Production Constraints,Farmers Preferred- traits and Farming System of Cowpea in the Southern Ethiopia

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Abstract

The study was conducted at Gofa, Humbo, Kindo koyisha and Konso districts of South Nation Nationalities and Peoples Region (SNNPR) from May 2016 to February 2017 with the objective to assess the limitations on cowpea production conceived by farmers, farmers traits of interest and the farming system of cowpea. Participatory rural appraisal tools, which include seven focus group discussions and survey with 150 individual farmers, were used to generate data. Data recorded were analyzed on SPSS software and descriptive statistics were applied. The results showed that 85.3% of the farmers surveyed were men and the size of families ranged from 6 to 9 at the household level. Almost (40%) produced cowpea for household consumption, while 21.3% reported its food and income generation. The average cowpea fields were 0.24 ha with 503 kg/ ha as an average seed yield. The results revealed that 92.7% of farmers grow local landraces, whose seeds are recycled for many consecutive seasons, while approximately 7.3% grow both improved and local landrace. Cultivars were generally cultivated as intercrop (92.7 %) with maize or sorghum. Many factors limiting cowpea production were identified, key of which were lack of improved varieties, disease and insect pests, drought, poor access to extension, poor access to credit services, low soil fertility, farmland shortage, inappropriate agronomic practices and storage pests. Farmers also specified to have developed few managing mechanisms to counter the restraints. Farmers showed preference for high yielding coupled with early maturing cowpea varieties that are in addition, resistant to pests and diseases, tolerant to drought ,good taste,large seed size, fast cooking and seed colour. Therefore,it is recommended that there be a cowpea improvement program that can address above-mentioned constraints as well as the prefrences of farmers for sustainable cowpea production in Southern Ethiopia.

Background: The success of crop varieties growing is closely associated to the utilizations, biophysical conditions, the cropping systems in which the crop is combined and preferences of farmers'. Cowpea is one of the lowland legumes grown for food, cash crop and medicinal purposes in the different growing areas of Southern Ethiopia. It is ranks the 5th to 9th important legume crop for household food, nutrition, and income generation for cultivating farmers, which contributes significantly to food security of the region. In spite of its importance, the crop received little research attention in the development improved varieties, cowpea productivity remains low.Exploring and describing the current cowpea cropping system, production constraints and farmers varietal perefrences in the main production areas will help in defining the cowpea improvement priorities.

Methods: The study was conducted in four cowpea-growing districts in South Ethiopia. Participatory rural appraisal tools including seven focus group discussion,key informants and survey with 150 individual farmers, were conducted in Gofa, Humbo,Kindo koyisha and Konso districts from May 2016 to February 2017 to collect information on production system, constraints and preferred traits. Data collected through the questionnaires were processed and analyzed using the Statistical Package for Social Sciences (SPSS) version 20.0 (SPSS, 2012). Analysis was performed for descriptive statistics, mean, frequencies and percentages. Cross tabulations were performed for data summary and chi-square analysis performed to test for significant differences between variables.

Results: Farmers grow both local and improved varieties to meet their various goals in cowpea farming. Nearly 92.7 % of the farmers grow local landraces, whose seeds are recycled for many consecutive seasons, whilst approximately 7.3% grow both improved and local landrace. The results showed that 85.3% of the farmers surveyed were men and the size of families ranged from 6 to 9 at the household level. Almost (40%) produced cowpea for household consumption, while 21.3% reported its food and income generation. The average cowpea fields were 0.24 ha with 503 kg/ ha as the average grain yield. About 92.7% of cowpea growers associated cowpea with other crops, while 7.3 % of them grew the crop in pure stand. Cowpea grown in combination with maize (68.7 %) and 22.7 % with sorghum was the most encountered cropping system. The lack of improved varieties, disease and insect pests, drought, poor access to extension, poor access to credit services, low soil fertility, farmland shortage, inappropriate agronomic practices and storage pests are some of the important constraints affecting cowpea productivity. Framers showed preference for high

yielding coupled with early maturing cowpea varieties that are in addition, resistant to pests and diseases, tolerant to drought ,good taste,large seed size, fast cooking and seed colour.

Conclusion: Our results confirm the importance of cowpea both in the cropping systems and in contributing to ensure food security in the growing areas in South Ethiopia. Key production constraints and farmers' varietal preferences were identified. The results of this study are helpful to breeders and agronomists to design appropriate strategies for sustainable cowpea production. Therefore,it is recommended that there be a cowpea development program that can address the above-mentioned constraints and the farmers' preference for sustainable cowpea production in Southern Ethiopia. It implies that these findings can be used as the basis for designing research and development plans for continuous cowpea production and productivity by smallholder farmers in South Ethiopia.

1. Introduction

Cowpea is an important food legume cultivated in the semi-arid tropics, covering Africa, Asia, Southern Europe and Central South America[1] . More than 12.61 million hectares of cowpea acreage worldwide, with an annual grain production of about 5.59 million tons. Of these, 94% of grain production is found in Africa [2]. Nigeria is the world's largest producer of cowpea, accounting for more than 2.5 million tons of grain production from an estimated 4.9 million hectares[2].

Cowpea is a vital food and food security crop in Africa's traditional low-input, traditional legume-based farming systems. The optimum temperature required for fruitful cowpea cultivation is between 20^0 and 35^0C [3].Cowpea is well adapted to a wide variety of soil conditions. It has food, feed, vegetables and cash /economic value [4].

In Ethiopia, cowpea is grown in most of the lowlands of the North, the South, Gambella and the Eastern parts of Ethiopia [5] however the key production complexes are situated in the southern and western parts of the country [6]. In Ethiopia, cowpea generates income, medicinal purpose ,enhances food security and provides a natural ground cover where it is grown [7]. It has a high potential to counter food insecurity owing to its resilience and ability to grow and produces reliable yields in marginal areas where most other crops will fail. . Regardless of these benefits, cowpea has not been given satisfactory research consideration, and this is partly reflected in its insignificant attempts to appreciate the production system and also its production constraints. For food, animal feed, vegetables, economics, nutrition and other potential impacts, the crop needs to be improved through research and the use of indigineous knowledge. Cooked cowpea mixed with maize flour and cabbage / Moringa leaves to prepare a local dish called 'Possosse/Kurkufa' like beans in Gofa district. Onyibe et al. [8] reported that cowpea porridge was a breakfast dish eaten alone or with bread in Nigeria.

Cowpea can be a multi-purpose crop that provides grain and fodder haulms that contain about 20% protein with a high digestibility and low fibre. It is also used for livestock, especially during the dry season ,when feeds are scarce,so the crop provides an excellent supplements to the lower nutritional content and quality of cereals, roots and or tubers that often consumed in most of resource-poor households [9]. Cowpea also improves soil fertility,thereby reducing fertilizer costs, especially for low input smallholder farming households [10]. Infonet-biovision[11] has further stated the important contribution of cowpea as source of green manure that improves soil structure. The crop also has a symbiotic relationship with soil bacteria (Rhizobium spp.) in the root nodules to fix atmospheric nitrogen.

Despite its versatility and economic value for the lives of lots of subsistence farmers, the national mean yield of cowpea in Ethiopia is estimated to be 0.4 t ha^{-1} [6] while the yield potential of cowpea averaged 1.5 to 6 t ha^{-1} depending on genotype [12]. Therefore, there is a large gap among the actual and potential yield of a crop; and hence this calls for research interventions. Constraints that cause low cowpea yields include lack of suitable varieties for farmers needs, a

biotic stresses (drought, low soil fertility) and biotic stresses like pests , diseases , poor agronomic practice and limited research work [13].

It is important to start with farmers' existing knowledge of exisisting or improved varieties /introduced genetic materials in an active participatory research approach. In developing countries ,PRA has been used extensively and successfully in elucidating systems in rural areas. Horn *et al.* [14] used PRA techniques to elucidate farming systems, production limitations and cowpea preference traits as an implication for breeding in the northern Namibia. Ibitoye et al [15] used PRA technique to identify impact of drought stress on cowpea production and farmers' income ,production constraints and preferred traits in Kano state, Nigeria for inclusion in breeding for improved varieties. Tekalign *et al.* [16] used PRA techniques to evaluate threats to production, farmers' desired traits and faba bean selection criteria. Salifou *et al.* [17] used PRA to know farmers' favorites and views of cowpea cultivation and its limitations in Niger. However, these useful tools have not been extensively applied on cowpea farming, especially in Southern Ethiopia. In most of cowpea growing areas of southern Ethiopia,information on traits need of farmers', the cultivars, the uses of the crops and various production constraints are limited. This information will be useful to set cowpea improvement strategies aimed at developing high yielding varieties that incorporating other traits of interest to farmers.The objective of this study was to assess farmers'- observed cowpea production limitations, farmers traits preferences and the farming system of cowpea in southern Ethiopia.

2. Materials And Methods

2.1. Study area description

The study was carried out from May to June 2016 in the districts of Gofa, Kindo koyisha and Humbo while from January to February 2017 in the district of Konso in southern Ethiopia (Fig. 1). Gofa is located in the Gamo gofa Zone and is located at 6^o 18'N, 36^o 54'E. Kindo koyisha and Humbo districts are located in the Wolayta zone and are respectively at 6^o 57'N,37^o 32'E and 6^o 39'N, 37^o 48'E whereas konso is located in the Segen people's area Zone and lies at 5^o 21'N ,37^o

The altitude of the konso zone ranges between 501 and 2000 meters above sea level. The zone has a hot-semiarid climate with an erratic rainfall of between 601 and 1200 mm/year. The district of Humbo (6^o 39'N, 37^o 48'E) is characterized by an altitude of 1100 to 2335 meters above sea level with rainfall ranging between 841.3-1434.1 mm and clay soils. All the districts are suitable for production of cowpea with a bimodal rainfall pattern of short rains (from Febrary to June) and the long rains (from July to December).

2.2. Sampling procedures

Both formal and informal approaches were used to collect data for the study. Multi-stage sampling was used for the study. In each district, two villages were sub-sampled and thirteen to twenty-six cowpea farmers were randomly selected from each village. This provided a total of 150 farmers for semi-structured interviews. The number of farmers who participated in the different districts is presented in Table 1. The survey involved individual interviews with the 150 farmers. This allowed individual farmers to express their own views without the influence of the community. The informal approach of Participatory rural appraisal was used to generate information on farmers' perceptions of features of cowpea production. Before to the survey, the list of villages in each district was provided by the agricultural and natural resources development office in each district. Participants were selected from each village with the help of the kebele chairman, development agents and kebele managers providing the list of farmers. A total of 150 farmers participated (128 men and 22 women). A further seven other focus groups were established with 84 farmers for focus

group discussions. Each focus group included 12 farmers selected by local leaders and agricultural experts from each village. Participants in the group discussions were selected to represent the range of individual farmers in the villages.

2.3. **Data collection**

Data for a semi-structured survey were collected using pre-tested questionnaires that covered socio-economic and demographic characteristics of farmers, cropping systems, production limitations and farmer preferred traits in cowpea.

Table 1: The number of farmers to be involved in survey in each district

			Group discussion			Survey		
Districts	**villages**	**Key informants**	**Men**	**Women**	**Total**	**Men**	**Women**	**Total**
Gofa	Suka	3	10	2	12	16	2	18
	Boreda		8	4	12	20	2	22
Konso	Dogatu	3	11	1	12	20	3	23
	Turayte		9	3	12	21	5	26
Humbo	Abela sipa	3	8	4	12	15	5	20
	Abela farcho		7	5	12	18	3	21
Bele	Mundena	3	11	1	12	18	2	20
Total		12	64	20	84	128	22	150
%			76.1	23.9	100	85	15	100

The PRA for this study included key informant interviews (KII), focus group discussions (FGD), and pairwise ranking. Participants were gathered in each target village and began to list the constraints persuading cowpea cultivation, the prominence of cowpeas, the strategies used to control the problems (coping mechanisms), the agronomic practices of farmers and were asked to rank production problems according to their importance. In general the study was divided into two components: i) a participatory rural appraisal was conducted to reveal the varieties farmers had been growing, traits of prefernces in a cowpea varieties, production limitations and knowledge on cultivation and management, and ii) a survey was also conducted with individual farmers to confirm the PRA findings.

2.4. Data analysis

The data collected through the questionnaires were processed and analyzed using the Statistical Package for Social Sciences (SPSS) version 20.0 (SPSS, 2012). Analysis was performed for descriptive statistics, mean, frequencies and percentages. Cross tabulations were performed for data summary and chi-square analysis performed to test for significant differences between variables.

3. Results

3.1 .The Respondents Socio-Economic Characteristics

This study emphasized the socio-economic features of cowpea farmers in southern Ethiopia expending the variables of gender, marital status, age, household size, education status and farming experience (Table 2). During the household

survey, a total of 150 individual farmers were interviewed. Of the 150 farmers interviewed, 14% were women and 86 % were men, which implies that cowpeas are grown by both men and women farmers. There was no significant difference ($p > 0.05$; $\chi 2 = 1.92$) in gender representation among the four districts. Women participation in cowpea production was relatively higher in Humbo district (20%) compared to Gofa (10%). Forty one percent of the participants were under the age of 30, 51 % were between 31 and 60 years old with an average age of 47.1 years , representing that the farmers are still in their economically active age group capable of various agricultural activities. Only 8% of farmers were above the productive age of 60 years.

Across districts about 60.9 % of the sampled farmers had one form of formal education or the other while 39.3 % had no formal education. Due to the low level of education in some survey areas, researchers need to communicate with the farmers via local language in transmitting the latest technical knowledge promotion. This stresses that farmers who have attained some level of formal education are likely to raise their productivity through innovative use of technologies. Most of the farmers (82.7 %) have been cultivating cowpea for 6 years and above while the average years of experience of the farmers in cowpea production was 19.65 years. This supposes that farmers in SNNPRS have been cultivating cowpea many years ago except kindo koyisha. Also, about 93 percent of the respondents in the study area were married couples, and this is an indication of their chances of getting family labour for use on their cowpea farms. There were significant differences ($P<0.05$; $\chi 2 = 26.1$) in family size among districts (Table 2). In Humbo, 61% of the respondents had a family size of 6 to 9 individuals, whereas in Kindo koyisha, 50% of respondents had a family size of ≥10 individuals with the average family size across districts being 6.97. The implication is that farmers with large family size will however; also need to increase their productivity to meet up with the consumption need of the family. Among the farmers interviewed, on average 96.7 % of the farmers planned to expand cowpea production, while only 3.3 % reported that they do not have an expansion plan.

Almost all respondents expressed their willingness to expand cowpea production if crop yield increase through the selection, introduction and promotion of improved varieties as well as agronomic practices. The results suggest that cowpea production is still on a small scale and needs many improvement in terms of yield and constraints to its production.

Table 2. Demographic and socio-economic information about the farmers in the study areas.

		Gofa		K/koyisha		Humbo		Konso				
variable	category	Freq	%	freq	%	freq	%	freq	%	% mean	df	χ2
Gender	Male	36	90	18	90	33	80	41	84	86	3	1.92
	Female	4	10	2	10	8	20	8	16	14		
Marital status	Single	1	2.5	4	20	0	0	0	0	6	6	27.3**
	Married	39	97.5	15	75	41	100	49	100	93		
	Divorced	0	0	1	5	0	0	0	0	1		
Age (year)	21–30	8	19	16	80	11	27	18	37	41	6	24.7*
	31–60	27	68	3	15	28	68	26	53	51		
	>60	5	13	1	5	2	5	5	10	8		
	Mean age	43		60		48		44		47.1		
Family size	≤5	10	25	4	20	8	20	14	29	23	6	26.1*
	6–9	21	53	6	30	25	61	27	55	50		
	≥10	9	23	10	50	8	20	8	16	27		
	Mean	7		9		7		6.1		6.97		
Education status	illiterate	11	27.5	3	7.5	14	35	31	63.3	39.3	9	31.9**
	1–4	6	15	5	12.5	10	25	12	24.5	22.1		
	5–8	16	40	5	12.5	10	25	4	8.2	23.3		
	9-10	7	17.5	7	17.5	7	17.5	2	4.1	15.3		
Farming experience	≤5	2	5	20	100	2	5	2	4	17.3	6	140.8**
	6–20	13	32	0	0	34	83	19	39	44.0		
	>20	25	63	0	0	5	12	28	57	38.7		
	Mean	22.3		2.3		24		20.9		19.65		
Willing to expand cowpea	Yes	39	97.5	19	95	40	97.6	47	95.9	96.7	3	0.44
	No	1	2.5	1	5	1	2.4	2	4.1	3.3		

Source: field survey, 2016 & 2017,*Probability values based on chi-square test,1timad=0.25ha

3.2. Farming system and Crop production

The main livelihoods of the farmers in all study districts were both crop and livestock production as major sources of food, feed, and income. The distribution of respondents based on the size of their farm holding and oher crops grown is shown in Table 3. About 59 % of respondents owned a farm of ≤2 ha, whereas 23 % owned a farm of 2.1 to 3 ha and 18 % owned a farm of >3 ha. Majority (82 %) of the farm family in the study area had small farm holdings of 3 ha or less. The size of farm determines the extent to which other resources (capital, labour etc) are used for ideal yield. The

analysis of land use reveals that overall of 393.4 hectare were cultivated by total respondents and individual plot sizes ranged from 0.125 to 5 ha with a mean of 2.61 ha. This indicates that majority of the farmers in the study area were small holders. This situation where many farmers cultivated only small plots of land will not promote agricultural production beyond subsistence level. Furthermore, the result exhibited that 60 – 90 % farmers cultivated up to 0.25 ha or less of cowpea, 10 – 33 % utilized between 0.26-0.5 ha and only 0 – 14.6 % were engaged in 0.5 ha and above. This means that most farmers in this part of the country cultivate cowpea majorly within 0.1-0.25 ha of land with average farm size of 0.24 ha. Estimated yield across ditricts ranged from 626 kg ha−1 for Gofa to 423 kg ha−1 for Konso district with an average yield of 503.5 kg ha-1(Table 3). There was a significant difference ($p < 0.0001$; $\chi 2 = 29.8$) in cowpea yield among the four districts. This investigation as estimates given by the farmers were based on memory recall and use of local measures. In all districts, cowpea was the important food and cash crop in the area after mung bean and common bean. During the FGDs, farmers explained that they used a low amount of inorganic fertilizers for cereal crops grown after cowpea, due to its ability to fix valuable nitrogen into the soil.

Table 3. Farm size and other crops grown in survey areas, 2016/2017.

		Gofa		K/koyisha		Humbo		Konso				
variable	**category**	**Freq**	**%**	**freq**	**%**	**freq**	**%**	**freq**	**%**	**% mean**	**df**	**χ2**
Farmland size(ha)	≤2	30	75	9	45	13	32	40	82	59	6	40.7**
	2.1–3.0	2	5	7	35	20	49	2	4	23		
	>3	8	20	4	20	8	20	7	14	18		
	Mean	1.65		5		3.6		1.6		2.61		
Cowpea farm size (ha)	≤0.25	30	75	18	90	25	60.0	30	61	68	6	11.7
	0.26-0.5	9	22.5	2	10	10	24.4	16	33	25		
	>0.5	1	2.5	0	0	6	14.6	3	6	7		
	Mean	0.20		0.13		0.26		0.31		0.24		
cowpea yield (kg/ha)	≤200	13	32.5	14	70	34	82.9	38	77.6	66.0	6	29.8**
	201-500	23	57.5	4	20	6	14.6	10	20.4	28.7		
	>500	4	10	2	10	1	2.5	1	2.1	5.3		
	Mean	626		452		505		423		503.5		
Other crops grown	Maize	12	30	6	30	14	35	11	22.5	29	30	47.9*
	Sorghum	1	3	1	4	1	2	15	30	10		
	common bean	4	10	2	10	4	10	6	12.5	11		
	Mung bean	2	5	1	5	1	2	2	5	4		
	Cowpea	2	4	1	2	2	4	5	10	5		
	Pigeon pea	2	5	1	5	4	10	2	5	6		
	Tef	4	11	3	14	6	15	7	15	14		
	Cassava	5	13	2	9	4	10	0	0	8		
	Sweet potato	3	7	2	11	2	6	0	0	6		
	Taro	2	5	2	10	2	6	0	0	5		
	Groundnut	3	7	0	0	0	0	0	0	2		

Source: Field survey, 2016 and 2017. †No. of respondents of konso, kindokoyisa, Humbo and gofa = 49, 20, 41 and 40, respectively Freq=Frequency, % =percent

Apart from cowpeas, 29 % of the interviewed farmers grew maize (*Zea may*s L.), Tef [*Eragrostis Tef* (Zucc.) Trotter] 14%, common bean *(Phaseolus vulgaris)* 11 %, sorghum (*Sorghum bicolor*)10%,cassava (*Manihot esculenta* Crantz) 8 % , pigeonpea ([*Cajanus cajan* (L.) and sweet potato[*Ipomoea batatas* (L.) each 6%, Taro (*Colocasia esculenta)*

*5%,*mung bean(*Wigna radiata L.* Wilezek) 4% and groundnuts(*Arachis hypogaea*) 2%. Maize,tef,common bean and sorghum are important crops for the survey areas.

Cowpea Production Systems: Cowpea was mostly grown in an intercropping system (Fig. 2 and 3). The findings of the study showed that farmers grow cowpea in together with other crops. Farmers reported that they intercrop their cowpea with sorghum, maize and cassava. Intercropping is a traditional practice that is well integral among the study area's farmers. Across study areas, cowpea is often planted with a number of crops (Fig.2). Thus,the important cowpea cropping system practised in the study areas as intercropping (92.7%) and occasional monocropping/sole cropping (7.3%).

Among the interviewed farmers, 61.2% intercrop cowpea with sorghum, 34.7 % intercrop cowpea with maize, 4.1 % of the farmers grow cowpea sole in Konso. In the Humbo district, 78 % grow cowpea with maize, 17.1 % of the farmers grow cowpea sole and 4.9 % practiced cowpea/sorghum. Likewise in Gofa, 2.5% cultivate cowpea sole, 92.5% intercrop cowpea with maize and 5 % intercrop cowpea with cassava.

In kindo koyisha,85% intercrop cowpea with maize, 5% cultivate cowpea sole and 10 % practiced cowpea/sorghum intercropping system (Fig.3a). Across survey districts of the region, 68.7 % intercrop cowpea with maize, 22.7 % intercrop cowpea with sorghum, 1.3 % intercrop cowpea with cassava, 7.3 % practiced sole cowpea production(Fig 3b). The results imply that most farmers in survey areas intercropped cowpea with maize and sorghum and few people practice sole cowpea production.The practice of intercropping cowpea with cereals is in certainty with those practices in other parts of Africa. This also points to the need to develop varieties suitable for intercropping systems,sole cropping, as well as crop and livestock integration.

3.3. Cowpea varieties, types and sources of seed cultivated by farmers

Cultivation of local cowpea varieties (92.7%) occupied the cowpea cropping system in the four districts (Table 4).Most of farmers were not aware of improved cowpea varieties in the survey districts. Across districts, 92.7% predominantly grow local landraces, whilst only 2.4 % cultivate improved varieties, commonly in addition to the local landraces. Cowpea seeds were commonly sourced from local markets (54.7 %) while 36 % sourced their seed mainly from Farm saved seed in each of the survey areas (Table 4). Chi-square analysis found significant differences among the four districts for cowpea seed sources ($p < 0.001$; $\chi 2 = 53.4$). Other sources are seeds from the research (2.7%); provided by the Agricultural office (3.3%); provided by NGOs (0.7 %); obtained from a neigbour (2.7%). Nearly 40% of farmers reported the usage of recycled seeds for more than four years, probably as due to poor extension support,which resulted in absence of technical advice on improved cowpea packages. In study areas, farmers grew two to three cowpea cultivars: reddish brown, gray and white seed colour (Table 5). Farmers in Konso cultivated three local cultivars of cowpea (Tambara, Saritota and Bekada) with Tambara being the dominantly cultivated variety in the area. Majority of the farmers (51%) in konso grew Tambra varieties, followed by Saritota (26.5 %) varieties (Table 4). Most of farmers (90%) in Gofa, 73.2% in Humbo and 60 % in Kindo koyisha grew Bota wohe landraces. A few farmers grew Zo'o wohe, Bulla and Bekada cultivars. In the survey areas, the local name for cowpea varies. Cowpea is generally called "Ohoda" in Konso, 'Wohe' in Gofa district, while known as 'Eka wohe' in the wolayta zone, respectively (Table 4). Presently cultivated improved cowpea varieties in the survey districts are very limited and 92.7 % of the respondents in all the four survey districts used local cowpea varieties. Though, these varieties are cultivated by farmers'; they are still low have yields, late maturing, susceptible disease and insect pest (aphid) and susceptible to drought. From these results; it is also obvious that cowpea growers in the survey areas required new modern cowpea varieties with full improved packages and faced a challenge in selecting cowpea cultivars. Thus, there is a fundamental need for research intervention to introduce/generate cowpea varieties that are highly yielding, early maturing, diseases and insect pests resistant to meet farmers' expectations. The cowpea varieties grown in study areas are presented in Table 5.

Table 4: cultivars grown,types of cowpea seeds cultivated and sources

Practices	variables	Gofa	KK	Humbo	Konso	overall	DF	X2
Varieties	Local	35(87.5)	20(100)	38(92.7)	46(93.9)	139(92.7)	6	5.25ns
	Improved	1(2.5)	0	1(2.4)	2(4.1)	4(2.4)		
	both	4(10)	0	2(4.9)	1(2.0)	7(4.9)		
Sources of seed	Research	4(10)	0	0	0	4(2.7)	15	53.4**
	Market	30(75)	7(35)	15(36.6)	30(61.2)	82(54.7)		
	Neighbor	0	0	0	4(8.2)	4(2.7)		
	NGOs	0	0	0	1(2)	1(0.7)		
	BoA	3(7.5)	0	2(4.9)	0	5(3.3)		
	Local saved seed	3(7.5)	13(65)	24(58.5)	14(28.6)	54(36)		
Land races	Bota wohe	36(90	12(60)	30(73.2)	0	78(52)	15	173.9*
	Bulla wohe	0	0	5(12.2)	0	5(3.3)		
	Zo'oo wohe	4(10)	8(40)	6(14.6)	0	18(12)		
	Tambara	0	0	0	25(51)	25(16.7)		
	Saritota	0	0	0	13(26.5)	13(8.7)		
	Bekada	0	0	0	11(24.5)	11(7.3)		
Local name	cowpea	"Wohe"	"Eka wohe"		"Ohoda"			

Source: BoA=Beru of agriculture, Field survey, 2016 and 2017, Values in parentheses are percentages. Key: DF=degrees of freedom, X2=chi-squares=non-significance; * and ** denote significance at 5% and 1%, respectively.

3.4 . Cowpea production management practices

Farmers in the four survey areas presented the cropping calendar. The survey areas were experienced by bimodal rainfall systems. Two production seasons (belg,and meher) were characterised in the study areas. In all districts, farmers grew cowpeas twice in a year (Table 5). In study areas ,the planting times for cowpea were from end of Febrary to March for Belg and from end of June to July for Meher. The majority of the farmers (47%) in konso grew in the Belg season ,while 70% of the farmers grew in the *Meher* season in the Kindo koyisha district. Across the districts, nearly half (43.3%) of the farmers cultivate cowpea twice in a year, by planting in the Meher and Belg seasons, while 56.7% cultivate once in a year either in Belg or Meher.Some times belg season production constrains with aphid infestation thus *belg* season production should be supplemented with proper pest control measure or use of aphid resistant variety.

The interviewed farmers indicated several reasons they are growing cowpea for their use as food ,feed and as a cash crop. Farmers in the four district showed that they grew cowpea for household consumption (38 %), market and feed (23.3),market and food (21.3%), market (10 %) ,feed (4%) and vegetable (3.3) (Table 3).There were significant differences between districts ($P < 0.001$) in the purposes of growing cowpeas. In Humbo and kindo koyisha, cowpeas were grown mainly for market and livestock feed (50%,and 48.8%); while in Gofa and Konso they were grown for the household consumption and market (Table 5). The grains and leaves were the most important products harvested from

cowpea and have an important role throughout the districts. Conversely, there were differences on important products harvested from cowpea between districts: grain was more important in all districts. Leaves and green pods were more important in konso than others. On the other hand, straw (biomass yield) was equally important in Kindo koyisha (Table 5). Farmers also reported that cowpeas is grown for its versatile use because the leaves and seeds, during different times of the cultivating period, was so vital that there is a potential in developing multi-purpose varieties with good productivity, gives high yield in terms of both above ground biomass and seeds.Therefore, it is important to breed high-yielding varieties that can be cultivated during the *Belg* and *Meher* seasons, so that poor farmers would benefit the most.

Of the the interviewed farmers, 81.3 % of the interviewed farmers practiced broad cast method of planting, 14.7 % said they used row method of planting while 4 % reported that they used both methods of planting. None of the interviewed farmers use herbicides to control weed on cowpea and more than 75 % of farmers uses manual weed control on cowpea. Farmers identified poor soil fertility as cowpea production constraints. Fertilizer use is one of the widely accepted practices for increasing agricultural productivity and farm cost-effectiveness in production of crop. In contrast, only very few farmers (4%) in the study areas used fertilizers on their cowpea farms. It is known that cowpea does not need much fertilizer as it fixes nitrogen unless the soil is markedly exhausted of nutrients. Farmers indicated that cowpea production is limited by various field pests and diseases (Tables 5) which commonly lead to crop damages. Traditional practices and chemical methods were among the methods used by few farmers against diseases and insect pests (Table 5). Across the districts, more than sixty percent (62.6 %) of the respondents do nothing to control insects pests and diseases (Table 5). Research intervention aimed at generating diseases and insect pests resistant varieties adaptable to poor soil fertility with their full packages has therefore been a priority for farmers in the survey areas.

Table 5. Management practices in cowpea cropping systems at survey districts

Practices	variables	Gofa	KK	Humbo	Konso	overall	DF	X2
Planting season	Belg	5(12.5)	2(10)	6(14.6)	23(47)	36(24)	6	33.5*
	Meher	12(30)	14(70)	14(34.1)	9(18)	49(32.7)		
	Both	23(57.5)	4(20)	21(51.2)	17(35)	65(43.3)		
Method of weeding	Manual	32(80)	16(80)	30(73)	38(78)	116(77)	9	2.18
	Hoeing	4(10)	2(10)	8(20)	7(14)	21(14)		
	Both	2(5)	1(5)	1(2)	2(4)	6(4)		
	Not weeded	2(5)	1(5)	2(3)	2(4)	7(5)		
Purpose of growing cowpea	Consumption	11(27.5)	4(20)	12(29.3)	30(61.2)	57(38)	15	68.5**
	Market	4(10)	2(10)	5(12.2)	4(8.2)	15(10)		
	Feed	1(2.5)	1(5)	2(4.9)	2(4.1)	6(4)		
	Vegetable	1(2.5)	0	0	4(8.1)	5(3.3)		
	Market & consumption	20(50)	3(15)	2(4.9)	7(14.3)	32(21.3)		
	Market & feed	3(7.5)	10(50)	20(48.8)	2(4.1)	35(23.3)		
Most important product of cowpea	Grain	20(50)	9(45)	24(58.5)	28(57.1)	81(54.)	9	31.7**
	Leaves	2(5)	0(0)	0(0)	12(24.5)	16(10.7)		
	Green pods	1(2.5)	1(5)	2(4.8)	4(8.2)	6(4)		
	Stover	17(42.5)	10(50)	15(36.6)	5(10.2)	47(31.3)		
Planting methods	Broad cast	34(85)	16(80)	25(60)	47(94.9)	122(81.3)	6	20.1*
	Row	5(12.5)	4(20)	12(30)	1(2.6)	22(14.7)		
	Both	1(2.5)	0	4(10)	1(2.6)	6(4)		
Fertilizer use	Yes	2(5)	0	2(4.9)	2(4.1)	6(4)	3	1.02ns
	No	38(95)	20(100)	39(95.1)	47(95.9)	144(96)		
Insect pests & diseases control	Traditional	6(15)	1(5)	7(17.1)	20(40.8)	34(22.7)	6	27.5**
	chemicals	2(5)	1(5)	8(19.5)	11(22.5)	22(14.7)		
	No action	32(80)	18(90)	26(63.4)	18(36.7)	94(62.6)		

Source: Field Survey, 2016 and 2017, Values in parentheses are percentages. Key: DF=degrees of freedom, X2=chi-square,ns=non-significance; * and ** denote significance at 5% and 1%, respectively.

3.5. **Criteria in choosing varities of cowpea**

In the survey districts, evaluation of farmers preffered traits in cowpea ranking was performed (Table 6). Though the criteria for variety selection were relatively similar in all four study sites, there were significant variations in the traits of the chosen varieties. These differences varied from site to site. Farmers confirmed high yield potential, early maturity, resistance to disease and insect pests,drought resistance ,short cook ability,seed color,seed size ,leaf shedding, large

seed size and good taste as the vital preference criteria when selecting cowpea varieties (Table 6). The most significant favored traits by farmer across study areas were high yield , insect pest and diseases resistance, drought tolerance, earliness,short cookability and seed colour. Moreover, farmers did not appear to experience problems with shattering except in konso. In all areas studied, high grain , those that allowed the crop to escape from drought (e.g., earliness), or produce yield, even though exposed by drought or pests and (i.e., resistant varieties). Early maturity assured the early provision of food for households , hence preventing hunger. On the contrary in all districts, most of the reported landraces are low yielding ,late maturing, small seed size and are susceptible to diseases and insect pests and drought, which requires research intervention to introduce or generate problem solving cowpea technology.

Farmers were asked to rank cowpea traits of cowpea, which they preferred to be incorporated into cowpea varieties that would improve easy and high adoption by them (Table 6). In Gofa and kindo koyisha, high yield and tolerance to diseases and insect pests came first followed by early maturity. In Konso and Humbo, early maturity , high yield and diseases and insect pests were tied in rank as their main favored traits. When the scores for the criteria was computed across all the communities nested within their respective districts, it was observed that early maturity, high yield , resistance to insect pests and diseases, drought tolerance, short cooking time, seed colour, seed size, good taste , high market value, leaf shedding , suitability to intercropping (upright growth habit) and above ground biomass yield were tied in rank as the preferred traits followed by shattering resistance (Table 6).

Table 6.The preference traits of cowpea varieties, as ranked by farmers in four surevy districts

Preference trait	District				overall	
	Gofa	k/k	Humbo	Konso	score	rank
High yield	13(1)	12 (1)	11 (2)	13 (2)	12.25	1
Above ground biomass yield	2(11)	4 (10)	4 (8)	3 (11)	3.25	13
Seed size	10(4)	8 (6)	6 (7)	6 (8)	7.5	7
Seed colour	6(8)	9 (5)	6 (7)	11 (3)	8	5
Disease and insect pests	13(1)	12 (1)	9 (3)	10(5)	11	3
Suitability for inter cropping	5(9)	5 (9)	6 (7)	4(10)	5	12
Good taste	4(10)	10 (4)	6 (7)	9 (6)	7.25	8
Short cook ability	9 (5)	6 (8)	9(3)	8 (7)	8	5
Drought tolernace	11(3)	11(3)	10(2)	11(3)	10.75	4
Resistant to weevils	7(7)	7 (7)	8 (5)	6(8)	7	9
Leaf shedding	8(6)	7 (7)	7 (6)	5 (9)	6.25	11
Shattering resistance	0 0	0 0	0 0	6 (8)	1.5	14
Earliness	12(2)	11 (3)	12(1)	14 (1)	12.25	1
marketability	8(6)	7 (7)	7 (6)	5 (8)	6.75	10

Ranking: 14 represented the top score and 1 the least preferred trait.whereas 1= less important trait and 14=highly important trait,0=problem not listed by farmers

3.6. **Constraints to cowpea production**

Cowpea production constraints varied from household to household, depending on household characteristics and socio-economic conditions. In this study, numerous production constraints of cowpea were identified (Table 7). Between the limitations identified, insect pests and diseases at 87.3 % , drought (86.7 %) , lack of improved varieties (80 %); poor credit service (73.3 %); poor agronomic practices (plant spacing, weeding ,soil management)(71.3%), poor extension service (73.3%) , land shortage(62.7%), low soil fertility (66%),storage pest(57.3%), wild goat (14.7 %) , shattering (10.7 %) and the combination of ape and porcupine (11.3%), were important. There was a significant difference ($P < 0.001$; $\chi2 = 162.7$) in production constraints between the four districts (Table 7). Some of the constraints mentioned cannot be solved from the cowpea improvement programs. However, resistances to drought, pests, diseases, aphid,low soil fertility, shattering,weevils, low palatability,long cookability and seed size (Table 7) are quite possible in the research on the development cowpea varieties.

Table 7: Major constraints and coping mechanisms of cowpea production across the 4 districts

Constraints		Konso	Humbo	Gofa	K/koyisha	Overall	OR	DF	X2
Lack of improved seeds		36(73.5)	30(73.2)	36(90)	18(90)	120(80)	3	33	162.7**
Drought		44(89.8)	32(78)	38(95)	16(80)	130(86.7)	2		
Diseases & insect pests		45(91.8)	32(78)	38(95)	16(80)	131(87.3)	1		
Weak credit service		35(71.4)	26(63.4)	35(87.5)	14(70)	110(73.3)	4		
Poor agronomic conditions		30(61.2)	29(70.7)	33(82.5)	15(75)	107(71.3)	6		
Poor extension service		34(69.4)	28(68.3)	34(85)	13(65)	109(72.7)	5		
Storage pest		32(65.3)	24(58.5)	30(75)	0(0)	86(57.3)	9		
Low soil fertility		31(63.3)	27(65.9)	29(72.5)	12(60)	99(66)	7		
Shattering		16(32.7)	0(0)	0(0)	0(0)	16(10.7)	12		
Land shortage		29(59.2)	22(53.7)	32(80)	10(50)	93(62)	8		
Ape & porcupine		0(0)	6(14.6)	0(0)	11(55)	17(11.3)	11		
Wild goat		0(0)	23(56.1)	0(0)	0(0)	23(15.3)	10		
Constraints	**Strategy**	**Coping strategies for drought stress and bruchids**							
Drought stress	Soil mulching	2(5)	1(2.4)	1(5)	6(12.24)	16(10.7)	2	12	10.9
	Use of ridges	0(0)	1(2.4)	1(5)	6(12.24)	9(6)	3		
	AP dates	4(10)	3(7.4)	0(0)	4(8.2)	5(3.3)	4		
	No option	34(85)	36(87.8)	17(85)	33(67.3)	120(80)	1		
Bruchids	Ash	1(2.5)	0	0	3(6.12)	4(2.7)	4	9	18.3*
	Sand	2(5)	1(2.4)	1(5)	2(4.08)	6(4)	3		
	Hot pepper	1(2.5)	1(2.4)	0	9(18.4)	11(7.3)	2		
	No option	36(90)	39(95.2)	19(95)	35(71.4)	129(86)	1		

Calculated chi-square value is 162.7 and DF= (12-1) x (4-1) = 33,12,9 AP=adjusting planting dates, The numbers in parenthesis indicates the percentage of respondents using that respective strategy;*=significance at 5% and ns= non-significance,OR=Overall rank

Farmers listed the most important constraints in their areas and ranked them as per priority (Table 7). Insect pests (aphid) and diseases were by far, the most important constraint limiting cowpea production in the survey districts (Table 7). Most those interviewed in Konso indicated that Bekada and Saritota were the most susceptible variety to aphids, while in Gofa and Humbo, farmers did not perceive any difference between the grown varieties (Bota, Bulla,and Zoo'o wohe,all susceptible to aphids)(Table 4). Drought ranked second, followed by the lack of improved seeds. It has been observed that cowpea yield is reduced during the years of short and unreliable rainfall despite cowpea being a drought tolerant crop. Other constraints mentioned were weak credit service, poor agronomic practices, poor extension service, land shortage storage pest, wild goat, shattering, combination of ape and porcupine.Farmers in Kindo koyisha perceived the ape and porcupine as the seventh most important constraint followed by land shoratge while in Humbo, wild goat was ranked seventh followed by land shoratge (Table 7). Regarding the storage pests (bruchids) attack, farmers reported that although all cowpea groups were attacked, all local cultivars were the most susceptible. Farmers in all districts have indicated that all existing varieties of cowpea could be completely infested within one month of harvest. In the study areas, diseases and insect pests and drought are the most important biotic and abiotic constraints on cowpea. Majority of farmers (> 60%) have not applied any strategy to mitigate the effects of drought, aphids and poor soil fertility. 80% of farmers across districts have not used any strategy to deal with drought stress. However, mulching the soil, using ridges and adjusting planting dates are coping mechanisms that have been used by other farmers to alleviate the effects

4. Discussion

4.1. Farming and cropping systems

In study areas, the farming system were mainly crop and livestock. The results showed that cowpea plays an important role in the cropping system in four districts. Typically, cowpea was intercropped with maize or sorghum in the selected areas of this study. Most of the farmers (92.7%) intercropped cowpea with maize, sorghum or cassava in the study areas, with about 7.3% of the respondent farmers who own considerable plot of land cultivated it as sole crop (Fig.2). Planting maize and cowpea together has been shown to increase productivity per unit area of land. Sisay et al [7] and Mulugeta [18] made similar statements that the crop is grown in mixtures with cereals such as maize, millet and Sorghum. This has been reported by Salifou et al. [17] Niger ' stating that cowpea is mostly sown with pearl millet or sorghum; however, some farmers grow it on sole cropping for seed multiplication purposes and to test new released or promising varieties. The practice of intercropping cowpea and cereals is in line with those practices in other parts of sub-Saharan Africa. This elucidates the importance of cowpea as a companion crop in cereal-legume cropping systems, which are common practices adopted by farmers in sub-Saharan Africa to avert risk, crop failure and distribution of farm labour [19,20]. This also views to the need to generate appropriate varieties for intercrop systems, sole cropping as well as crop livestock integration. Recent results of cowpea survey showed that over 96 % of farmers across the study areas in South Ethiopia did not use fertilizers for cowpea production (Table 5). Soil fertility levels were reported to be very low across districts, and most of farmers did not apply any fertilizers on cowpea as they believed it did not require fertilizer. In general,the use of chemical fertilizer is limited for legume crops, especially in Ethiopian agriculture.

In the present study, surveyed farmers reported that farmers grow cowpea for food security; to feed livestock; for the combination of income and food and for both income and feed in the study areas. Results are in line with Horn *et al.* [14] findings who stated that 59% farmers grew cowpea for home consumption or food while 23.4% grew for home consumption and sale, some 13.5% use the crop foliage for animal feed during excess production. Interview results

revealed that 92.7% of farmers predominantly grow local landraces, the seeds of which they recycled for many seasons, whilst around 7.3 % grow mixture of local cultivar and improved varieties, commonly in addition to the landraces (Table 4). This is inconsistence with Horn *et al.* [14] who reported that 70.2 % farmers cultivate local unimproved cowpea varieties and 29.8 % utilized improved varieties either singly or in combination of two or three. Although the study identified low productivity of the prevailing cowpea cultivars as another production constraint in Southern Ethiopia. Farmers stated that the existing cowpea cultivars in the study areas performed poorly with the yield response varied from 423.2-626.1 kg/ha with an average yield of 503.5 kg/ha (Table 3). Therefore, farmers used a small number of inferior cultivars which are susceptible to biotic and abiotic constraints. This is in line with the findings of [21] where he reported that farmers used poor genetic materials which are prone to many biotic and a biotic factors.

4.2. Cowpea farmers' preferred Traits

Farmers stated that the most important characteristics of cowpea varieties had been maturing early, high yield, disease and insect pest resistance, drought resistance, short cook ability, seed color, seed size and good taste . Similarly, in Uganda, [22] stated that preferred traits were white seed color, earliness, yield potential, good taste, and tolerance to insect pests and diseases. Salifou et al. [17] reported that desired traits were grain yield, early maturity, white-colored seed coat and good taste as the most important traits in cowpea varieties. The results of the survey shown that the requirements of farmers can be met if newly improved varieties with the following traits are generated: top yield, resistant to disease and insects , earliness, drought resistance, short cook ability, seed color, seed size and good taste. High ranking of yield and culineary traits indicate that farmers grow cowpea for their food security and income source in the study districts of Southern Ethiopia. These observations are in consistent with the findings of Gonné et al. [23] who reported that cowpea contributes considerably to family food security and domestic market in the sudano-sahelian zone of Cameroon. The direct implication of these results is that combining yield and earliness traits as well as the resistance or tolerance to cowpea insect pests (aphid) should be the first target while breeding for new improved cowpea varieties or introducing improved varieties having above mentioned desired traits. Such varieties can help to mitigate yield losses and guarantee food security to resource-poor farmers in South Ethiopia. Future cowpea research programs could take into account the incorporation of other traits like drought tolerance, seed color, large seed, taste, and fast cooking.

Some group of farmers might prefer a particular variety owing to its seed colour, early maturity or seed size. Seed colour preference varied from farmer to farmer. The colours identified among farmers included, reddish brown, gray, white and black. Favorite for maturity groups was based on the rainfall length and appropriateness to intercropping. Farmer in the surevy areas preferred early-maturing varieties to avoid drought damage whereas some preferred prostrate late-maturing cowpea because of higher foliage as vegetables; fodder yield for their livestock. These mean that, in order to meet the favorites of farmers and consumers, breeding aims should be towards the improvement of cowpea varieties with various seed colors, maturity groups and seed sizes.

However, there is no documented information about cowpea production constraints,farmers preferred traits and coping mechanisms. The main reasons for using the appropriate coping strategy were the efficiency, ease to access and the lack of information on the existence of alternative coping mechanisms. These results suggest that farmers need additional information and pratical training to help them better control insects in the field. Farmers reported that they obtained the cowpea seeds from various sources. However, 36 % of the respondents usually saved seeds from their former harvest and most of the varieties were their local materials (Table 4). On the contrary, farmers stated the lack of improved varieties, the susceptibility to drought, diseases and insect pests, poor extension and credit services to explain the low success of cowpea production. These observations suggest that study should take in to account information from farmers and be integrated into research activities in South Ethiopia. The findings from this result support directing

the attention of future cowpea imrpovement programs do demand driven research incorporating farmers-preferred traits.

4.3. Cowpea production constraints

In this study, farmers distinguished disease and insect pests as the primary limitation to cowpea production (Table 7). This finding is consistent with previous studies carried out by Baidoo and [24], Gonne *etal.* [23] and [25], in which farmers had reported disease and insect pests as a major restraint to cowpea production. Furthermore, previous investigations carried out by [26], in which 89.47% of respondent farmers had described disease and insect pests as a major limitation to cowpea production.Another major constraint reported across all the districts was drought and occasionally the notorious and voracious ape and porcupine in the kindo koyisha district. This study revealed the insistence of the disease and insect pests ,shortage of improved varieties and drought problems in cowpea production as confirmed by farmers' responses. [27] also specified that insects, drought and weeds are the most important constraints for cowpea production in Ghana.

Based on the findings over the survey areas, disease and insect pests were observed as the most important constraints for the production of cowpea across all the districts and shattering occupied the last position. In all the study areas, out of the twelve important constraints listed by all respondent farmers, disease and insect pests,drought,lack of improved varieties,poor of credit services, weak extension services, inappropriate agronomic practices and poor soil fertility were the most restraining to cowpea production. [26] also made similar findings and suggested the most vital restraints in cowpea production in Nigeria were disease and insects, drought,inadquete credit facilities, insufficient research and promotion and lack of improved seeds.Drought was the second most important limitation stated by farmers across the districts of the South region, while the lack of improved varieties was third for farmers in the study areas. This is in line with the findings of Muchero *et al* [24] who reported that quite a number of farmers in Ghana (Akatsi) believe that drought is one of the most limiting factors to cowpea cultivation, although, cowpea is a short season crop with relatively high drought tolerant capacity., According to respondents, drought suspensions the sowing of cowpea and other crops in the study areas.These limiting factors from first to six ranking by respondent farmers across the four study areas are important as an urgent matter that research needs to address as a priority or should be included in further research programs.

5. Conclusion

This research confirmed the significance of cowpea as food, feed, vegetables, nutrition security, and a crop as source of income in Southern Ethiopia. However,its productivity in the growing areas of the region is relatively low. In our study, farmers mentioned shortage of improved varieties, disease and insect pests, drought, poor access to extension, poor access to credit services, poor soil fertility, farmland shortage, improper agronomic practices and storage pests as the key cowpea production restraints. Between the appreciated production limitations, insect pests and diseases, drought ,shortage of improved varieties,weak credit services and poor access to extensions were reported by majority of the farmers to considerably reduce cowpea productivity across survey areas. Farmers in the study zones rely on agricultural activities, like animal husbandary and cultivating a variety of crops, other than cowpea, for food and generating income. Farmers grow unimproved cowpea landraces (92.7%), whilst only 2.4 % grow improved varieties. This study found that farmers need early maturing high-yielding and adaptable modern cowpea varieties for cultivation under biotoc (insect pests and diseases) and abiotic (poor soil fertility and drought) stresses. Cowpea traits preffered by farmers were high yielding coupled with early maturing cowpea varities that are besides, resistant to pests and diseases, tolerant to drought stress ,good taste,large seed size, fast cooking and white seed colour. Therefore, cowpea improvement programs should take into account and incorporate the production constraints and farmer-preferred characters over the enhancement of new improved varieties. This will improve cowpea cultivation and yield in southern Ethiopia. Besides to

improved varieties, researchers should develop packages of improved technology for cowpea cultivation and the Ethiopia government should create encouraging environment for researchers and extension workers to attend in cowpea research and extension services (access to inputs and credit) to improve cowpea production

Declarations

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Authors' contributions

YG designed the study, developed the questionnaire, carried out the survey, analyzed the data, interpreted the results, and write up the manuscript. WW contributed to revising and correcting the draft manuscript. HM, and EU participated in the manuscript correction. All authors have agreed to be personally accountable for the author's own contributions and to the accuracy or integrity of the work. All authors read and approved the final manuscriptt

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Ethics approval and consent to participate

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Competing Interests

The authors declares no competing interests.

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Figures

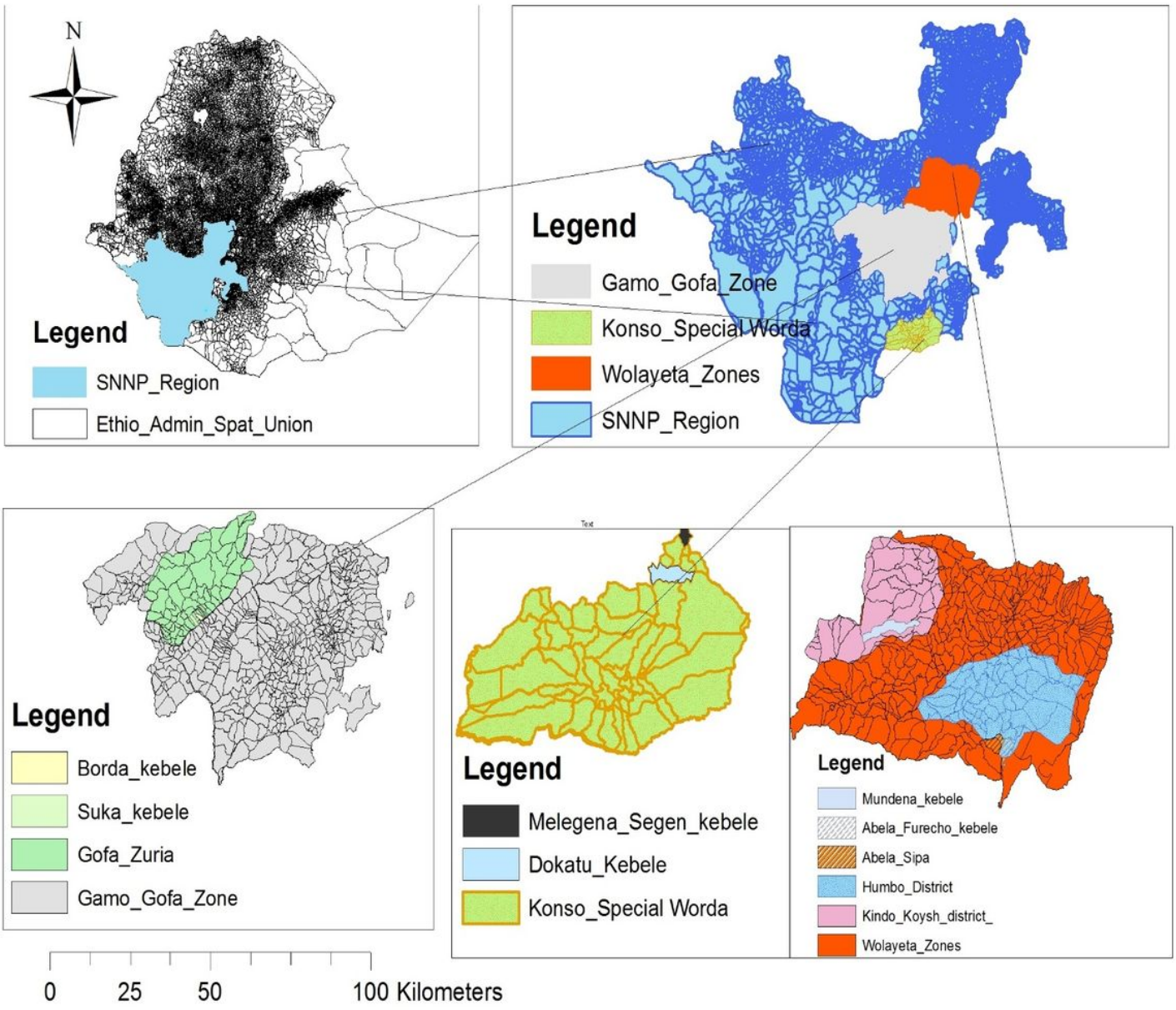

Figure 1

The map of SNNPR showing the three zones surveyed: Konso, Wolayta and Gamo Gofa

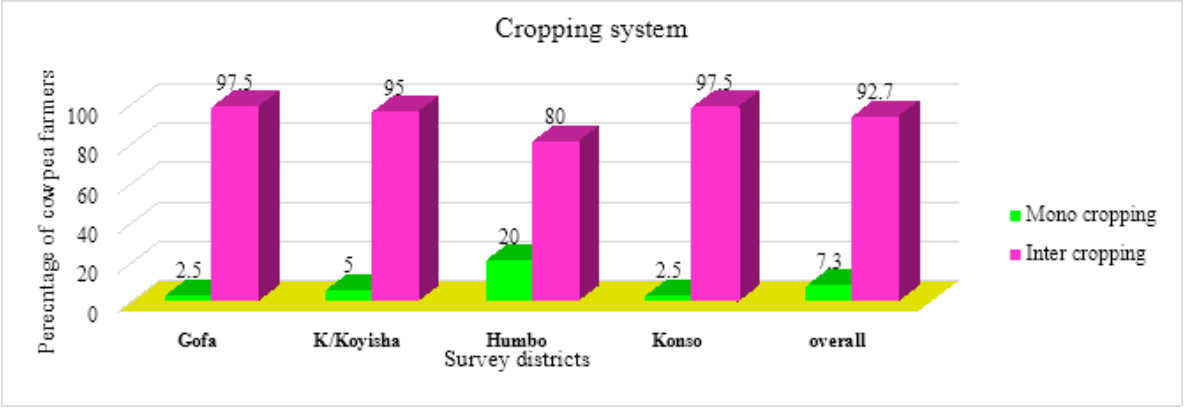

Figure 2

Cowpea production systems across the four districts surveyed

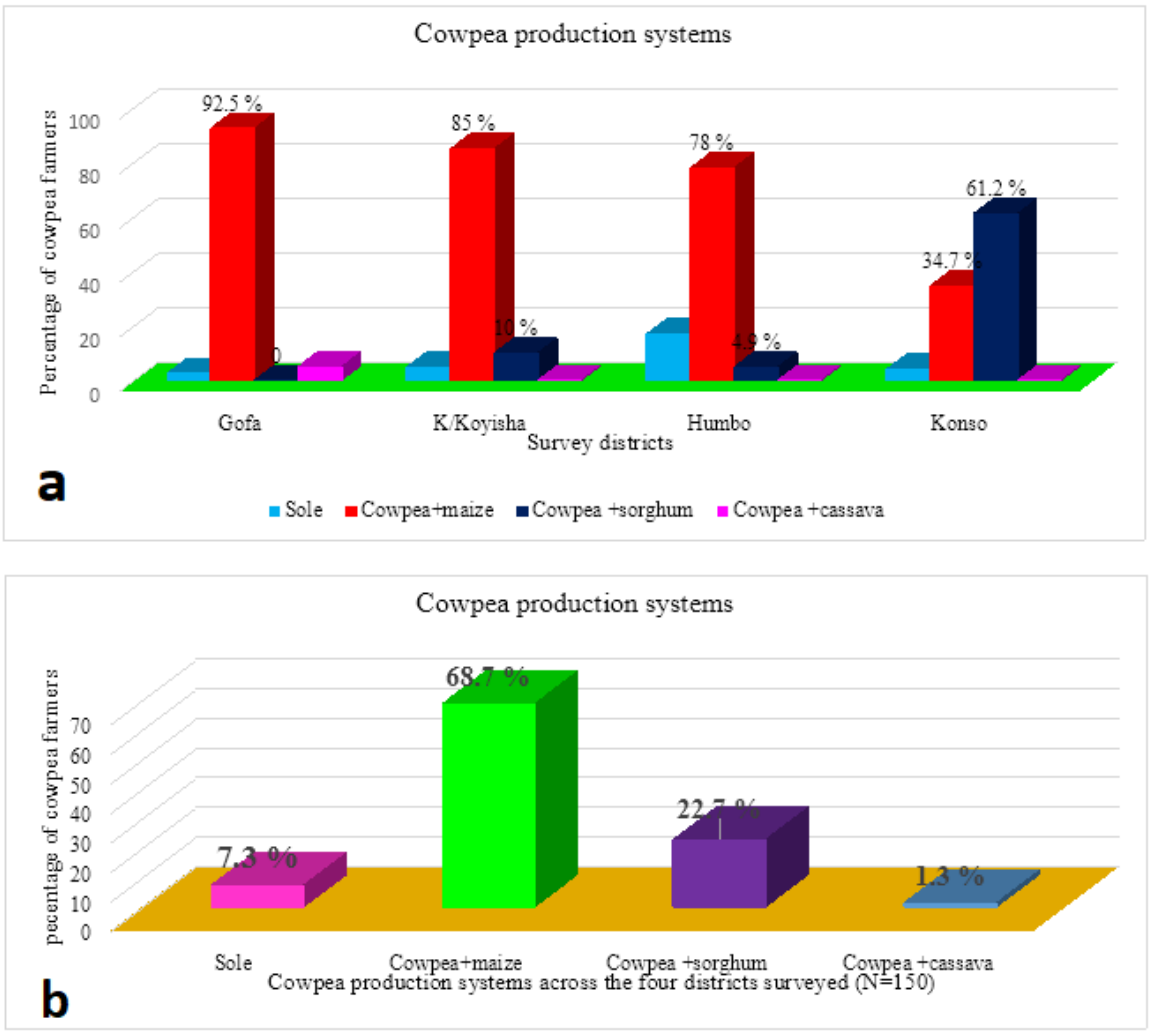

Figure 3

a: crops intercropped with cowpea at individual survey districts. b: Crops intercropped with cowpea across the four districts surveyed (N=150)