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Cowpea (*Vigna unguiculata* (L.)Walp., Fabaceae) landrace (local farmers' varieties) diversity and ethnobotany in Southwestern and Eastern parts of Ethiopia

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The present research was carried out to identify and document the landrace diversity and ethnobotanical uses of cowpea (*Vigna unguiculata* (L.) Walp) (Fabaceae) in Southwestern and Eastern Ethiopia. Data were collected through field observations, semi-structured interviews, guided field walk with cowpea farmers and users, and market surveys. Descriptive statistics, preference ranking and informant consensus were employed in the analysis. Forty-four cowpea accessions were collected from geographical locations ranging from 428- 2128 m.a.s.l. and 05° 17' 06.6" to 09°33' 58.5" N and 34° 15' 54.5" to 42° 26' 30.4" E. The landraces had diverse seed sizes, colours, growth habits and germination potentials. Local variety 'Rapo' (Anywaa language) of *V. unguiculata* subsp. *dekindtiana* was found in Gambella Region; 'Atera babile' (Oromo language) of *V. unguiculata* subsp. *cylindrica* and subsp. *unguiculata* were found in all regions studied. Farmers grew cowpea for the purposes of human food, livestock Feed, improving soil fertility and medicine. The majority of farmers (63.33%) preferred the widely known 'Atera babile' which belongs to subsp. *unguiculata* because of its spreading nature, ability to produce more biomass than other varieties, effectiveness for improving soil fertility and ability to supersede weeds as a ground cover. Further research should focus on local landraces maintained by farmers and the crop wild relative is a worthwhile undertaking given its local importance and for future genetic improvement both as a food and feed crop.

Key words: Cowpea, ethnobotany, inter-cropping, landrace, sole cropping.

INTRODUCTION

Grain legumes are important sources of proteins with essential vitamins and minerals for food (Abebe et al.,

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2005; Patil et al., 2013) and can therefore be used as a substitute for animal protein in the regions of the third world where production of the latter is limited (Fall et al., 2003) with an added role of increasing animal production through use as feed and forage. Legumes contribute to smallholder income, as a higher-value crop and to diet, as a cost-effective source of protein (Chilot et al., 2010; Patil et al., 2013). Moreover, pulses offer natural soil maintenance benefits through nitrogen-fixing, which improves yields of cereals through crop rotation or intercropping, and can also result in savings for smallholder farmers from low rate of fertilizer use (Chilot et al., 2010). Among legumes grain, cowpea (*Vigna unguiculata* (L.) Walp.) is the most widely cultivated and consumed especially in Asia, Tropical Africa, South America, parts of Southern Europe and the United States (Singh et al., 1997; Lemma et al., 2009; Patil et al., 2013). However, Africa is the main area of production, where the crop is very important for low input agriculture, which characterizes most countries of the continent (Pasquet, 1998; Ba et al., 2004).

Cowpea is a multipurpose grain legume; in which the entire plant can be used for either human or livestock consumption (Pottorff et al., 2012). Its major importance is to the livelihoods of millions of relatively low income people in less developed countries of the tropics. Cowpea young leaves, pods and seeds are mainly used for human consumption and animal feeding (Ogbemudia et al., 2010). According to Islam et al. (2006), all parts of the plant are used as food, which is nutritious, providing protein and vitamins. Immature pods and seeds are used as cooked vegetables while several snacks and main dishes are prepared from the grains (Agbogidi and Egho, 2012). The pulses as a group constitute considerable number and diversity of crop species and are critical to smallholder livelihoods in Ethiopia (Chilot et al., 2010; Fikreselassie, 2012). The EBI (2004) has archived a total of 94 germplasm accessions of cowpea collected over the years and conserved at the gene bank for subsequent utilization in breeding and enhancement. Additionally, a total of 54 germplasm accessions and six representative botanical voucher specimens of cowpea were collected from different geographical locations of northern Ethiopia (Alemu et al., 2016) and deposited in custody of the Cowpea Research Coordination Office at Melkassa Agricultural Research Center to be given to EBI at a later date, and at the National Herbarium (ETH) of Addis Ababa University, respectively. Although Vavilov (1951) as cited by Westphal (1974) indicated that Ethiopia is a secondary center of diversity for cowpea, there is limited information regarding the diversity, ethnobotany, utilization and production status of cowpea landraces in Ethiopia at present. The main objective of this study was to identify and document the landrace diversity, the local nomenclatural systems and ethnobotanical uses of cowpea in Gambella, Oromia, Dire Dawa and SNNP Regions.

MATERIALS AND METHODS

Site and informant selection

The study sites were selected based on the ecological requirements of the crop as shown by suitability map, assistance of district agricultural office workers and accessibility of the area and the availability of time. The study was undertaken in areas distributed in four regions (Gambella, Oromia, Dire Dawa and SNNP) located in the Southwestern parts of Ethiopia. Nine administrative zones, 20 Woredas (districts) and 20 kebeles (sub district, smallest administrative unit in Ethiopia) were purposively sampled for the study. From each kebele, three cowpea farmers were randomly selected in which one of them was deliberately included with the facilitation and help of local guides and agricultural extension experts of each wereda as key informant. A total of 60 local farmers (38 males and 22 females) aged 28 to 78 were interviewed using pre-prepared semi-structured interview guide. Thus, 20 of the informants were marked as key informants and further interview and discussion was conducted with them. The questions included the local names of the landraces of cowpea that farmers cultivated and those they used to cultivate in the past, the parts used, how the parts were prepared as human food, other uses of cowpea, seed sources, methods of cultivation and management, production constraints including pests and diseases, wild forms that the farmers recognized and related aspects.

Ethnobotanical data collection

Ethnobotanical data were collected between September 2014-December 2015, following the method by Martin (1995), Alexiades (1996) and Cotton (1996). Semi-structured interviews, direct field observations and recording of information and market surveys were among the main techniques employed in data collection. During each field trip, voucher specimens were collected and dried using a plant press, a GPS was used to record the geographical coordinates and other materials including plastic bags, notebook, secateurs and a digital photo camera were used to facilitate collection of both specimens and other relevant ethnobotanical data. All of the interviews were held based on a checklist of questions prepared beforehand in English and later translated into Amharic and other languages as was necessary in the respective localities with the help of translators. Voucher specimens and seed accessions of cowpea were collected from different geographical provenances. The voucher specimens obtained from farmers' fields were used for taxonomic determination and as reference collection following IBPGR (1983) cowpea descriptor list. The georeferenced (passport data) of the crop was collected using GPS. Colored photos of cowpea accessions were also used for ease of communication with farmers and local guides regarding the identity, distribution and local names of cowpea landraces before starting the interview.

Primary data were collected from farmers' fields, threshing grounds, home gardens and local market places. Sources for secondary data were both from offices of governmental and non-governmental organizations including agriculture and rural development offices and the National Meteorological Service Agency. Additional data were sourced by further casual discussions with local communities and researchers. After taxonomic determinations, the voucher specimens were deposited at the National Herbarium (ETH), Addis Ababa University while the seed samples were delivered to Melkassa Agricultural Research Center with the understanding that the Center will eventually transfer sufficient germplasm material to the Ethiopian Biodiversity Institute (EBI) for proper safe keeping and conservation at the gene bank.

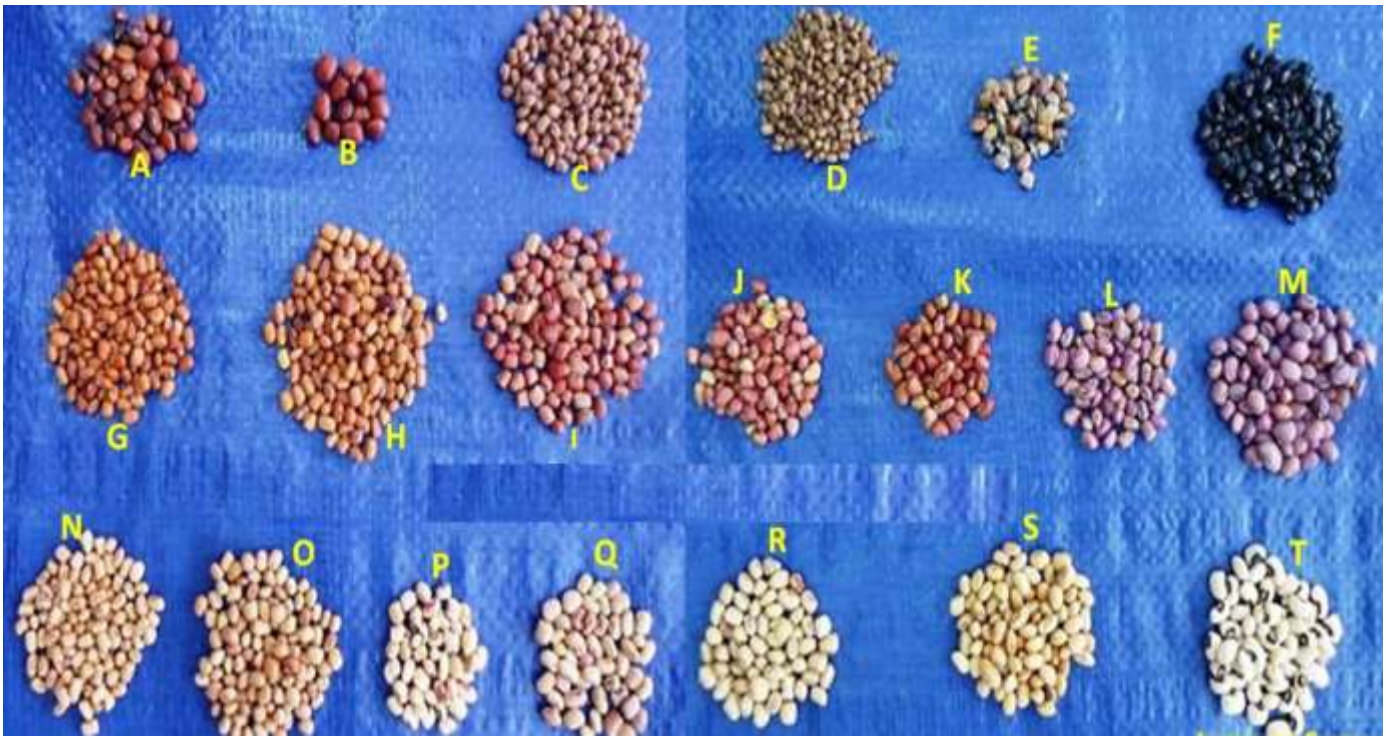

Figure 1. Seed samples and morphological variations of cowpea germplasm accessions (**A**, **B** and **P** from Gambella Region; **C**, **D**, **G**, **H**, **J**, **K**, **M** and **R** from Oromia Region; **E**, **F**, **L** and **N** from Dire Dawa Region and **I**, **O**, **Q**, **S** and **T** from SNNP Region). The details of the pictures are described in Table 1.

The collected ethnobotanical data were summarized in tables and figures and analyzed using both quantitative and qualitative approaches as recommended by Martin (1995), Cotton (1996) and Phillips (1996). Descriptive statistics, preference ranking and informant consensus tools were used to analyze the quantitative data. MS Excel 2010 was used to quantify and sort data, determine proportions, and to show the results in tabular form.

RESULTS

Cowpea landrace diversity in southwestern and eastern parts of Ethiopia

A total of 44 cowpea germplasm accessions were collected in the 20 surveyed kebeles of the four regions. Among these collections, 10 (23%) were collected from three Woredas of Gambella Region. The ten landraces collected from Gambella Region are locally called ‘Rapo’, ‘Wenu’ and ‘Boho’ (Anywaa language) and 16 (36%) cowpea germplasm accessions were collected from SNNPR. Additionally, in Oromia and Dire Dawa regions a total of ten Woredas were surveyed and 18 (41%) (ten from Oromia and eight from Dire Dawa) cowpea germplasm accessions namely QECHINE, ‘Atera babile’ and ‘Atera yusufi’ (Oromo language) were collected (Figures 1 and 2). The details of the pictures are described in Table 1.

Traditional nomenclature of cowpea landraces and the indigenous knowledge encoded in the names

The local names of the cowpea landraces collected from different Woredas and kebeles were different. The naming system is also based on morphological characteristics, appearance, adaptation, seed colour, growth habit, seed size, locality of source and the multipurpose nature of the crop. The names collected from the different areas together with indigenous knowledge encoded in the names are given in Tables 2 growth habit, seed size, locality of source and the multipurpose nature of the crop. The names collected from the different areas together with indigenous knowledge encoded in the names are given in Tables 2 and 3 show information retrieved on wild forms of cowpea recognized by farmers in the respective areas.

Cowpea landrace distribution in Southwestern and eastern parts of Ethiopia

The collected cowpea landraces from different geographical locations were determined using Flora of Ethiopia and Eritrea and IBPGR (1983) cowpea descriptor list. Accordingly, the collected cowpea landraces namely ‘Rapo’ or ‘Boho’ (*V. unguiculata* subsp.

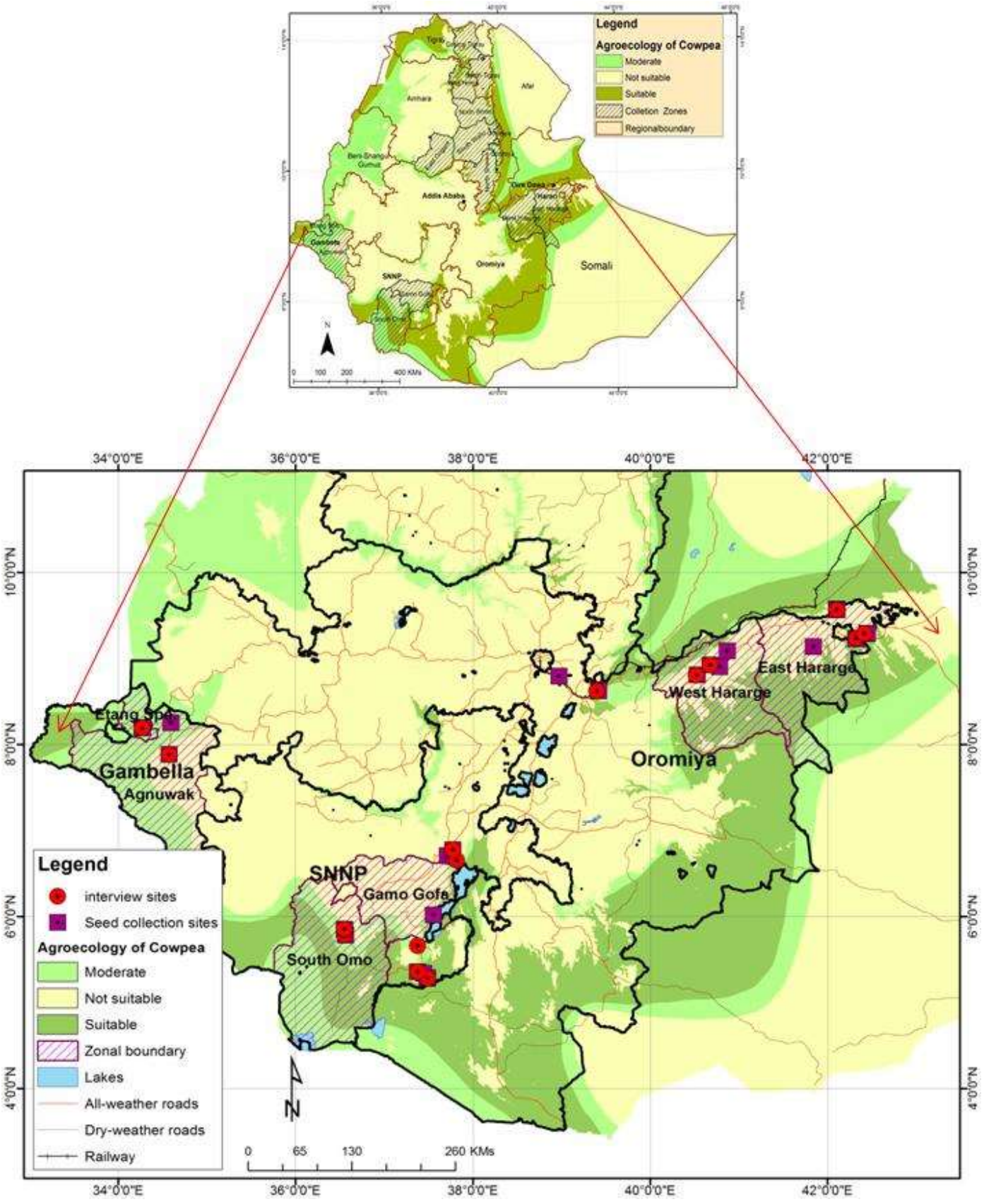

Figure 2. Map of the southern half of Ethiopia showing regional states and collection zones and districts for cowpea landraces (Map credit: Demeke Nigusse, GIS specialist, EIAR).

Table 1. Proportions of cowpea germplasm accessions collected from the four regions.

Landrace provenance	Proportions of cowpea germplasm accessions	Sample code	Local name of cowpea landraces*	Local language used in the study area
Gambella	10 (23%)	A	'Boho'	Anywaa
		B	'Rapo'	Anywaa
		P	'Wenu'	Anywaa
Oromia	10 (23%)	D	'Qechine'	Afaan Oromo
		H, J, K, M and R	'Atera yusufi'	Afaan Oromo
		C and G	'Atera babile'	Afaan Oromo
Dire dawa	8 (18%)	E, F, L and N	'Atera babile'	Afaan Oromo
SNNPR	16 (36%)	I	'Alita'	Derashigna
		O	'Ohoda'	Konsogna
		I and T	'Woqa'	Aari
		Q and S	'Aeqa'	Wolayita

Source of local name: Local informants.

dekindtiana) were found only in Gambella Region and *V. unguiculata* subsp. *cylindrica* and *V*. *unguiculata* subsp. *unguiculata* were found in all the study areas. Among the above subspecies, 'Atera babile', 'Boho', 'Ohoda', 'Qechine' and 'Woqa' (*V. unguiculata* subsp. cylindrica) and 'Aeqa', 'Alita' 'Atera yusufi' and 'Wenu' (*V. unguiculata* subsp. unguiculata) were widely distributed and found in all the regions of Southwestern and eastern parts of Ethiopia covered in this study. The distribution map (Figure 2) made using the GPS readings taken by the first author during the fieldwork shows the collection sites of the landraces.

Importance of cowpea in the Southern half of Ethiopia

Based on farmers' perception, cowpea is primarily used for human food, livestock fodder, and medicinal purpose. In Gambella and SNNP regions (South Ari and Konso special wereda) the majority of respondents (53%) used different parts of the crop (fresh leaves, young shoot and grain) for home consumption in the form of traditional foods. The remaining respondents (47%) in Oromia, Dire Dawa and SNNP regions (Wolayeta, Arbaminch zuriya and Derashe Woredas) farmers said they grew cowpea for the purpose of human food in the form of boiled grains (NIFRO) (Figure 4), local sauces as SHIRO WET or KIKE WET (split grain sauce), local soup (SHORBA) and porridge (GENFO). In addition to its human food value, the crop is also used for animal feed which can be prepared from grain and leaf. In Gambella Region (Itang and Abobo Woredas) and SNNPR (Konso and South Aari Woredas), the local farmers mostly preferred the fresh leaves of cowpea as green vegetable for home consumption to eat in the form of traditional stew and sauce. In addition, the local farmers used cowpea landrace for improving soil fertility via crop rotation and intercropping with cereals, mainly with sorghum and maize. In the areas studied, a reasonable number of respondents (23.3%) used the green leaves and seed of cowpea for medicinal purpose to cure liver disease, gastric discomfort and malarial infection. Furthermore, the farmers are using the crop for income generation including by selling the grains and the leaves in the local markets (Figure 3) and cowpea grains used as NIFRO and leaves used as cooked vegetables (Figure 4).

Farmers' seed source

Among the total respondents, the majority of local farmers (92%) used their own home saved seed and gifts from neighbours and relatives. Only 8% of the respondents said that annually they are obtaining cowpea seeds from government agricultural offices.

Production constraints and traditional management techniques

In the Southern half of Ethiopia, local farmers are facing different constraints on production and utilization of cowpea. In this connection, farmers listed major constraints such as storage pests, field insects, parasitic weeds and diseases for production and utilization of cowpea. Among these problems, diseases such as 'Guteni' (Wolayita language), 'Machole/keshekeshe'

Table 2. Traditional nomenclature of cowpea landraces and indigenous knowledge of local farmers in southwestern and eastern parts of Ethiopia.

Region	Collection Woredas (Kebeles)	GPS reading latitude and longitude (dd mm ss)	Local name of cowpea landrace	Encoded indigenous knowledge	Scientific name
Dire Dawa	Biya Awale (Belewa Kebele,)	09 29 28.2N 41 45 15.0E	'Atera babile' (Afaan Oromo)	Landrace origin	*V. unguiculata* subsp. *cylindrica*
	Abobo (Chobo Kere Kebele,)	07 53 34.8N 34 32 29.8E	'Rapo' (Anywaa)	Climbing habit that hold on to other plants	*V. unguiculata* subsp. *dekindtiana*
Gambella	Gambella Zurya (Abole Kebele,)	08 15 58.2N 342711.5E	'Boho' (Anywaa)	Climbing habit	*V. unguiculata* subsp. *dekindtiana*
	(Abole Kebele-Itang Village,)	08 11 29.4N 34 15 53.1E	'Wenu' (Anywaa)	Creeping habit	*V. unguiculata* subsp. *unguiculata*
	Ada (Godino Kebele-Boset (Dengoro Kebele)	08 51 17.4N 39 01 02.9E	'Qechine' (Afaan Oromo)	Seed morphology that is thin and small	*V. unguiculata* subsp. *cylindrical*
	Babile (Ifa Kebele,)	09 14 11.7N 42 19 06.5E	'Atera yusufi' (Afaan Oromo)	Name of a person and attractiveness of flower or seed	*V. unguiculata* subsp. *unguiculata*
Oromia	Gursum (Awdei Kebele)	09 22 06.0N 42 23 35.9E	'Atera yusufi' (Afaan Oromo)	Name of a person and attractiveness of flower or seed	*V. unguiculata* subsp. *unguiculata*
	Oda Bultum (Badessa,)	08 5216.5N 40 40 57.6E	'Atera babile' (Afaan Oromo)	Landrace origin	*V. unguiculata* subsp. *cylindrical*
	Habro (Gelemso)	08 47 08.4N 403136.6E	'Atera babile' (Afaan Oromo)	Landrace origin	*V. unguiculata* subsp. *cylindrical*
	Kurfa Chelie	09 13 51.5N 41 49 11.7E	'Atera babile' (Afaan Oromo)	Landrace origin	*V. unguiculata* subsp. *cylindrical*
	Derashi (Walayeti Kebele)	05 38 19.2N 37 21 25.7E	'Alita' (Derashi language)	Grain legume	*V. unguiculata* subsp. *unguiculata*
SNNPR	Konso (Nalyasegen Kebele)	05 21 13.2N 37 28 53.8E	'Ohoda' (Konso language)	Grain legume	*V. unguiculata* subsp. *cylindrical*
	South Aari (Aykamer Kebele)	05 50 18.8N 36 32 42.8E	'Woqa' (Aari language)	Grain legume	*V. unguiculata* subsp. *cylindrical*

Table 2. Contd.

South Aari (Geza Kebele)	05 49 06.4N 36 32 55.7E	'Woqa' (Aari language)	Grain legume	*V. unguiculata* subsp. *cylindrica*
South Aari (Yetnebershe Kebele)	05 51 42.0N 36 33 42.8E	'Woqa' (Aari language)	Grain legume	*V. unguiculata* subsp. *cylindrica*
Wolaita (Larena Kebele,)	06 41 43.9N 37 45 31.5E	'Aeqa' (Wolayita)	Seed morphology	*V. unguiculata* subsp. *unguiculata*

Table 3. Information retrieved on wild cowpea (Vigna spp.).

Local names of wild *Vigna*	Language	Encoded indigenous knowledge
'Yezinjero Boho' (boho mere ajamo/ bime/)	Anywaa (Gambella)	Monkey cowpea
'Yecha kaboho (Boho merpape),	Anywaa (Gambella)	Forest cowpea or found in forest area
'Yayete qechine'	Amharic (Dire dawa)	Mostly eaten by Rat
'Atera werabo'	Afan Oromo (East Hareregе)	Mostly eaten by Monkey
'Atera werabo'	Afan Oromo (West Harerge)	Mostly eaten by Monkey
'Dikala babile'	Afan Oromo (East Hareregе)	Hybrid with local cowpea
'Yechaka alita'	Wolayetigna (SNNPR)	Forest cowpea or found in forest area
'Yechaka ohoda'	Konsigna (SNNPR)	Forest cowpea or found in forest area
'Woka beysi'	Aarigna (SNNPR)	Thin seeded cowpea
'Brwoke'	Aarigna (SNNPR)	Looks like cowpea
'Turna'	Aarigna (SNNPR)	Wild cowpea
'Berbera'	Wolayetigna (SNNPR)	Wild cowpea

Source: local farmers and agricultural office experts.

(Oromo language), 'Sinta' (Anywaa language), 'Roja', 'Jegedo', 'Atorena' (Aari language) are the most important constraints that attack the leaves, grains and pods during the growth stages of the crop (Table 4). In addition, as per the information gathered from local farmer respondents the most serious problem for production and utilization of cowpea is insect pests locally known as 'Alora', 'Jore' and 'Awero' (Anywaa language) which are mainly found in Gambella Region and insect type 'Bawsha' (Aari language) is found in SNNPR. In addition to that, 'Akanchira' (*Striga* spp.), 'Astenager' (*Datura stramonium)*, 'Lemboche' (*Parthnenium* spp.), 'Asheket' (*Gallium purpureum*.) and 'Yewofenkur' (*Commelina* spp.) were recorded as weeds of cowpea (Table 4). To solve this problem, the farmers use different traditional techniques including hand weeding, combination of spreading ash with chemicals (malathion) to prevent the severity of storage pest problem. In addition, farmers reported and demonstrated that in their traditional practice they cut the shoot part of the crop to promote lateral growth which, as they say, also reduces weed infestation.

Cropping system and management

In the southern half of Ethiopia, cowpea planting

Figure 3. BOHO *(Vigna unguiculata* subsp. *dekindtiana)* cowpea landrace green leaves presented in the local market by women at Itangn town in Itang Wereda, Gambella Region.

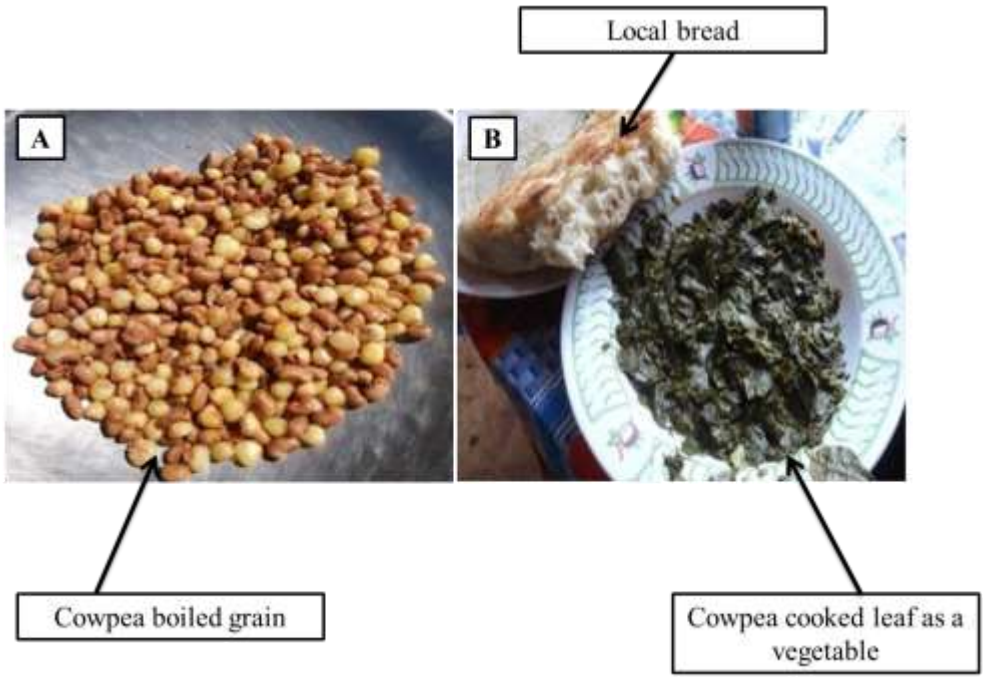

Figure 4. A) Boiled cowpea grain locally called NIFRO in Amharic used in Babile in Oromia Region; **B)** Cooked cowpea as leafy vegetable to be eaten with local bread.

begins from June and goes to September and by the end of January, all farmers harvest cowpea from the field depending on the Agroecological conditions. The majority of farmers (60%) produce cowpea using broadcast sowing, 18% use row sowing with intercropping of maize and sorghum, 12% use only hoeing and 10% use row and broadcast sowing then weeding and hoeing. About 53% of the farmers grow cowpea via sole cropping and 31% use intercropping. Intercropping is mainly with maize (60%) and sorghum (40%) (Figure 5). Farmers also used hand weeding and sometimes hoeing to reduce the severity of weeds. In addition, local farmers used crop rotation system in order to harvest diverse products, reduce weed infestation, and improve soil fertility. The

Table 4. Information on pests and diseases reported by farmers.

S/N	Pests and diseases reported by farmers in local language	Language	Region	Problem type	Mainly attached parts of cowpea
1	'Guteni'	Wolayita	SNNP	Disease	Cowpea leaves, grains and pods
2	'Machole/keshekeshe'	Afan Oromo	Oromia	Disease	
3	'Sinta'	Anywaa	Gambella	Disease	
4	'Roja', 'Jegedo', 'Atorena'	Aari	SNNP	Disease	
5	'Alora',' Jore' and 'Awero'	Anywaa	Gambella	Insect pest	Cowpea leaves
6	Bawsha	Aari	SNNP	Insect pest	Cowpea leaves
7	'Akanchira' (*Striga* spp.), 'Astenager' (*Datura* spp), 'lemboche' (*Parthnenium* spp.), 'Asheket' (*Gallium* spp.) and 'Yewofenkur' (*Commelina* spp.)	Amharic	Found in all regions of the study area	Weeds	Has a great impact of the overall growth and development of the crop via nutrient competition

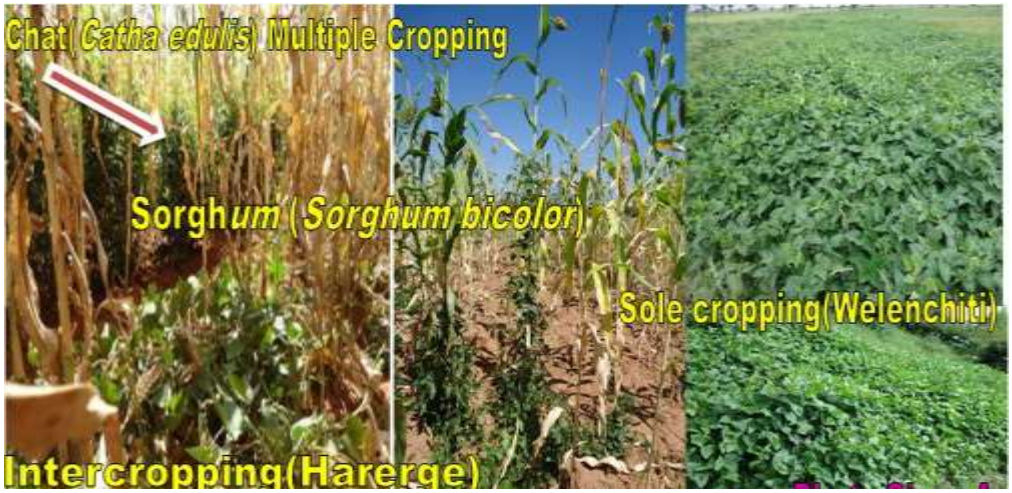

Figure 5. Cowpea sole cropping in Oromia Region (Welenchiti) and intercropping with CHAT/Khat (*Catha edulis*) and Sorghum in Oromia Region (East Harerge).

majority of respondents (90%) do not use inorganic fertilizer to increase productivity of the crop. The remaining 10% of respondents used organic fertilizers (compost and manure) for better growth and development of the crop.

Farmers' perceptions and practices in relation to cowpea

From the farmers' point of view, cowpea landraces have better performances than other crops under difficult conditions and are well adapted to drought and extreme heat conditions. About 17% of the informants responded that, the crop has better performance in poor soil fertility and better resistance to grow in unusual rainfall pattern, 15% of respondents said local cowpea varieties have better adaptation to unusual timing of rainfall (early or late) and 17% of the respondents mentioned that the crop has better growth in poor soil fertility and the remaining respondents mentioned that, cowpea has an ability to grow in hailstorm area and tolerant to harsh conditions.

In the study area, farmers stated some general limitations on cultivation and utilization of cowpea in their locality. Among these, disease prevalence, extreme and frequent drought and shortage of rainfall, pest infestation, shortage of land, low production capacity and low market demand, demand for frequent weeding, problem of wild grazing animals are the most series limitations to grow cowpea for farmers. Additionally, in Gambella Region (Itang and Abobo Woredas), because of the increased use of the leaf of cowpea as a vegetable, there is a limited amount of seed production and this leads to shortage of cowpea seed for the next growing season. In order to overcome the aforementioned limitations, the local farmers reported using and suggesting different techniques such as disease preventing chemicals, herbicides, developing irrigation systems, and the culture

of frequent weeding, protecting the crop from wild grazing animals, developing access to markets and raising awareness of urban dwellers to consume cowpea and its varieties.

DISCUSSION

Cowpea landrace diversity in Southwestern and eastern parts of Ethiopia

Farmers have different farming traditions and food cultures and their maintenance of cowpea subspecies and landraces are varied. Thulin (1989) reported that *V. unguiculata* subsp. *sesquipedalis* and subsp. *dekindtiana* are mainly cultivated in northern Ethiopia. The results of this study, however, showed much wider distribution than that indicated in the Flora of Ethiopia and Eritrea. In the present study, landraces belonging to 'Rapo' (*V. unguiculata* subsp. *dekindtiana)* were found only in Gambella Region. A similar study recently undertaken in northern parts of Ethiopia (Alemu et al., 2016) did not find landraces of this subspecies. On the other hand, 'Atera babile', 'Boho', 'Ohoda', 'Qechine' and 'Woqa' belonging to *V. unguiculata* subsp. *cylinderica* and AEQA, 'Alita', 'Atera yusufi' and 'Wenu' belonging to *V. unguiculata* subsp. *unguiculata* were found in the southern and eastern parts of Ethiopia. The study by Alemu et al. (2016) also showed that landraces of the latter subspecies are widely cultivated in the northern parts of the country. Similarly, the landrace diversity at the field level is greater for farmers who apply more selection criteria to define their diverse needs and requirements. In this process, both natural factors and farmers' selection criteria shape crop genetic diversity at the field and landscape levels as shown for sorghum in central Ethiopia (Teshome et al., 2015). Genetic diversity is also shaped by selections by women and men based on food quality and acceptability for various local dishes in the diverse ethnolinguistic communities found in the southern parts of the country.

As indicated in the cowpea suitability map, the crop can grow in many parts of southern Ethiopia but still the production is low because of low market demand and poor production management system i.e. cultivation as border crop as a buffer for main crops to protect them from livestock damage. In the last three decades, agricultural research and extension services favoured improved varieties. But mitigation or preservation methods suggested by Eticha et al. (2010) reported that landrace conservation can be influenced by their end-use, market demand and price. The presence of wild cowpea species in parts of the study area is another important finding that could be taken up by cowpea breeders not only for the present study areas but also for other parts of Ethiopia. Thus, the EBI can do germplasm collections and the pulse research group can include these species in their future breeding programmes.

Use values of cowpea landrace varieties

As observed in Gambella Region in this study, Chilot et al. (2010) reported that young cowpea leaves are eaten as boiled pot herbs and enjoyed in many parts of Africa. The same paper explains that freshly harvested leaves are sold in local markets in many parts of Ghana, Mali, Benin, Cameroon, Ethiopia, Uganda, Kenya, Tanzania and Malawi. Other researchers have shown that cowpea young shoots and leaves are rich sources of calcium, phosphorous and Vitamin B (Barrett, 1987). The young leaves are especially important in drought-prone regions of Sub-Saharan Africa as they are used the local populations to bridge and pass over the "hungry period" which usually occurs after planting but before the main harvest of fresh pods and dry grains. Similarly, this research showed that the leaves and young shoots of local landraces including RAPO, BOHO and WENU in Gambella and OHODA in Konso Woreda are mainly used as leafy vegetables for home consumption. In addition, in Gamo Gofa and Wolaita zones and Oromia Region, farmers use the seeds of cowpea for food and leaves and crop residue as fodder for their livestock. Prepared food types from cowpea are mostly boiled grain locally known as NIFRO and KIKE WET (Amharic language) in all study sites. In Woredas found in Dire Dawa and East and West Harerge farmers' variety 'Atera babile' is used to prepare traditional sauce. In South Aari Wereda, the variety WOQA is used by the local community as cultural foods known as 'Ayebza' and 'Zegola'. Similarly, farmers' variety 'Ohoda' in Konso Wereda, ALITA in Derashe Wereda, AEQA in Wolayita are used as local food preparations known as 'Changa', 'Kurkufa' and 'Polando' (POCHE/HOCHE) respectively. Accordingly, 23% of respondents said that cowpea variety 'Boho' and 'Atera babile' are mainly used for medicinal purpose in Gambella, Oromia and Dire Dawa regions by using green leaf for treating human liver pain and local farmers use cowpea seed to treat malaria pain and gastric discomforts.

Cowpea cultivation and management

Cowpea cultivation and management practices such as crop rotation and intercropping with maize and sorghum are the major practices which are mainly used by the local farmers in the study areas. In Gambella and eastern Oromia region (West Harerge Zone), farmers do not use any crop rotation system instead they use intercropping with sorghum and maize to maximize and optimize space utilization due to the shortage of land they face. In contrast, all SNNPR and East Shewa and East Harerege zones farmers used crop rotation system for the purpose of enhancing or improving soil fertility, reducing weed infestation and to boost production. SNNPR, South Omo and Wolayita zones and in Gambella Region, farmers used broadcast sowing method and hand weeding to

manage cowpea farm land. Likewise, in West and East Harerge zones farmers used row planting method via intercropping with sorghum and maize. In East Shewa Zone, Boset Wereda farmers used broadcast sowing and hoeing. Farmers in SNNPR, Segen Peoples Zone, Konso and Gidole Woredas used combination of row and broadcast sowing methods. Intercropping cowpea with sorghum has been adopted in Cameroon to show the effects on suppression of parasitic weeds (Carsky et al., 1994). The results indicated that the ground cover ranged from 20 to 80% and the density of mature capsule-bearing *Striga* plants was low when the cowpea ground cover was high. This suggested that any spatial arrangement that increases cowpea ground cover at the base of the sorghum plants can reduce the density of mature *Striga hermonthica* (Carsky et al., 1994). This technique can be adopted by Ethiopian farmers (particularly in the north) where the case of *Striga* in sorghum fields is very serious.

Sole-crops are becoming important as cowpea production is commercialized to meet the demands of a rapidly increasing urban population. In Senegal, most cowpea is sole-cropped (Thiaw et al., 1993). Intercropping is an important agricultural technique that improves diversification of food supply and ensures high economic returns. It also suppresses weeds particularly when short stature, bushy cowpea varieties are used (Zimdahl, 1999). Our research results showed that, in Welayita Zone of SNNPR and Gambella Region, all farmers grow cowpea crop as sole-cropping method and in Konso and South Aari Woredas cowpea is mainly grown as intercropping with maize and sorghum. In Oromia Region, except Boset wereda, all farmers produced cowpea via intercropping with sorghum and maize.

Women's contribution to maintenance of cowpea diversity

It should be noted that in Ethiopia women are the one and only members of the households who are fully responsible for the processing of food and beverages. Women's contribution in agriculture and their decisions about the utilization of biological resources to satisfy the needs of rural households are often ignored (Eticha et al., 2010). In this study, 22 (37%) respondents were female farmers who were better suited to describe the landraces particularly in regard to the organoleptic properties of the edible parts, flour taste, cooking characteristics and preparation of cultural foods, while men had better knowledge about agronomic traits such as plant height, maturity, disease tolerance, threshing quality, yield performance and straw quality. In SNNPR and Gambella regions, women have the bulk of responsibilities both in the farm and household activities including weeding, hoeing and harvesting, grain separation and treating and handling the grain during storage using ash and/or Malathion.

Cowpea cultivation advantages

Cowpea is a grain legume which is highly drought resistant and tolerates a wide range of soil types (Kolawole et al., 2000; Zuofa et al., 2000; Mashingaidze, 2004). This research result also showed that, in the study areas cowpea landraces have ability to tolerate pests, diseases and weeds. Cowpea can perform better than other crops under difficult conditions because of its ability to adapt to extreme drought and heat occurrence; it can grow in poor soil fertility areas, unusual rainfall pattern and in hilly stone areas such as those observed in Dire Dawa and Gambella regions in particular.

Production constraint and traditional management technique

Cowpea is faced with so many constraints, such as diseases and the limited use of fertilizers and irrigation input for the sake of cowpea production and utilization as mentioned by Brisibe et al. (2011), insect pests are one of the major constraints for cowpea production in southern parts of Ethiopia. Cultural management techniques of local farmers on disease, insect and weeds are less emphasized by wereda agricultural office experts on field protection of the crop. Similar results were reported by Singh and Allen (1982), fungal diseases, seedling mortality disease, stem, root and foot rots (*Anthracnose)* disease, *Phthium* and *Sclerotium* stem rot, Wilts (*Fusarium wilts*), leaf diseases; like *Cercospora* leaf spot Target spot, *Septoria* leaf spot, and *Dactuliophora* leaf spot. In Africa, *Striga gesneriodes* and *Alectra vogelii* are the most known weed species which affect cowpea production (Duruigbo, 2010; Timko and Singh, 2008; Dudu, 1996). After some periodic exposure to the sun of grains in order to remove pest and putting the seed in closed stone pots, tins or plastic bottles; seeds were mixed with DDT and some preservative chemicals supplied from agricultural input suppliers to prevent post-harvest pests. Accordingly, in SNNPR leaf and seed diseases locally known as GUTENI and SINTA are the most common problems in Wolayita and South Aari Woredas respectively; seed disease namely 'Roja', 'Jegedo', 'Atorena' in South Aari Woreda were recorded and similarly in Oromia Region leaf and seed disease called 'Machole' and 'Keshekeshe' were reported. Common insect pests found in Gambella Region are locally known as 'Alora', 'Awero' and 'Jore' (Anywaa language). Insect pests in SNNPR are a common problem and locally called BAWSHA and wild nocturnal grazing animals and this is also found in Oromia Region as pests which mainly attack cowpea plants.

Conclusion

In the study area, cowpea is a multipurpose crop where

the green leaves are primarily used as cooked vegetables and the crop also has medicinal uses in parts of the study area. In addition, the majority of local farmers use the grain of cowpea for home consumption and for livestock feed. *V. unguiculata* subsp. *unguiculata* farmers' variety ATERA BABILE is preferred by the majority of farmers because of the spreading nature of the crop, ability to produce more leaves than other varieties, improving soil fertility and ability to supersede weeds as a ground cover. Could this preference of farmers for soil fertility improvement have relation to more nodulating ability of this landrace? Further research that compares this landrace with others may throw some lights in this regard. This study discovered that, there is a moderate existence of important diversified cowpea landraces but the production coverage has been declining over the year as affirmed by farmers. Local farmers mainly grew cowpea in marginal land and crop protection mechanism of cowpea is underdeveloped. The decrease in production is due to limited use of improved inputs, small fragmented plots, sowing in marginal soils, inadequate farm management practices and gaps in scientific knowledge of local farmers and agricultural extension agents. The agricultural research system must be keen towards such crops that play multiple roles in the field, at market places and at home. The wild *Vigna* spp. that farmers talked about also need further studies for possible useful traits and use in the development of feed and as breeding stocks.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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