sustainable utilization. Vohland and Wydra (2011) indicated that efforts to promote neglected and underutilized plants are challenged by the fact that too often these resources are

wrongly perceived as being “food of the poor”. Gelmesa et al. (2010) studied shifting to alternative food source: potential to overcome Ethiopia’s’ malnutrition and poverty problems. The author reported that consumption pattern of wild plants were highly related with economic status and food shortage rather than recognizing the nutritional value of the plants. For the poorest indigenous vegetable make up an important portion of their daily dietary intake in most part of the country especially during food shortage.

A wide range of studies showed a renewed or increasing interest in consuming stinging nettle plants despite the stigma related to “a poor man crop”. For example, the tradition of eating stinging nettle has not completely disappeared, their food and nutritional role (Guil-Guerrero, Rebolloso-Fuentes and Torija Isasa, 2003; Kavalali, 2003; Sajfrtová et al., 2005; Garcia, 2006; Kukrić et al., 2012; Nencu et al., 2015; Branisa et al., 2017; Carvalho et al., 2017; Durović et al., 2018; Marchetti et al., 2018; Shonte, Duodu and de Kock, 2020; Pavković, 2021; Repajić et al., 2021; Garcìa et al., 2021) and health benefits (Gülçin et al., 2004; Kukrić et al., 2012; Upton, 2013; Ghaima, Hashim and Ali, 2013; Johnson et al., 2013; Ahmed Kk and Parsuraman, 2014; Zeković et al., 2017; Jan, zarafshan and Singh, 2017; Dhouibi et al., 2020; Moreira et al., 2020; Rawat, Bameta and Gaur, 2020; Karg et al., 2021) being reported in many recent studies worldwide.

Additionally, a number of comparative studies on the use-value index of wild plants in different areas of the world showed that stinging nettle, *Urtica spp*., belongs to among the top 20 most culturally important species with high preference for consumption (González, García-Barriuso and Amich, 2010; Demir, 2020; Ding et al., 2021; Hassen, 2021). However, in Ethiopia the stigma related to stinging nettle “samma” being as poor man food is one of the reason masking its cultural importance and underutilization by the community. Therefore, urgent ethnobotanical studies and subsequent conservation measures are needed to salvage this plants and the associated knowledge from further loss.

# Seasonal availability of stinging nettle

Stinging nettle give new flushes of growth during dry months of December to February (winter) and shortly after small rains of March to May (Spring). Which is in agreement with the findings of Feyssa and Feyssa (2012), when there is shortage of food from farm managed crops wild edible plants become optional food and feed resources However the authors noted that weedy vegetables were available only during short rainy seasons. The availability of stinging nettle during the dry periods implies their drought resistance characteristic that puts them in a relatively better position in their contribution to the community lacking alternative vegetable sources. Hence, there exists biological security to livelihood of people in the study areas by consuming stinging nettle to cope up times of food shortage.

Studies reported the seasonal availability of wild plants, e.g. stinging nettle plants (Asfaw and Tadesse, 2001a; Wondimu, Asfaw and Kelbessa, 2006; Yesil and Inal, 2019; Alemneh, 2020; Agarwal and Chandra, 2021; Ding et al., 2021). For example, the Chenthang Sherpa people collect wild edible plants (e.g. Stinging nettle) almost throughout the year, except for January and February (Ding et al., 2021). In Batman Province-southeast Turkey, Yesil and Inal (2019) found that farm herbaceous plants are ey dry out in the summer heat and local people

shift to consuming wild plants instead. Gelmesa et al. (2010) reported that consumption of indigenous vegetables is mainly during grain shortage.

Seasonal food shortages, when household stocks were empty and the new crop were still in the field were common times to dowel on collecting and consuming of stinging nettle in the study area. These could act as a motives for local people to conserve stinging nettles and encourage their domestication. Fentahun and Hager (2009) and Addis, Urga and Dikasso (2005) indicated that the year-round availability of wild edible plants provides supplementary food and nutrition and presents an opportunity for trade if properly supported by extension services. Wild plants were mostly consumed by households when there is a collapse in the harvest of cultivated food crops because of drought (Asfaw and Tadesse, 2001; Wondimu, Asfaw and Kelbessa, 2006; Alemneh, 2020). On the other hand, utilization of wild edible plants as complementary food indicates low awareness on the use and management of wild edible plants (Feyssa, 2012).

# Consumable parts and traditional manipulation practices to collect stinging nettle

Local people explained that they use young and tender shoots to prepare local sauces, roots for medicine and the whole plant for fodder. Similarly, young and tender shoots represent the consumable part of the stinging nettle plant as these have higher nutritional value compared to mature leaves (Kavalali, 2003; Ioana et al., 2013). Recent studies reported that young nettle leaves extracts are a good source of polyphenols and phytochemicals that render them with nutritional, nutraceutical and functional properties. Polyphenols content of nettle leaves showed a decreasing trend with the phenological stage, total polyphenols decreased for almost 50% by the 3rd phenological stage (Repajić et al., 2021).

A number of studies reported that young and tender nettle leaves are cooked as vegetable, boiled or added to soups and sauce, dried as spice, used to prepare infusion and decoction, and for salad (Bhat, Rubuluza and Jäger, 2002; Kavalali, 2003; Maria S. Gião et al., 2007; Moskovitz, 2009; Maanda and Bhat, 2010; González, García-Barriuso and Amich, 2010; Jimoh et al., 2010; Roberts, 2011; Adhikari, Bajracharya and Shrestha, 2016; Çakir, 2017; Yesil and Inal, 2019; Prakash et al., 2020; Demir, 2020; Hançer et al., 2020; Ding et al., 2021; Kumar, 2021).

In some recent works on young nettle leaves were used for production of functional foods e.g. nettle enriched egg pasta showed the highest levels for bioavailability of micronutrients and plant metabolites at a lower colonic fermentation time (Bonetti et al., 2016; Marchetti et al., 2018); stinging nettle extract in combination with ε-polylysine enhanced the quality, safety, and shelf life of rainbow trout fillets (Azmir et al., 2020); bread-making products enriched with nettle leaves significantly increased the level of fibers, calcium and copper, and total phenolic content, lutein and β-carotene (Maietti et al., 2021); addition of whole leaves decreased the sensory quality of the bread whereas the extract improved the sensory quality and phenolic acids, flavonoids, micro elements, and macro elements (Đurović et al., 2020); addition of freeze dried extract of nettle in chocolates resulted in chocolates with an enhanced and stable

polyphenolic profile during 12 months of storage, furthermore dark chocolates enriched with nettle extracts was preferred over milk and semisweet chocolates (Belščak-Cvitanović et al., 2015).

Interestingly, covering hands with cloths and wearing plastic bags were traditional manipulations practiced by the local community to protect themselves from stinging hairs thereby avoiding stinging sensation and collect the young and tender shoots from the plant. The leaves and stems of stinging nettle plant has stinging hairs called trichomes (Fig. 5). The trichomes contain chemicals such as histamine, 5- hydroxytryptamine and acetylcholine and when touched by humans and other animals it produces a stinging sensation (Bisht, Bhandari and Bisht, 2012; Mithril and Dragsted, 2012). The root, however, lacks stingers (Upton, 2013). Therefore, hand gloves and leg protection should be used to avoid the stings when harvesting the leaves (DiTomaso and Healy, 2007). The irritating contents of the stinging hairs are dissipated upon drying (Upton, 2013), blanching and cooking of the leaves (Hughes et al., 1980; Rutto et al., 2013).

# Traditional methods of preparing stinging nettle for human consumption

Processing of stinging nettle plants will add value to their palatability and add charisma to the consumers. This could enable the local people to add value and support their livelihoods better than the way they use them traditionally. Stinging nettle leaves based dishes are used in the diet of many countries, particularly among low socioeconomic populations. In the study areas, a sauce is prepared from young nettle leaves and barley powder and served with injera (Table 7). As an example, nettle soup or potherb in Nepal (Adhikari, Bajracharya and Shrestha, 2016), and nettle leaves added to soups or stews in Nordic countries (e.g. Denmark, Finland, Iceland, Norway and Sweden) (Mithril and Dragsted, 2012). In the areas around the Black sea, nettles are traditional foods consumed for health purposes. It is used in the form of a sour soup in Romania, as a nettle walnut sauce in Georgia and as a herb in Ukraine (Danesi et al., 2013). Maanda and Bhat (2010) reported that stinging nettle has a flavour similar to spinach when cooked, and it is used as a side dish to flavour the meal or used to add a bitter taste to meals. Infusion and decoction made from nettle leaves leaves and leaf powder is the most traditionally used form of drinks in Portugal (Maria S Gião et al., 2007).

Furthermore, wide range of recent studies reported the traditional cooking methods of stinging nettle leaves for human consumption. For example, the leaves and the aerial parts of stinging nettle: fresh leaves cooked as vegetable or dried leaves added to soup, especially in winter (Demir, 2020); leaves are used to prepare saag for remedy to Anthelmintic, antiseptic, dandruff, gout, nephritis sprain (Kumar, 2021); decoction and infusion (Maria S. Gião et al., 2007; González, García-Barriuso and Amich, 2010; Shonte, 2017); first boiled and then fried with onions (Yesil and Inal, 2019), frequently used as green vegetable (Prakash et al., 2020); Sauteed in oil, added to pastry, fried with egg, boiled as salad and tea (Hançer et al., 2020); eaten raw, cooked with bulgur in Iğdır Province, Turkey (Çakir, 2017); roasted and then cooked, and boiled with oil and salt Vegetable (Ding et al., 2021). Local people have good knowledge



cessing, and cooking method as well about their

traditional medicinal value. The findings from the current and previous studies stinging nettle plant indicates its potential for domestication, value addition and processing for food and nutritional security and wellbeing of the consumers.

A number of recent studies attested the importance of stinging nettle plants for biological security of food source (González, García-Barriuso and Amich, 2010; Ranjan, Jamir and Ozukum, 2013; Çakir, 2017; Suwardi et al., 2019; Yesil and Inal, 2019; Miskoska-milevska, Stamatoska and Jordanovska, 2020; Prakash et al., 2020; Alemneh, 2020; Demir, 2020; Hançer et al., 2020; Agarwal and Chandra, 2021; Al-fatimi, 2021; Katrahalli and Siddeshwari, 2021; Kumar, 2021; Purba and Silalahi, 2021; Woldemariam, Demissew and Asfaw, 2021; Woldemedhin, Lulekal and Bekele, 2021; Ding et al., 2021; Golait, Auti and Laware, 2021; Hassen, 2021). Earlier studies support the present findings in the existence of high potential of stinging nettle plant to food security (Mohammed S Ali-Shtayeh et al., 2008; González, García-Barriuso and Amich, 2010; Çakir, 2017; Yesil and Inal, 2019; Ding et al., 2021; Hassen, 2021).

# Analysis of Gender to collect and prepare stinging nettle

Although there were still prevailing attitudes in the community in favour of more responsibility (93.25%) on women and girls. Stinging nettle shrubby growth nature and wide availability near homesteads could have made the harvesting and collection process easier for women. Earlier studies support the present findings that stinging nettle plant predominantly leaves and young shoot parts collected and traditionally cooked by women and children (Abdulkadir and Kusolwa, 2020). In contrast, most species of tall and tree wild edible plants were predominately collected by young males especially by shepherds whereas females take full responsibility of cooking and serving the food to the family members (Alemneh, 2020). The authors' reason out that males might have better ability to climb and grip mature tallest trees than females.

# People's perception and factors limiting harvesting and consumption of stinging nettles

Although socio-cultural barrier (e.g. religion and cultural norms and values) is the major limiting factor for consumption of stinging nettles, lack of knowledge on its food and nutritional importance and its stinginess contributed much to the underutilization of the plant. A number of recent studies stressed on the need to preserve oral traditional knowledge of the local wild plants used as food and/or nutraceutical sources for human (Pardo-de-Santayana et al., 2007; Yesil and Inal, 2019; Al-fatimi, 2021; Woldemedhin, Lulekal and Bekele, 2021). (Pardo-de-Santayana et al., 2007) studied traditional knowledge of wild edible plants used in the northwest of the Iberian Peninsula, Spain and Portugal. The authors reported that wild edible plant usage appear to depend mainly on socio-cultural factors rather than biological ones such as climate or richness of the wild edible flora. Flyman and Afolayan (2006) indicated that indigenous people in remote areas are endowed with deep knowledge concerning the use of these wild species as food especially during period of drought, famine, and civil unrest.

According to the information available, stinging nettles consumption is considered as shame and insult. In normal times only women and the poorest families regularly collect and consume stinging nettles. Farmers interviewed stated that stinging nettles are not consumed except when there is a serious shortage of food. Some of the farmers when questioned obviously felt ashamed and maybe offended by outsiders asking questions about such sensitive issues as the consumption of famine food. Under such precarious situation, the indigenous knowledge associated with the plant can be lost irreversibly. It has been previously reported that efforts to promote wild edible plants are also challenged by the fact that too often these resources are wrongly perceived as being “food of the poor” (Vohland and Wydra, 2011). Stinging nettle has been used as famine food in many areas of the world, from the Great Potato Famine in Ireland, 1845/49, to famines in Scandinavia, Ethiopia, and North India. Recent studies reported that wild edible plants such as *Snowdenia polystachya* (Muja), *Eleusine coracana* (Degelie or wanga), *Urtica simensis* (Sama) and *Medicago polymorpha* (Amaqito) are consumed during normal and famine periods (Woldemedhin, Lulekal and Bekele, 2021). In rural Spain and Portugal, many wild edible plants are regarded as famine food and are no longer gathered (Pardo-de-Santayana et al., 2007).

Although stinging nettle plants often have a stigma attached to them, being regarded as poor people's food, they are increasingly popular as local food that reflects regional identity. For example, there is a traditional song by Maritu Legesse and Amharic sayings, “These Ambassels’ know the recipe, they use samma sauce on barley bread/injera”, reflecting the food value of stinging nettles by the local community of Ambassel district of Northern Ethiopia. Additionally, movements such as chefs' interest in offering new flavours and dishes can play a crucial role in boosting the social importance of such resources. For example, one of the great chefs’ of Ethiopia, Chef Johannes, demonstrated the food and nutritional value of stinging nettle “samma” together with its cultural norms and values. Therefore, the indigenous knowledge on the way local people perceive and use stinging nettles “samma” plays an important role in their conservation and as to whether a family could maintain nutritional well-being or succumb to malnourishment.

# Conclusions

The results data reflects the strong relationship between the local peoples and the valuable knowledge of the uses of samma as a sources of food, feed and medicine. The highest use-value indices of stinging nettle plant was in North Shewa zone (UVc = 0.93), followed by Arsi zone (UVc = 0.9), and Bale zone (UVc = 0.63). Its central role in North Shewa (FL = 51.7%) and Arsi zone (FL = 50 %) is as a source of both food and fodder, where as in Bale zone (FL = 33.3%) is as a source of food only. Seasonal food shortages, when household stocks were empty and the new crop were still in the field were common times to dowel on collecting and consuming of stinging nettle in the study areas. There exists biological security to livelihood of people in the study areas by consuming stinging nettle to cope up times of food shortage. Although the local people have good knowledge of stinging nettles season of availability, harvesting and cooking method as well about its medicinal value, the stigma related to samma being as poor man food is one of the reason masking its cultural importance and underutilization by the community. Therefore, plants and the associated knowledge from

further loss. This result shed light on further research and a needs to popularize, awareness creation, the potential for domestication, value addition and processing for food and nutritional security and wellbeing of the consumers.

## Declarations

# Authors' contributions

Tigist T. Shonte: Conceived and designed the experiments; Performed the experiments; Analysed and interpreted the data; wrote the paper. Kebede W/Tsadik: Conceived and designed the experiments; wrote the paper.

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# Ethics approval and consent to participate

The study was approved after an official permission letter from the office of research and extension Haramaya University and submitted to the North Shewa, Bale and Arsi zones, District Administrative and Kebele Administrative Offices. Verbal consent was also obtained from each and all informants who participated in the individual and group discussions after explaining the main objectives of the study with assistance of local language translators.

# Availability of data and materials

All data generated or analysed during this study are included in this published article.

# Consent for publication

"Not applicable" in this section

# Competing interest statement

The authors declare no conflict of interest.

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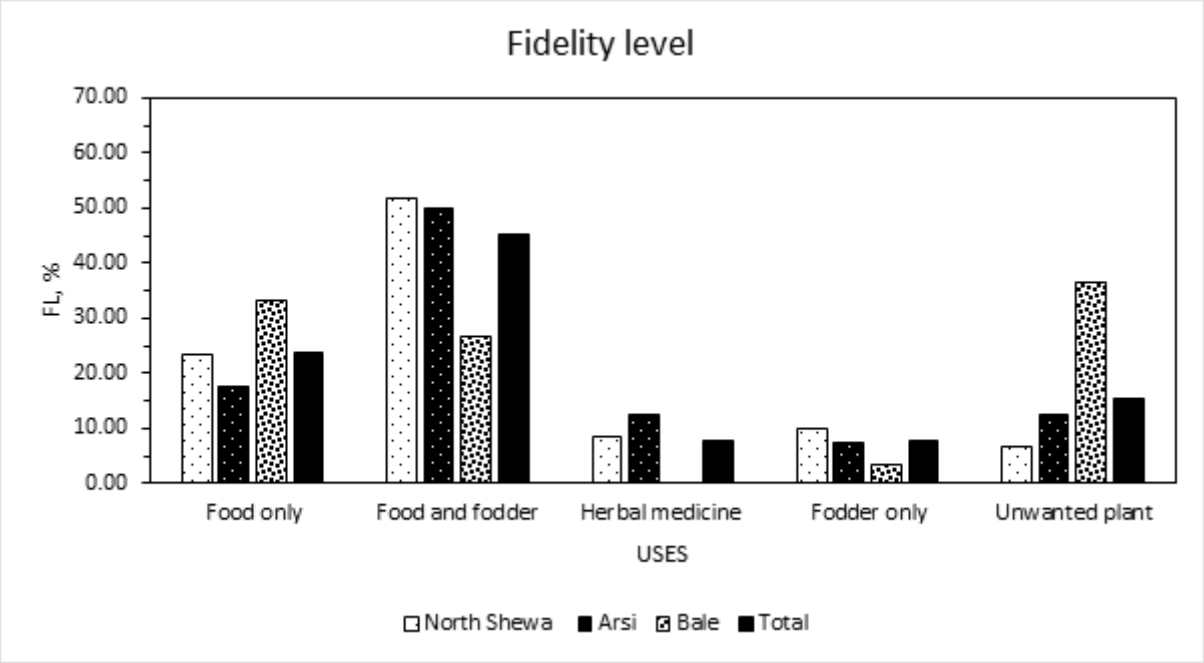
# Figures

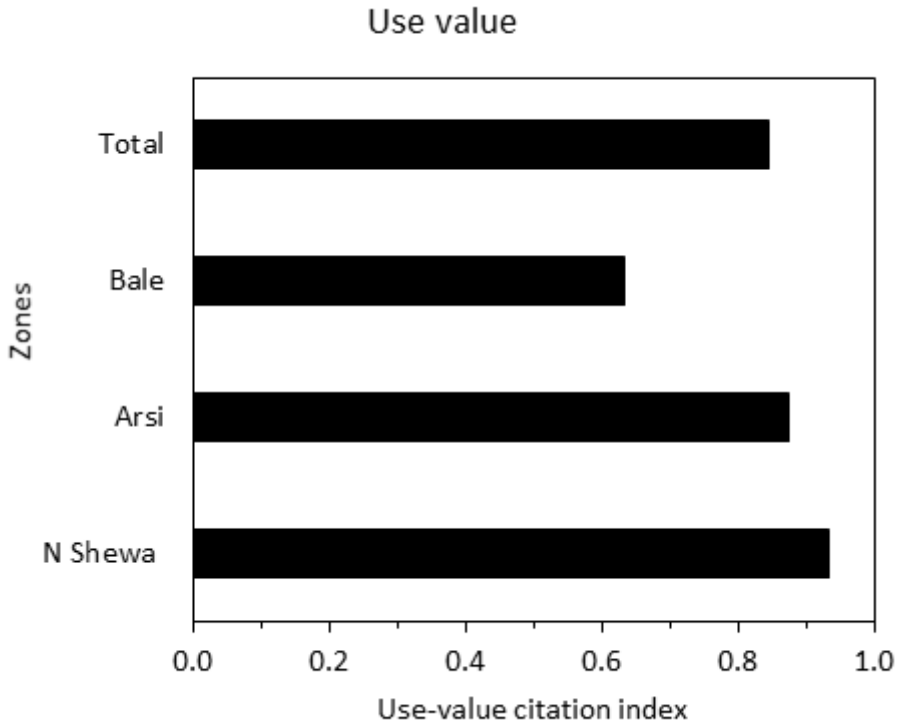

**Figure 1**

Map of Oromia regional states of Ethiopia showing study areas (North Shewa, Arsi and Bale zones)



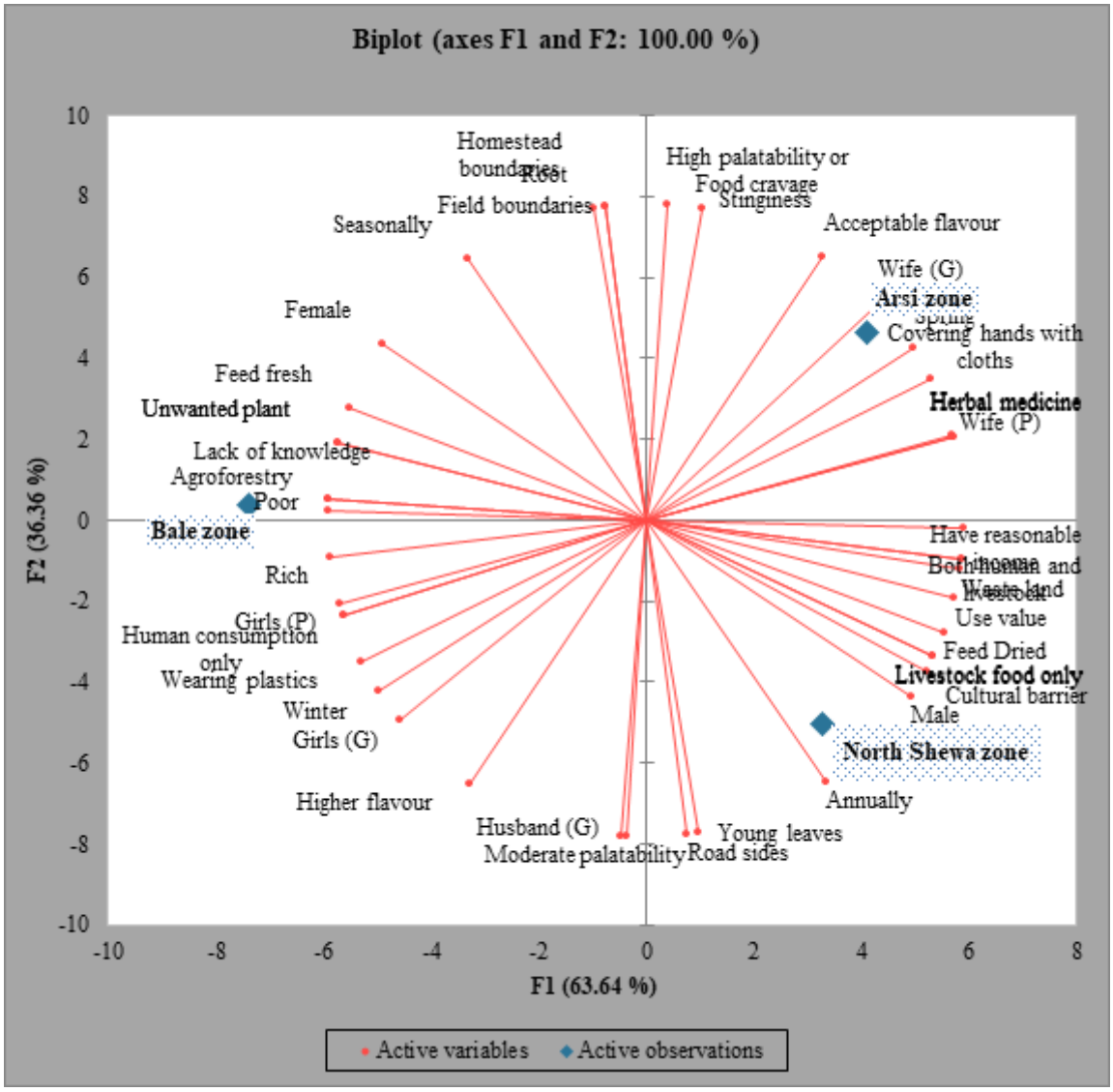

## Figure 2

Fidelity level percentage of the various uses of stinging nettles in the three zones of Oromia regional states, Ethiopia.




## Figure 3

Use-value citation analysis of stinging nettles in the three zones of Oromia regional states, Ethiopia.




## Figure 4

Principal component loadings of frequency table in percentages with in districts to show a visual interpretation of differences in indigenous knowledge and consumer's perspectives of stinging nettles in North Shewa, Bale and Arsi zones of Oromia regional states of Ethiopia.

**Figure 5**

Stinging hairs on stems and leaves of nettle plant