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Research Article

Ethnobotanical knowledge and utilization of *Arisaema schimperianum* (Schott) in the Gamo highlands of South Ethiopia

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Abstract

Arisaema schimperianum (Schott) is an underutilized crop grown in the Gamo highlands of Ethiopia. It supports the food security and livelihoods of local people, while its management and utilization constitute an essential component of ethnobotanical knowledge and food culture within local communities. This study was intended to document the indigenous knowledge of local people concerning the production and utilization of the crop and its uses. A mixed sampling strategy was used for data collection: purposive sampling for districts and kebeles, random sampling for household heads, and a combined purposive and snowball sampling approach to select knowledgeable elders for the study. Ethnobotanical data were collected from a total of 357 informants: 318 through semi-structured interviews, 30 through focus group discussions, and nine through key informant interviews. The results revealed that local people recognize the diversity of *A. schimperianum* landraces and their associated folk names and classify them. Approximately two-thirds of respondents identified landraces based on morphometric attributes; approximately four-fifths cited the plant as a food crop, and a small fraction (13%) cited it as a source of food, ethnomedicine, and ethnoveterinary medicine, while only a small minority (5%) reported it as a source of food and ethnoveterinary medicine. Planting propagules and managing the farm throughout the dormancy period highlighted growers' tacit ecological knowledge of the plant's phenology, while intercropping practices revealed environmentally friendly agriculture. Postharvest practices, namely pulverization and fermentation, have been pivotal traditional skills in making the crop nutritious for human consumption. The local community domesticates, manages, and continues to use the crop, which helps preserve local food traditions and biodiversity. The multiple regression output highlighted that sociodemographic factors (age, gender, education level, occupation, marital status, and family size) significantly influenced informants' local knowledge ($F = 78.507$, $p < 0.001$). Social stigmatization, tedious culinary processes, land-use changes, and lack of promotion have been threatening the sustainability of the crop and associated traditional knowledge.

Key words: *Arisaema schimperianum*, ethnobotany, gender, indigenous knowledge, Qolxo, underutilized crop

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Introduction

Indigenous knowledge systems consist of context-specific understandings, practices, and belief structures that emerge from prolonged, adaptive interactions between human communities and their local ecosystems and are preserved through intergenerational transmission (Berkes 2009). These systems include detailed expertise in agriculture, natural resource management, dietary utilization, and adaptive strategies tailored to specific environmental conditions. Over time, such accumulated experience has enabled indigenous populations to ensure subsistence security and sustainably manage biological diversity (Huidrom et al. 2026). Ethnobotanical inquiry offers a critical lens for analyzing plant-human interactions, particularly how communities recognize, cultivate, conserve, process, and apply plant species for nutrition, medicine, and livelihood support (Knorr and Augustin 2025). However, these knowledge systems are not static; they are vulnerable to erosion due to socioeconomic shifts, transformations in land use, and disruptions in the transfer of knowledge across generations. Systematic documentation is therefore essential to preserve culturally significant botanical resources and promote their sustainable application.

Ethiopia exhibits marked biodiversity and cultural heterogeneity and has long been acknowledged as a key center for plant genetic diversity, with smallholder farmers playing a central role in the domestication, selection, and stewardship of crop varieties over successive generations (Engels et al. 1991). Despite this rich agrobiodiversity, food insecurity persists, underscoring the need to diversify food systems beyond a narrow reliance on staple cereals (Borrell et al. 2020). Neglected and underutilized crops offer potential for enhancing dietary variety, strengthening local food resilience, supporting rural livelihoods, and conserving agricultural biodiversity (Padulosi et al. 2013). In Ethiopia, species such as *Ensete ventricosum* (Welw.), *Plectranthus edulis* (Vatke), and *Coccinia abyssinica* (Lam.) exemplify the contribution of locally adapted, historically marginalized crops to regional food systems (Ashebir 2022). However, agricultural research and policy have traditionally prioritized major cereal crops, leaving many indigenous root and food crops, particularly those in southern Ethiopia, understudied and undervalued (Awoke 2017). This marginalization often extends to the associated indigenous knowledge, cultural practices, and traditional management techniques.

The genus *Arisaema* includes approximately 200 species, predominantly distributed across tropical and temperate regions of Asia and Africa (Murata et al. 2013; Ohi-Toma et al. 2016). Species within this genus serve diverse ethnobotanical and socioeconomic functions, including use as food, medicine, and ornamental plants. Certain *Arisaema* species are consumed as food following detoxification procedures, while others are employed in traditional medicine or cultivated for aesthetic value (Heena and Yaqoob 2021; Norhazlini et al. 2021). These applications highlight the role of localized knowledge in enabling the safe and effective use of species containing potentially toxic compounds.

Arisaema schimperianum (Schott) occurs in tropical eastern and central Africa, including Ethiopia and the Democratic Republic of the Congo (Sue et al. 1997). In Ethiopia, it holds notable ethnobotanical significance in the Gamo highlands of the southern region, where it is traditionally grown and used as a food source (Gadebo et al. 2007). The species is found in both cultivated

fields and wild habitats, but its culinary use is most closely linked to the Gamo people. As such, *A. schimperianum* serves as a culturally salient resource for examining indigenous ecological knowledge, crop husbandry, food-processing techniques, and patterns of intergenerational knowledge transfer.

Despite its traditional importance in the Gamo highlands, information on *A. schimperianum* remains limited relative to major crops and more extensively researched indigenous species. While prior studies confirm its presence and dietary role, comprehensive data on associated knowledge, particularly regarding its ecology, cultivation, harvesting, processing, usage, and cultural context, are sparse. Moreover, there is minimal analysis of how knowledge varies across demographic groups or how modern socioeconomic and environmental changes affect its continuity and application.

This gap is significant because the long-term viability of underutilized crops depends not only on their genetic and ecological integrity but also on the sociocultural systems that govern their management and use. Shifts in land tenure, economic development, and weakened knowledge transmission may jointly threaten both the continued use of *A. schimperianum* and the preservation of its associated indigenous knowledge. Documenting these practices provides a necessary foundation for integrating the species into local food system planning and for formulating culturally grounded strategies for its conservation and sustainable use.

Accordingly, this study examines the ethnobotanical knowledge and use of *A. schimperianum* among communities in the Gamo highlands of South Ethiopia. Specifically, the study aims to: (1) systematically record indigenous knowledge related to the ecology, cultivation, harvest, processing, and application of *A. schimperianum*; (2) evaluate differences in knowledge distribution across sociodemographic categories within the study area; and (3) identify key challenges affecting the sustainable cultivation, use, and intergenerational transmission of knowledge concerning *A. schimperianum*, thereby generating evidence to guide targeted conservation and sustainable-use interventions.

Materials and methods

Study area

The Gamo highlands occur along the western escarpment of the Great Rift Valley system, extending from 5°53' to 6°26'N and 37°10' to 37°42'E, South Ethiopia (Fig. 1). The area receives a bimodal rainfall pattern, with high intensity from June to September and low intensity from February to April. The densest rural population, oldest agricultural practices, and richest sociocultural systems are found in the Gamo highlands (Desalegn 2007). The livelihoods of the people depend on subsistence agriculture on less than 1 ha of land. The main root and tuber crops grown in the highlands include *E. ventricosum*, *Solanum tuberosum*, *P. edulis*, and *A. schimperianum*. Peculiar to the Gamo people is their indigenous cotton weaving art, *Shema*, which has been practiced for centuries.

This study was carried out in the Chencha and Dita districts of the Gamo highlands. Chencha district is located at 6°7' to 6°24'N and 37°30' to 37°41'E, while Dita district is located at 6°6' to 6°23'N and 37°19' to 37°31'E (Fig. 1). Both districts display environmental and cultural connections, sharing comparable physiographic and agroecological conditions. They exhibit undulating

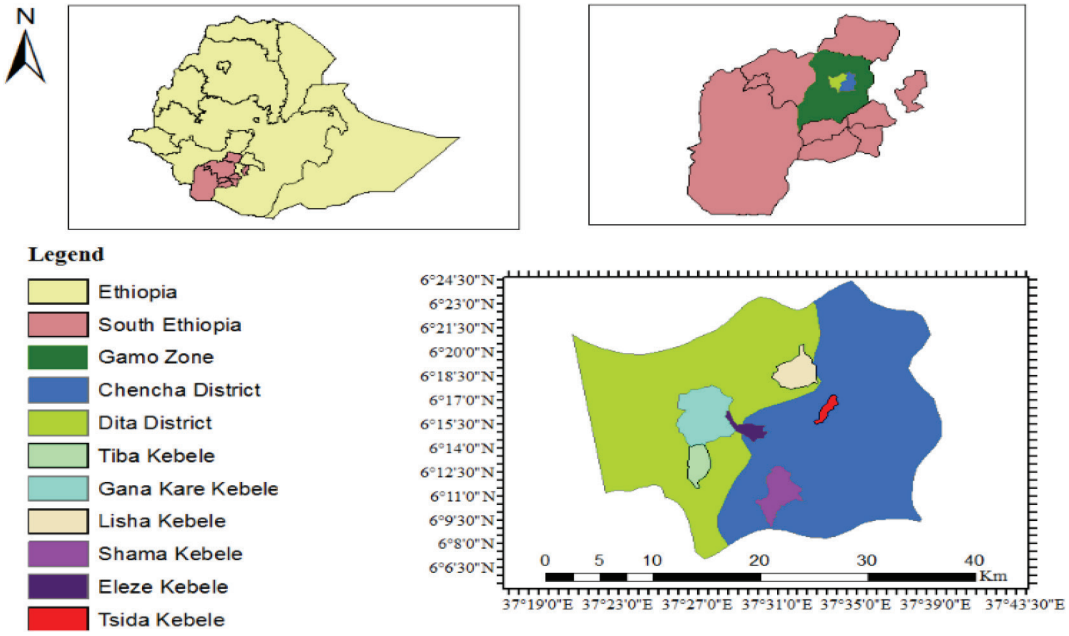

Figure 1. Map of the study area showing districts and kebeles.

highlands, similar altitudinal belts, and seasonal patterns. The sociocultural landscape of the districts shares ethnic heritage and traditional agricultural practices (Desalegn 2007). The corresponding ecological and sociocultural settings of both districts support the comparability of data collected concerning *A. schimperianum* management and utilization are akin.

Sampling design

A preliminary reconnaissance survey was carried out throughout the Gamo highlands to identify districts and kebeles with active cultivation and use of *A. schimperianum*. Drawing on data from this initial assessment and in consultation with local agricultural and administrative officials, Chencha and Dita districts were purposively selected due to their notably high levels of *A. schimperianum* production and utilization. Within each district, kebeles reporting the greatest cultivation intensity were identified. From these, three kebeles per district were chosen through random sampling. As a result, six kebeles were included in the study: Eleze, Shama, and Tsida from Chencha, and Gana Kare, Lisha, and Tiba from Dita.

A mixed sampling strategy was used for different respondent groups. Random sampling was employed to select household-level informants for semi-structured interviews; a combined purposive and snowball sampling approach was used to locate knowledgeable individuals for focus group discussions (FGDs) and key informant interviews (KIIs) (Creswell 2014). A total of 3,354 households were identified across the six selected kebeles using household lists, yielding a sample of 357 household respondents (Table 1). Yamane's formula was applied to determine the sample size:

$$n = \frac{N}{1 + N(e2)}$$

where n = sample size, N = total household number, e = significance level (fixed at 5%), and 1 = even occurring probability.

Table 1. Districts, kebeles, environmental gradients, and sample sizes of respondents.

District	Kebele	Elevation (m asl)	GPS coordinates	Agroecology	HH no	Sample size
Chencha	Eleze	2,821–2,887	6°15'N, 37°29'E	Highland	493	52
	Shama	2,613–2,735	6°11'N, 37°31'E	Highland	920	98
	Tsida	2,761–2,827	6°16'N, 37°33'E	Highland	457	49
Dita	Gana Kare	2,806–2,861	6°19'N, 37°28'E	Highland	487	53
	Lisha	2,556–2,643	6°18'N, 37°32'E	Highland	532	57
	Tiba	2,930–3,050	6°13'N, 37°26'E	Highland	465	48
Total	NA	NA	NA	NA	3354	357

NA = not applicable, HH no = household head number.

Data collection

Data collection was carried out from February 2024 to October 2025. Prior to data collection, ethical issues were addressed by providing briefings on the research scope and submitting official letters to administrative bodies at the district and village levels. Informed consent was obtained from respondents after they were informed of their rights as participants.

Data collection tools included semi-structured interviews, FGDs, and KIIs (Creswell 2014). The questionnaires focused on the informants' demographic and socioeconomic characteristics, knowledge of *A. schimperianum* utilization, its varieties and local naming, management, culinary processing, sociodemographic factors influencing the indigenous knowledge of informants, and threats confronting the crop. Four FGDs (two per district) and nine KIIs (four in Dita and five in Chencha) were used to triangulate the data. The FGDs included 30 informants (Dita = 14, Chencha = 16), and the KIIs included nine individuals (Dita = 4, Chencha = 5), comprising a total of 25 men and 14 women.

Informants' local knowledge was assessed using live specimens of *A. schimperianum*. First, respondents were asked to mention the local names of *A. schimperianum* landraces growing in their landscapes. Second, respondents were asked to mention the morphological attributes they use to identify each landrace. Third, samples of the top three *A. schimperianum* landraces were presented, and respondents were asked to match them with the names or types they had mentioned. In addition, field observations were carried out to obtain authentic evidence that validated the collected data. During guided field walks, inherent management practices on the farms were scrutinized and photographed. The qualitative methods enhanced understanding and augmented the interpretation of the findings.

Data analysis

Statistical analyses were performed using Microsoft Excel and IBM SPSS version 26.0. Multiple regression models were used to assess sociodemographic factors influencing respondents' knowledge of the use and management of the crop. Sociodemographic factors were taken as predictor variables, whereas informants' knowledge of folk naming and utilization was taken as the dependent variable. Model selection was based on the Akaike Information Criterion

(AIC). The best-fitting model was selected step by step by excluding predictor variables from the full model until the lowest AIC value was achieved. Ethnobotanical indices were used for ethnobotanical data analysis:

$$RCF = \frac{Np}{N} * 100$$

RCF is the relative citation frequency for each usage category of *A. schimperianum*, expressed as a percentage; *Np* is the number of respondents who mentioned a specific use of the species, and *N* is the total number of respondents.

$$UV = \sum Ui/N$$

UV is the use value, *Ui* is the number of uses reported by each informant *i*, and *N* is the total number of informants citing the uses.

Pairwise ranking was used to determine activities cited as constraints and threats to *A. schimperianum* sustainability, with the highest scores considered the most serious threats. Graphical illustrations were constructed using SPSS, and photographs collected during fieldwork were displayed to support the quantitative data.

Results

Socio-demographic characteristics of respondents

A total of 357 respondents were involved in the ethnobotanical study. Of the total, men accounted for 67.8%, while 32.2% were women. The respondents' ages ranged from 18 to 91 years, and they were classified into three groups: <30 years (29.4%), 30–59 years (43.4%), and ≥ 60 years (27.2%). The marital status of interviewees exhibited great disparity: 96.6% were married, 2.5% were unmarried, and 0.8% were divorced. Respondents' educational backgrounds varied widely: 58% had no formal education, 24.9% had primary education, 14% had secondary education, and 3.1% had college/university education (Table 2). The family size of respondents ranged from 1 to 13 members per household. Approximately 88.2% of respondents relied on agriculture for their livelihood, 10.4% on trade, and 1.4% were employed. Informants' work experience varied; 44.8% had more than 20 years, 30.8% had less than 10 years, and 24.4% had 10–20 years of agricultural experience (Table 2).

Indigenous knowledge on naming and classification of *A. schimperianum* landraces

Informants stated that they use several criteria to distinguish one *A. schimperianum* landrace from another and classify it. The most frequently used attributes include (i) morphological traits such as seedling sheath color, petiole color, fruit color, and corm color; leaflet shape, broadness, and curling pattern; peduncle length and width; and plant height (Fig. 2); and (ii) yield qualities such as size, palatability, moisture content, and toxicity. Informants cited 1–13 folk names of *A. schimperianum* varieties. The most frequently cited names include Bangayo, Dasharo, Gistaqo, Malao, Etera, Kafo Tsugunta, Kalao, Kalayo, Kalazo, Malayo, Malazo, and Wodala.

Table 2. Sociodemographic characteristics of respondents (*n* = 357).

		District		Total	B/n Districts	
		Dita	Chencha		*T*	*p*
Gender	Male	107	135	242	0.024	0.981
	Female	51	64	115		
Age	Young (<30)	47	58	105	−0.489	0.625
	Adult (30–59)	71	84	155		
	Old (≥60)	40	57	97		
Marital status	Unmarried	5	4	9	0.161	0.872
	Married	152	193	34		
	Divorced	1	2	3		
Education level	Uneducated	93	114	207	−0848	0.397
	Primary	42	46	88		
	Secondary	19	32	51		
	College/University	4	7	11		
Family size	Small (≤5)	69	64	133	−2.199	0.029
	Middle (6–9)	61	88	149		
	Large (≥10)	28	47	75		
Occupation	Agriculture	141	174	315	−0.507	0.612
	Trade	15	22	37		
	Employee	2	3	5		
Experience	Less (<10 yrs.)	52	58	110	0.814	0.416
	Medium (11–20 yrs.)	45	41	86		
	High (>20 yrs.)	61	100	161		

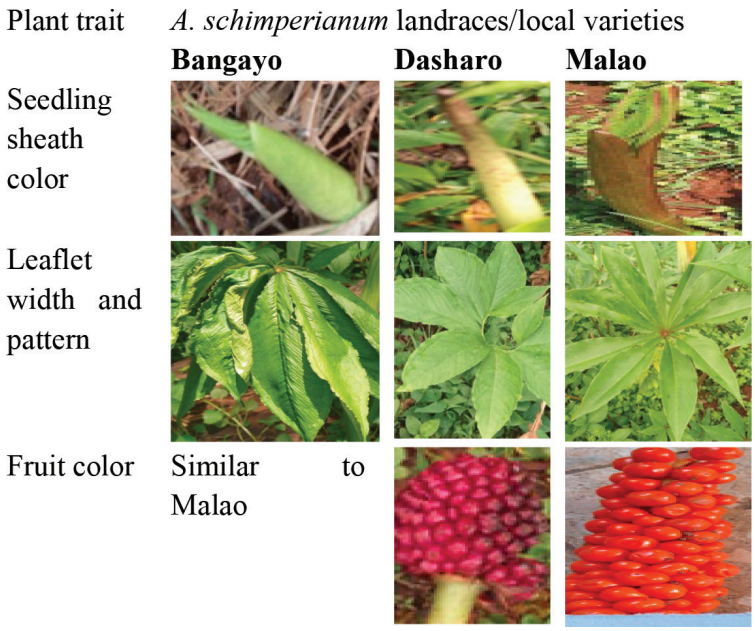

Figure 2. Morphological features of three typical landraces of *A. schimperianum*.

For instance, the sheath color of Bangayo seedlings is bright green, that of Dasharo has whitish spots on a purple background, and that of Malao is purple (Fig. 2). The colors of the landraces persist on the pseudostem, petiole, and leaflet midribs at maturity. The leaflet color of all three landraces is bright green. The fruit color of Malao and Bangayo is red, whereas that of Dasharo is purple (Fig. 2). The leaflets of Bangayo are broad and exhibit a curled-down pattern;

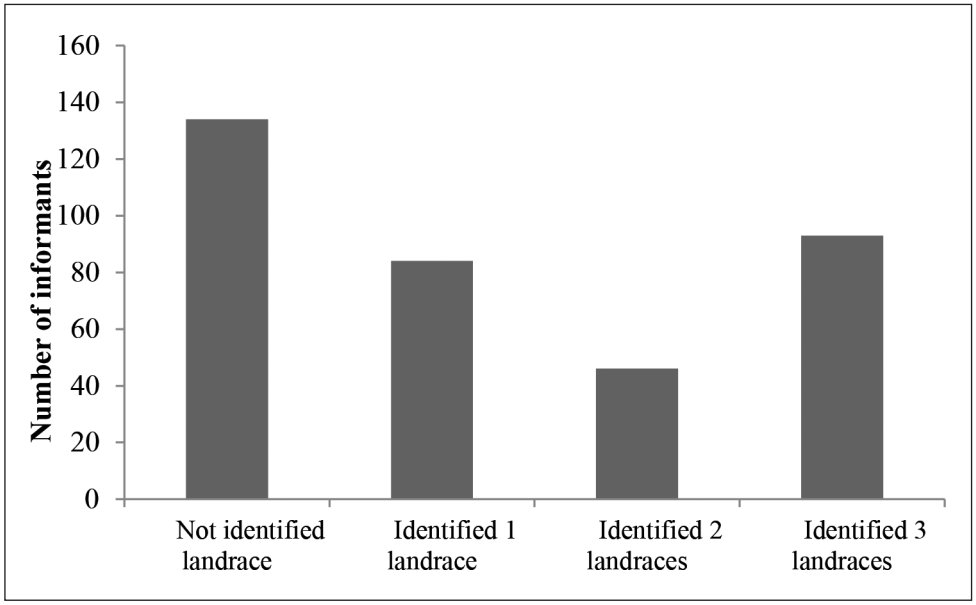

Figure 3. Frequency of respondents who identified *A. schimperianum* landraces (*n* = 357).

those of Dasharo are broad but incompletely divided, whereas those of Malao are narrow (Fig. 2). Dasharo exhibits horseshoe-shaped leaflets, whereas Malao and Bangayo display lanceolate leaflets. However, the leaves of all three *A. schimperianum* landraces are palmately compound, with leaflets radiating from a single petiole tip. Malao exhibits the longest peduncle, and Bangayo develops a medium-sized peduncle, whereas no peduncle is recorded for Dasharo.

The assessment results revealed that landrace recognition varied markedly among respondents, with more than one-third unable to distinguish any landrace, whereas only approximately one-quarter correctly identified all three landraces. This variation indicates an unequal distribution of indigenous taxonomic knowledge within the community (Fig. 3).

Indigenous knowledge on propagation and management of *A. schimperianum*

Informants revealed that sections of mature corms, including buds (small lateral outgrowths), are used as planting material. Corm harvesting takes place from late June to August, while the harvested corms are partitioned into two unequal sections, i.e., at a 75%:25% ratio (Fig. 4C, D). The larger basal portion (approximately 75%) is used for consumption, while the apical portion, which contains active vegetative tissue (propagules), is reserved for planting. The planting corm is buried 30–40 cm deep in the soil together with buds. It remains dormant for approximately 4–5 months (September–February), and then seedlings sprout. Informants noted that after germination, *A. schimperianum* seedlings do not require labor-intensive agronomic management, and they are well suited to mixed farming systems under shade. Usually, plots containing *A. schimperianum* seedlings are also used for cereal cultivation. However, during the dormancy period, tending the garden, careful shallow tillage, minimizing disturbance, and organic fertilization are traditional management techniques required to produce adequate yields.

Custodian growers stated that individual *A. schimperianum* plants reach maturity and produce harvestable yields after 3–5 years. However, in traditional

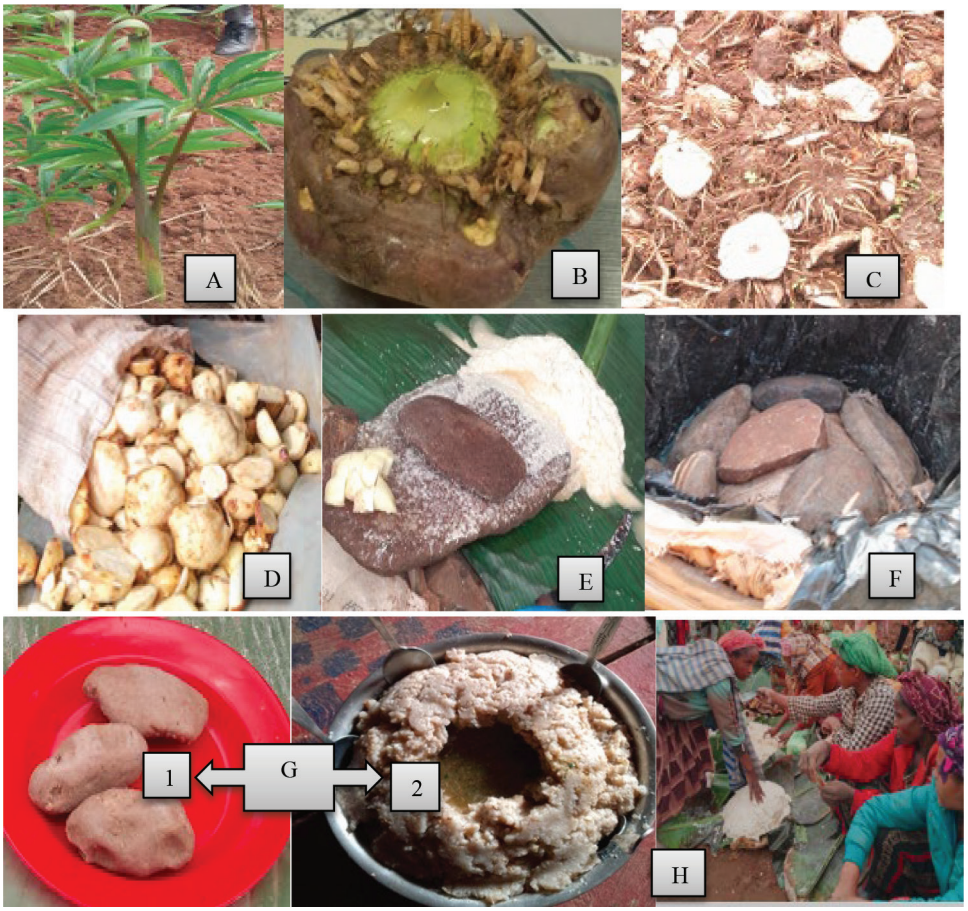

Figure 4. Field-to-table stages of *A. schimperianum* (**A–H**): *A. schimperianum* plant; **B.** Harvested corm; **C.** Planting material; **D.** Collection of corm for consumption; **E.** Milling corm using a traditional mill (Wotsa); **F** Fermenting pulverized corm in a pit (underground store); **G.** Cultural dishes of *Arisaema*: (1) Inchilla, a dish for young people and travelers, and (2) porridge (Shendera), a dish for household heads, guests, and elders; **H.** Zantsa (fermented product) at Chencha market.

farming systems, fields are composed of mixed populations containing plants at different growth stages. As a result, farmers are able to harvest corms continuously on an annual basis, selectively collecting mature individuals while leaving younger ones to develop. This dynamic age structure ensures a stable and regular yield despite the long maturation period of individual plants. With increasing maturity, interviewees observed corresponding increases in corm size, starch content, and palatability, accompanied by decreases in toxicity and moisture content.

Indigenous knowledge on postharvest management and culinary culture

Informants indicated that the transition of *A. schimperianum* from field to table follows a series of progressive steps (Fig. 4A–G). Initially, the mature corm is harvested when the leaves of the plant turn yellow and the aboveground part disintegrates (Fig. 4B). Following harvest, the corm is partitioned into two parts; the apical part (Fig. 4C) is preserved as planting material, whereas the basal section is prepared for consumption (Fig. 4D). This part is soaked repeatedly in water to remove waxy coatings and impurities. Thereafter, the corm is crushed manually using a local mill and placed in an underground pit for fermentation

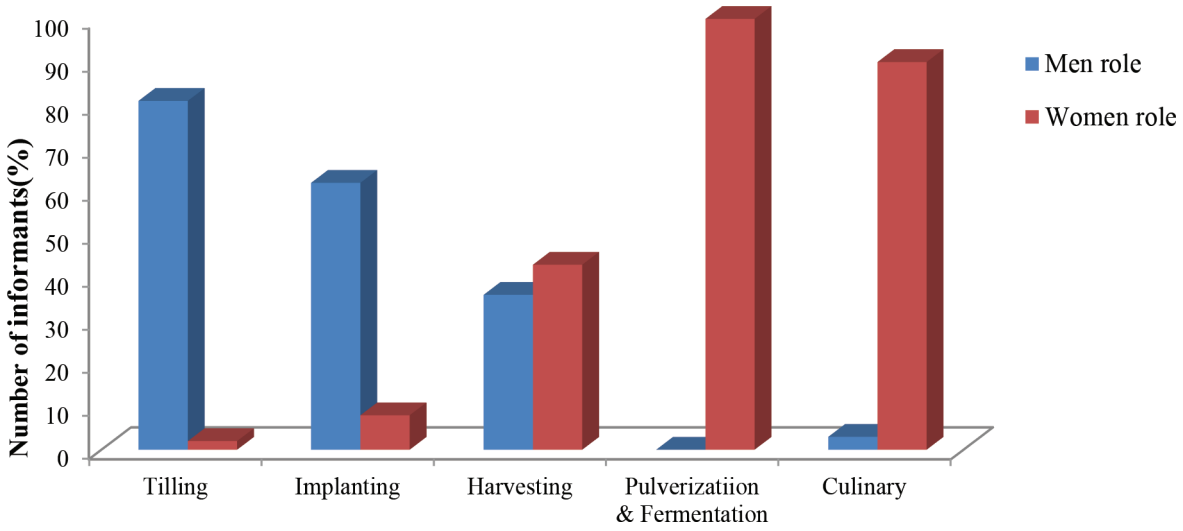

Figure 5. Citation frequency of gender roles in the production of *A. schimperianum* (*n* = 357).

(Fig. 4E). Key informants, mainly custodian women, stated that soaking the corm, milling it, and fermenting it are the most essential steps for preventing skin burning during handling and consumption of the product (Fig. 4D–F).

Gender role in *A. schimperianum* production

The findings show that *A. schimperianum* cultivation and utilization were gender-related, with women playing a focal role (Fig. 5). Women's duties include collecting and planting seedlings, fertilizing gardens, harvesting the yield, cleaning impurities, milling and fermenting the product, preparing cultural dishes, and marketing the products.

Indigenous knowledge on the use values of *A. schimperianum*

A. schimperianum is a multipurpose crop with various uses. Frequently cited use categories were food (80%), food, ethnomedicine, and ethnoveterinary medicine (13%), food and ethnoveterinary medicine (5%), and food and ethnomedicine (2%) (Fig. 6). The plant part used as food is the corm (underground organ), whereas petiole exudates are used to treat injuries in domestic animals

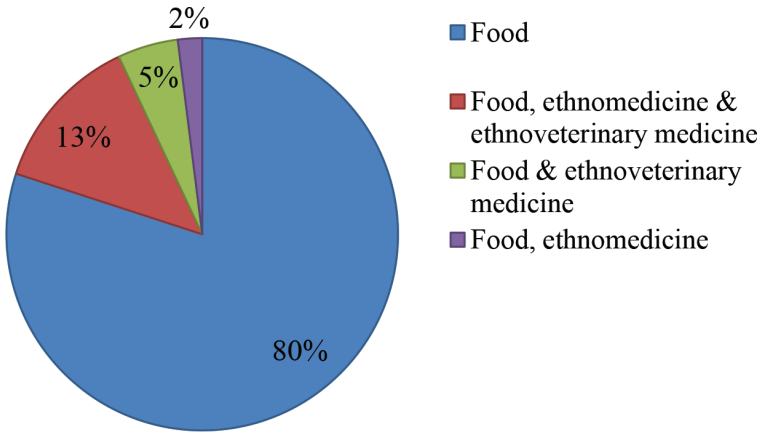

Figure 6. Citation frequency of different uses of *A. schimperianum* (*n* = 357).

and humans. Elderly informants reported that local herbalists apply exudates to injured areas in animals or humans, after which the areas heal.

Determinants of farmers' indigenous knowledge of *A. schimperianum* landrace identification

The multiple regression model significantly explained variation in farmers' indigenous knowledge of *A. schimperianum* landrace identification (F = 78.507, p < 0.001), accounting for 57.4% of the observed variance (R^2 = 0.574; adjusted R^2 = 0.566). Age demonstrated a positive association with landrace-identification knowledge (β = 0.914, p < 0.001), while education exhibited a negative association (β = −0.237, p = 0.008). The effects of additional sociodemographic variables are detailed in Table 3. Neither district nor kebele emerged as a significant predictor of landrace-identification knowledge (p = 0.207 and p = 0.426, respectively).

Threats to *A. schimperianum* agriculture

Findings from key respondents revealed that various anthropogenic factors threaten the sustainability of *A. schimperianum*. The pairwise ranking analysis showed that social stigmatization, tedious food processing, changing land-use systems, lack of research and promotion, and prolonged maturation period were the factors ranked from first to fifth (Table 4).

Table 3. Factors influencing estimates of farmers' indigenous knowledge associated with *A. schimperianum* landraces.

Parameter	Estimate	SE	*t*-value	*p*
Intercept	−0.202	0.394	−0.513	0.608
Gender	0.375	0.094	3.988	<0.001*
Age	0.914	0.096	9.517	<0.001*
Marital status	0.091	0.182	0.499	0.035*
Education	−0.237	0.090	−2.649	0.008*
Family size	0.127	0.081	1.564	0.042*
Occupation	0.207	0.144	1.440	0.013*
District	0.315	0.249	1.265	0.207
Kebele	−0.063	0.079	-0.797	0.426

Multiple regression model: R^2/R^2 adjusted R^2 = 0.574/0.566; residual standard error = 0.423; AIC = 336.3; SE = standard error; * = significant at the 5% level.

Table 4. Pairwise ranking of factors considered threats to *A. schimperianum* production (n = 30).

Threatening factor	Key respondents							
	El	Sh	Td	Gk	Li	Tb	Total	Rank
Social stigmatization	5	4	5	5	5	4	28	1
Tedious food processing	3	5	2	3	4	5	22	2
Changing land-use systems	4	3	3	4	1	2	17	3
Lack of research and promotion	2	1	4	1	2	3	13	4
Prolonged maturation period	1	2	1	2	3	1	10	5

El = Eleze; Sh = Shama; Td = Tsida; GK = Gana Kare; Li = Lisha; Tb = Tiba.

Discussion

A. schimperianum is locally referred to as Qolxo. While previously reported as 'Kolto' (Gadebo et al. 2006) and 'Qoltso' (Utallo et al. 2021), the name Qolxo is adopted here to reflect the Gamogna pronunciation used by native speakers in the study area. Farmers grow a diversity of *A. schimperianum* landraces and use the crop as an important food source during food-scarcity seasons. It has been used as a co-staple food crop, contributing to seasonal food security and livelihood means for smallholders (Utallo et al. 2021). The traditional cultivation, management, and utilization of *A. schimperianum* reflect the traditional ecological knowledge and food culture of the local community regarding this underutilized crop. This finding is consistent with previous studies on underutilized crops in Ethiopia (Yemataw et al. 2016; Dilebo et al. 2024).

Farmers developed a tacit body of indigenous knowledge about the crop by growing and using it for many years. This rich knowledge enabled growers to identify the diversity of landraces, characterize them, and assign folk names to each landrace. The folk classification system of local people depends upon morphological attributes (phenotypic features) and use values of landraces.

The findings disclose that farmers recognize the phenotypic variation of the species and identify the landraces based on key morphological attributes throughout the plant's developmental phases. Among the cited morphological attributes, leaf traits emerged as frequently used tools by respondents, suggesting their accessibility throughout the plant's growth cycle. In addition, the use of reproductive organs, such as fruit color, and underground organs, specifically corm traits, highlights the depth of indigenous knowledge of the local community. The diversity of diagnostic traits recognized by farmers demonstrates a sophisticated folk taxonomic system that closely corresponds to observable morphological variation, indicating long-term interaction between local communities and *A. schimperianum*. This finding is consistent with a previous study (Mayo and Gilbert 1986), which reported the importance of color in studying the morphological variation of *Arisaema* species in Ethiopia. The variation in morphological attributes of *A. schimperianum* landraces aligns with findings from previous studies (Matsumoto 2021; Matsumoto et al. 2024).

However, *A. schimperianum* landrace-identification knowledge among respondents exhibited disparity: landrace recognition varied markedly among respondents, with more than one-third unable to distinguish any landrace, whereas only approximately one-quarter correctly identified all three. This variation indicates an unequal distribution of indigenous taxonomic knowledge within the community. Informants who failed to distinguish specific landraces cited the collective name Qolxo to refer to the crop. Recognizing a greater number of landraces could suggest an in-depth level of indigenous knowledge associated with active engagement in the production and utilization of the crop, while being unable to identify landraces may indicate the erosion of indigenous knowledge (Yemataw et al. 2016).

Demographic and socioeconomic variables significantly influenced informants' knowledge of the utilization of *A. schimperianum*. For instance, respondents' age (B = 0.914, SE = 0.096, t = 9.517, p < 0.001) exhibited a significant positive association with local knowledge of *A. schimperianum* landrace identification (Table 3). Almost all respondents aged above 60 years identified one to three landraces, while those aged below 30 years either did not cite any

landrace or identified only a few landraces. The positive association between informants' age and *A. schimperianum* landrace-identification ability might reflect the informants' persistent interaction with the plant and its morphological attributes (Yematawet al. 2016). Conversely, education level (B = −0.237, SE = 0.090, t = −2.649, p = 0.008) was negatively correlated with respondents' landrace-identification knowledge. Informants who did not attend formal education cited a much higher number of *A. schimperianum* local varieties than educated respondents. The result suggested that formal education does not adequately support indigenous knowledge of underutilized crops and may inadvertently contribute to the erosion of indigenous knowledge. The overall trend highlights that the ethnobotanical knowledge of underutilized species is better preserved among older people, while it declines among younger, more educated groups.

Gender (B = 0.375, SE = 0.094, t = 3.998, p < 0.001) and occupation (B = 0.207, SE = 0.144, t = 1.440, p = 0.013) significantly affected respondents' *A. schimperianum* landrace-identification knowledge (Table 3). Women cited more landraces than men, which highlights women's more active involvement in *A. schimperianum* management than that of their male counterparts. Family size (B = 0.127, SE = 0.081, t = 1.564, p = 0.042) and marital status (B = 0.091, SE = 0.182, t = 499, p = 0.035) significantly affected respondents' *A. schimperianum* landrace-identification knowledge (Table 3). Married respondents' landrace-identification ability might be associated with increased family responsibilities and the need to sustain alternative food sources, whereas the association of larger family size with landrace identification might be related to a stronger intergenerational knowledge-sharing role within households. The study indicated that informants' indigenous knowledge of *A. schimperianum* landrace identification and utilization was embodied in social structure, livelihood systems, and collective experience. Previous studies (Dilebo et al. 2024; Li et al. 2026) reported that sociodemographic factors inevitably influence the utilization and management of underutilized species; the findings of the present study were consistent with these studies.

The detailed evaluation of folk names of *A. schimperianum* landraces suggested taxonomic overlap. For instance, local names sharing a common prefix but different suffixes, such as Kalao/Kalayo/Kalazo or Malao/Malayo/Malazo, designate morphologically similar plants, probably indicating the same variety. In contrast, a single landrace could be identified by distinct names (e.g., Bondare, Dasharo, and Etera) in different kebeles and districts, signifying synonymy. Such inconsistency in folk naming could affect the total number of *A. schimperianum* landraces reported in the area. KII results revealed that *A. schimperianum* landraces were categorized into two major groups: Adde Qolxo (male) and Macca Qolxo (female). The basis for such grouping is the utilitarian value and biochemical properties of the landraces. Informants stated that the term 'male' implies unpalatability, high toxicity, difficulty in grinding and fermentation, and high moisture content, whereas 'female' symbolizes high palatability, lower toxicity, superior culinary quality, and high starch content. FGD results indicated that farmers conserve both categories of landraces owing to their nutritional and food-security roles; i.e., they use landraces with high starch content (female) for regular consumption while reserving the less palatable varieties for food-insecure periods. On-farm conservation of various types of *A. schimperianum* landraces by local communities implies that they play key roles in biodiversity conservation by managing the genetic reservoirs of the crop and addressing nutritional insecurity. Various studies have reported

the importance of folk naming and local classification of on-farm crops for food security and biodiversity conservation (Yemataw et al. 2016; Dilebo et al. 2024).

Farmers implement fractional propagation methods to enhance the dual use of *A. schimperianum*. Growers divide the corm into two unequal portions and then preserve the apical portion with meristematic tissue for planting, whereas they use the starch-rich basal portion for consumption. Field observations revealed that farmers plant the propagules at an optimum soil depth (30–40 cm) and protect gardens from disturbance during the dormancy period. In addition, the local community has practiced intercropping for centuries and therefore utilizes gardens containing dormant *A. schimperianum* seedlings for cereal cultivation. The traditional propagation and management of the plant indicate a dynamic body of indigenous agricultural knowledge within the local community because these practices reflect cumulative knowledge of resource-use efficiency and the crop's growth phenology. These practices also enhance food security, sustainable seed sources, and biodiversity conservation (Nishigabiraki and Sekiyama 2025).

Harvesting and culinary techniques for *A. schimperianum* corms are intertwined with the indigenous knowledge and food culture of the local community. Harvesting of *A. schimperianum* corms occurs from June to July when the plant completes its active growth stage, manifested by degeneration of the aboveground vegetative organs. Farmers use traditional tools to harvest the crop while preserving the residual crops and soil structure (Gadebo et al. 2007).

Postharvest activities involve a series of domestic activities, such as cleansing, soaking, milling, and fermentation. FGD informants revealed that these activities in general, and fermentation in particular, are key steps in reducing toxicity and making the product palatable. Custodian women highlighted that the traditional fermentation of the pulverized material requires up to 3–5 days and that a traditional underground store (pit) is used for fermentation. Elderly women underscored that they maintain the cleanliness of the Zantsa using traditional wrapping materials made of enset leaves and also press it down using stones to drain water. The study underscored that making *A. schimperianum* a nontoxic and nutritious food for human consumption was an indigenous innovation of the Gamo Highland community. Custodian women revealed that prestigious cultural dishes such as porridge (Shendera), Kitta (bread), and Inchilla are prepared from Zantsa, highlighting the indigenous culinary knowledge of the local community. Informants acknowledged that meals made from *A. schimperianum* do not develop mold for several days and hence are used as portable meals (sinq) for travelers and laborers. Elderly informants underlined that meals made from *A. schimperianum* have sociocultural and ritual values because porridge (Shendera) is prepared for household heads, guests, and elders, whereas Kitta is consumed with raw meat during the Meskel New Year festival.

A. schimperianum agriculture is an entirely gendered practice, with women being the main custodians of indigenous knowledge. Women's involvement ranges from agronomic management to postharvest activities and culinary processes. Women play an extensive role in fertilizing the soil, selecting seedlings, and providing agronomic care for the crop. In addition, feminized agriculture often occurs in the study area due to men's out-migration for *Shema* (weaving), and on such occasions, women undertake all household agricultural work. Highlighting the indispensable contribution of women, a key informant from Lisha kebele stated, "*Maccasi baynako*

Qolxoy sharaffako", interpreted as "without women's contribution, *A. schimperianum* might be a rubbish weed with no food value." This means that women's skillful contribution transforms *A. schimperianum* from a wild herb into an essential food source. Women play an exclusive role in culinary heritage, while marketing products makes them economic agents generating household income. This gendered labor division positions women as key custodians of traditional knowledge and central actors in sustaining *A. schimperianum*-based food systems. These findings were consistent with previous studies (Contzen and Forney 2017; Salam 2026) that reported the indispensable role of women in traditional agriculture.

Anthropogenic and environmental factors largely affected the production and utilization of *A. schimperianum*. Key respondents' pairwise ranking indicated that social stigmatization was the main problem constraining the sustainable utilization of *A. schimperianum*. Elders described an intergenerational gap between elders and youth concerning knowledge and perceptions of using *A. schimperianum* as a crop. The younger generation dislikes *A. schimperianum* meals largely because of their taste and tends to regard *A. schimperianum* as a "poor people's food," worsening its social stigmatization. Another constraint is the lack of innovative postharvest handling and processing tools. Informants indicated that *A. schimperianum* corms contain delicate mucilage that causes skin irritation during handling and an unpleasant taste if not properly managed. Elderly women underscored that manual postharvest methods are labor-intensive and time-consuming and that the younger generation disregards the crop.

In addition, shifts in agricultural practices have greatly constrained *A. schimperianum* cultivation (Table 4). The recent transition from diversified, shade-based traditional agricultural systems to monoculture has led to the removal of indigenous shade-providing plants, disrupting the regeneration and survival of *A. schimperianum* landraces in the landscape. Lack of research and policy support was a major factor mentioned by informants. They reported that existing extension programs emphasize cereal crops and overlook indigenous root and tuber crops, with *A. schimperianum* being greatly neglected. Informants stated that they had never received training or support related to its production. The prolonged maturation period of the plant is another constraint cited by informants. Key informants highlighted that the growth cycle of the crop, characterized by sequential dormancy and vegetative growth and extending up to 5 years before harvesting, discourages farmers. Growers reported that they face a scarcity of seedlings with desirable traits due to such biological features. These constraints, together with environmental factors, pose a serious threat to the sustainable utilization of *A. schimperianum* genetic resources. Thus, these constraints call for targeted conservation efforts, including research and policy support, awareness-raising training, provision of postharvest technologies that integrate ecological and cultural values, and development of genetic resource conservation initiatives. In addition, the distinctive morphology of *A. schimperianum* landraces in the area requires further consideration and taxonomic revision.

Conclusion

The Gamo Highland community holds extensive indigenous knowledge of *A. schimperianum*, spanning classification, cultivation, processing, and conservation. Landraces are identified through distinct morphological traits and

local names, reflecting a sophisticated folk taxonomy rooted in phenotypic observation. Farmers sustain production through selective corm division, preserving meristematic tissue for planting while using the rest for food, thereby ensuring continuous propagation. Practices such as precise planting depth, dormancy protection, and intercropping reveal a refined understanding of the crop's biology. Processing by pulverization and fermentation is critical for reducing antinutritional traits and enhancing taste and acceptance. Culinary practices, shaped by gendered roles, underscore the crop's cultural integration, with women serving as key stewards of knowledge across production and preparation. However, this knowledge and its associated genetic diversity face growing threats: generational gaps, social stigma, shifting farming systems, labor demands, long growth cycles, and weak institutional backing. Effective conservation demands integrated action, including on-farm landrace preservation, documentation of traditional knowledge and naming systems, support for women custodians, better postharvest methods, and stronger research-extension linkages. These steps are vital to safeguard both crop diversity and the cultural practices ensuring its sustainable use.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

The study was conducted in accordance with ethical guidelines, with respect for local knowledge and confidentiality. Written permission was obtained from the local administration. Verbal consent was obtained from community participants.

Artificial Intelligence (AI) use

The authors accept full responsibility for the content of the manuscript, including the disclosure of any use of AI.
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Fantaye Fekede was responsible for the research design, data collection, analysis, and manuscript preparation, while Abera Uncha and Degife Asefa supervised data collection and edited the manuscript. All authors read and approved the final manuscript.

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Data availability

Supporting data will be available upon request.