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Ethnobotany of stinging nettle (*Urtica simensis Hochst*. ex. A. Rich.) in the Oromia region of central and southeastern highlands of Ethiopia

Tigist Tadesse Shonte* and Kebede Woldetsadik

Abstract

Background: Stinging nettle, *Urtica simensis*, has a wide range of distribution in the highlands of Ethiopia with untapped potential for a sustainable supply of healthy and nutritious food. This study was conducted to document ethnobotanical uses of *U. simensis* and the associated traditional knowledge of the indigenous people and to identify the factors limiting harvesting and utilization of stinging nettle in North Shewa (R4), Bale and Arsi zones of the Oromia region, central and southeastern highlands of Ethiopia.

Methods: Thirteen districts were purposively selected from the three zones and a total of 130 respondents were sampled, with consideration of gender, age, occupation, and wealth status. Data were collected using semistructured interviews, tour-guided field observations, and focus group discussions. IBM SPSS Statistical software package was used to analyze ethnobotanical data.

Results: Pearson's chi-square analysis showed that there is a significant association ($P < 0.05$) between zones and districts in the ethnobotanical knowledge of use categories. Stinging nettle plants have an average use value index of 0.91 with a central role (FL = 44.8%) as a source of food and fodder. Cultural norms and values followed by lack of knowledge and stinginess were the main limiting factor for harvesting and consumption of *U. simensis*. Cultural norms and values showed significantly higher correlations with the various uses of *U. simensis* ($r2 = 0.931$, $p < 0.001$) indicating the stigma related to stinging nettle being associated as poor man food or famine food were probably a major limiting factor for the utilization of *U. simensis*.

Conclusions: Future strategic policies should consider *U. simensis* as a source of food and fodder to fight food insecurity and improve the wellbeing of society. There is a need for local level and countrywide awareness creation, domestication, and future research on value addition and processing for effective utilization of the plant.

Keywords: Traditional knowledge, Use-value index, Wild plants, North Shewa (R4), Arsi, Bale, Cultural norms and values, Samma recipe

Background

Stinging nettle, *Urtica simensis,* is a ubiquitous herb with untapped nutraceutical potential for a sustainable supply of healthy and nutritious food in Ethiopia. Among the Urticaceae family that comprises 40 genera and greater than 700 species; *U. simensis Hochst.* ex. A. Rich.,

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is endemic to Ethiopia and has been known for a long time as a medicinal and food plant (Kavalali 2003). Studies reported that *U. simensis* (locally known as Samma), has a wide range of distribution in the highlands of Ethiopia, specifically in Gondar and Mekelle (Abdulkadir and Kusolwa 2020), West Showa zone of Oromia Regional State (Erenso and Maryo 2014), Yilmana Densa and Quarit Districts of West Gojjam Zone (Alemneh 2020), North Wollo zone (Hassen 2021), Yem Special District, SNNPR (Woldemariam et al. 2021), and Ensaro district, Amhara regional state (Woldemedhin et al. 2021).

Recent studies showed that stinging nettle plants are one of the most frequently consumed wild plants as a cooked vegetable and as a herbal medicine in different parts of the world. For example, Hassen (2021) reported that from a total of 66 indigenously available wild plants, *U. simensis* belongs to the top five which have a 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). Ding et al. (2021) reported that stinging nettle, Urticaceae, has the highest cultural importance value next to Rosaceae from the total of 84 species of wild edible plants used by Chenthang Sherpa People.

Stinging nettle is a rich source of phytochemicals, e.g. carotenoids (Durović et al. 2018; Kukrić et al. 2012); ascorbic acid (Durović et al. 2018; Shonte et al. 2020); phenolic compounds (Farag et al. 2013; Orčić et al. 2014; Repajić et al. 2021); protein and antioxidants (Shonte et al. 2020) and fatty acids (Guil-Guerrero et al. 2003; Kukrić et al. 2012). These attributes make nettle leaves a rich source of phytochemicals with confirmed antioxidant, antidiabetic, antimicrobial, antiulcer, and antihypertensive activities thereby justifying its use as a functional food as well as traditional medicine (Dhouibi et al. 2020; Johnson et al. 2013; Karg et al. 2021; Moreira et al. 2020; Tsegaye et al. 2009; Upton 2013; Zeković et al. 2017).

Urtica simensis have an underexploited potential for increased dietary diversity and utilization as herbal medicine documentation of the traditional knowledge on *U. simensis* of the indigenous people in the study area is essential. The present study was conducted to document the different ethnobotanical uses of stinging nettle (*U. simensis*) and the associated traditional knowledge of the indigenous community and to identify the factors limiting harvesting and utilization of stinging nettle in North Shewa (R4), Bale and Arsi zones of Ethiopia. The research answers various questions about the influence of demographic factors on the traditional knowledge, uses, preferences for habitats, frequency of gathering, seasonal availability, consumable parts, and factors limiting harvesting and consumption of stinging nettle by the indigenous community.

Methods

Descriptions of the study area and sampling method

The Oromia region with 353,690 km^2 of land area (32% of the country), represents the largest regional State of the 11 regions found in Ethiopia. Administratively, the Oromia region is divided into 17 zones, 245 Weredas, and 36 town administrations with 6500 kebele subdivisions. This study was conducted in North Shewa (R4), Bale, and Arsi zones of the Oromia region, central and southeastern highlands of Ethiopia (Fig. 1). North Shewa (R4) zone is located at 9° 75′ to 11° 92′ N and 41° 84′ to 44° 93′ E with altitude ranging from 1551 to 3010 m.a.s.l in the central part of Ethiopia. Arsi zone is located between 7° 72′ to 10° 32′ N and 42° 62′ to 46° 28′ E with altitude ranging 2000 to 3207 m.a.s.l in the southeastern part of Ethiopia. Bale zone located is between 5° 56′ to 9° 68′ N and 42° 89′ to 48° 51′ E with altitude ranging from 2492 to 3207 m.a.s.l in the southeastern part of Ethiopia.

According to Hurni (1998), in Ethiopia agroecological zonation is applied for a spatial classification of the landscape into area units with "similar" agricultural and ecological characteristics. These attributes include comparable agroclimatic conditions, similar conditions for livestock raising, comparable land resource conditions such as soil, water, or vegetative parameters, and similar topography. The authors further indicated that in mountainous countries such as Ethiopia the topography, in particular altitude, steepness, and slope characteristics, plays an important role in agroecological zonation. In line with this four major agricultural zones are identified in Ethiopia more precisely as being 'Kolla' at altitudes below 1800 m a.s.l., 'Weyna Dega' for altitudes between 1800 and 2400 m, and 'Dega' for areas above 2400 m; and 'Wurch', for areas higher than 3800 m a.s.l. Accordingly, the study areas North Shewa (R4) and Arsi zones are categorized under Weyna Dega whereas Bale zone is Dega (Fig. 2).

The study areas experience a temperate climate of moderate temperature, (mean temperature of the coolest month is less than 18 °C) and annual precipitation ranging from 1200 to 2000 mm (Adugna 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 plants.

A reconnaissance survey was conducted in April 2019 to produce a specific description of the study sites and gain an overview of the availability, distribution, and consumption practice of stinging nettle. In the study, six districts from the North Shewa (R4) zone (Wara Jarso,

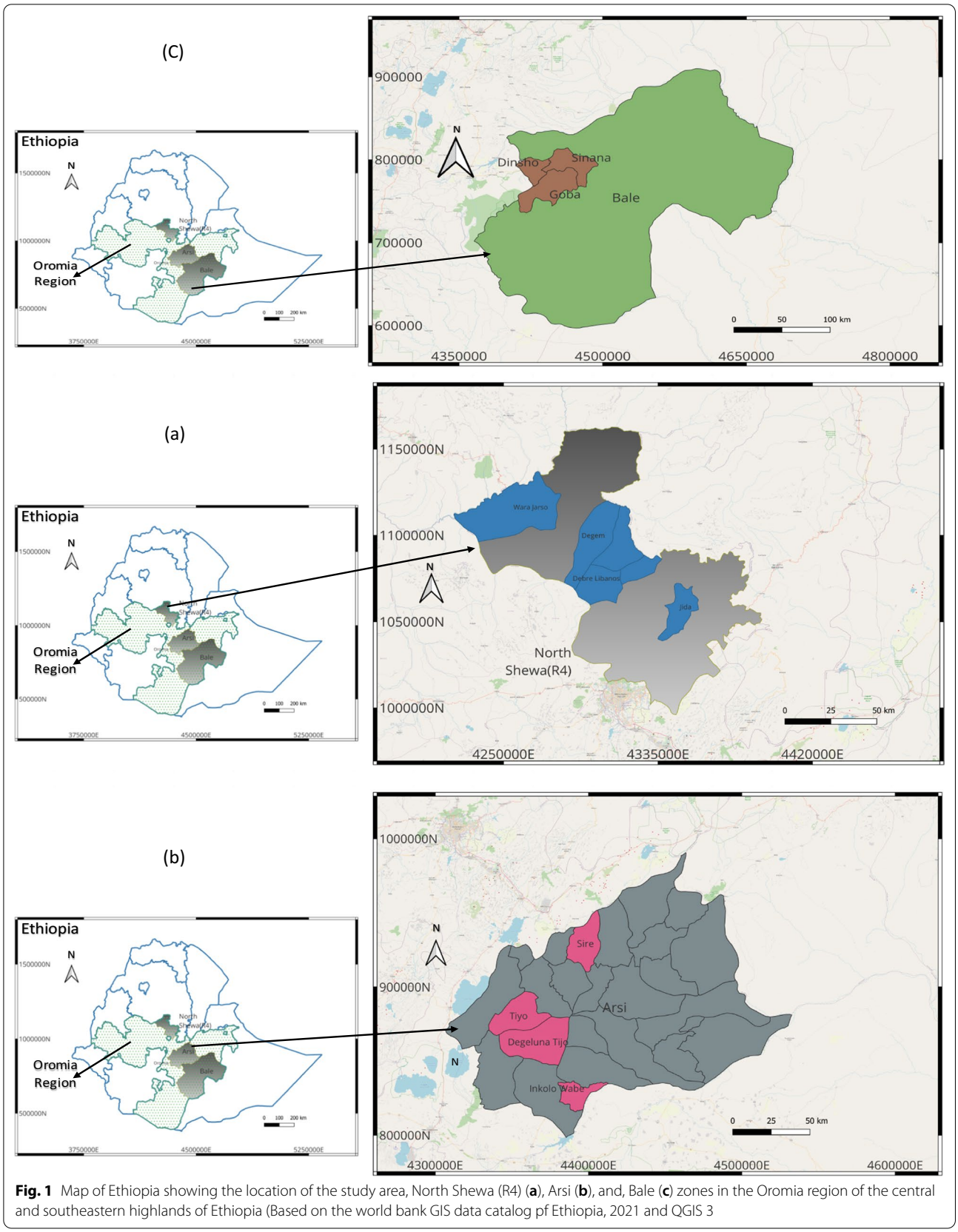

Fig. 1 Map of Ethiopia showing the location of the study area, North Shewa (R4) (**a**), Arsi (**b**), and, Bale (**c**) zones in the Oromia region of the central and southeastern highlands of Ethiopia (Based on the world bank GIS data catalog pf Ethiopia, 2021 and QGIS 3

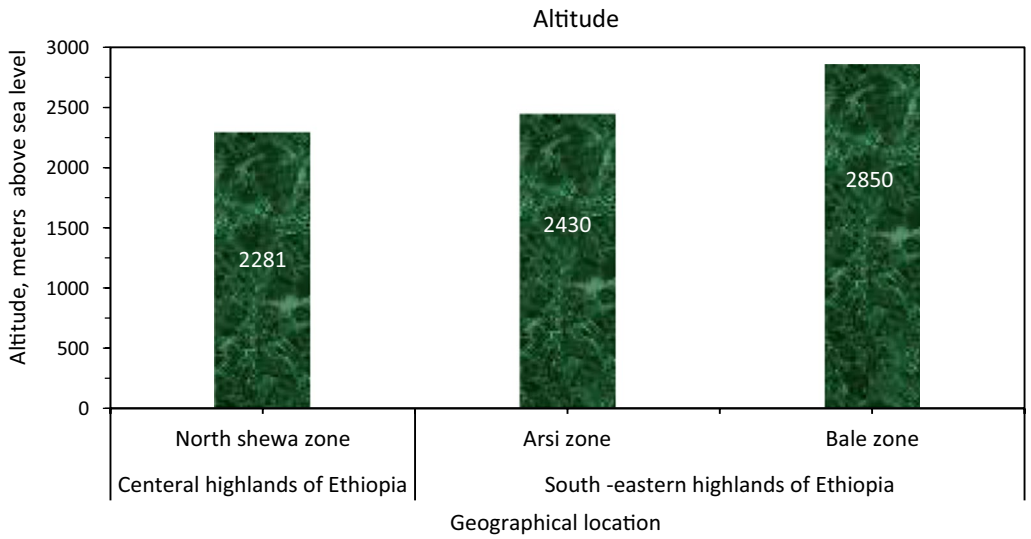

Fig. 2 The altitude of North Shewa (R4), Arsi, and Bale zones

Degem, Gerar Jarso, Debre libanos, Yaya Gulele, and Jida), four districts from the Arsi zone (Tiyo, Sire, Degeluna Tijo, and Inkolo Wabe districts) and three districts from Bale zone (Dinsho, Sinana, and Goba districts were selected considering the long history use and availability of stinging nettle. After selecting the study sites, a discussion was made with the respective responsible government officials of the districts administrators and agricultural development agents. The discussion was conducted after a clear explanation of the objectives, planned activities, and duration of the research. Kebeles (villages) were then selected that met the selection criteria. Tour-guided field observation was made jointly with agricultural development agents to select Kebeles and to check the availability of stinging nettle plants within the study area. The information generated through this activity supported purposively selecting five households and two sample Kebeles from the respective districts of each zones. Formal letters were written to selected rural kebeles by the responsible district offices. It was essential to maintain contact with the indigenous people while studies were conducted.

Respondents were stratified by age, gender, wealth status, and occupation of the households. The household wealth index is constructed based on "the number and kinds of consumer goods they own, ranging from a television to a bicycle or car, in addition to housing characteristics such as a source of drinking water, toilet facilities, and flooring materials" (Adugna 2021). Accordingly, each participating household was scored for wealth status as either low income or middle income to high income. The 104 general informants were identified by taking three household informant from each stratified randomly identified household and one key informant from each Kebele were purposively selected making a total of 130 informants. Informant sampling approach was following (Alexiades 1996). Thus, out of the 130 informants, 104 (4 informants × 2 Kebeles × 13 districts) were general informants selected randomly by a lottery method from the stratified households to give equal chances. The other 26 informants (from 13 districts × 2 Kebeles × 1 key informant) were key informants selected purposively based on the recommendations from local authorities, confirmed to be knowledgeable about stinging nettle, and volunteered to participate in the study. This procedure satisfied local customs and official ethical guidelines on carrying out the study on traditional knowledge and uses of stinging nettle (*U. simensis*) in the central and southeastern highlands of Ethiopia. Government bodies and indigenous community members have fully consented and facilitated the work.

Demographic characteristics of informants

A total of 130 informants (49 male and 81 female) between 18 and 78 years of age were interviewed (Table 1) and four to five individuals in each kebele were involved in the focus group discussions for triangulation of the collected information. About 17.7% were 18–30 years old, 16.2% were 31–45 years old, 19.2% were 46–55 years old, 21.5% were from 56 to 70 years old, and the remaining 25.4% were 71–78 years old. Respondents were from different occupations, 46.2% were farmers, 13.1% were merchants, 13.1% were students, 10% were

Table 1 Cross-tabulation of gender with age and occupation of the households

	Gender			
	Male	Female	Total	%
Age of the households				
18–30	13	10	23	17.7
31–45	10	11	21	16.2
46–55	6	19	25	19.2
56–70	8	20	28	21.5
> 70	12	21	33	25.4
Total	49	81	130	100.0
Occupation				
Farmer	21	39	60	46.2
Merchant	6	11	17	13.1
Student	8	9	17	13.1
Agricultural development agent	6	7	13	10.0
Teacher	5	10	15	11.5
Government officers	3	5	8	6.2
Total	49	81	130	100.0

agricultural development agents, 11.5% were teachers and the remaining 6.2% were government officers.

Data collection

The ethnobotanical data on traditional knowledge and uses of stinging nettle were collected using a semi-structured interview, tour-guided field observation, and focus group discussions (Alexiades 1996). The semi-structured interviews comprised of a checklist of open-ended questions were prepared in English and translated to the local languages Amharic and Afaan Oromo by a proficient local translator. Each interviewee was asked the same questions independently without contacts or sharing information with the other informants or with the target population.

Tour-guided field observation with the agricultural development agents (Fig. 3) and a total of 26 focus group discussions (FGDs), one from each Kebeles, were conducted for crosschecking and triangulating the ethnobotanical data collected through the semi-structured interviews. Accordingly, the FGDs were undertaken in groups of four to five key informants, farmers, Kebele administrator, and agricultural development agents, mediated by the researcher in each of the selected Kebeles.

Data analyses

A Pearson's chi-square test was used to detect (at $P < 0.05$) the relationship of the ethnobotanical knowledge held by respondents between different districts, gender, wealth status, age groups, and occupation using IBM SPSS® Statistics. Two ethnobotanical quantitative indices, the use-value (UVc) citation index, and fidelity level (FL) percent were adopted in this study.

Use-value citation index

The use-value (UVc) citation index was used to evaluate the relative significance of stinging nettle plants in the three zones based on its cited uses. It was calculated using the following formula (de Albuquerque et al. 2007) (1):

Fig. 3 *U. simensis* around homestead boundaries of Goba district, Bale zone

$$UV_c = \frac{\sum U_{is}}{N} \quad (1)$$

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

Fidelity level

Fidelity level percent (FL %) was used to identify the central role of stinging nettle plants in a given study zone. It is a ratio between the total number of informants that individualistically cited a specific use (Nt) of the plant and the total number of informants (N) that cited the plant for any use (Friedman et al. 1986) (2):

$$FL\% = \frac{N_t}{N} \times 100 \quad (2)$$

Results

The various uses of stinging nettles

The results of the study show that stinging nettle is a multipurpose wild edible plant used by the indigenous people as a source of food, fodder, and herbal medicine while it is also regarded as a weed when found in the crop farming system. Almost 84.7% of the respondents of the thirteen districts widely expressed that they use stinging nettle as a source of food and fodder (58.5% of the respondents as both food and fodder, 20% of the respondents as source of food only, and 6.2% of the respondents as fodder only) (Fig. 4). About 10% of the respondents confirmed that they use stinging nettle as a herbal medicine whereas by 5.4%.of the respondents it is regarded as a weed.

A significant relationship was observed between traditional knowledge of the uses of stinging nettle with the age, wealth status, and occupation of the respondents ($X2 = 260$, $df = 24$, $P < 0.001$). Pearson correlation analysis demonstrated significant correlations between the age of respondents and the various uses of *U. simensis* in the study areas ($r2 = 0.929$, $p < 0.001$). This could probably indicate that older age respondents have more traditional knowledge about the uses of stinging nettle than younger age respondents. The different use categories in each district were analyzed using Pearson's chi-square test and the result shows that there is a significant association ($P < 0.05$) between zones ($X2 = 15.8$, $df = 8$, $P < 0.046$) and districts ($X2 = 72.7$, $df = 48$, $p < 0.012$) in the ethnobotanical knowledge of the different use categories.

Fidelity level analysis

Fidelity level (FL) analysis enable evaluation of the central role of the stinging nettle plant in the study areas; it is particularly important when considering the different use citations of the plant. For example, in North Shewa (R4) zone, the stinging nettle plant has a wider range of utilities, was cited for use 58 times with an average Use-value citation index (UVc) of 0.93 (Fig. 4). Stinging nettle plant, while it has cited uses for as a source of food only, food and fodder, herbal medicine and fodder only, its central role (FL = 43.9%) is as a source of food and fodder. In the Bale zone, on the other hand, the plant has a

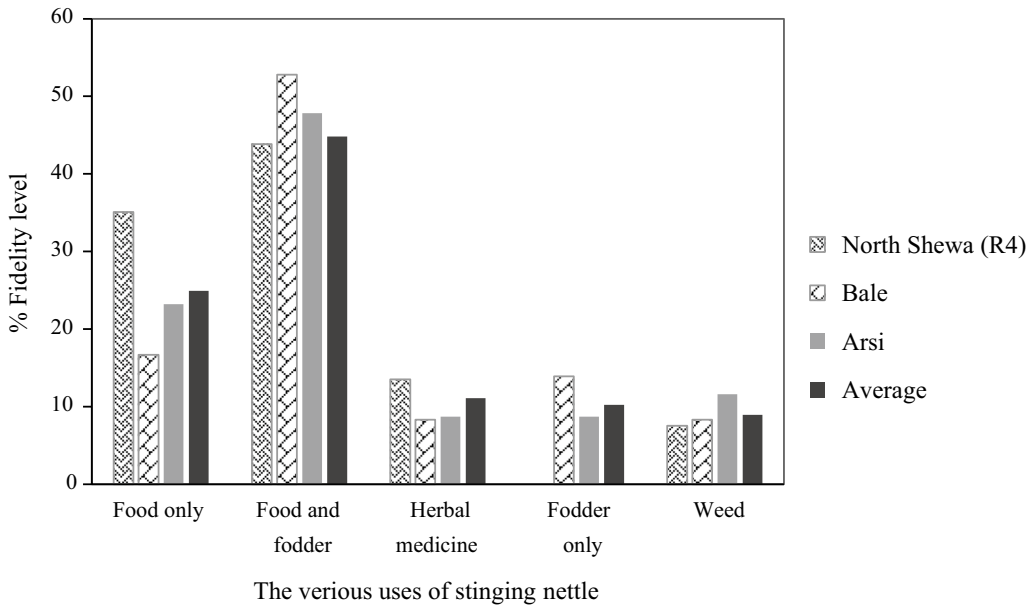

Fig. 4 Fidelity level percentage of the various uses of *U. simensis* in North Shewa (R4), Bale, and Arsi Zones

range of utilities, with a UVc of 0.92. Its highest FL value is 52.8% (for food and fodder), followed by as a source of food only (16.7%), fodder only (13.9%), and herbal medicine (8.3%).

In the Arsi zone, the plant has a use-value, UVc, of 0.88, and it was reported as a source of food and fodder (FL = 47.8%) or food only (23.2%). The stinging nettle plant has the highest FL value as a weed in Arsi (11.6%), followed by Bale (FL = 8.3%) and North Shewa (R4) (FL = 7.5%). Fidelity level analysis showed that the stinging nettle plant has an average use value index of 0.91, its central role (FL = 44.8%) is as a source of food and fodder, followed by as a source of food only (FL = 24.9%) (Fig. 4).

Use-value citation analysis

Use-value citation indices were determined for all cited uses of the plant. It enables the determination of the overall rank of the uses of the plant by informants, allowing for comparative analysis at the rank of individual zones.

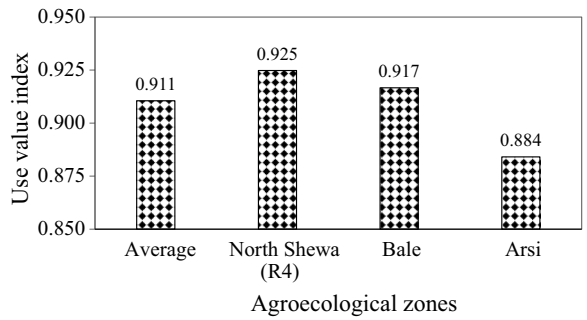

Fig. 5 Use-value index of *U. simensis* in North Shewa (R4), Bale, and Arsi Zones

The zone with the highest use-value indices for stinging nettle plant was North Shewa (R4) zone (UVc = 0.93), followed by Bale zone (UVc = 0.92), and Arsi zone (UVc = 0.88) (Fig. 5). Notably, the plant has UVc = 0.91 distributed across the different zones. Comparison of use-value indices at the zone level revealed that North Shewa (R4) zone and Bale 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 interviews administered to 130 informants indicated that the indigenous people gather stinging nettle almost from everywhere with a higher preference for agroforestry (32.3%) followed by wastelands (24.6%) and homestead boundaries (17.7%) (Fig. 6). The indigenous people indicated that stinging nettle survives and performs 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. The majority of the respondents in the Bale zone (34.8%) gather stinging nettle from homestead boundaries while in North Shewa (R4) zone high preference for roadsides (17.4%) followed by wastelands (16.4%).

Respondents' preferences for habitats to gather stinging nettle plant in each district were analyzed using Pearson's chi-square test and the result shows that there is a significant association ($P < 0.05$) between geographical locations (zones $X2 = 62.526$ df $= 8$ $P < 0.001$) and districts ($X2 = 246.276$, df $= 48$, $p < 0.001$). There is a significant ($P < 0.05$) relationship between age, gender, wealth

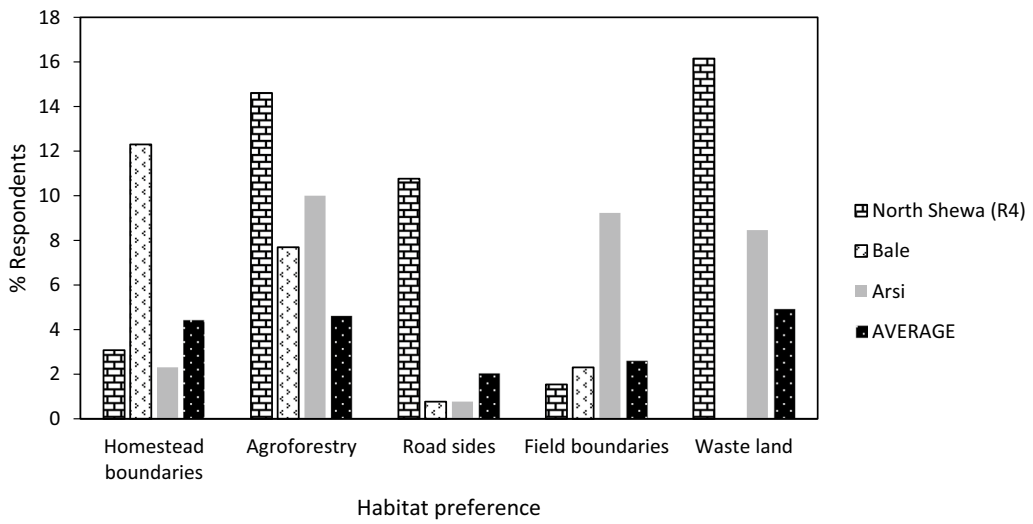

Fig. 6 Preferences for habitats to collect *U. simensis* in North Shewa (R4), Bale, and Arsi Zones

status, and occupation of the respondents regarding their preferences for habitats to gather stinging nettle plant ($X2 = 260$, $df = 24$, $P < 0.001$).

Frequency of gathering stinging nettle

The indigenous people gather stinging nettle seasonally and annually (Table 2). About 76.9% of the indigenous community gather stinging nettle seasonally and 17.7% annually. The results can be an indicator of the seasonal availability of stinging nettle and a need for preservation techniques to extend the utilization of the plant during the off-season. The majority of the respondents in the North Shewa (R4) zone (36.2%) gather stinging nettle seasonally, followed by the Arsi zone (23.3%) and Bale zone (18.5%).

There is a significant relationship between the age of respondents and their frequency of gathering stinging nettle ($X2 = 29.386$, $df = 8$, $p < 0.001$). Older age respondents gather stinging nettle more frequently than younger age respondents (Fig. 7a). A significant ($P < 0.05$) relationship also observed between the frequency of gathering stinging nettle with wealth status and occupation of the respondents ($X2 = 260$, $df = 24$, $P < 0.001$). Low-income indigenous people frequently gather stinging nettle over those who have a reasonable income and high income (Fig. 7b). Key informants during the focus group discussion explained that gathering and consumption of stinging nettle have linked to the economic standard. According to informants, the indigenous people who gather and cook stinging nettle are commonly referred to as the poor and they call stinging nettle crop as a poor man crop. This could indicate a need for further policy and local level awareness creation to value wild edible plants and improve their uses and enhance their conservation for sustainable utilization.

Seasonal availability of stinging nettle

Stinging nettle is adapted to specific seasons of the year. About 53.8% of the respondents indicated the availability of stinging nettle in the spring season whereas 46.2% of the respondents during winter seasons (Fig. 8). The indigenous communities of the different districts of the three

Table 2 Frequency of gathering of *U. simensis* in different districts of North Shewa (R4), Bale, and Arsi Zones

Districts	How frequently do you gather?					
	Seasonally		Annually		Never	
	No. respondents	%	No. respondents	%	No. respondents	%
North Shewa (R4)						
Jida	7	7.0	3	13.0	0	0.0
Degem	9	9.0	1	4.3	0	0.0
Gerar Jarso	8	8.0	1	4.3	1	14.3
Yaya Gulele	5	5.0	4	17.4	1	14.3
Wara Jarso	9	9.0	1	4.3	0	0.0
Debre Libanos	9	9.0	1	4.3	0	0.0
Total	47.0	36.2	11.0	8.5	2.0	1.5
Average	7.8	6.0	1.8	1.4	1.0	0.8
Bale						
Goba	7	7.0	2	8.7	1	14.3
Sinana	7	7.0	3	13.0	0	0.0
Dinsho	10	10.0	0	0.0	0	0.0
Total	24.0	18.5	5.0	3.8	1.0	0.8
Average	8.0	6.2	2.5	1.9	1.0	0.8
Arsi						
Inkolo Wabe	6	6.0	2	8.7	2	28.6
Tiyo	9	9.0	0	0.0	1	14.3
Degeluna Tijo	9	9.0	0	0.0	1	14.3
Sire	5	5.0	5	21.7	0	0.0
Total	29.0	22.3	7.0	5.4	4.0	3.1
Average	7.3	5.6	3.5	2.7	1.3	1.0
Total	100	76.9	23	17.7	7	5.4

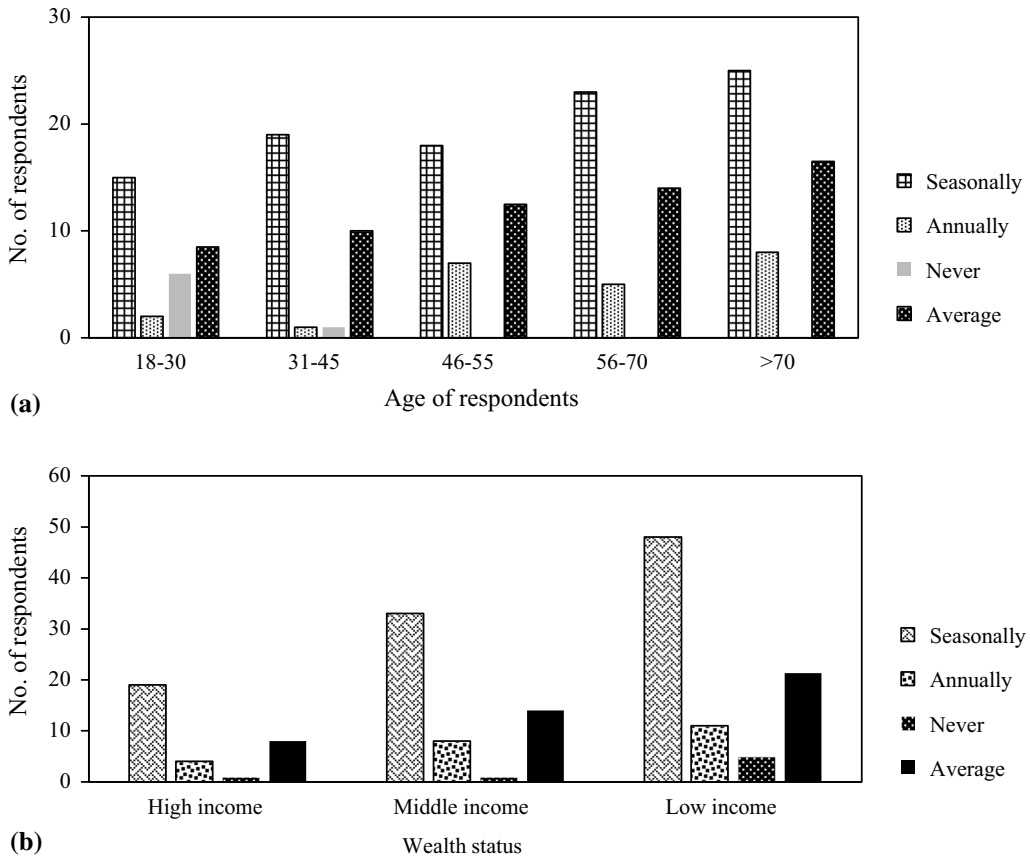

Fig. 7 The effect of wealth status (**a**) and age (**b**) of the households on the frequency of gathering *U. simensis* in the three zones of Ethiopia

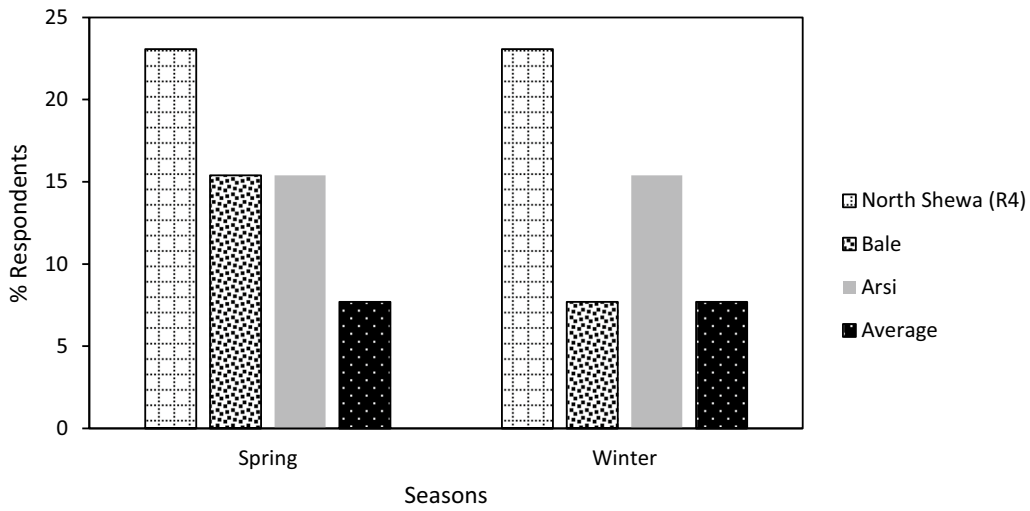

Fig. 8 The months (seasons) in which *U. simensis* is most available and consumed in three zones of Ethiopia

zones expressed that stinging nettle gives new flushes of growth during dry months of December to February (winter) and shortly after small rains of March to May (Spring) (Fig. 7).

The seasonal availability of stinging nettle in each district was analyzed using Pearson's chi-square test and the result shows that there is a significant association ($P < 0.05$) between the season of availability stinging nettle with geographical locations districts ($X2 = 130$, $df = 12$, $P < 0.001$), age, gender, wealth status, and occupation of the respondents ($X2 = 260$, $df = 24$, $P < 0.001$).

Consumable parts

Indigenous people explained that they use young shoots (87.7%) to prepare local sauces and the roots (6.2%) for their medicinal value (Fig. 9a). About 40% of respondents in North Shewa (R4), 27.7% in Arsi, and 20% in the Bale zone use young stinging nettle leaves as a source of food. Thirty-nine percent of the respondents use the leaves, 35.4% whole plant, and 23.1% root of the stinging plant as a source of fodder for their animals (Fig. 9b). There is a significant relationship between the age of respondents and their traditional knowledge of the consumable parts of stinging nettle ($X2 = 33.81$, $df = 8$, $p < 0.001$). Older age respondents know more about the consumable parts of stinging nettle as a source for food and herbal medicine than younger age respondents. A significant ($P < 0.05$) relationship was also observed between traditional knowledge on the consumable parts of stinging nettle plant with wealth status and occupation ($X2 = 260$, $df = 24$, $P < 0.001$).

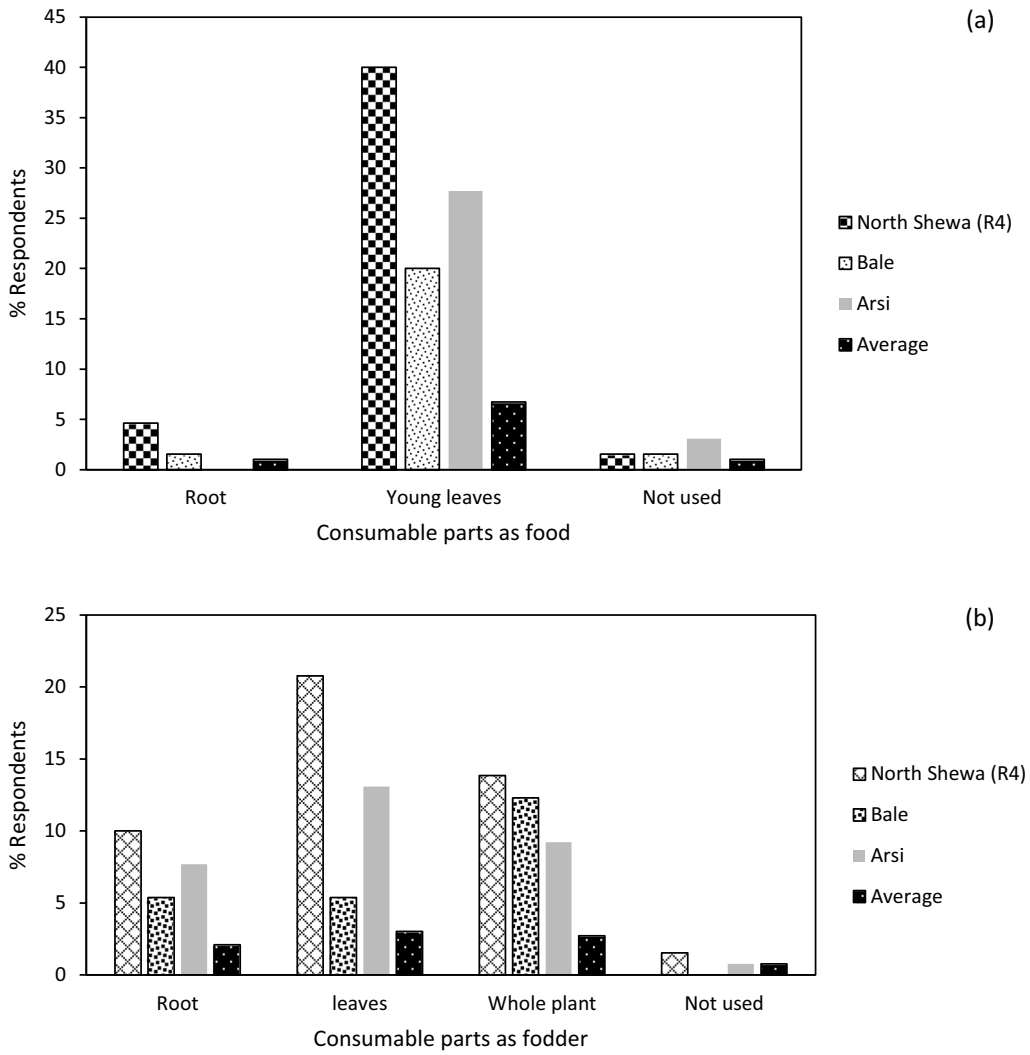

Fig. 9 Consumable parts of *U. simensis* as a source of food for human beings (**a**) and fodder for animal feed in North Shewa (R4), Bale, and Arsi zones

A traditional recipe of stinging nettle based sauce (Samma recipe)

The results of the study show that stinging nettle-based sauces are commonly consumed by indigenous communities. Table 3 presents a Traditional recipe for preparing stinging nettle sauce. Briefly, stinging nettle sauce is prepared by boiling young nettle leaves followed by adding roasted barley powder (cooking for 25–25 min), and then cooled sauce is served with injera. Focus group discussions and interactions made with households have shown that stinging nettle can contribute to people's livelihood and food security.

Traditional practices to collect stinging nettle

The majority of the respondents 69.2% (31.5% of North Shewa (R4), 16.9% of Bale, and 20.8% of Arsi) indicated that they cover their hands with cloths to collect stinging nettle (Fig. 10). Whereas 30.8% (14.6% of North Shewa (R4), 6.2% of Bale, and 10% of Arsi) of the respondents wear plastic bags to collect or harvest stinging nettle. Based on the consensus points of the focus group discussions, covering hands with cloths and wearing plastics were traditional manipulations practiced for protecting themselves from the stinginess and to harvest stinging nettle. The implication is that communities probably use sustainable techniques.

The traditional manipulations to collect stinging nettle in each district of North Shewa (R4), Bale and Arsi zones was analyzed using Pearson's chi-square test and the result shows that there is a significant association between geographical locations, districts ($X2 = 38.93$, $df = 12$, $p < 0.001$) and traditional manipulations to collect stinging nettle. A significant relationship was also observed between age, gender, wealth status, and occupation of the respondents regarding the traditional manipulations to collect stinging nettle ($X2 = 260$, $df = 24$, $P < 0.001$).

Table 3 Traditional methods of preparing *U. simensis* for human consumption in three zones of 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 min of boiling, separating the leaves from the liquids and they discard used water
5th	Mixing partly cooked leaves with specially prepared barley flour (hulled, slightly roasted, and milled barley grains) and recooking for 15 min
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)

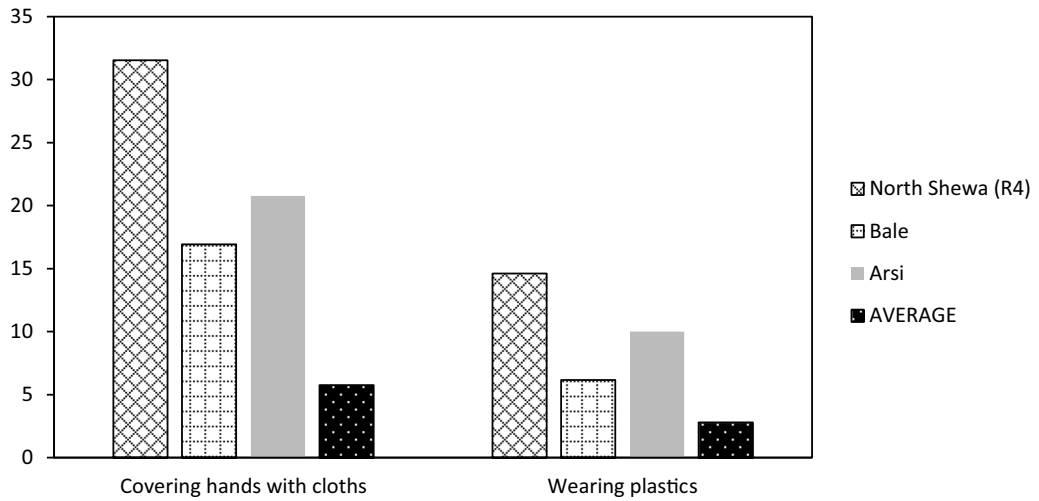

Fig. 10 Traditional manipulations to collect *U. simensis* in different districts of North Shewa (R4), Bale, and Arsi zones

Analysis of gender to collect and prepare stinging nettle

The results of the study show that all household members participate in collecting and preparing stinging nettle for home consumption; however, women carry 92.2% (63.8% wife and 28.5% girls) of responsibilities for collecting and 100% (76.2% wife and 23.8% girls) of responsibilities for preparing and serving the family food (Fig. 11). Cross-tabulation of occupation with gender in collecting and preparing stinging nettle for home consumption showed that women farmers take the majority of the burden for collection and preparation of stinging nettle.

Analysis of gender to collect and prepare stinging nettle in each district of North Shewa (R4), Bale, and Arsi zones were analyzed using Pearson's chi-square test. The result showed a significant association ($P < 0.05$) between gender of the respondents who collect and prepare stinging nettles with geographical locations, districts ($X2 = 62.12$, $df = 24$, $P < 0.001$), age, wealth status, and occupation of the respondents ($X2 = 260$, $df = 24$, $P < 0.001$).

Factors limiting harvesting and utilization of stinging nettles

The results of the study show that cultural norms and values, lack of knowledge, and stinginess were factors limiting harvesting and utilization of stinging nettles (Fig. 12). The majority of the respondents 65.4% (31.5% of North Shewa (R4), 14.6% of Bale, and 19.2% of Arsi) indicated that cultural norms and values were the main limiting factor for harvesting and marketing of stinging nettle. Whereas 20.8% of the respondents and the remaining 13.8% of the respondents indicated that lack of knowledge and stinginess were the limiting factors,

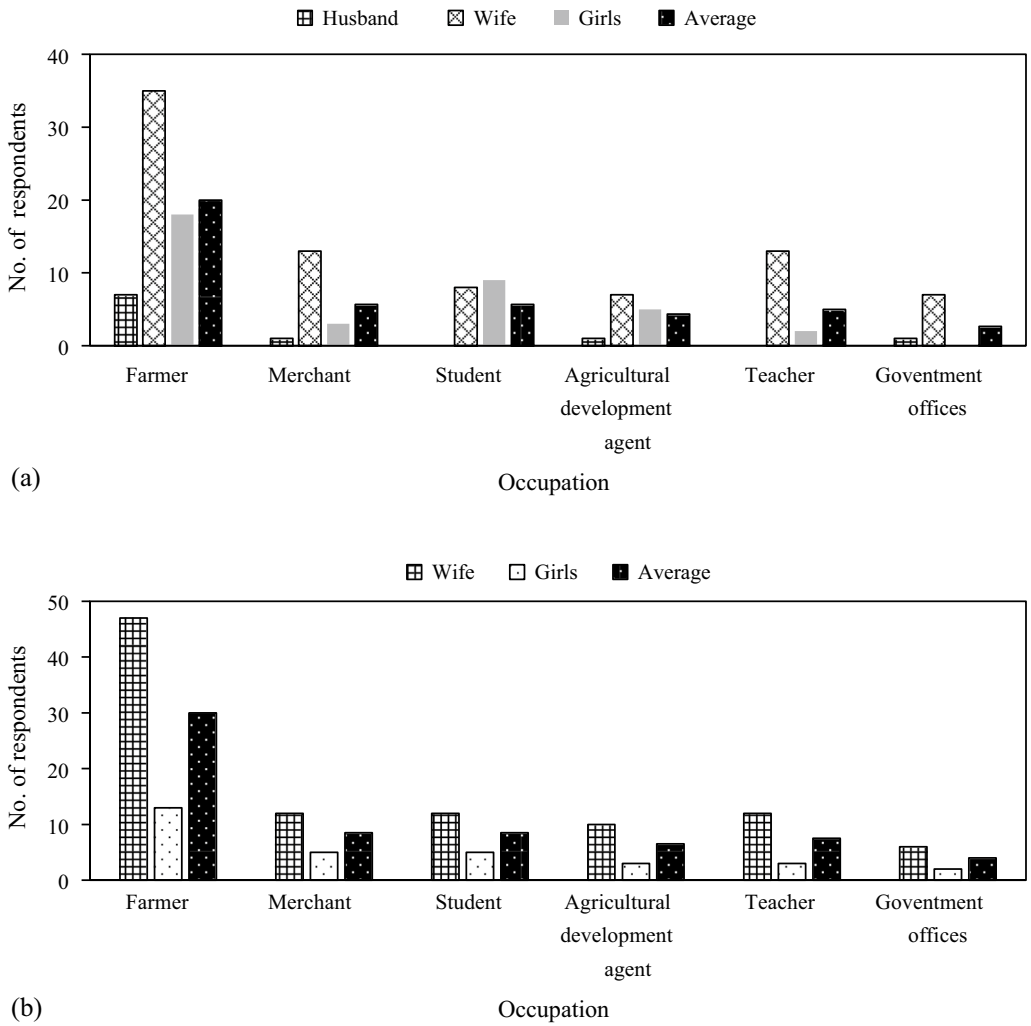

Fig. 11 The interaction of gender with the occupation of the respondents to collect (**a**) and prepare (**b**) *U. simensis*

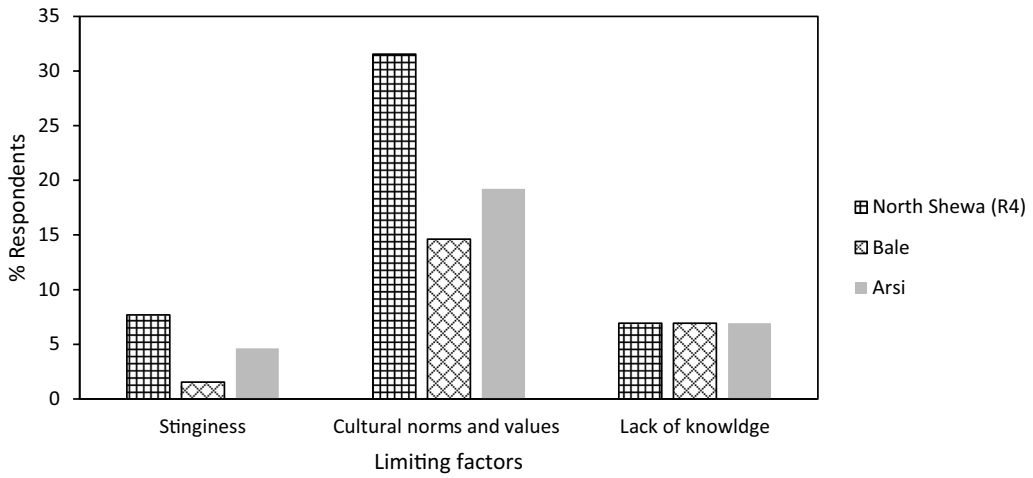

Fig. 12 Factors limiting harvesting and consumption of *U. simensis* in North Shewa (R4), Bale, and Arsi zones

respectively. The factors limiting harvesting and utilization of stinging nettles could be ranked as cultural norms and values (65.4%) > lack of knowledge (20.8%) > stinginess (13.8%).

Factors limiting harvesting and consumption of stinging nettles in each district of North Shewa (R4), Bale, and Arsi zones were analyzed using Pearson's chi-square test. The result showed that there is a significant association ($P < 0.05$) between geographical locations, districts ($X2 = 37.38$, $df = 24$, $P < 0.04$), age, gender, wealth status, and occupation of the respondents ($X2 = 260$, $df = 24$, $P < 0.0001$) regarding the factors limiting harvesting and consumption of stinging nettles. Pearson chi-square analysis indicated that stinginess, lack of knowledge, cultural norms, and values significantly affected the various uses and services of *U. simensis* in the study areas ($X2 = 260$, $df = 24$, $P < 0.0001$) (Table 4). The Pearson chi-square values clearly showed that cultural norms and values as the major factor limiting harvesting and consumption of stinging nettles, followed by lack of knowledge and stinginess in order of importance.

Pearson correlation analysis demonstrated significant correlations between the various uses and factors that limit harvesting and consumption of *U. simensis* in the study areas (Table 5). Cultural norms and values such as showed significantly higher correlations with the various uses ($r^2 = 0.931$, $p < 0.001$) indicating that the association of stinging nettle with famine food or poor man's food were probably a major limiting factor for harvesting and consumption of *U. simensis simensis* in the study areas. These observations also agreed with those found in the Pearson chi-square analysis presented in Table 5. Additionally, a significant association was observed between cultural norms and values with the wealth status of the respondents using Pearson chi-square analysis ($\times 2 = 170$, $df = 24$, $p < 0.001$).

Table 4 Pearson chi-square analysis of the relationship between the various uses and factors limit harvesting and consumption of *U. simensis* in the study areas

Uses	Limiting factors	Pearson chi-square	Asymptotic significance (2-sided)
Food only	Stinginess		
	Cultural norms and values	36	P < 0.001
	Lack of knowledge	6	P < 0.112
	Total	52	P < 0.001
Food and fodder	Stinginess	30	P < 0.008
	Cultural norms and values	90	P < 0.001
	Lack of knowledge	32	P < 0.004
	Total	152	P < 0.001
Herbal medicine	Stinginess		
	Cultural norms and values	20	P < 0.067
	Lack of knowledge		
	Total	26	P < 0.054
Fodder only	Cultural norms and values	6	P < 0.199
	Lack of knowledge	2	P < 0.157
	Total	8	P < 0.156
A weed	Cultural norms and values	12	P < 0.151
	Lack of knowledge		
	Total	14	P < 0.173
Total	Stinginess	36	P < 0.003
	Cultural norms and values	170	P < 0.001
	Lack of knowledge	54	P < 0.001
	Total	260	P < 0.001

Table 5 Pearson correlation coefficient (Pearson's R) analysis of the various uses and factors limit harvesting and consumption of *U. simensis* in the study areas

Uses	Limiting factors	Pearson's R	Significance
Food only	Stinginess		
	Cultural norms and values	0.947	P < 0. 001
	Lack of knowledge	0.843	P < 0.035
	Total	0.949	P < 0.001
Food and fodder	Stinginess	0.936	P < 0.001
	Cultural norms and values	0.924	P < 0.001
	Lack of knowledge	0.937	P < 0.001
	Total	0.928	P < 0.001
Herbal medicine	Stinginess		
	Cultural norms and values	0.934	P < 0.001
	Lack of knowledge		
	Total	0.917	P < 0.001
Fodder only	Cultural norms and values	0.923	P < 0.009
	Lack of knowledge		
	Total	0.898	P < 0.002
A weed	Cultural norms and values	0.990	P < 0.001
	Lack of knowledge		
	Total	0.978	P < 0.001
Total	Stinginess	0.931	P < 0.001
	Cultural norms and values	0.931	P < 0.001
	Lack of knowledge	0.923	P < 0.001
	Total	0.929	P < 0.001

Discussion

The various uses of stinging nettles

The indigenous communities of the study areas use *U. simensis* as a source of food, fodder, and herbal medicine. Ethnobotanical studies reported that stinging nettle is used as a source of food and herbal medicine (Ertuğ 2000; Güneş and Özhatay 2011; Kargioğlu et al. 2008; Mükemre et al. 2015; Özdemir and Alpınar 2015; Ozgen et al. 2004; Senkardes and Tuzlaci 2014; Simsek et al. 2004; Şükran 2008; Thapa et al. 2014; Yeşilyurt et al. 2017) and fodder (Şükran 2008). Recent studies on *U. simensis* indicated that the plant is used as a source of food in the highlands of Ethiopia (Alemneh 2020; Hassen 2021; Woldemariam et al. 2021; Woldemedhin et al. 2021). Purba and Silalahi (2021) reported that stinging nettles are among the 53 plant species used as food plants by Karo people in North Sumatra, Indonesia. Miskoska-milevska et al. (2020) investigated the traditional uses of wild edible plants in the Republic of North Macedonia. The authors reported that stinging nettle plants are used as a source of food and herbal medicine.

The stinging nettle plant has an average use value index of 0.91 with a central role (FL = 44.8%) as a source of food and fodder indicating its high cultural value and importance in the study areas. A number of comparative ethnobotanical studies on wild plants showed that stinging nettle, *Urtica spp*., belongs among the top 20 species with a high preference for consumption with cultural importance index (CI) ranging from 0.5 to 1.26 CI (Ali-Shtayeh et al. 2008; Çakir 2017; Ding et al. 2021; González et al. 2010; Yesil and Inal 2019). For example, Hassen (2021) reported that *U. simensis* belongs to the top five with a high preference for consumption from a total of 66 indigenously available wild plants in North Wollo, Ethiopia. In Turkey, stinging nettle is among the 20 widely consumed wild plants with 1.26 CI among 154 wild plant taxa of Iğdır Province (Çakir 2017). Recently, Ding et al. (2021) reported that stinging nettles have the highest cultural importance value from the total of 84 species of wild edible plants used by Chenthang Sherpa People. Furthermore, Ali-Shtayeh et al. (2008) studied traditional knowledge of wild edible plants used in Palestine. The authors described that stinging nettle is one of the top 20 widely consumed wild plants with the highest mean cultural importance values in all five areas of Palestine. This could probably indicate that *U. simensis* can potentially be domesticated and grown as alternative crops in the future's agriculture for a sustainable supply of healthy and nutritious food.

Preferences for habitats to collect stinging nettles

The indigenous people gather stinging nettles almost from everywhere with a higher preference for agroforestry followed by wastelands and homestead boundaries. This could indicate that stinging nettles can perform well from marginal areas to fertile soil without any agricultural input and cultivation requirement. For example, Prakash et al. (2020) reported that stinging nettles, *U. dioica*, grows very well in shady moist, dry, degrade9d and rocky habitats of Himachal Pradesh, North-Western Himalaya. Afolayan and Jimoh (2009) indicated that wild plants besides their natural attributes of resistance against diseases, are more adaptive to harsh environments and grow less intensively. Notably, some studies reported that stinging nettles are an easily accessible source of food as they can be harvested from boundaries of farmlands, roadsides, forests, and near houses (Alemayehu et al. 2015; Alemneh 2020; Assefa et al. 2013; Gebrezgabiher et al. 2013; Kefalew et al. 2015). The results from the present findings can be an indicator of the potential integration of stinging nettle plants into the farming system for diversification of the human diet.

Seasonal availability and frequency of gathering of stinging nettle

The results from the present findings showed that about 76.9% of the indigenous community gather stinging nettle seasonally indicating the seasonality of the plant and a need for preservation techniques (e.g. solar drying of the leaves) to extend the utilization of the plant during the offseason. The respondents reported that stinging nettle gives 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 (2012), who reported that weedy vegetables were available only during short rainy seasons. In the rain-fed dependent agriculture production system of Ethiopia, stinging nettles and other wild plants could become optional sources of food and fodder. The availability of stinging nettle during these seasons implies their drought tolerance and contribution when the indigenous community or farmers suffer from food shortage. This could probably indicate the significant role of stinging nettles to cope with times of food shortage. In Batman Province-southeast Turkey, Yesil and Inal (2019) found that indigenous people shift to consuming wild plants when farm plants dry out in the summer heat. Gelmesa et al. (2010) reported that consumption of indigenous vegetables is mainly during grain shortage.

Focus group discussions with key informants also showed that seasonal food shortages, when household stocks were empty and the new crop was still in the field were common times to dowel on collecting and consuming of stinging nettle in the study areas. These could act as a motives for indigenous people to conserve stinging nettles and encourage their domestication. Fentahun and Hager (2009) and Addis et al. (2005) indicated that wild edible plants provides supplementary food and nutrition. Additionally, wild plants were mostly consumed when there is a collapse of cultivated crops by drought (Alemneh 2020; Asfaw and Tadesse 2001; Wondimu et al. 2006). On the other hand, utilization of wild edible plants as complimentary food indicates low awareness of the use and management of wild edible plants (Feyssa 2012). Therefore, the results on the seasonal availability and frequency of gathering of stinging nettle could indicate the needs of local level and countrywide awareness creation for effective utilization of the plant.

Consumable parts and traditional practices to collect stinging nettle

Key informant discussions and interviews made with indigenous peoples explained that young and tender shoots are used to prepare local sauces, young leaves, and roots for medicinal purposes and the whole plant as a source of fodder. This shows that the indigenous community has the traditional knowledge of the nutraceutical value of consuming young nettle leaves. A wide range of studies reported that young and tender nettle leaves are cooked as a vegetable, boiled or added to soups and sauce, dried as a spice, used to prepare infusion and decoction, and for salad (Çakir 2017; Demir 2020; Hançer et al. 2020; Kavalali 2003). Studies indicated that young and tender shoots of stinging nettles are rich sources of phytochemicals compared to mature leaves. For example, Kavalali (2003) and Ioana et al. (2013) reported that young and tender shoots represent the consumable part of the stinging nettle plant as they have higher nutritional value compared to mature leaves. Polyphenols content of nettle leaves showed a decreasing trend with the phenological stage, total polyphenols decreased by almost 50% by the 3rd phenological stage (Repajić et al. 2021).

Interestingly, covering hands with cloths and wearing plastic bags were traditional manipulations practiced by the indigenous community. These could provide physical protection from stinging hairs thereby avoiding stinging sensation and collecting the young and tender shoots from the plant. The leaves and stems of stinging nettle plants had stinging hairs called trichomes (Fig. 13). 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 et al. 2012; Mithril and Dragsted 2012). Therefore, hand gloves and leg protection should be used to avoid stings when harvesting the leaves (DiTomaso and Healy 2007).

A traditional recipe of stinging nettle based sauce

In the study areas, traditional stinging nettle sauce is prepared from young nettle leaves and barley powder and then served with injera (a flatbread). Stinging nettle leaves-based dishes are used in the diet of many countries, particularly among low socioeconomic populations. As an example, nettle soup or potherb in Nepal (Adhikari et al. 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). In South Africa, Maanda and Bhat (2010) reported that stinging nettle is used as a side dish to flavor the meal or used to add a bitter taste to meals.

Furthermore, a wide range of recent studies reported different types of traditional recipes of stinging nettle leaves, e.g. fresh leaves cooked as a vegetable or dried leaves added to soup, especially in winter (Demir 2020); leaves are used to prepare saag for a remedy to

Fig. 13 Stinging hairs on stems and leaves of the stinging nettle plant

Anthelmintic, antiseptic, dandruff, gout, nephritis sprain (Kumar 2021); decoction and infusion (Gião et al. 2007; González et al. 2010; Shonte 2017); first boiled and then fried with onions (Yesil and Inal 2019), frequently used as a 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). Focus group discussions with key informants attested that indigenous people have a good knowledge of stinging nettles cooking methods. The findings from the current and previous studies on stinging nettle plants indicate the need for future research on value addition and processing techniques that preserve the nutritional value for effective utilization of the plant.

Analysis of gender to collect and prepare stinging nettle

The result of the current study showed the existence of prevailing attitudes in the community in favor of more responsibility (92.2%) given to women and girls. Whereby women and girls take the full responsibility of harvesting, cooking, and serving stinging nettle-based dishes to the family. Singing 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 plants predominantly the young shoot were collected and traditionally cooked by women and children (Abdulkadir and Kusolwa 2020). This could probably indicate the significant roles of women and girls of the indigenous community in assuring household food security.

Factors limiting harvesting and consumption of stinging nettles

Pearson chi-square values clearly showed that cultural norms and values, e.g. stinging nettle being associated with famine food and poor man's food, followed by lack of knowledge and stinginess, contributed much to the underutilization of the plant. Pardo-de-Santayana et al. (2007) reported that wild edible plant usage depends on socio-cultural factors rather than biological ones such as climate or richness of the wild edible flora. Al-Fatimi (2021) also indicated that the use of wild plants is linked to indigenous cultural tradition, food shortage, and nutritional values.

Cultural norms and values showed significantly higher correlations with the various uses of *U. simensis* ($r^2 = 0.931$, $p < 0.001$) indicating that the association of stinging nettle with famine food or poor man's food were probably a major limiting factor for harvesting and consumption of *U. simensis simensis* in the study areas. Key informant discussions pointed out that stinging nettles consumption is considered as shame and insult (e.g. poor man's food) among the indigenous community of the study areas. 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 (Kavalali 2003). Recent studies reported that *Urtica simensis is* consumed during normal and famine periods (Woldemedhin et al. 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). 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".

The respondents stated that stinging nettles are not consumed except when there is a serious shortage of food and the poorest families regularly collect and consume stinging nettles. A significant association was observed between cultural norms and values with the wealth status of the respondents using Pearson chi-square analysis ($\times 2 = 170$, df = 24, $p < 0.001$). The Pearson chi-square value ($\times 2 = 26$ for high income, $\times 2 = 58$ for reasonable income, and $\times 2 = 86$ for low income) was high for low-income indigenous people indicating that they regularly gather and consume stinging nettle over those who have a reasonable income and high income. Pearson correlation result indicated a high correlation between Wealth status and cultural norms and values ($r2 = 0.930$, $P < 0.001$). Which is in agreement with the findings of Gelmesa et al. (2010), who reported consumption patterns of wild plants were highly related to economic status and food shortage rather than recognizing the nutritional value of the plants. Under such precarious situation, the indigenous knowledge associated with the plant can be lost irreversibly. This could indicate a need for further policy and local level awareness creation to value stinging nettle plants and improve their uses and enhance their conservation for sustainable utilization. For example, movements such as chefs' interest in offering new flavors and dishes can play a crucial role in boosting the cultural value of stinging nettles.

Conclusions

Urtica simensis Although there is a good transfer of traditional knowledge between the indigenous communities on the uses of *U. simensis,* there is a significant knowledge gap through generations signifying that the youth are less knowledgeable on the various uses of *U. simensis*. It was observed that stigma related to stinging nettle being as poor man food, lack of knowledge, and stinginess contributed much to the underutilization of the plant. This could indicate a need for documentation of the traditional knowledge of the indigenous peoples and awareness creation on the various uses of *U. simensis* is crucial. The availability of stinging nettle during the dry periods implies their contribution to the community to ensure food security during times of seasonal food shortage. It is also an excellent source of fodder. Hence, future strategic policies should consider *U. simensis* directly as food or indirectly as fodder to fight food insecurity and improve the wellbeing of the society. Stinging nettle is a registered herbal medicinal plant worldwide and in the traditional health care system of Ethiopia, however, in the study areas, it is less known in its medicinal value. Therefore, there is a need for local level and countrywide awareness creation.

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Authors' contributions
TTS : Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Writing (first draft). KW: Conceived and designed the experiments; Supervision; Wrote review and editing. Both authors read and approved the final manuscript,

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Availability of data and materials
All the data used to support this study have been deposited in the Dryad repository (Available at: https://doi.org/10.5061/dryad.ghx3ffbpp).

Declarations

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 the assistance of local language translators.

Consent for publication
Not applicable.

Competing interests
The authors declare no conflict of interest.

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