Expounding the production and importance of cowpea (Vigna unguiculata (L.) Walp.) in Ethiopia

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Abstract: Cowpea is an important legume crop growing across the world mainly in tropical and subtropical regions including Ethiopia. Besides its noticeable production, little is known about its yield, productivity, importance, and distribution in Ethiopia. This review paper aimed to reveal the production and importance of cowpea in Ethiopia. Cowpea is produced in Ethiopia primarily for its edible seeds, pods and the leaves that are used as human food and animal feed, and income provision to households. Its production is practiced under varying cropping systems including sole cropping, intercropping and mixed cropping system. The yield of cowpea has generally remained below the potential of the crop and consistently remained below the world averages as a higher proportion of farm households grow cowpea on marginally fertile and infertile soils. The overall low yield potential of cowpea is mainly attributed to limited attention by research and development programmes, severe attacks of pest complexes, low soil fertility, drought, poor management practices, marketing problems, and poor technology dissemination and popularization. However, Ethiopia has a high potential for the production of various crops, especially cowpea, due to the diverse agroecology and suitability of the country. Moreover, the integration of cowpea with the farming system has significant importance in improving nutrition, soil productivity, feed quality, and
withstands the impact of climate change. Therefore, further research strategies, promotion of improved agronomic practices, and successful marketing systems are required to alleviate problems and boost the production of cowpea in Ethiopia.

Subjects: Crop Science; Botany; Soil Sciences; Nutrition

Keywords: cowpea; cropping system; management practices; nutrition; production

1. Introduction
Grain legumes are the most important family of agricultural crop species after cereals worldwide. In Ethiopia, grain legumes are the most important group of crops providing food to humans, feed to livestock, and income to more than 10 million households. Ethiopia with diverse agroecology permits different agricultural systems and production of different crops especially grain legumes which are critical to smallholder livelihoods (Kebede, 2020a). Among the grain legumes, cowpea (Vigna unguiculata (L.) Walp.) is an important food legume growing in tropical and subtropical regions of the world. It is a principal and multipurpose food legume in many African countries including Ethiopia, where tender leaves, fresh pods, and grains are consumed (Alemu et al., 2016).

Cowpea is cultivated primarily in lowland areas of Ethiopia for its edible seeds, pods and leaves. Besides, cowpea provides feed, forage, hay, and silage for livestock, and green manure and cover crop which maintain the productivity of soils (Alemu et al., 2016). In the agricultural system, it compensates for the loss of nitrogen absorbed by cereals, thus, it has a positive impact on soil properties. This is due to its unique capacity to fix atmospheric nitrogen and performs well even in poor soils. The crop has also weeds suppressing ability. Being a drought-tolerant and warm-weather crop, it is a promising food and forage species in a typical tropical lowland climate (Alemu et al., 2016; Belay et al., 2017; Bilatu et al., 2012).

Cowpea is grown across the world on an estimated 14.5 million ha of land planted each year and the total annual production is 6.2 million metric tons. Over the last three decades, global cowpea production grew at an average rate of 5%, with 3.5% annual growth in area and 1.5% growth in yield, and the area expansion accounting for 70% of the total growth during this period (Boukar et al., 2016). About 84% of the world’s production area and 83.4% of the world’s overall production of cowpea is from Africa, with over 80% of African production in West Africa. According to FAOSTAT (2016), cowpea was grown on an estimated 12.3 million ha in Africa in 2014 with the bulk of production occurring on 10.6 million ha in West Africa, particularly in Nigeria, Niger Burkina Faso, Mali and Senegal. Even though Ethiopia is a center of diversity for cowpea (Beshir et al., 2019), previous studies on the production and productivity of cowpea in cowpea producing countries of Africa and elsewhere ignore to mention about Ethiopia.

Although there have been successes of cowpea production in the country and major producing regional levels, little is known about its production, productivity, distribution, importance, and utilization. The yields of cowpea have generally remained below the potential of the crop and consistently remained below the world averages. The lack of information and sustained production is indicative of the fact that the production of cowpea is dominated by small-scale farming. The production and productivity of cowpea in the country are hindered by the lack of access to modern technologies such as improved varieties and the accompanying crop and pest management practices, inputs such as fertilizers (both mineral and biofertilizers), seeds of improved varieties, and poor input and output market access. However, Ethiopia has a high potential for the production of various crops as more than 66.5% of the arable land is very suitable for cowpea production (Simion, 2018). Hence, this paper aimed to review the production status and importance of cowpea in Ethiopia.

2. Methodology
This review adopted preferred reporting items for systematic literature review approach to search and select past and current publications relevant to the topic. The development of the final review
paper is based on the review and use of selected published articles in journals, research centers reports, annual reports, technical and consultant reports available in the studies conducted by various researchers, institutions, and organizations. A literature search for this review was not restricted to a time period and recently published articles especially for gathering information on the general descriptions of the crop. However, a literature search for this review focused primarily on studies conducted in Ethiopia, African countries and other cowpea producing countries. The keywords used as a search string generally relate to cowpea including its origin, domestication, taxonomy, production trends, area of production, productivity, management practices, production constraints and challenges, importance in human nutrition and animal feed, soil fertility management, cropping system, and economic importance.

Published articles and reports for the review were searched and identified from different electronic databases such as Web of Science, AGRIS (agris.fao.org), Research Gate (https://www.researchgate.net); through a literature search in Science Direct, Taylor and Francis, Springer, Wiley, different African and Ethiopian Journals using Google Scholar; and online libraries of the Ethiopian Institute of Agricultural Research (EIAR) and different National Research Institutes. The articles and reports obtained through the search from different electronic databases and journals were scrutinized for relevance through setting inclusion criteria. The review considers the following inclusion criteria: (1) studies that exclusively conducted in Ethiopia and other cowpea producing countries; (2) studies that exclusively state production and importance of cowpea as an objective; (3) studies that evaluate the constraint and challenges facing cowpea production; (4) availability and accessibility of full-length peer-reviewed articles and reports; and, (5) study location and crop of interest (cowpea) considerations. Based on the critical review, individual articles from the collected literatures were grouped with respect to the review objective. Finally, forty-nine publications were used to develop the final review on the production and importance of cowpea in Ethiopia.

3. Results and discussions

3.1. General description of cowpea

3.1.1. Cowpea origin and domestication

The previous speculation on the origin and domestication of cowpea had been based on botanical and cytological evidence, information on its geographical distribution and cultural practices, and historical records (Ng, 1995). Several authors have reported different probable centers of origin and domestication of cowpea is in Africa. Reports by Padulosi and Ng (1997) and OECD (Organization for Economic Co-operation and Development) (2016) indicated that cowpea was domesticated probably in West Africa about 2000 B.C. and the progenitor of cultivated cowpea was the wild cowpea Vigna unguiculata var. spontanea. Faris (1965) also stated that cowpea was originated from the domestication of Vigna unguiculata subspecies dekindtiana forms in West Africa. Rawal (1975) suggested that cowpea was domesticated in the sub-humid and semi-arid regions of West Africa. More importantly, Steele (1972) showed that there is greater variability in subspecies dekindtiana in Ethiopia and reported that the probable origin of cowpea is Ethiopia than West Africa. The author also suggested that domestication could have occurred in Ethiopia and dissemination went westwards across Africa and eastwards across the Indian subcontinent. Besides, Thulin (1989) reported that Vigna unguiculata subsp. Sesquipedalis and subsp. dekindtiana are mainly cultivated in northern Ethiopia. Centers for the diversity of cowpea have also been identified in both Africa and Asia; however, the exact region of domestication is still under speculation (Angessa, 2006).

3.1.2. Cowpea taxonomy

Cowpea belongs to the class Dicotyledonae, order Fabales, family Fabaceae, subfamily Papilionoideae, tribe Phaseoleae, subtribe Phaseolinae, and genus Vigna (OECD 2016; Padulosi & Ng, 1997). Linnaeus described cowpea as Dolicho sunguiculatus L. (later renamed Vigna
Vigna unguiculata (L.) Walp.) in 1753. Between 1753 and 1845, more than 20 binomials were described from cultivated Vigna unguiculata species. However, annual cowpea has two botanical varieties, the cultivated Vigna unguiculata unguiculata and the wild form Vigna unguiculata unguiculata var. spontanea, both of which are inbreeding. Vigna unguiculata unguiculata var. spontanea is typically found mostly near the borders of cultivated cowpea fields and within them (OECD, 2016). Wild perennial forms are ascribed to ten subspecies (Pasquet, 1997). Besides, wild annuals are easily crossed with cultivated cowpeas (Ng, 1995).

All cultivated cowpeas are grouped under Vigna unguiculata subspecies unguiculata, which is the largest cultivar group. Cultivated cowpeas have been divided into five cultivar groups mainly based on the pod, seed and ovule characteristics (Table 1). These divisions are Unguiculata (grown as a pulse (the common cowpea)), Biflora (mainly used as a forage (the catjang)), Sesquipeda1is (the yard-long bean), grown as a vegetable), Textilis (used for fibers) and melanopthalimus. The classification and nomenclature of the wild taxa within Vigna unguiculata, however, is complicated, and could sometimes be confusing. More than 20 epithet names have been used in the past to designate wild taxa within the Vigna unguiculata species complex (Padulosi, 1993).

### 4. Cowpea production and productivity in the world and Ethiopia

The global production of grain legumes has increased over the decades; the mean annual world grains production reached a high of 75.68 million tonnes during 2008–2017. India is the largest producer of grain legumes accounting for about 24% of the global legume production and holding 32% of the world grain legumes harvested land and accounting for more than a quarter of global production, followed by Myanmar, Canada, and China contributing 7% each. Africa as a whole account for 22% of the global production of grain legumes (Kebede, 2020a). According to the report of FAOSTAT (2016), the global area under cultivation of some of the major legumes (groundnuts, chickpea, pigeon pea, common bean, cowpea, and soybean) in 2014 was about 220 million hectares (ha), with the production of about 430 million metric tons (MT) at average productivity of 1.7 MT per ha (beans = 1.6, chickpea = 1.4, cowpea = 0.44, groundnut = 2, pigeon pea = 1.4, soybean = 1.8).

During 2014 production year, the area coverage in Sub-Saharan Africa (SSA) was about 36 million ha (about 16.3 percent of global area), with production of about 27 million MT (around 6 percent of global production) at an average productivity of 0.89 MT per ha (beans = 0.94, chickpea = 0.98, cowpea = 0.48, groundnut = 0.96, pigeon pea = 0.86, soybean = 1.01). The Eastern Africa region accounted for 8.8 million ha (about 24.4 percent of the SSA area), 7.7 million MT (about 28.6% of SSA production), with an average productivity of 1.00 MT per ha (beans = 1.29, chickpea = 1.01, cowpea = 0.54, groundnuts = 1.15, pigeon pea = 0.78, soybean = 1.28) (Ojiewo et al., 2018). The trends of different grain legumes production area and yield, and rate of growth in production in the world, Sub-Saharan Africa and South Asia, are shown in Table 2.

### Table 1. The five cultivar groups of cultivated cowpeas and their features

| Cultivar group | Selected features |
|----------------|-------------------|
| unguiculata    | Includes most African grain and forage types. More than 16 ovules/pod. |
| biflora (Catiang) | Smooth seed in short erect pods. Common in India. Less than 17 ovules/pod. |
| sesquipedalis | Asparagus or yard-long beans. Very long pods consumed fresh, especially in the People’s Republic of China. |
| textilis      | Rare form with very long peduncles once used for fiber in Africa. |
| melanopthalimus | Blackeye pea types. Less than 17 ovules/pod. Grown mostly in the Americas. |

Source: OECD (2016)
| Crop           | Area (1000 ha) | Yield (Kg per ha) | Production (1000 MT) |
|---------------|----------------|-------------------|----------------------|
|               | 1985–87 | 2005–07 | ROG (%) | 1985–87 | 2005–07 | ROG (%) | 1985–87 | 2005–07 | ROG (%) |
| World         |          |          |         |          |          |         |          |          |         |
| Chickpea      | 10,294  | 10,914  | 0.4     | 692     | 818     | 0.0     | 7,136    | 8,929    | 1.2     |
| Common Bean   | 26,185  | 27,232  | 0.1     | 582     | 723     | 0.0     | 15,230   | 19,705   | 1.2     |
| Cowpea        | 5,466   | 14,500  | 4.5     | 341     | 454     | 1.4     | 1,718    | 6,155    | 5.9     |
| Groundnut     | 18,784  | 22,633  | 1.0     | 1,137   | 1,607   | 1.0     | 21,363   | 36,379   | 2.9     |
| Pigeon pea    | 3,549   | 4,655   | 1.1     | 845     | 885     | 0.5     | 2,679    | 3,663    | 1.1     |
| Soybean       | 52,503  | 92,622  | 3.0     | 1,877   | 2,348   | 1.4     | 98,569   | 217,397  | 4.4     |
| Total         | 116,781 | 172,556 | 1.7     | 895     | 1,116   | 0.9     | 146,695  | 292,028  | 2.8     |
| Sub-Saharan Africa |      |          |         |          |          |         |          |          |         |
| Chickpea      | 250     | 398     | 2.4     | 587     | 769     | 1.4     | 132      | 315      | 4.4     |
| Common bean   | 3,045   | 5,190   | 2.9     | 684     | 596     | −0.9    | 2,070    | 3,045    | 2.0     |
| Cowpea        | 4,629   | 14,440  | 4.3     | 333     | 450     | 1.5     | 1,427    | 5,145    | 5.8     |
| Groundnut     | 5,507   | 9,057   | 3.0     | 782     | 1,007   | 1.3     | 4,277    | 8,942    | 4.3     |
| Pigeon pea    | 249     | 499     | 3.1     | 593     | 729     | 1.7     | 148      | 363      | 4.3     |
| Soybean       | 380     | 1,228   | 3.8     | 928     | 1,060   | 3.5     | 257      | 1,279    | 7.3     |
| Total         | 13,627  | 26,864  | 3.3     | 648     | 767     | 1.4     | 8,186    | 18,557   | 4.7     |
| South Asia    |          |          |         |          |          |         |          |          |         |
| Chickpea      | 8,585   | 8,334   | −0.1    | 693     | 855     | 1.3     | 5,747    | 6,792    | 4.4     |
| Common bean   | 9,959   | 11,532  | 0.3     | 602     | 985     | 1.8     | 3,714    | 5,908    | 2.9     |
| Cowpea        | 50      | 159     | 5.4     | 655     | 975     | 1.0     | 33       | 154      | 4.4     |
| Groundnut     | 7,647   | 7,038   | −1.1    | 930     | 1,122   | 1.0     | 6,310    | 8,657    | 0.2     |
| Pigeon pea    | 3,255   | 4,118   | 1.0     | 710     | 840     | −1.1    | 2,495    | 3,068    | 0.9     |
| Soybean       | 1,526   | 8,490   | 8.4     | 701     | 1,275   | 1.6     | 979      | 5,735    | 10.0    |
| Total         | 31,022  | 39,671  | 2.3     | 715     | 1,009   | 1.1     | 19,278   | 30,114   | 3.2     |
Among the legume crops, cowpea is grown in 45 countries across the world (Abate et al., 2011). An estimated 14.5 million ha of land is planted to cowpea each year worldwide, with over 6.5 million metric tons produced annually. The world average yield is estimated at 450 kg per ha with most of the world cowpea production coming from Africa where countries such as Nigeria, Niger, Burkina Faso, Tanzania, Cameroon, Mali, and Kenya are the most important producers. Nigeria and Niger each cultivate over 4 million ha and account for more than 45% and nearly 15% of the world’s total production, respectively (Abate et al., 2011; Boukar et al., 2018; Kamara et al., 2018). Myanmar and Sri Lanka are the only two countries that produce substantial amounts of cowpea in the world. Besides, production in Myanmar has shown sustained growth whereas Sri Lanka’s production has declined over the years (Abate et al., 2011).

According to Kamara et al. (2018), over 12.61 million ha are grown to cowpea worldwide, with an annual grain production of about 5.59 million tons. Africa accounts for 84% of grain production; Nigeria being the largest cowpea producer in the world and accounts for over 2.5 million tons of grain production from an estimated 4.9 million ha. Niger, Burkina Faso and Tanzania are the leading cowpea producer both in terms of area coverage (ha) and production (tons) following Nigeria (Table 3). Other important production areas include lower elevation areas of eastern and southern Africa and in South America (particularly in northeastern Brazil and in Peru), parts of India, and the southeastern and southwestern regions of North America. Uganda and Kenya are also the largest cowpea-producing countries in eastern Africa (Ojiewo et al., 2018).

World cowpea production has reported to be increased by 88% and yields have increased by 35% between 1994–06 and 2006–08. The total cowpea area harvested has also risen by 38% in the

| Rank | Country                    | Production (tons) | Area (ha) | Yield (Kg/ha) |
|------|----------------------------|------------------|-----------|---------------|
| 1    | Nigeria                    | 2,137,900        | 3,701,500 | 578           |
| 2    | Niger                      | 1,593,166        | 5,325,168 | 299           |
| 3    | Burkina Faso               | 573,048          | 1,205,162 | 475           |
| 4    | United Republic of Tanzania| 190,500          | 197,323   | 965           |
| 5    | Cameroon                   | 174,251          | 209,019   | 834           |
| 6    | Mali                       | 149,248          | 353,382   | 422           |
| 7    | Kenya                      | 138,673          | 281,877   | 492           |
| 8    | Myanmar                    | 115,200          | 132,000   | 873           |
| 9    | Mozambique                 | 103,837          | 377,900   | 275           |
| 10   | Sudan                      | 80,000           | 260,000   | 308           |
| 11   | D R C                      | 70,042           | 159,945   | 438           |
| 12   | Senegal                    | 64,088           | 153,142   | 418           |
| 13   | Malawi                     | 35,903           | 81,753    | 439           |
| 14   | Haiti                      | 29,895           | 41,525    | 720           |
| 15   | United States of America   | 21,591           | 12,060    | 1,790         |
| 16   | Peru                       | 17,588           | 12,779    | 1,376         |
| 17   | Serbia                     | 16,189           | 4,777     | 3,389         |
| 18   | Sri Lanka                  | 15,281           | 11,519    | 1,327         |
| 19   | China, mainland             | 13,500           | 13,000    | 1,038         |
| 20   | Uganda                     | 10,100           | 25,000    | 404           |

Source: Boukar et al. (2018)
same production period time (Akibonde & Maredia, 2011). This increase in area, production and yield have been made possible by a similar trend in SSA, which dominates the world scene. Total area, yield, and production in SSA grew at the rate of about 4.3%, 1.5%, and 5.8%, respectively (Abate et al., 2011). Production level in countries like Brazil, Cuba, Ghana, Mozambique, Nigeria, Sri Lanka, Sudan, Zambia, and Zimbabwe is increasing due to availability of improved cowpea varieties (Ngalamu et al., 2015). The increment in area coverage, yield, and overall production trends of cowpea in SSA countries from 1961 to 2014 is shown in Figure 1.

Despite the dramatic increase in production and productivity, cowpea yields remain one of the lowest among all grain legumes, averaging at 450 kg/ha in 2006–08, which is half of the estimated yields in developing regions. In comparison, cowpea yields in developed countries are estimated at 2.4 tons/ha (Akibonde & Maredia, 2011). Besides, an estimated 38 million households (194 million people) are growing cowpea in SSA indicating that cowpea productivity has not been sustained growth over the last two decades (Abate et al., 2011). However, cowpea production in SSA is projected to grow from about 6.2 million MT in 2010 to nearly 8.4 million MT by 2020 (Ojiewo et al., 2018). The average global cowpea production (million metric tons) from 1993 to 2014 and the global production trends (million metric tons) from 2010 to 2014 are indicated in Table 4.

In Ethiopia, information on the cowpea production and productivity is scanty, but a few sources show that the average national yield of cowpea in Ethiopia is estimated to be 400 kg ha$^{-1}$, while yields of 2200 to 3200 kg ha$^{-1}$ have been commonly recorded from improved varieties with proper crop management and protection practices (Ashinie et al., 2020). The higher average grain yield means of 6.91 Quintal/ha (691 kg/ha) was obtained from Forage Agronomy Research in Adami Tulu Agricultural research center at research station bases on different accession (Etana et al., 2013). The average grain yield for the seven cowpea varieties was 22.2 Quintal/ha and this value was significantly varied among varieties. Bilatu et al. (2012) reported the highest grain yield of 28.9 Quintal/ha which was recorded from Black-eyed bean (a commercial cultivar of cowpea) and the lowest grain yield of 11.7 Quintal/ha obtained from “VIU UN 12713D” variety under research environment at Ethiopian Agricultural Research Center, Pawi (Mandura) research station.

In a recent study, Beshir et al. (2019) indicated that the average grain productivity of cowpea was observed to be low (0.8 tons per hectare) on farmers’ field as compared to the yield on-farm demonstration research station. The average yield recorded on demonstration plots on farmers’ field was 1.7 to 2.1 tons ha$^{-1}$ for the improved varieties whereas the average yield of cowpea on the research plot was 2.2 to 3.2 tons ha$^{-1}$. These suggest that a high possibility of furthering the current cowpea yield by two to three folds using locally available technologies. Based on the survey conducted in five major producing regional states (Amhara, Gambella, Oromia, Southern Nations, and Nationalities and People Region (SNNPR) and Tigray), Beshir et al. (2019) reported that the annual cowpea production is estimated to be 55,600 tons produced on 69,500 ha land.

![Figure 1. Trends in area, yield and production of cowpea in SSA (from 1961 to 2014). Source: Ojiewo et al. (2018).](Image)
Although this much production is comparably very low, the crop has a significant contribution to the food security of the smallholder farming communities, particularly residing in a semi-arid area of the country where food insecurity is prevalent.

According to Abate et al. (2011), cowpea production in SSA is projected to grow at nearly 3% per annum that is from 6 million MT in 2010 to 8 million MT in 2020. Nigeria, Niger, Cameroon, Burkina Faso, Ghana, Mali, and Senegal are predicted to continue to dominate cowpea production in SSA. The high rates of growth of 5.9%, 4.5%, and 4.2% were projected for Mali, Senegal, and Niger, respectively, for cowpea production. Other countries with a relatively high rate of growth include Ghana (3%) and Cameroon (2.7%). Besides, the overall demand and supply for cowpea grain in SSA are projected to grow at about 5% per year. High rates of growth in demand are predicted for Uganda (4.4%), Mozambique (3.6%), Burkina Faso (3.5%), Tanzania (3.4%), Niger (3.4%), and Benin (3.1%). Both demand and supply are projected to decline in South Africa and Kenya (Abate et al., 2011), but the future projection and rate of growth of cowpea in Ethiopia are not reported yet.

### 5. Production and management practices of cowpea

Most cowpea grown in the African region is intercropped with sorghum (Sorghum bicolor) or pearl millet (Pennisetum glaucum), and sometimes with other crops such as maize (Zea mays), cassava (Manihot esculenta) or cotton (Gossypium spp.) (OECD (Organization for Economic Co-operation and Development), 2016; Singh et al., 1997). The crop is typically planted at wide spacing (1 m) irregularly through young stands of the component cereal or other crops. According to the report of OECD (Organization for Economic Co-operation and Development) (2016), cowpea is planted after cereal crop establishment, at low density, without inputs, and dry grain cowpea yields of only 300 kg/ha are typically achieved in such systems. However, in the last decade, an increasing portion of the cowpea crop in different parts of Africa has been planted in a pure stand, at a relatively higher density, using improved varieties and with agricultural inputs, especially insecticides, resulting in average yields of between 1 to 2 tons/ha. This is mainly due to the strong demand for cowpea-based foods in urban areas and good prices which drives this shift to more intensified production and management practices.
In Asia and Brazil, both sole-cropping and intercropping are practiced, while in the United States generally only sole-crops are grown. In India, some intercropping of cowpea is still practiced, but the majority of the crop is produced under sole-cropping with inputs. OECD (Organization for Economic Co-operation and Development) (2016) showed that cowpea production in the United States is entirely mechanized with machinery and agronomic practices adopted from other crops such as common beans or soybeans. Large growers in Brazil have also adopted similar modern farming practices to produce high yields. In Africa, most of the farmers prefer to grow dual-purpose cowpea, which is a type where both leaves and grains are the final important products. Besides, it is common that many growers who are engaged in producing dual-purpose cowpea sequentially harvest leaves along the growing period followed by seed harvest at the end of the season (Kabululu, 2008). In intercropping production systems, the spreading indeterminate type of cowpea serves as a ground cover and, thus, suppresses weeds as well as protects the soil against erosion. Kebede (2020a) indicated that cowpea act as the best cover crop and reduced soil erosion in maize-cowpea intercropping system. Similarly, sorghum-cowpea intercropping reduced runoff by 20 to 30% compared with sorghum sole crop and by 45–55% compared with cowpea monoculture. Some cowpea varieties were reported to cause suicidal germination of the seed of Striga hermonthica, a parasitic plant that usually infests cereals with devastating effects (Alemu et al., 2016; Beshir et al., 2019).

In Ethiopia, cowpea is becoming among the most commonly cultivated lowland pulses. It is grown in different areas of Ethiopia for its fodder and grain value (dual purpose) (Etana et al., 2013). According to Alemu et al. (2016), presently a total of 94 germplasms of cowpea were collected by the Ethiopian Biodiversity Institute for conservation and subsequent utilization. Different genotypes of cowpea are also reported to adapt well to the semi-arid lowlands of Ethiopia (Gebreyowsans & Gebremeskel, 2014). Cowpea grows well in northwest Ethiopia, eastern Ethiopia (East and West Harerge), central rift valley, Southern region (Konso, Derashe, Jinka, Goffa) areas (Karanja, 2016). Though cowpea is a leguminous crop, farmers grow it on available soil types mainly on marginal land probably because the soils of those areas are of low fertility and the rainfall is largely erratic. In Ethiopia, cowpea is grown in different types of soils and there are differences across the production areas in the type of land allocated to cowpea. A higher proportion of farm households grow cowpea on fertile to marginally fertile soils and a few farmers grow cowpea on soils of low fertility (Table 5). Alemu et al. (2016) also indicated that farmers produce cowpea in sandy and marginal soil conditions since the crop has the ability to withstand drought and poor soil fertility conditions. A sizable proportion (two-third) of farmers reported to grow cowpea using intercropping with maize and sorghum and a few of them grow cowpea in a relay cropping (Beshir et al., 2019).

As indicated in Table 5, farmers allocated an average of 0.08 to 0.25 ha of their farmlands to cowpea production. Considering the area planted to cowpea across the production areas of Ethiopia, a larger area was allocated to cowpea production in Amhara regional state while a relatively smaller area was allocated to the crop in Gambella regional state. The land allocation for cowpea production is mainly dependent on the part of crop consumed as major grain consumers allocated larger plots to cowpea while users of leaves and pods (as a vegetable) allocated smaller plots. The allocation of land to cowpea also depends on soil fertility and moisture availability in the area.

In Ethiopia, cowpea production is practiced under varying cropping systems including sole cropping, intercropping and mixed cropping. According to Alemu (2015), the main production practice in Gambella, SNNPR and central Oromia region were sole-cropping whereas local farmers used only intercropping with sorghum and maize for the sake of improving soil fertility, to produce a diverse product and to use as a supporting mechanism for cowpea in Oromia region (East and West Harerge zones). In northern Ethiopia, however, cowpea is mostly intercropped with cereals, commonly with sorghum and maize using different planting methods mainly broadcasting (85%) and row planting (13.75%) (Figure 2).
In their recent study, Beshir et al. (2019) reported that sole cropping is practiced by the majority (59%) of cowpea growing households whereas a significant (33%) of farm households practiced intercropping with sorghum and maize. Cowpea is produced using sole cropping in Gambella whereas both intercropping and sole cropping were used in Amhara, Oromia, SNNP and Tigray regional states. Intercropping of cowpea is usually done with cereals such as sorghum and maize though a few farmers in Oromia while intercropping cowpea with groundnut and common beans reported in SNNPR. Mixed cropping of cowpea, which planting of cowpea with other crops such as maize and sorghum randomly scattered in small amounts, is practiced to a lesser extent throughout the country (Alemu et al., 2016; Beshir et al., 2019). These indicates that the production system across the major cowpea producing areas have significant differences. Besides, the yield obtained under different production and management system varies greatly. Kamara et al. (2018) indicated that grain yields ranging from 0.5 to 2.76 t ha$^{-1}$ can be obtained in the sole crop, whereas grain yields ranging from 0.37 to 1.27 t ha$^{-1}$ is attainable in intercropping system. Considering the large

### Table 5. Soil on fertility status and average area of land allocated to cowpea production in Ethiopia

| Perceived soil fertility | Amhara (%) | Gambella (%) | Oromia (%) | SNNP (%) | Tigray (%) | Total (%) |
|-------------------------|------------|--------------|------------|---------|-----------|-----------|
| Fertile                 | 23.8       | 80.0         | 85.6       | 37.7    | 21.7      | 44.8      |
| Medium                  | 52.3       | 18.8         | 14.4       | 47.4    | 51.7      | 40.1      |
| Marginal                | 23.1       | 1.2          | 0.0        | 14.9    | 22.5      | 14.1      |
| Medium and marginal     | 0.0        | 0.0          | 0.0        | 0.0     | 0.8       | 0.2       |
| Fertile, medium and marginal | 0.6   | 0.0          | 0.0        | 0.0     | 3.3       | 0.8       |

| Average area (ha) allocated to cowpea | 0.25 | 0.08 | 0.19 | 0.15 | 0.19 | - |

Source: Beshir et al. (2019)

Figure 2. Production system and agronomic practices for cowpea production in northern Ethiopia. Source: Alemu et al. (2016).
differences between farmers’ yields (0.3 t ha\(^{-1}\)) and experimental station yields (1.5–2.5 t ha\(^{-1}\)), however, the potential for on-farm yield increase in the region is high.

6. Major constraints and challenges facing cowpea production

The production and productivity of legumes are low especially in Africa, with average yields, compared with yields of up to 5000 kg/ha reported from the best performing countries (FAOSTAT, 2016). Overall, grain legumes have given limited attention by research and development programmes in the past as they have been referred to as “orphan crops” (Ojiewo et al., 2018). According to Kamara et al. (2018), cowpea cultivation is mainly under traditional systems and cowpea grain yields in farmers’ fields are low especially in the African region (0.025–0.3 t ha\(^{-1}\)). This is caused by severe attacks of pest complexes, diseases, low soil fertility, drought, inadequate planting systems, inappropriate cultivars and lack of inputs. Ojiewo et al. (2018) also indicated that the low productivity of cowpea is attributed to various production and socio-economic constraints including persistent drought episodes, deteriorating soil fertility, market failures and limited access to improved varieties on account of challenges in the seed systems.

In addition, several biotic and abiotic stresses, and existing planting practices limit crop yields. According to FAOSTAT (2016), cowpea is grown in intercrop systems primarily with maize, cassava, and sorghum and Kyei-Boahen et al. (2017) indicated that cowpea grain yields are very low under this system averaging 275 kg ha\(^{-1}\). Sibhatu et al. (2015) reported that the intercropped cowpea yield was reduced by 58.34% than sole cropping system. This is mainly due to poor planting arrangement that leads to shading by the companion crops and low plant population, low soil fertility, inappropriate planting time, the use of traditional cowpea cultivars with low yielding potential, pest and disease attack and lack of inputs. Besides, the continuous cropping of the land with no external inputs is mining the nutrients in the soil and has led to a progressive decline in yields. Yield losses of up to 70% have been reported from insect pests alone. In some areas, the losses caused by insect pests account for a reduction in grain yield as much as 80% (Kamara et al., 2018).

According to Takim and Uddin (2010) average cowpea yields on the farmers’ fields are low (< 300 kg ha\(^{-1}\)) despite its widespread cultivation across the world. Timko et al. (2007) reported that the low yielding of cowpea has been attributed to a number of the biotic stresses such as insect pests, nematodes, diseases, and parasitic weeds and abiotic stresses such as drought, high temperature, low soil fertility, low pH and aluminium toxicity. In the developing world, most of the cowpea is grown without the use of fertilizers and plant protection measures such as pesticides and herbicides. Although cowpea is more drought tolerant than many other crops, moisture availability is also the major limitation to growth and development, especially during germination and flower setting. Erratic rainfall also affects both plant population and flowering ability resulting in a tremendous reduction of grain yield and total biomass in general (Timko & Singh, 2008).

Research and extension services in Ethiopia are very often weak and information provided to farmers is usually limited (Kebede, 2020b). Due to this, less attention is given in terms of crop management and input utilization and there is a lack of complete production packages. Alemu et al. (2016) indicated that there is limited information regarding the genetic resource as well as major production challenges and social factors related to cowpea production in Ethiopia although the country is a center of diversity for cowpea. According to the report of the collaborative crop research program led by Melkassa Agricultural Research Centre, production statistics for cowpea in Ethiopia are not available and the crop is often confounded with common beans. Previously, only six cowpea varieties released from 1976 up to now with recommended production packages in Ethiopia in a one-size-fits-all fashion. Besides, the lowland pulse research program of the Ethiopian Institute of Agricultural Research (EIAR), which is in charge of cowpea research in the country, depends on the imported germplasm (Beshir et al., 2019).
Despite this, major cowpea production constraints in Ethiopia are scarcity of sufficient improved varieties for climate-resilient such as drought, disease, weed, and insect pest attacks at the field, storage and poor management practices, low soil fertility, the prevalence of insect pests and diseases and drought conditions, and poor technology dissemination and popularization. Alemu (2015) indicated that the decrease in the production of cowpea in Ethiopia is due to limited use of improved inputs, small fragmented plots, sowing in marginal soils and inadequate farm management practices and also the agricultural office experts’ outlook on cowpea as they believed that it is forage crop so that the extension workers do not incorporate into extension packages for this crop. In addition to this, Alemu et al. (2016) reported that smallholder farmers in Northern Ethiopia are facing different constraints on cropping, storage and consumption of cowpea including storage pests, field insects, parasitic weeds and diseases.

Besides, marketing and connected problems are another reason for the low production of grain legumes in Ethiopia (Kebede, 2020a). Information on cowpea marketing and trade is lacking and data on cowpea production and consumption economics is scarce in African countries including Ethiopia (Ngalamu et al., 2015). Furthermore, the marketing of cowpeas is mainly limited to local markets and farm gate due to lack of access to urban markets by farmers partly due to the poor road network and poor modes of transportation. On the other hand, the production system in the country is characterized by the lack of access to modern technologies such as improved varieties and the accompanying crop and pest management practices, inputs such as fertilizers (both mineral and biofertilizers), seeds of improved varieties, and poor input and output market access (Abate et al., 2011).

7. Importance of cowpea to livelihoods
Cowpea is of major importance to the livelihoods of relatively poor people in less developed countries of the tropics, especially where animal protein is not easily available for the family. Widely consumed in many countries, with excellent nutritional and nutraceutical properties and several agronomic, environmental and economic advantages, contributing to food security and maintenance of the environment, cowpea is a strategic culture for the promotion of food security and health of populations on all continents (Carneiro da Silva et al., 2018). The potential importance of cowpea is summarized in Figure 3 and described below in detail.

7.1. Provision of nutritious food and high-quality feed
Cowpea is one of the most nutritionally important indigenous African grain legumes produced throughout the tropical and subtropical areas of the world. All the parts of cowpea which can be used for food and feed (fresh leaves, immature pods, and grains) are nutritious, providing protein, carbohydrate, vitamins, and minerals (Alemu, 2015; Alemu et al., 2016). As indicated by Carneiro da Silva et al. (2018), cowpea plays a critical role in the lives of millions of people in the developing world, which were estimated as 38 million households (194 million people) in SSA, providing them a major source of dietary protein that nutritionally complements low-protein cereal and tuber crop staples. This makes cowpea to be a multifunctional crop, providing food for humans and feed for livestock, as a concentrate for farm animals, hay, silage, pasture, soil cover and green manure (Alemu et al., 2016).

In Ethiopia, cowpea is cultivated primarily for its edible seeds, the leaves, and pods that are used for human consumption and animal feed (Alemu, 2015; Alemu et al., 2016). The grain of cowpea is the most important part of the cowpea plant for human consumption containing 22–23 % protein (as opposed to 2 % in cassava and 10 % in maize) and a good quantity of thiamine (vitamin B₁), riboflavin (vitamin B₂) and niacin (vitamin B₃), and richer than cereals in iron and calcium content (Ngalamu et al., 2015). Household survey conducted in Ethiopia indicated that grain of cowpea is the most popular parts of cowpea for consumption in Ethiopia particularly Amhara, Oromia and Tigray regional states (Table 6). The total crude protein in foliage ranges from 14–21% and in crop residues it is 6–8%. The fat contents study of 100 advanced breeding lines of cowpea showed a range in fat contents from 1.4 to 2.7% and fiber content about 6% (Alemu et al., 2016).
Figure 3. Schematic representation of the potential contributions of cowpea in food nutrition, income and crop-livestock systems in the dry savannas as modified from Fatokun et al. (2002).

Table 6. Cowpea consumption across major producing regional states in Ethiopia

| Cowpea part                           | Amhara | Gambella | Oromia | SNNPR | Tigray | Mean |
|---------------------------------------|---------|----------|--------|-------|--------|------|
| Grain                                 | 52.3    | 0.0      | 48.1   | 10.7  | 48.6   | 31.9 |
| Leaves                                | 0.0     | 3.5      | 0.0    | 1.3   | 0.0    | 1.0  |
| Grain and leaves                      | 0.0     | 51.8     | 0.0    | 20.0  | 1.9    | 14.7 |
| Grain, leaf and green pod             | 0.0     | 44.7     | 3.8    | 51.3  | 2.8    | 20.5 |
| Grain and green pod                   | 47.7    | 0.0      | 48.1   | 16.7  | 46.7   | 31.8 |

Average cowpea consumption per household (% respondents) in Ethiopia

| Amount (kg)  | Amhara | Gambella | Oromia | SNNPR | Tigray | Average |
|--------------|--------|----------|--------|-------|--------|---------|
| Less than 25 | 12.3   | 10.6     | 13.7   | 20.3  | 20.6   | 15.5    |
| 25–50        | 33.1   | 24.7     | 30.4   | 31.1  | 28.0   | 29.5    |
| 51–100       | 29.2   | 37.6     | 32.3   | 20.9  | 15.0   | 27.0    |
| 101–200      | 16.9   | 22.4     | 20.6   | 17.6  | 21.5   | 19.8    |
| 201–300      | 4.5    | 3.5      | 1.0    | 4.6   | 6.5    | 4.1     |
| 301–400      | 1.9    | 1.2      | 1.0    | 3.4   | 4.7    | 2.4     |
| 401–500      | 0.6    | 0.0      | 1.0    | 0.7   | 2.8    | 1.0     |
| > 500        | 1.3    | 0.0      | 0.0    | 1.4   | 0.9    | 0.7     |
| Sum          | 99.8   | 100      | 100.0  | 100.0 | 100    | 100     |

Source: Beshir et al. (2019)
Cowpea grains can also complement the grains of cereals as foods for people by enhancing the quantities and qualities of proteins and vitamins. For example, cowpea grains have substantial levels of folic acid, which is a critical vitamin for all people and especially pregnant women since it prevents the occurrence of neural tube defects such as spina bifida in infants. Fresh and dry grains of early-season cowpea cultivars and fresh pods and leaves are often an important source of food during the “hungry period” (OECD (Organization for Economic Co-operation and Development), 2016). Alemu et al. (2016) stated that cowpea is primarily used for human food in the form of boiled grains (Nifro), bread (Kita) and as a constituent for various sauces like “Shiro wet” in northern Ethiopia mainly Amhara Region. Beshir et al. (2019) reported that fosese, kukurfa, nifro and soups are the major cowpea recipes which can be prepared from cowpea alone or by mixing it with other crops. Besides, the seeds are most often harvested and dried for storage and consumption at a later time, either after cooking whole or after being milled like a flour product and used in various recipes (OECD (Organization for Economic Co-operation and Development), 2016). Parts of cowpea used for consumption (%) and average cowpea consumption per household (%) across major producing regional states of Ethiopia are shown in Table 6.

Although cowpea is mostly utilized as a dry grain and animal fodder crop, cowpea leaves are also used as a high-protein pot herb in many countries of Africa. Cowpea leaves are a significant source of β-carotene and ascorbic acid (vitamin C) (Ngalamu et al., 2015). The young leaves and shoots of cowpea are consumed as spinach or vegetable and provide one of the most widely used pot herbs in tropical Africa; they are often dried and stored for dry season use (Alemu et al., 2016). The very early maturity characteristics of some cowpea varieties provide the first harvest earlier than most other crops during the production period. Owade et al. (2020) indicated that harvesting of cowpea leaves usually begins as early as two weeks after emergence (WEA) and continues until flowering, and the leaves can be consumed as boiled, blanched, dried, or fermented vegetables (Table 7). This is an important component in the hunger-fighting strategy, especially in Sub-Saharan Africa where the peasant farmers can experience food shortage a few months before the maturity of the new crop.

Cowpea grains are also consumed as a feed to livestock as a nutritious fodder. Cowpea residue is an important fodder resource for ruminant livestock. Farmers in the dry savannas deliberately grow varieties and use management practices that will ensure some cowpea fodder is available for

Table 7. Nutritional composition of cowpea vegetables (mg/100 g dry weight)

| Cowpea leaves (per 100 g dry matter) | Nutrient | Raw fresh | Dried (Solar and sun-dried) | Blanched | Fermented |
|-------------------------------------|----------|-----------|-----------------------------|----------|-----------|
| Moisture (g)                        | 85–90    | 7.04–7.35 | 12.0–15.02                  | 6.31–7.29|
| Crude Protein (g)                   | 28–42    | 29.09–39.24| 4.33–12.91                  | 1.68–1.92|
| Crude lipid (g)                     | 9.00–10.26| 1.31–2.28 | 7.5–11.87                   | 10.6–11.0|
| Crude ash (g)                       | 4.80–13.58| 10.84–14.80| 12.53–14.35                 | 17.10–29.48|
| Energy value (kJ)                   | 325.36–390.26| 219.8–290.51| 246.27–384.43               | 214–226.9|
| Micronutrients                      |          |           |                             |          |
| Beta-carotene (mg)                  | 32.74–36.55| 0.25–24.76 | 19.21–20.35                 | 0.8–30   |
| Vitamin C (mg)                      | 70–203   | 1.39–137.9 | 40.1–42.8                   | 45       |
| Iron (mg)                           | 66–75    | 0.58–7.50  | 0.56–0.57                   | 0.17–0.23|
| Calcium (mg)                        | 17.1–39.87| 1.40–25.1  | 24.3–24.6                   | 1.27–1.28|
| Zinc (mg)                           | 5.22–12.91| 1.66–144.5 | 0.14–7.9                    | 0.05–0.07|

Source: Owade et al. (2020)
harvest at the end of the growing season, even at the expense of grain production (Fatokun et al., 2002). Besides the nutritional value, Alemu (2015) reported the medicinal value of cowpea to rank fifth in cowpea utilization whereas a quarter of the farmers were reported to have used the leaves and grains of cowpea for the treatment gastric discomfort, malaria and liver diseases. Besides its importance in providing different nutrients, a well-known problem of cowpea grain is its content of tannins, trypsin inhibitors and flatulent sugar, raffinose, which cause bloating of the stomach when a meal containing cowpea is consumed. As a result, a meal of cowpea is repulsive to some people. This problem can easily be avoided by grain soaking before dehulling, heat treatment and breeding for cowpea varieties without or with low content of these factors (Ngalamu et al., 2015).

7.2. Importance of cowpea in soil fertility management and cropping system

Cowpeas play a critical role in the management of soil fertility in cereal-based intercropped and rotational cropping systems where they are often grown in sub-Saharan Africa, in terms of nutrient improvement and resistance to certain pests. It is an important component of the traditional cropping systems because it fixes atmospheric nitrogen and contributes to soil fertility improvement particularly in smallholder farming systems where little or no fertilizer is used (Kyei-Boahen et al., 2017). Besides, the crop performs well even in poor soils with more than 85% sand, less than 0.2% organic matter and low levels of phosphorus (Bilatu et al., 2012). Cowpea significantly contributes to the sustainability of cropping systems and soil fertility improvement in marginal lands by providing ground cover, fixing nitrogen and suppressing weeds (Beshir et al., 2019).

Biological nitrogen fixation (BNF) is one of the major benefits of cowpea production in cropping system. The species has a unique ability to fix atmospheric nitrogen with its nodules in association with soil dwelling bacteria, known as rhizobia. Cowpea can fix about 240 kg ha$^{-1}$ of atmospheric nitrogen and make available about 60–70 kg ha$^{-1}$ nitrogen available for succeeding crops grown in rotation with it (CRI (Crops Research Institute), 2006). Adjei-Nsiah et al. (2008) evaluated 5 cowpea varieties for nitrogen fixation with no fertilizer application and the amounts of nitrogen fixed in the above-ground biomass were 41, 43, 32, 34 and 67 kg ha$^{-1}$. Yusuf et al. (2009), on the other hand, reported that the amount of nitrogen fixed by cowpea genotypes ranged from 13.9 to 40.3 kg ha$^{-1}$ in the Northern Guinea Savanna zone of Nigeria. The differences observed in the amount of nitrogen fixed by the legume genotypes were attributed to the number of days required to attain maturity. Higher amounts of fixed nitrogen were found in longer duration genotypes. Sanginga et al. (2000) also reported a range of 13.1–31.9 kg ha$^{-1}$ fixed nitrogen for eight cowpea genotypes in the derived savanna of West Africa. Vesterager et al. (2008) stated that cowpea fixed around 60% of its nitrogen from the atmosphere amounting to 70 kg N ha$^{-1}$ under sole cropping and 36 kg N ha$^{-1}$ when intercropped with maize in the semi-arid zone of Tanzania.

According to Kamara et al. (2018), cowpea can fix between 20 and 100 kg N ha$^{-1}$ with an estimated N fertilizer replacement value ranging from 10 to 80 kg N ha$^{-1}$. The N fixed is made available to associated or succeeding cereals in the predominantly poor savannah soils. Carry-over of nitrogen from BNF such as in roots and fodder can supply the nitrogen demand of subsequent non-nitrogen fixing crops. For example, sorghum yields increased when sown after groundnuts and cowpea. The estimates of nitrogen fertilizer replacement value for cowpea range from 10 kg N ha$^{-1}$ to 60 kg N ha$^{-1}$ (Ghosh et al., 2007). Part of the nitrogen requirement of cereal crops can be satisfied by cowpea crop rotation. Bationo et al. (2002) stated that yields of cereals succeeding cowpea could, in some cases, double compared to continuous cereal cultivation. Furthermore, the benefits of cowpea rotation are sometimes higher than expected based on the nitrogen content of the cowpea crop alone. Reasons for this include substantial root biomass and N, substantial N-sparing by the legume, and other benefits such as a reduction in Striga hermonthica, pests and diseases, and possibly access to sparingly soluble P grown in one season. Bado et al. (2006) reported that cowpea fixed about 50–115 kg N ha$^{-1}$ in Burkina Faso which increased the yield of succeeding sorghum by 290%.
In Ethiopia, farmers feed cowpea fodder to livestock to increase income and collect the manure produced for use in their fields thereby reduces farmers’ reliance on commercial fertilizers and sustain soil fertility (Gebreyohans & Gebremeskel, 2014). As a provision of organic matter to the soil, the root, stem, and haulm residues of cowpea decay after harvest, providing organic matter and the contained nutrients to the soil. Besides, the spreading indeterminate and semi-determinate bushy growth of cowpea provide ground cover, thus, suppressing the growth of weeds and providing protection against soil erosion by running water during heavy rains. A complete ground cover also reduces the temperature of the soil (Ngalamu et al., 2015).

Another important feature of cowpea is also its ability to suppress weeds particularly Striga hermonthica which is a parasitic weed of crops such as sorghum and maize (Beshir et al., 2019). Cowpea genotypes can cause suicidal germination of the seeds of the weed parasite Striga hermonthica, which is a major pest of pearl millet, sorghum, and maize that has been difficult to solve by other means. According to Ngalamu et al. (2015), some cowpea varieties will stimulate the germination of striga seeds, but the roots of the germinated seedling of the Striga cannot penetrate the roots of the cowpea to obtain nutrients for its subsequent growth. Fatokun et al. (2002) reported that rotation with selected cowpea varieties has a substantial and rapid effect on reducing Striga hermonthica, with the number of attached Striga hermonthica plants per maize plant being reduced by at least 50% when maize was grown after cowpea. Some cowpea genotypes can reduce the reproduction of certain plant-parasitic nematodes (including Scutellonema cavenessi) that can damage pearl millet, sorghum, and peanut. Consequently, cowpea can enhance the edaphic conditions and thus the productivity of the cereals and other crops that are grown in rotation or as intercrops with it (OECD (Organization for Economic Co-operation and Development), 2016).

Currently, legumes are increasingly sought for their climate resilience, ecological role in improving soil fertility, provision of livestock feed and nutritional value, especially under the impending threat of climate change in dryland ecologies and their use as “climate-smart”, “smart-food” and “future” crops. The inherent resilience and hardiness of crops like groundnut, cowpea, pigeon pea, and chickpea allow them to continue to be suitable crops in the production regions even under climate change (Ojiewo et al., 2018). The integration of cowpea with the prevailing farming system could have significant importance in improving nutrition, soil fertility, and productivity, feed quality and withstands the impact of climate change (Etana et al., 2013; Gebreyohans & Gebremeskel, 2014). Subsequently, cowpea can enhance the edaphic conditions and, thus, the productivity of the cereals and other crops that are grown in rotation or as intercrops with it (OECD (Organization for Economic Co-operation and Development), 2016).

7.3. Economic importance of cowpea

In addition to its food, soil improvement, and forage values, cowpea has economic importance as income source; farmers often sell the grain and leaves in the local markets (Alemu et al., 2016). Cowpea is among the dominating grains legumes traded almost in all local markets especially in Sub-Saharan Africa. It is a cash-generating commodity for farmers, small and medium-size entrepreneurs (Timko & Singh, 2008). According to Ngalamu et al. (2015), trading of fresh cowpea leaves, fresh produce and processed food provides both rural and urban communities opportunities for earning some money, particularly women. Trading of cowpea haulms as food for large and small ruminants can also be economically rewarding.

According to the report of Beshir et al. (2019), the majority (61.2 %) of farm households in Ethiopia reported selling at least part of their cowpea produce in the local market from their previous harvests and grain marketing was more important in all cowpea producing areas. There is a significant difference among regional states concerning the parts of the cowpea marketed., Fresh cowpea leaves marketing is also the most important particularly in Gambella and southern parts of the country. Besides, most of the farmers (73.3 %) appreciated market prices of cowpea as...
the price is comparable to that of common bean price which is part of the commodity exchange market and a widely marketed legume in Ethiopia (Beshir et al., 2019).

8. Future trends and recommendations

Globally, the increasing human population has led to higher demands for increased agricultural productivity. According to Kyei-Boahen et al. (2017), addressing food insecurity resulting from low crop yields would require changes to the traditional crop production practices and would need an emphasis on sustainable intensification on the existing land. This would include growing more drought-tolerant cultivars, using improved crop management practices such as time of planting and plant population, residue management, tillage and inputs, such as crop protection chemicals, mineral fertilizers, and Rhizobium inoculants. Cowpea is known to be a drought-tolerant crop and given the importance of cowpea in ensuring food and nutritional security, there is the need to develop and select available germplasm for improved yields and nutrition. Therefore, researchers and plant breeders should make efforts to identify cowpea varieties with improved nutritional content, enhanced levels of drought and heat tolerance, high biological nitrogen fixation and other desirable traits.

In Ethiopia, the International Institute of Tropical Agriculture (IITA) and the International Livestock Research Institute (ILRI) have been working together to develop improved dual-purpose (for food and feed) cowpea varieties with resistance to biotic and abiotic stresses and better nutritional attributes (Kristjanson et al., 2001). Cowpea landraces collection has also been done in different production areas of Ethiopia where it is an important component of the agricultural system and the food culture of the society (Alemu et al., 2016). However, not yet still sustainable promising technologies have been achieved to alleviate the constraints. In general, there is still limited information regarding the genetic resource, major production challenges, dissemination of production packages, and social factors related to cowpea production in Ethiopia. Therefore, further research strategies are required to alleviate problems in cowpea production.

Although cowpea production in Ethiopia is increasing because of its importance in nutrition and agricultural system, the yields of cowpea in smallholders’ farms are quite low due to poor crop management practices and poor attention given to the crop on proper use improved varieties, integrated pest management and proper nutrients fertilization which would increase the productivity in the country. According to Kamara et al. (2018), agronomic practices that may increase cowpea productivity are optimal plant population, appropriate planting date, nutrient management, integrated pest management, and suitable cropping system. Besides, supplementary irrigation and the use of heat and drought tolerant cowpea varieties would help in improving cowpea productivity despite the inherent ability of the crop to tolerate different biotic and abiotic stresses. Therefore, awareness creation on increasing the demand of the crop by the farmers and finding a suitable solution for the major production constraints and introduction of improved cowpea varieties with improved agronomic management options should also be given priority. Introduction and promotion of improved agronomic practices such as row planting, identifying suitable varieties of cowpea and complementary crop for intercropping is also highly recommended.

Given that the potential yield can be exploited from unconstrained crop growth with adequate management practices, the promotion of production technologies and awareness creation should also be launched by the government and research centers. These technologies should focus on production and management aspects which avoids limitations from nutrient deficiencies, inadequate planting systems, and water stress and reductions from weeds, pests, and diseases, the uses of different cowpea varieties, and marketing of the crop. In addition, the agricultural experts should make the farmers aware of management techniques to prevent a series of problems of production constraints such as insect and pest damage using a combination of good hygiene, aeration, drying, treating storages and equipment and mixing chemicals with the grain.
The government should also focus on the key aspects of successful marketing of cowpeas. Information on marketing including local prices, demand and supply, and buyers’ preferences is also important as it would allow producers and role-players to make better production and marketing decisions that will increase efficiency and, hence, profitability. Besides, farmers should be encouraged to grow high yielding and improved varieties with appropriate cultivation and post-harvest handling practices to ensure the production and delivery of quality products to the market. The development of infrastructures and facilities and actions that enable consistent supply between producers and exporters should also be facilitated. A more flexible seed production and supply system that meets the needs of a diverse group of farmers, allows farmers source from different seed systems and reduces the current seed supply shortage is crucial to accelerate legume production and productivity and commercialization.

9. Conclusions

Cowpea is a multipurpose food legume and cultivated primarily in lowland areas of Ethiopia for its edible seeds, pods and leaves that are used as human food and feed for livestock, and its ability to maintain the productivity of soils. However, cowpea production and utilization in Ethiopia is very low as compared to other major producing countries. The yield of the crop in the country has generally remained below the potential of the crop and the world average yield. Nevertheless, the crop has a significant contribution to the livelihood of the smallholder farming communities. Its production is experienced under varying cropping systems including sole cropping, intercropping and mixed cropping system. The crop is mainly planted at low density, without inputs, and farmers grow it on available soil types mainly on marginally fertile and infertile soils. The major constraints and challenges facing cowpea production are limited attention to the crop, pests such as insects, nematodes, diseases, and parasitic weeds, low soil fertility, drought, marketing problems, poor management practices, and technology dissemination. However, Ethiopia has still different potentials and opportunities such as diverse agroecology and diversity of cropping system. Besides, the multipurpose nature of the cowpea which includes the provision of food and feed, soil productivity maintenance, and income generation would help to boost the production of cowpea and its contribution to livelihoods. Henceforward, strengthening of cowpea research programmes, promotion of improved agronomic practices and technologies, and facilitating effective marketing systems are crucial to enhance cowpea production, productivity, and commercialization.

Funding
This work did not receive any specific grant from funding agencies.

Competing interest
The authors declare no competing interests.

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Citation information
Cite this article as: Expounding the production and importance of cowpea (Vigna unguiculata (L.) Walp.) in Ethiopia, Erana Kebede & Zelalem Bekeko,Cogent Food & Agriculture (2020), 6: 1769805.

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