



**Background information on
agronomy, farming systems
and ongoing projects on grain
legumes in Ethiopia**

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N2Africa

**Putting nitrogen fixation to work
for smallholder farmers in Africa**



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1. Introduction

As part of the supplementary grant received from the Bill & Melinda Gates Foundation, N2Africa is exploring the opportunities for extension of the project to Ethiopia, Uganda and Tanzania. For each of these countries, relevant background information on the importance of grain legumes, past research on legume agronomy and farming systems, as well as ongoing projects around grain legumes is gathered. This will increase N2Africa's relevance by building on key issues raised from these previous experiences. The report falls under Milestones S 1.2.1 – 1.2.3: Prepare review and background of previous relevant agronomic, farming systems and market research in each country. This report provides background information for Ethiopia.

The report starts with general information on economy, poverty and malnutrition in Ethiopia in Chapter 2, followed by statistics on production and import of grain legumes in Chapter 3. Chapter 4 presents a characterization of Ethiopia's agro-ecological zones and market access in different regions. More detailed information on relevant grain legumes in Ethiopia (faba bean, common bean, chickpea and soyabean) and results of previous research on these crops is given in Chapter 5. Chapter 6 lists ongoing projects around grain legumes in Ethiopia.



2. General characteristics

Ethiopia has a population of about 85,000 inhabitants. Population growth is high and increasing agricultural production is necessary to keep up with national food demand the coming decades. Currently, the agricultural sector comprises 50% of total GDP (Table 1). Compared to neighbouring Kenya, this is a large share. Gross net income per capita is lower than in Kenya, and the country has a higher share of its population living below the poverty line. Half of the population is stunted, and underweight is prevalent among 35% of the population. Other indicators for malnutrition such as wasting, mortality rate among children under five and women with low BMI are high as well.

Table 1: Selected development indicators

	Ethiopia	Kenya	Source
Population (thousands)	84 734	38 765	UNDP (2011)
Gross net income (US\$ per capita, PPP)	930	1 580	Worldbank (2011)
Population below poverty line ¹ (%)	39	20	Worldbank (2011)
GDP (billion US\$)	28.5	34.5	Worldbank (2011)
Agriculture (%GDP)	51	21	Worldbank (2011)
Children under 5 (thousands)	13,323	6 540	UNICEF (2009)
Stunting prevalence (%)	51	35	UNICEF (2009)
Children stunted (thousands)	6,768	2 269	UNICEF (2009)
Underweight prevalence (%)	35	21	UNICEF (2009)
Wasting prevalence (%)	12	6	UNICEF (2009)
Children under 5 mortality rate (per 1000)	104	85	Worldbank (2011)
Women with low BMI (%)	27	12	UNICEF (2009)

¹ Poverty line defined as people living on less than US\$ 1.25 PPP per day.



3. Production and import of grain legumes

In Ethiopia, faba bean is the crop that has the highest absolute production, and the largest area cultivated (Table 2). Ethiopia is also the second largest producer of faba bean in the world (after China). Common bean and chickpea are also major legumes, with both a production of more than 200,000 MT grain. On the world market, Ethiopia ranks 6th in chickpea production, and 14th in production of common bean. Among African countries, Ethiopia is the largest producer of both chickpea and common bean (ICRISAT, 2011).

Table 2: Production, area cultivated and yield/ha of main grain legumes in Ethiopia in 2010

	Production (MT grain)	Area cultivated (ha)	Yield (t/ha)
Beans	244 000	263 000	0,9
Faba bean	512 000	607 000	0,8
Chickpea	213 000	310 000	0,7
Groundnut	42 000	56 000	0,8
Soyabean	6 000	9 000	0,7
Total	1 017 000	1 245 000	
Ranking of producers in the world	Faba bean 2 nd Chickpea 6 th Beans 14 th		

Source: FAOStat, 2012

In total, the area cultivated with the selected legumes is more than 1 million ha. Production per ha is low and far below the potential production of e.g. 2.9 t/ha for chickpea and 4 t/ha for common bean and faba bean (IFPRI, 2010b, USAID, 2011).

4. Agriculture in Ethiopia

4.1 Rainfall and agro-ecology

The west of Ethiopia receives the highest amount of rainfall: more than 1000 mm (Figure 1). Towards the east and southeast this amount diminishes. In general, annual precipitation ranges from 800 to 2200-mm in the highlands (>1500 meters) and varies from less than 200 to 800-mm in the lowlands (<1500 meters).

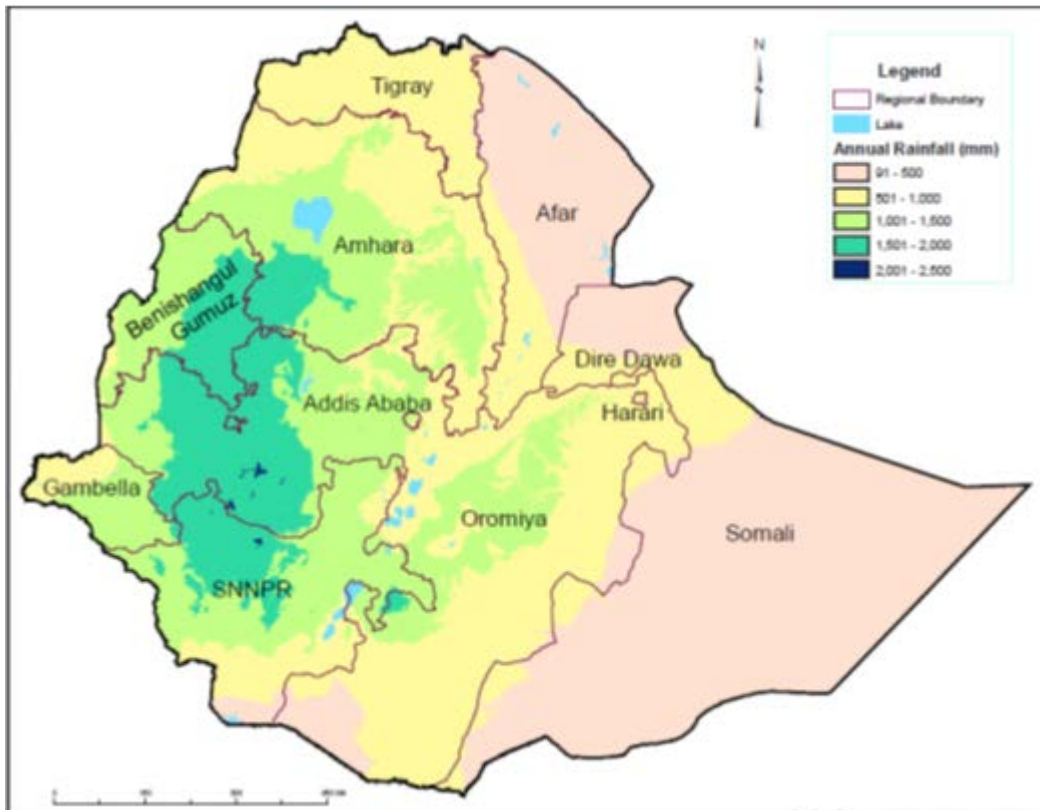


Figure 1: Long term annual rainfall (mm) in Ethiopia

Source: UN-OCHA (2006)

Ethiopia's agro-ecological zones range from warm to cool and from (semi-)arid to subhumid tropics (see Appendix 1 for an overview of agro-ecological zones in Ethiopia). The main agricultural production areas range between 3200 and 1500 m (highland and lowland) and they have either two or three seasons (FAO, 2006). The western half of Ethiopia has a wet season from June-September and a dry season from November-February (rainfall peak July-August), whereas the central and eastern part have two rainy periods and one dry period (the main *Kiremt* rains June-September, small *Belg* rains February-May and dry *Bega* season October-January) (USDA, 2003). The length of the growing season is more than 120 days in most of western Ethiopia, and between 60 and 119 days in central Ethiopia (Figure 2 and Figure 3) (FAO, 2006).

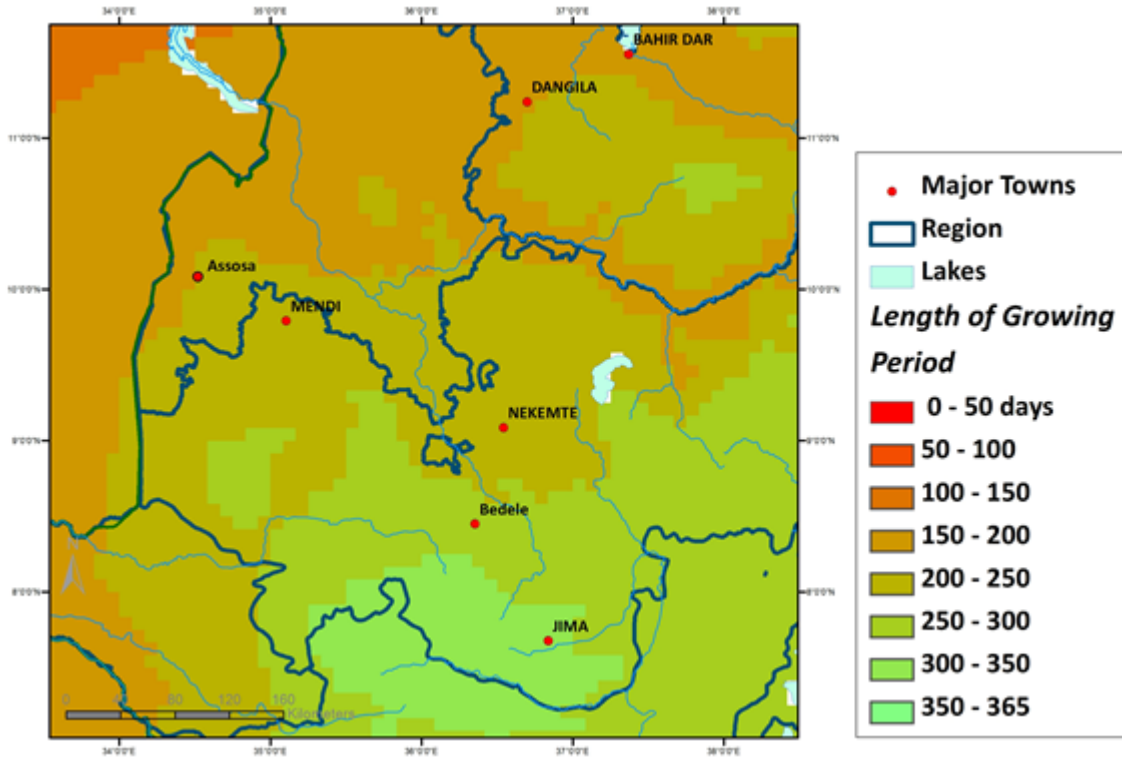


Figure 2: Length of growing period Western Ethiopia

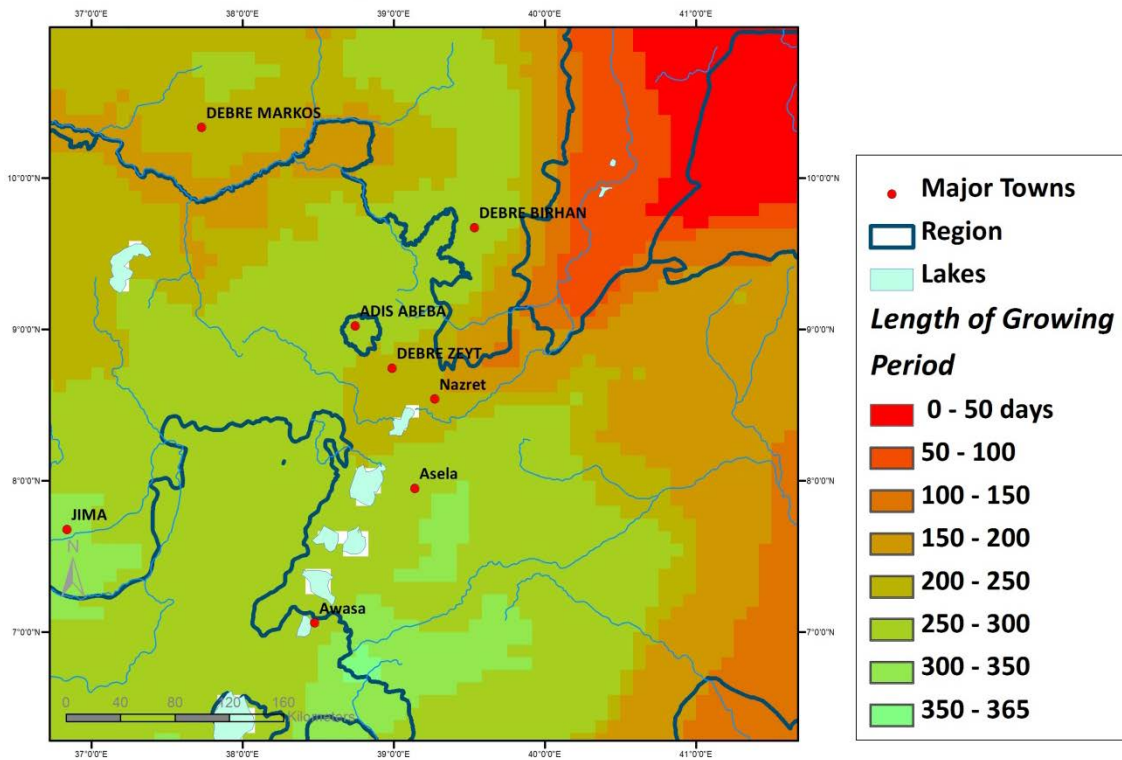


Figure 3: Length of growing period Central Ethiopia



4.2 Population density and market access

Population density is highest in central and western Ethiopia (Oromia, Amhara and Tigray) (Figure 4 and Figure 5). This implies that most important markets for agricultural production are also found in these regions.

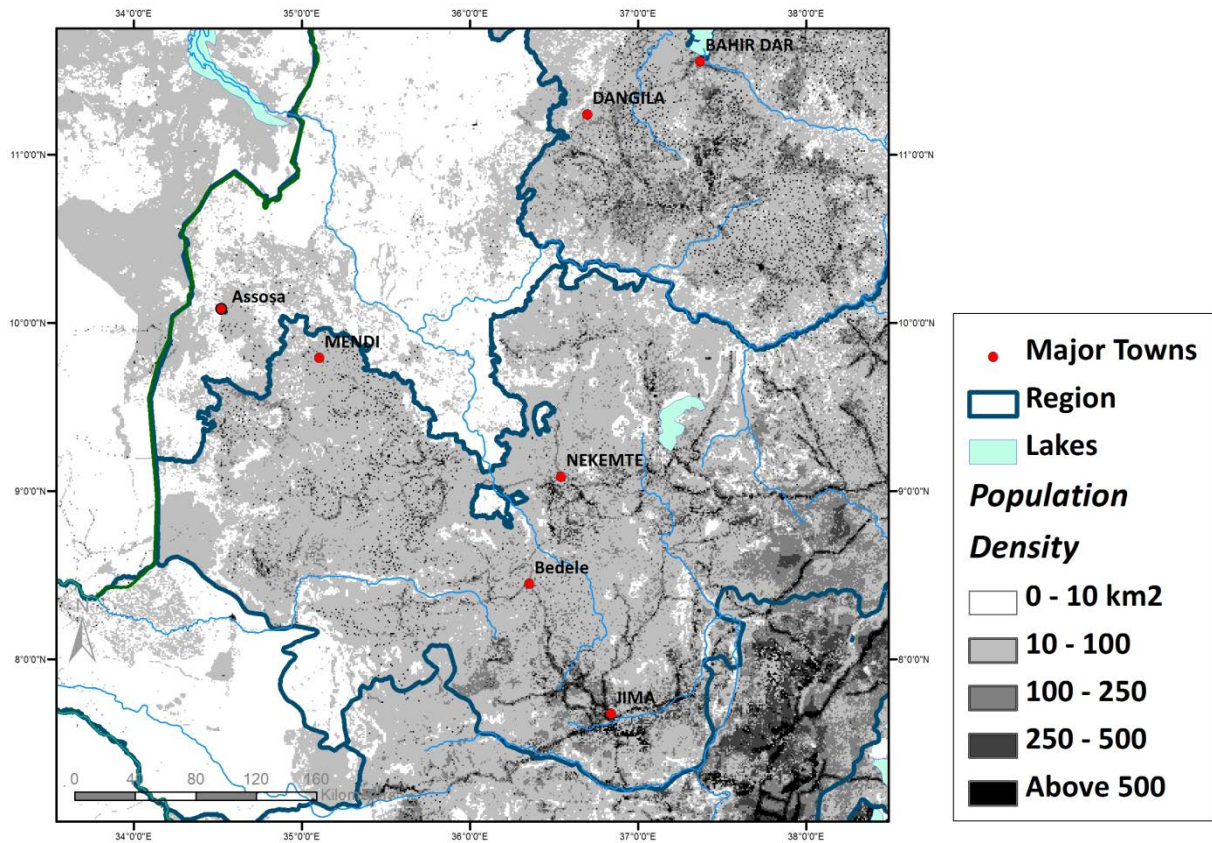


Figure 4: Population density Western Ethiopia

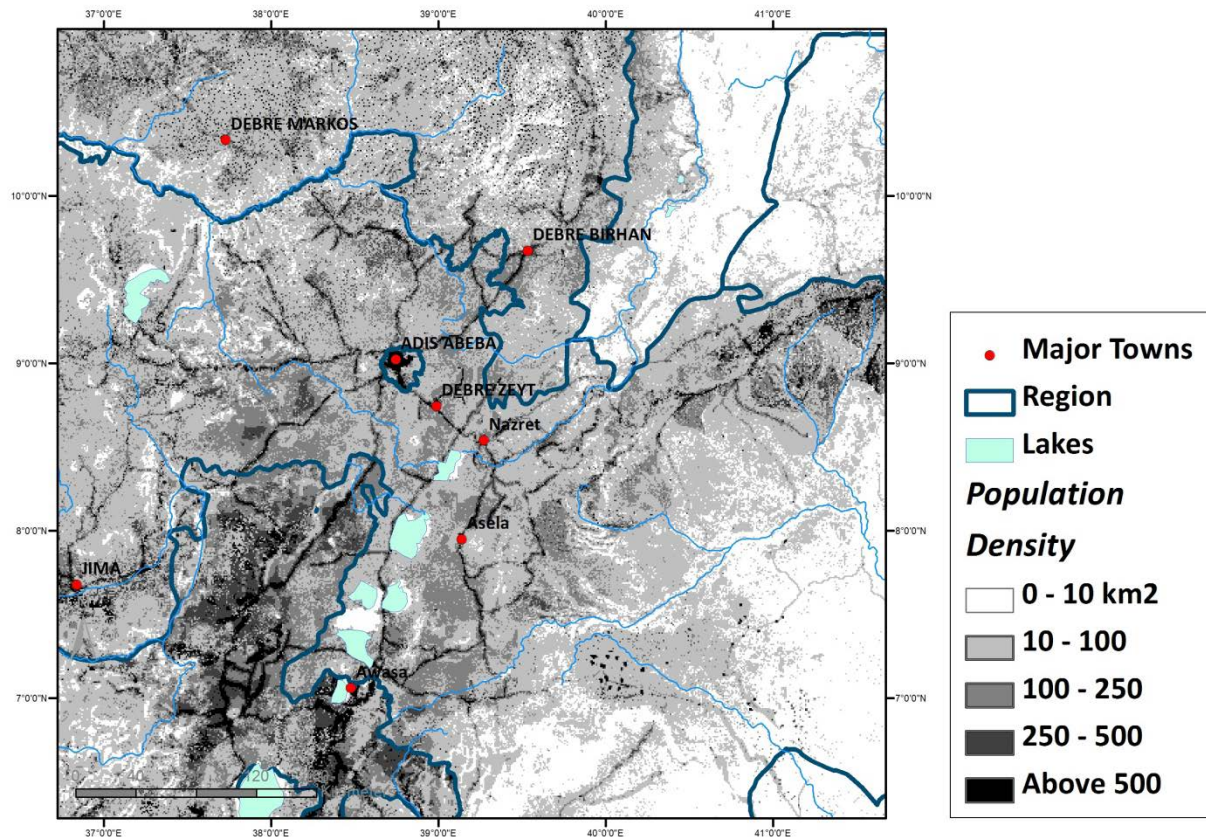


Figure 5: Population density Central Ethiopia

Accessibility of different areas is largely related to population density. The Benishangul-Gumuz region in Western-Ethiopia, for instance, has a low population density and a large part consists of remote areas in which the time to travel to towns of more than 50,000 people is between 8-16 hours (Figure 6).

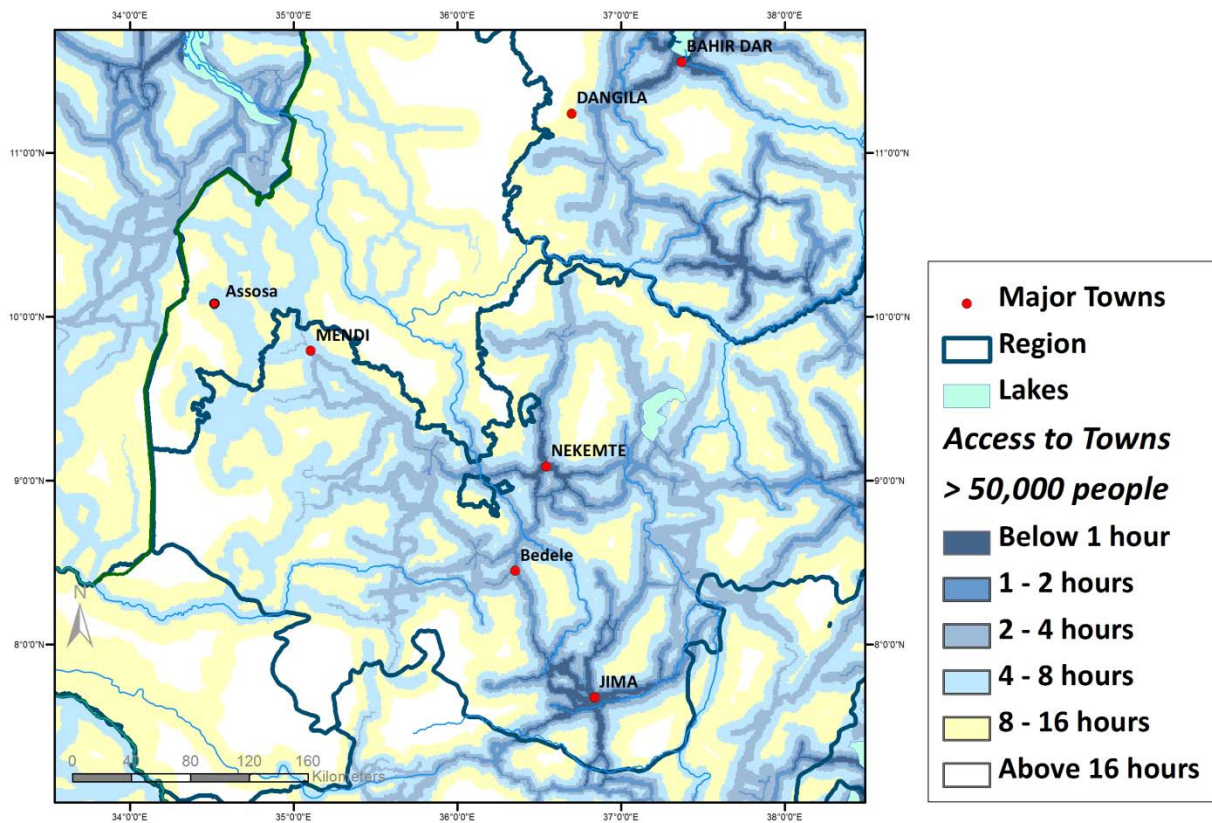


Figure 6: Accessibility to towns of >50,000 people in Western Ethiopia

Accessibility is higher in the Amhara and Oromia regions, around Bahir Dar and Jimma, and in Central Ethiopia (Figure 7). These areas therefore have advantages in production of cash crops for regional, national or export markets.

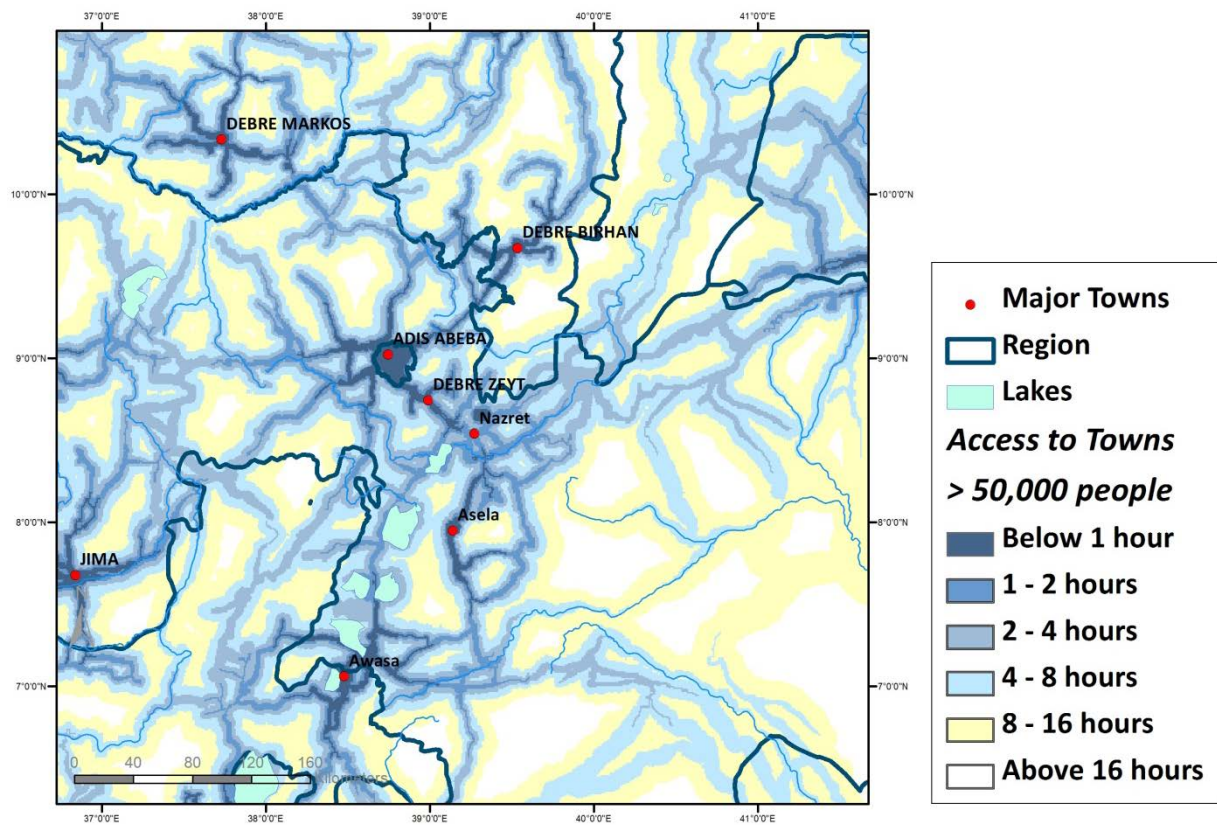


Figure 7: Accessibility to towns of >50,000 people in Central Ethiopia



5. Grain legumes in Ethiopia

Grain legumes occupy about 13% of cultivated land in Ethiopia and their contribution to agricultural value addition is around 10%. Pulses are the third-largest export crop of Ethiopia after coffee and sesame, contributing USD 90 million to export earnings in 2007/08 (IFPRI, 2010b). Apart from the selected legumes presented in Table 2, field pea and grass pea are also important grain legumes (Table 3). Faba bean and common bean together account for half of the total area under production of legumes.

Table 3: Status of tropical legumes production in Ethiopia (2008-2010 averages)

Crop name		1000 HH ²	1000 Ha	Kg/Ha	1000 MT	Percent of area
English/common	Scientific					
Faba bean	<i>Vicia faba</i>	3661	503	1335	668	34.1
Common bean	<i>Phaseolus vulgaris</i>	2287	249	1385	344	16.9
Chickpea	<i>Cicer arietinum</i>	948	218	1407	307	14.8
Field pea	<i>Pisum sativum</i>	1514	220	1153	253	14.9
Grass pea	<i>Lathyrus sativus</i>	706	142	1434	202	9.6
Lentil	<i>Lens culinaris</i>	676	93	1070	100	6.3
Fenugreek	<i>Trigonella foenum-graecum</i>	465	23	1205	28	1.6
Lupine	<i>Lupinus album</i>	100	20	1293	26	1.3
Soybean	<i>Glycine max</i>	67	8	1336	12	0.5
Total/avg.	-	10424	1477	1291	1940	100.0

Source: ICRISAT (2011)

Legumes are mostly grown in rotation or intercropped with cereals. The most important cereals are (CSA, 2011):

- Amhara: barley (more than 55% of total production of cereals in this region), teff and maize.
- Oromia: maize (50% of cereal production in this region) and barley.
- Benishangul-Gumuz: maize and sorghum.
- SNNPR: maize, teff, barley and wheat

Major production constraints for legumes are the absence of links to seed suppliers/ value chains and hence a lack of improved seeds and a high use of local varieties (on more than 95% of the total cropped area) (IFPRI, 2010a), inadequate farm management practices, underdeveloped infrastructure, and population pressure and land fragmentation (in dry areas average farm size is 5 ha, in sub-humid maize-legume based areas 2.5 ha) (USAID, 2011, CIMMYT, 2009). Low soil fertility in the high potential areas is another problem, while fertilizer use on legume crops is usually low (Asfaw and Shiferaw, 2009). In general, major soil fertility issues in Ethiopia include (IFPRI, 2010a):

- Depletion of organic matter due to the use of animal dung as fuel and crop residues as feed;
- Topsoil erosion, aggravated by high population densities in fertile areas;
- Macronutrient depletion due to little fertilizer use, continuous cropping, removal of crop residues, etc.;
- Acidity, reducing responses to phosphate and urea fertilization.

5.1 Faba bean

Amhara and Oromia are the areas in Ethiopia where production of faba bean is highest (Figure 8). Together these two regions account for 85% of the national faba bean production (IFPRI, 2010b). Faba bean is grown in the main season, on both red and black soils. Most of the faba bean production



is grown for consumption (e.g. 64% in 2007), and 18% is sold, primarily for export (IFPRI, 2010b). Over the past years, improved varieties have been introduced, for instance varieties that are tolerant to root rot and to waterlogging, which can be grown on Vertisols. Together with the introduction of improved management practices this led to a 47% increase in production between 2001/02 and 2006/07 (ICARDA, 2010). Disadvantages of faba bean production include its sensitivity for diseases (particularly chocolate spot) and the high seed rate (200 kg/ha) (IFPRI, 2010b).

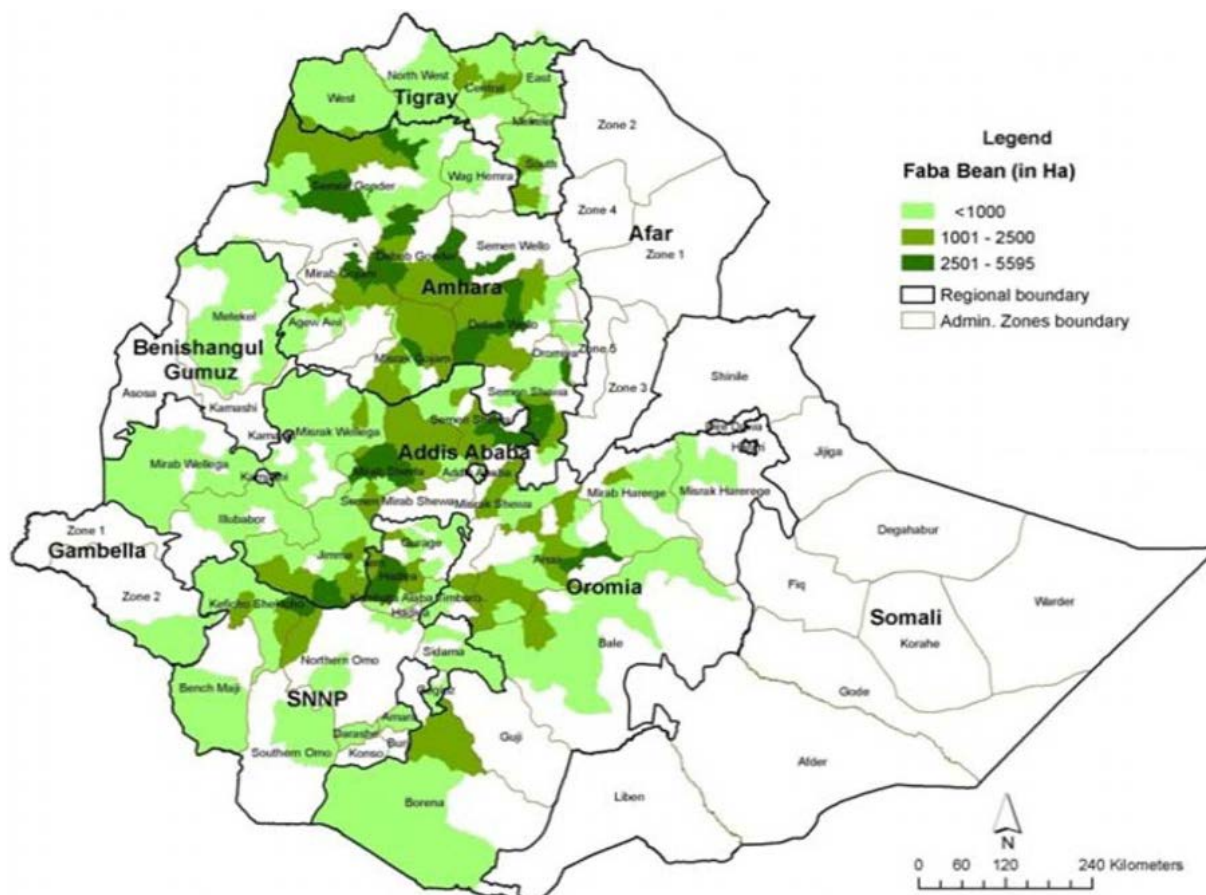


Figure 8: Land area in hectares under faba bean in Ethiopia

Source: IFPRI (2010b)

The average of three different studies in Ethiopia on the need for inoculation in faba bean shows that the response to inoculation alone was limited, but that in combination with P fertilizer grain yields were three times as high as in the control (Table 4). Application of P-fertilizer only also improved yields, but to a lesser extent.

Table 4: Faba bean response to inoculation*

Treatment	Grain yield (kg/ha)
Control	670
20 kg P	1085
Inoculation	593
Inoculation + 20 kg P/ ha	2023
20N + 20P (kg/ha)	1570

* Average of strains # 18, 51 and 64 (collected and isolated in Ethiopia)

Source: Ali et al. (2006)



5.2 Common bean

Common bean is widely grown in Ethiopia in areas between 1400-2000 m altitude. The main production areas include eastern Ethiopia, the south and the south west, the west and the Rift Valley (Figure 9). The latter area accounts for more than half of the country's bean production, mainly of the white pea bean type that is grown for export (Ali et al., 2006). Other bean types are for national use.

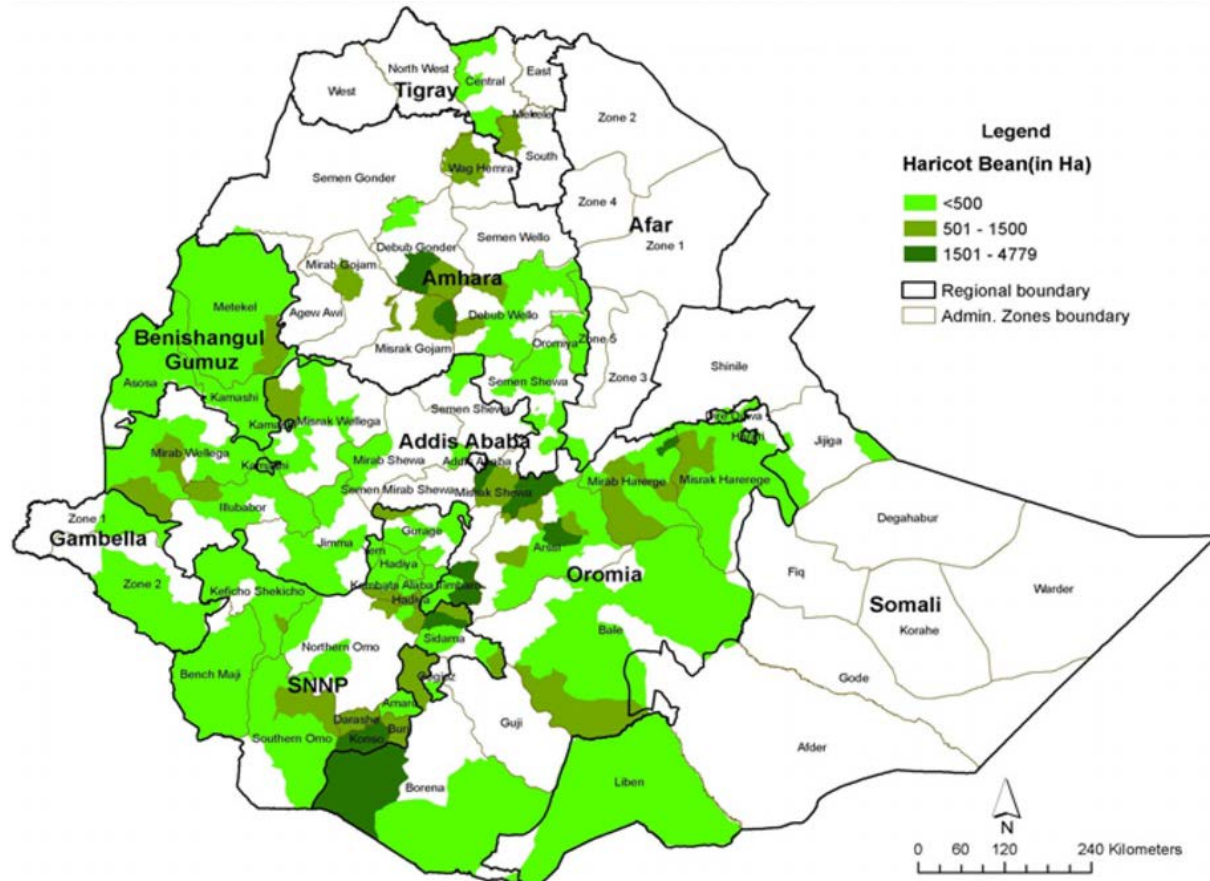


Figure 9: Land area in hectares under common bean in Ethiopia

Source: IFPRI (2010b)

Beans are grown as sole crop or intercropped with sorghum, maize or other crops. Production of common beans has increased over the last years, while the area planted remains more or less stable. Hence, yields per ha have improved (Figure 10). Important constraints for further yield increase is the lack of improved varieties (Gurmu, 2007a), low soil fertility (N and P), moisture stress, pests and diseases and weeds (Ali et al., 2006).

In mono-cropping systems, bush types are grown (mainly in central and southern Ethiopia). In west and southwestern Ethiopia, areas with higher rainfall and an extended growing seasons, climbing beans are intercropped with maize, planted along the borders of maize fields, or along homestead fences (Gebeyehu et al., 2006). In Southern Ethiopia, an experiment with climbing beans found higher yields for bush types than climbing types (Worku, 2008). A study in Eastern Ethiopia showed that in intercropping, climbing varieties were not preferred because they caused lodging in maize (after which evaluation in sole stands followed) (Assefa et al., 2005).

Planting dates between mid- and end-June gave highest grain yields around Hawassa, with a plant density of 400,000 seeds/ha. In the *belg* season, sowing between mid-February and mid-March resulted in the highest grain yields. Further agronomic data on haricot beans in the Rift Valley can be found in Ali et al. (2006), pp.157-165.

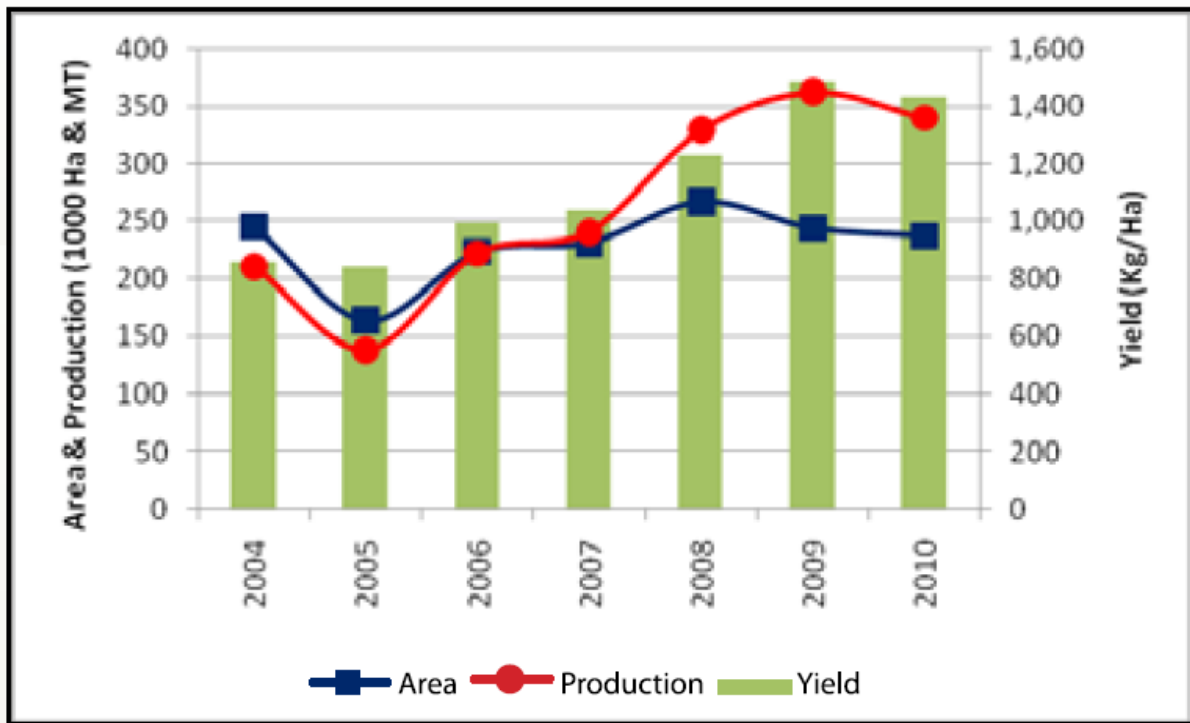


Figure 10: Production trends of common bean in Ethiopia

Source: ICRISAT (2011)

An experiment in Alemaya (Eastern Ethiopia, Vertisol) on the effects of *Rhizobium* inoculant (strain consisting of a mixture of the CIAT isolates 384, 274, and 632) or N-fertilizer (50 kg urea/ha) showed increased grain yield, number of nodules and dry matter production in common bean (Daba and Haile, 2000). A field trial in Boricha (SNNPR) also showed positive effects on grain yields of common bean by different *Rhizobium* strains (Figure 11).

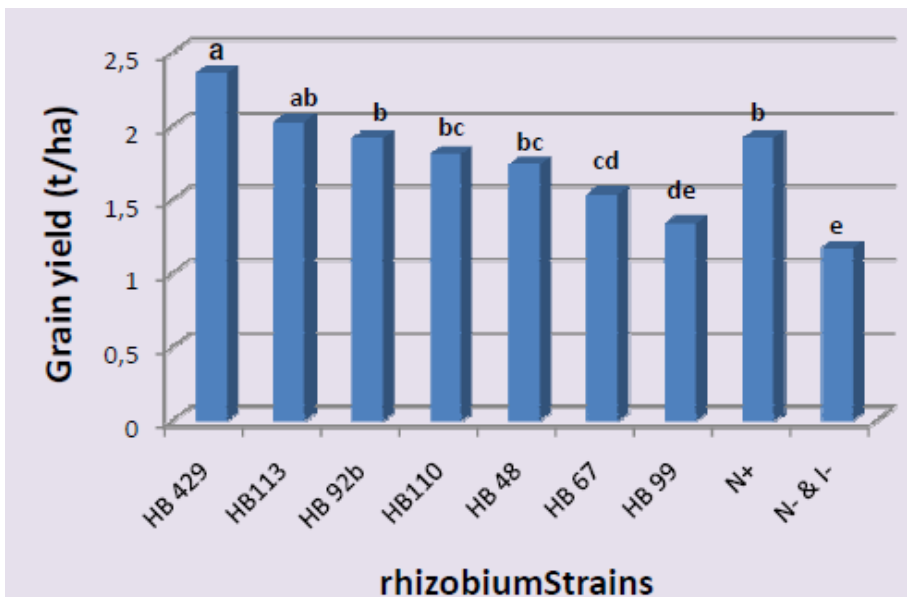


Figure 11: Grain yield (t/ha) in common bean as affected by inoculation

Source: Wolde-Meskel (2012)



5.3 Chickpea

Chickpea production is concentrated in Amhara and Oromia, although this crop is grown in many other parts of Ethiopia as well (Figure 12). The area around Debre Zeit is particularly an area with potential for upscaling improved chickpea varieties and marketing (Asfaw et al., 2010). Chickpea is typically grown on Vertisols, in rotation with wheat and teff, using the residual moisture at the end of the rainy season. Double cropping increases the productivity of scarce land and provides an additional source of income (Kassie et al., 2009).

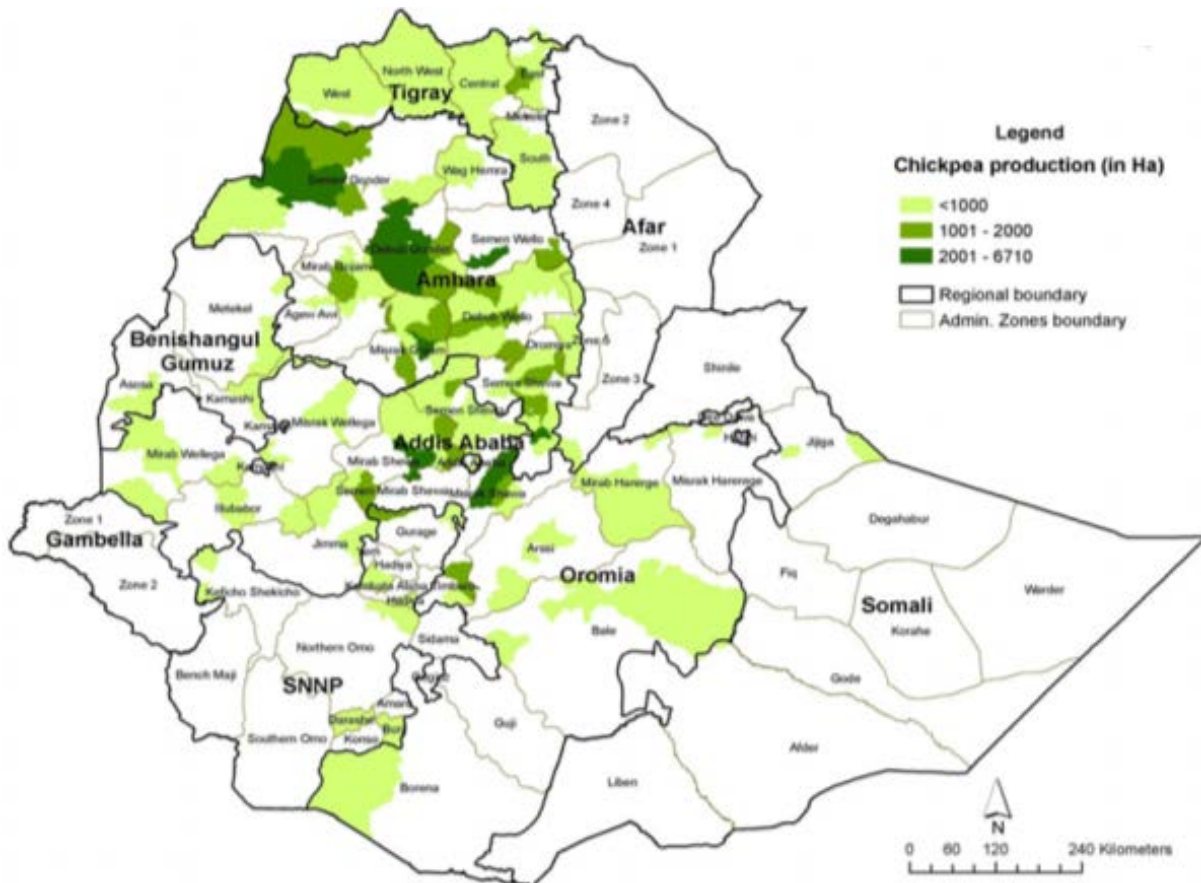


Figure 12: Land area in hectares under chickpea in Ethiopia

Source: IFPRI (2010b)

Traditional varieties, grown for national use, are the Desi varieties. Kabuli types are both for national use and for export. Research from EIAR in cooperation with ICRISAT and ICARDA has led to release of improved Desi and Kabuli varieties (see also Appendix 2), although adoption among farmers is only 5% (Shiferaw and Teklewold, 2007). In the area around Debre Zeit early planting (early to mid-August) resulted in highest grain yields, with an optimum seed rate of 110-120 kg/ha (Ali et al., 2006). Harvesting time is from October to January (green pods) and February to March (dry seeds) (Dadi et al., 2005).

In general, as with common beans, chickpea production and yields per ha show an upward trend (Figure 13). Volume and value of chickpea export has increased considerably over the last five years (ICRISAT, 2011) and the market outlook for chickpea production is favourable as well. In a 'business as usual scenario' chickpea production and area is forecasted to increase by 8% and 21% by 2020 (Kassie et al., 2009). With increased prices for fertilizer, cultivation of crops that do not require much fertilizer becomes even more attractive.

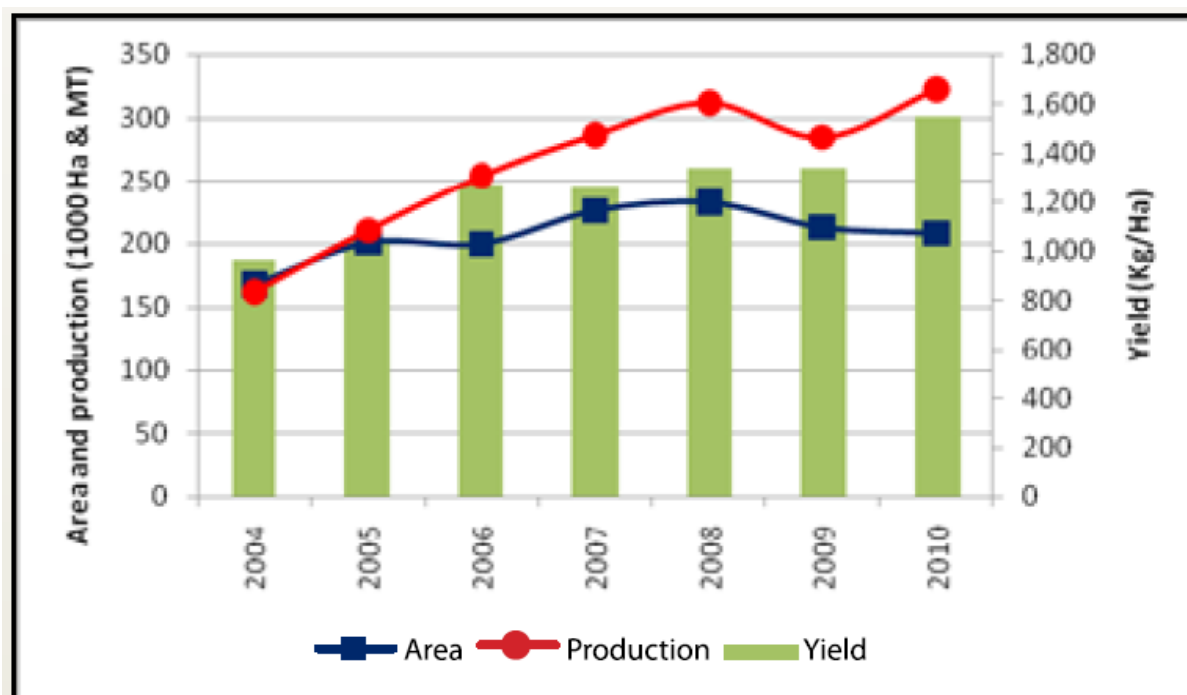


Figure 13: Production trends of chickpea in Ethiopia

Source: (ICRISAT, 2011)

A study in the Shewa region showed that about 80% of farmers that grow chickpea participate in marketing, indicating that it is primarily a cash crop. Moreover, a gross margin analysis showed that among legumes, chickpeas provide the highest net-returns. However, since mainly traditional Desi varieties are grown and productivity is low, farmers' competitiveness in high value (export) markets is limited. The system needs to become more market oriented, starting with higher adoption rates of improved varieties (Asfaw et al., 2010). In addition, the state controlled seed system produces insufficient amounts and quality of seeds, and there are problems with timely delivery. A revolving seed scheme could improve accessibility for farmers. Another constraint for growing chickpea is that large seeded Kabuli varieties are popular for their green pod consumption, so that additional labour is required for guarding the fields (Asfaw et al., 2010).

Research at EIAR Debre Zeit focused on application of synthetic fertilizer combined with irrigation, variety development, crop protection and technology popularization. In 1990, a study on the effect of rhizobium strains and NPK fertilizers on chickpea found that indigenous *Rhizobium* in non-inoculated and non-fertilized control plants did better than inoculated (source of strains unknown) and fertilized plants (Table 5). However, other studies by Ali et al. (2006) in Oromia, Gondar and SNNPR show some to strong responses to inoculation (source of strains unknown) for chickpea. Studies in other countries also indicate that chickpea generally responds well to inoculation, with increases in grain yield from 8 to 40% found in Iran and Canada (Gan et al., 2010, Namvar et al., 2011) and an 8 to 10% increase in stover yield in Iran and Pakistan (Ali et al., 2004, Namvar et al., 2011). In combination with P-fertilizer (90 kg/ha), grain yields in Pakistan even increased from 1600 to 3100 kg/ha and stover yields from 4350 to 7500 kg/ha (Ali et al., 2004). Inoculation with rhizobium and mycorrhiza improved both grain and stover yields by about 60% in Turkey (Erman et al., 2011).



Table 5: Chickpea response to inoculation*

Treatment	Number of nodules	Dry matter yield (kg/ha)	Grain yield (kg/ha)
Control	3.6	5070	3350
120 N + 35.2 P + 48 K (kg/ha)	3.8	5710	3710
35.2 P + 48 K (kg/ha)	3.3	4940	3380
Strain 31 + 35.2 P + 48 K (kg/ha)	3.0	5500	2980
Strain 36 + 35.2 P + 48 K (kg/ha)	3.3	5800	3230
Strain 39 + 35.2 P + 48 K (kg/ha)	3.3	5470	3070
120 N (kg/ha)	1.5	5620	3270
LSD 5%		NS	NS
CV %		3.7	15.7

* Source of strains unknown
 Source: Ali et al. (2006)

5.4 Soyabean

Soyabean in Ethiopia could be grown from sea level up to 2200m altitude and with annual rainfall as low as 500-700mm, but performs best between 1300 and 1800m altitude with annual rainfall of 900-1300mm, an average annual temperature between 20-25°C and a soil pH of 5.5 to 7 (Gurmu, 2007b, Tesfaye, no date). The growing season ranges from 90 to over 150 days and three different soyabean varieties can be distinguished (Gurmu, 2010):

1. Early maturing group with 90-120 days (Awassa-95, Williams, Crawford and Jallale)
2. Medium maturing group with 121-150 days (Clarck-63K, Cocker-240, Davis, Cheri and AFGAT)
3. Late maturing group with >150 days (Belessa-95 and Ethiougozslavia)

Agronomic recommendations for production include a seed rate of 60-80 kg/ha; row spacing for early maturing varieties of 40 cm x 5 cm and 60 cm x 5 cm for medium maturing varieties; 2 to 3 times of hand weeding and fertilizer rate of 100 kg/ha DAP (Gurmu, 2010). Potential crop yields are as high as 3.5 t/ha (Tesfaye, no date). A variety trial (early maturing varieties) in SNNPR shows that variety Crawford gave highest yields, although all varieties performed well in the study areas (Gurmu, 2007b).

Soyabean can be grown in rotation with e.g. cotton, maize and sorghum. Its nutritional value is high, with a higher protein content than other grain legumes (40% compared to 20-25%) (Gurmu, 2007b). Cultivation and production of soyabean is currently constrained by a lack of awareness about the crop by farmers and private sector and by a lack of knowledge on its potential uses and processing methods. Moreover, there is a lack of linkages between the small produce of farmers and soyabean demand from factories (Gurmu, 2010). Finally, use of improved varieties and fertilizer is low and better agronomic management practices need to be developed (Tesfaye, no date).

Regions with high potential for soyabean are Benishangul-Gumuz and SNNPR. Around Jimma, soyabean is grown by smallholder farmers (on average 0.5 ha). Farmers in this area are connected to cooperatives, where they sell their grain. As poor soil fertility is a major issue around Jimma, farmers appreciate soyabean in their rotation. Farmers here are not commercially oriented, however, and there is no union for soyabean (only cooperatives). High potential areas for upgrading of commercial soyabean production are Bedele and Chawaakka. In Pawe, farmers are not well organized (there are many cooperatives but no union), but there is potential for upscaling production, especially considering the mix of small scale and large scale soyabean producers (Sopov, 2011).

5.5 *Rhizobium* research in Ethiopia

Research on biological N₂-fixation in Ethiopia is carried out in e.g. laboratories at Holetta Agricultural Research Center, the National Soil Testing Center in Addis Ababa and at Hawassa University. The research focuses on *Rhizobium* population size and need for inoculation; collection & exploration for



genetic and symbiotic biodiversity; screening of rhizobia for N_2 -fixing effectiveness and host range; screening of pulse varieties (common bean, chickpea, soyabean, cowpea, pigeonpea and groundnut) and trees/shrubs (*Sesbania*, *Leucana* and *Acacia* spp.) for N_2 -fixation; management practices and farmers' adoption of legumes and inoculants. At Hawassa University, a biobank of more than 600 authenticated and 300 well characterized isolates exists, which show a great genomic diversity. Greenhouse experiments and field experiments on the accumulation of N in common bean, soyabean, chickpea and cowpea after inoculation by different rhizobia strains have been carried out by the university as well. Strains for common bean have also been tested on their effectiveness under soil moisture stress and different pH levels (Wolde-Meskel, 2012).



6. Projects on grain legumes in Ethiopia

This section summarizes some of the ongoing projects on grain legumes in Ethiopia. During the stakeholder workshop held in Ethiopia, more detailed information on relevant projects in the potential intervention areas was collected and presented as well. This information can be found in the workshop report nr. 41: *Opportunities for N2Africa in Ethiopia* (http://www.n2africa.org/workshops_training).

6.1 National initiatives

National Soybean Research Project

Lead organization: Pawe Agricultural Research Center

Year: 2011-2013 (2004-2006 E.C.)

Objectives:

- Variety development for different maturity group's and cropping systems,
- Cultural practice and cropping systems,
- Pest management,
- Technology transfer,
- Socio-economic studies and post-harvest technologies and utilization

Areas: Awassa, Pawe, Bako, Jimma and Asosa

Coordinator: Tizazu Degu

Ongoing activities: soyabean variety/ plant density/ nutrient/ tillage/ double cropping trials; assessment weeds and pests; community based seed multiplication; CBA/ promotion material/ impact assessment, etc.

Pulses and oilseed programme - chickpea

Lead organization: ATA

Coordinator: Dr. Y. Mussie

Year: 2012

Areas: Amhara (Dembia) and Oromia (Ada'a + Becho)

Objectives:

- Secure inputs: supply improved seeds + chemicals to farmers in Becho, Dembia and Ada'a (access to improved seed and pesticides is identified as major constraint for farmers).
- Production for export market (building farmers to market linkages). Includes also training of farmers on best agronomic practices for chickpea.

Bottlenecks identified for chickpea include:

- Insufficient research in value chain, particularly in on farm production
- limited seed availability (and quality for export) + affordability
- no extension system for chickpea
- poor farming practices reduce yields
- inadequate post-harvest processing + lack of storage facilities (post-harvest losses)
- weak links to markets

Pan-Africa Bean Research Alliance (PABRA)

PABRA-ECABREN has already done a lot of work on common bean. In cooperation with CIAT's bean programme, pest and disease resistant germplasm has been developed, as well as varieties that are tolerant to abiotic stresses, have improved nutritional values and are acceptable to farmers. Next to that, important work on seed systems and dissemination has been done in the so-called 'concerted partnership approach', which started in 2003. This approach introduced non-conventional approaches to disseminate seed of improved varieties by national researchers and extension workers, involving outlets as health centres, grain traders or even soft drink kiosks (PABRA, 2006). In Ethiopia alone, in one year's campaign, 137 tonnes of improved seed were disseminated to farmers, including poor farmers who were testing improved germplasm for the first time. Critical to this approach and its success has been the packaging of seed in small, affordable quantities such as 50 g packs.



6.2 International initiatives

Sustainable Intensification of Maize-Legume cropping systems for food security in Eastern and Southern Africa (SIMLESA)

Lead organization: CIMMYT

Year: 2010-2013

Objectives:

- to characterize maize-legume production and input and output value chain systems and impact pathways, and identify broad systemic constraints and options for field testing;
- to test and develop productive, resilient and sustainable smallholder maize-legume cropping systems and innovation systems for local scaling out;
- to increase the range of maize and legume varieties available for smallholders through accelerated breeding, regional testing and release, and availability of performance data; to support the development of regional and local innovations systems;
- capacity building to increase the efficiency of agricultural research today and in the future

Areas: Central Ethiopia (sub humid East Wellega and West Shewa, and drought stress East Shewa, Gurage, Arsi and Sidama)

Ongoing activities: In both regions, three communities are chosen and local production options are defined, tested and selected ("options include improved farmer resource allocation, maize-legume systems which are based on the principles of conservation agriculture, more productive, stress tolerant and farmer-preferred maize and legume varieties or *Rhizobium* strains, and opportunities for improved input and out marketing, rural financing and processing") (CIMMYT, 2009).

Activities in 2011: input and output market surveys and selection of input market opportunities; household typology; farmer resource allocation; exploratory and variety trials.

Activities in 2012: selection of output market opportunities; improved resource allocation and risk management strategies identified; trials; data available on first farmer experiments.

Agricultural Growth Program – Agribusiness and Market Development (AGP-AMDe)

Lead organization: ACDI/VOCA

Coordinator: IFDC, Abey Meherka

Year: 2011-2012

Areas: Amhara, Tigray, SNNPR, Oromia

Objectives: 1: improving the competitiveness of selected value chains; 2: improving access to finance; 3: improving the enabling environment of selected value chains; 4: stimulating increased innovation and investment.

Ongoing activities (until September 2012): beans and pulses have been added to value chain activities.

Activity 1: Select cooperative unions and trader/processors with capacity to process and distribute for domestic, regional and export markets. Conduct assessment of each cooperative to determine needs, strategies, interventions.

Activity 2: Develop business and investment plans for selected primary coops and cooperative unions, based on assessments. Employ SMFM ToT for primary cooperatives.

Activity 3: Establish direct links among unions, exporters and other buyers to develop a long-term plan for supply of quantity and quality; establish a basis for forward contracts at the export and supply levels.

Activity 4: Establish a plan for seed selection and multiplication for each selected site and partner (i.e., co-op unions).

Activity 5: Develop plan for demonstration plots for varieties, fertility, seeding and tillage practices at selected sites.

Activity 6: Continue work with PepsiCo on chickpea pilot and demonstration; provide assistance in identifying modalities for seed multiplication and selection of additional production sites and marketing co-operators.

Activity 7: Support EPOSPEA in the development of long-term market development strategy for dry bean and pulse exports.

Activity 8. Integrate beans and pulses in other value chains as viable rotation and cash crop.



Tropical Legumes (TL) II

Lead organization: ICRISAT

Year: 2011-2014

Objectives: (i) to exploit the improved germplasm that already exists, by using 'fast track' evaluation and seed production; (Lambers et al.) to encourage farmer-participatory varietal selection; (Lambers et al.) to develop improved crop cultivars (including hybrids in the case of pigeonpea) by combining conventional plant breeding with modern breeding tools and techniques developed at the participating institutes and by the Tropical Legumes I Project; and (Tavasolee et al.) to strengthen national programs' capacity for plant breeding

Areas: Oromia

Ongoing activities: apart from breeding also improving seed systems (e.g. making bean seed available in smaller quantities); seed distributed + recovered in kind + cash through unions and NGOs.

Commercial Products (COMPRO) II

Lead organization: IITA

Year: 2012-2016

Coordinator: Cargele Masso

Objectives:

- To screen, evaluate, and scale up innovative chemical and biological commercial products, among which biological nitrogen-fixing products (rhizobial products).
- To share experiences, information and building institutional capacity on top quality effective commercial products
- To support implementation processes aimed at strengthening quality monitoring and capacity building for commercial products to ensure that farmers have access to information on high quality soil improvement technologies

Integrated Innovations for Improving Legume Productivity, Market Linkages and Risk Management in Eastern and Southern Africa

Lead organization: ICRISAT

Coordinator: Franklin Simtowe

Year: 2007-2010

Areas:

Objectives: addressing supply and demand side constraints in the legumes sub-sector:

- Institutional innovations for improving markets and reducing transaction costs for smallholder farmers
- Market-preferred low-risk varieties and complementary management practices
- Institutional innovations for improving access to and utilization of quality seeds of improved varieties and complementary inputs
- Decision support tools for better targeting of improved varieties and management practices
- Capacity strengthening for service providers and agro-enterprises to better utilize legume innovations

Breeding Chickpea for Drought Tolerance and Disease Resistance

Lead organization: ICARDA

Year: 2007-2013

Objectives: develop efficient and reliable field and laboratory screening techniques for the evaluation of germplasm and breeding materials for biotic and abiotic stresses, understand their genetic bases and develop efficient and high yielding cultivars with combined resistances to these stresses through conventional and molecular breeding approaches.



Feed the future

Lead organization: USAID

Links: focus on value chains. In Ethiopian Highlands. Crop/livestock components for intensification of the system.

CGIAR research programmes:

CRP 1.1: Integrated Agricultural Production Systems for the Poor and Vulnerable in Dry Areas

Lead organization: ICARDA

Website: <http://crp11.icarda.cgiar.org/crp/public/>

CRP 1.2: Integrated Systems for the Humid Tropics

Lead organization: IITA

CRP 3.5: Grain Legumes: enhanced food and feed security, nutritional balance, economic growth and soil health for smallholder farmers

Lead organization: ICRISAT

CRP 3.7: More Meat, Milk and Fish by and for the Poor

Lead organization: ILRI

Links: forage legumes

CRP 5: Water, Land and Ecosystems

Lead organization: IWMI

Links: crop residues – livestock; water productivity



References

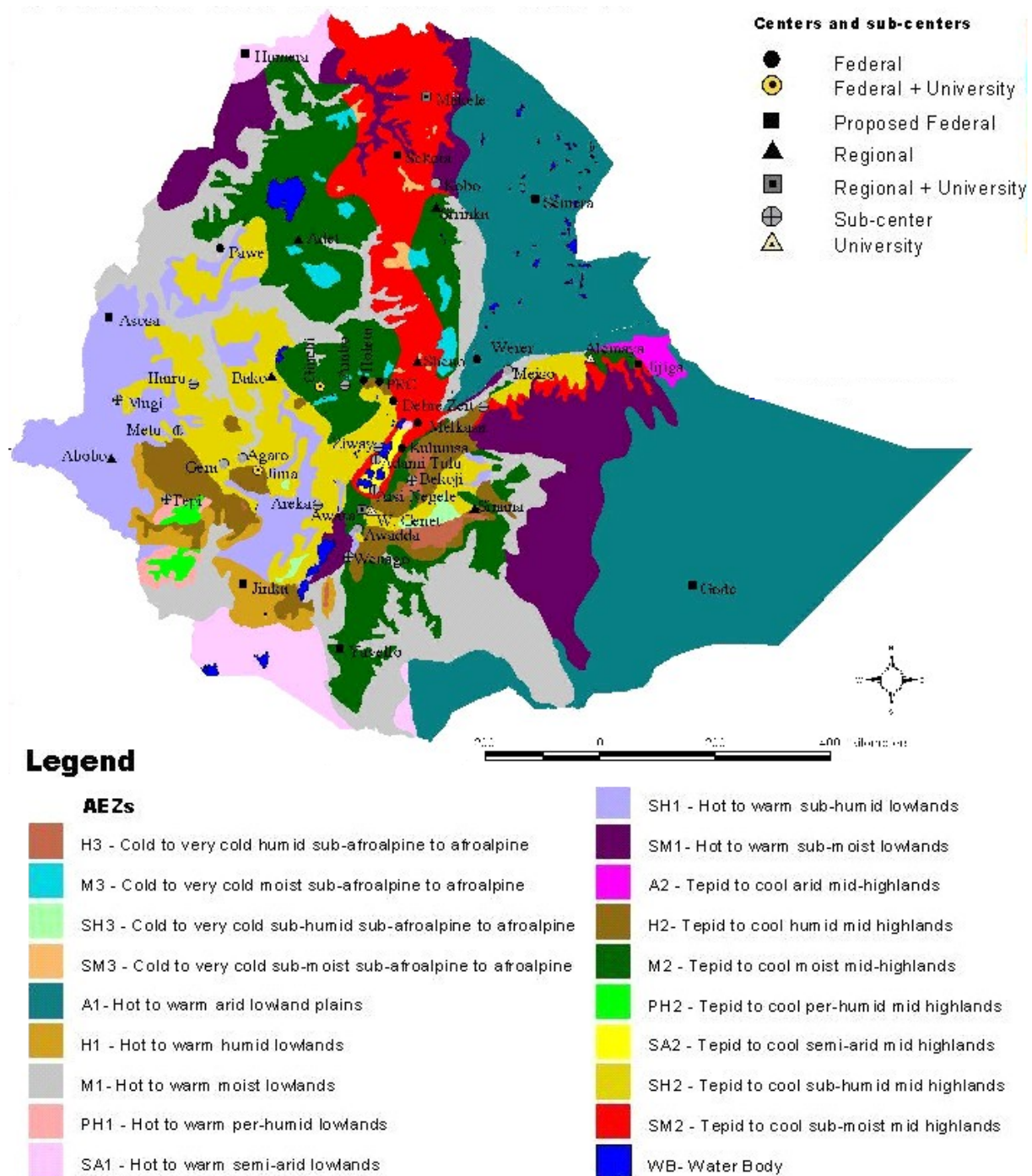
- ALI, H., KHAN, M. A. & RANDHAWA, S. A. 2004. Interactive Effect of Seed Inoculation and Phosphorus Application on Growth and Yield of Chickpea (*Cicer arietinum* L.). *International Journal of Agriculture & Biology*, 6, 110-112.
- ALI, K., KENNENI, G., AHMED, S., MALHOTRA, R., BENIWAL, S., MAKKOUK, K. & HALILA, M. H. 2006. *Food and Forage Legumes of Ethiopia: Progress and Prospects.*, Aleppo, ICARDA.
- ASFAW, S. & SHIFERAW, B. 2009. Baseline Assessment of Groundnut, Chickpea and Pigeonpea for Eastern and Southern Africa: Baseline research report for Tropical Legumes-II. Lilongwe: ICRISAT.
- ASFAW, S., SHIFERAW, B., SIMTOWE, F., MURICHO, G. & FEREDÉ, S. 2010. Socio-economic Assessment of Legume Production, Farmer Technology Choice, Market Linkages, Institutions and Poverty in Rural Ethiopia. Nairobi: ICRISAT.
- ASSEFA, T., ABEBE, G., FININSA, C., TESSO, B. & AL-TAWAHA, A. M. 2005. Participatory Bean Breeding with Women and Small Holder Farmers in Eastern Ethiopia. *World Journal of Agricultural Sciences*, 1, 28-35.
- CIMMYT 2009. Program document: Sustainable intensification of maize-legume cropping systems for food security in eastern and southern Africa (SIMLESA). CIMMYT.
- CSA 2011. Agricultural Sample Survey. Addis Ababa: Central Statistical Agency of Ethiopia.
- DABA, S. & HAILE, M. 2000. Effects of Rhizobial inoculant and nitrogen fertilizer on yield and nodulation of common bean. *Journal of Plant Nutrition*, 23, 581-591.
- DADI, L., REGASSA, S., FIKRE, A., MITIKU, D., GAUR, P. M., GOWDA, C. L. L. & BANTILAN, M. C. S. 2005. Adoption Studies on Improved Chickpea Varieties in Ethiopia. Addis Ababa and Patancheru: EIAR and ICRISAT.
- ERMAN, M., DEMIR, S., OCAK, E., TÜFENKÇİ, Ş., OĞUZ, F. & AKKÖPRÜ, A. 2011. Effects of Rhizobium, arbuscular mycorrhiza and whey applications on some properties in chickpea (*Cicer arietinum* L.) under irrigated and rainfed conditions 1-Yield, yield components, nodulation and AMF colonization. *Field Crops Research*, 122, 14-24.
- FAO. 2006. *Country Pasture/Forage Resource Profiles: Ethiopia* [Online]. Available: <http://www.fao.org/ag/AGP/AGPC/doc/counprof/ethiopia/ethiopia.htm> [Accessed 14-12 2011].
- GAN, Y., JOHNSTON, A. M., KNIGHT, J. D., MCDONALD, C. & STEVENSON, C. 2010. Nitrogen dynamics of chickpea: Effects of cultivar choice, N fertilization, Rhizobium inoculation, and cropping systems. *Canadian Journal of Plant Science*, 90, 655-666.
- GEBEYEHU, S., SIMANE, B. & KIRKBY, R. 2006. Genotype x cropping system interaction in climbing beans (*Phaseolus vulgaris* L.) grown as sole crop and in association with maize (*Zea mays* L.). *European Journal of Agronomy*, 24, 396-403.
- GURMU, F. 2007a. Participatory Varietal Selection of Haricot Beans (*Phaseolus Vulgaris* L.) Varieties in Umbullo Wacho and Beresa watersheds in the Southern Region. *Operational Research and Capacity Building for Food Security and Sustainable Livelihoods: Proceedings of Irish Aid Supported Operational Research Project Review Workshop*.
- GURMU, F. 2007b. Participatory Varietal Selection of Soybean [(*Glycine max* (L.) Merrill) Varieties in Umbullo Wacho and Beresa Watersheds in the Southern Region. *Operational Research and Capacity Building for Food Security and Sustainable Livelihoods: Proceedings of Irish Aid Supported Operational Research Project Review Workshop*.
- GURMU, F. 2010. Overview of Soybean Research in Ethiopia. Hawassa: SARI.
- ICARDA 2010. Ethiopia and ICARDA. Ties that Bind. No.29. Aleppo, Syria: ICARDA.
- ICRISAT 2011. Bulletin of Tropical Legumes, August 2011.
- IFPRI 2010a. Fertilizer and Soil Fertility Potential in Ethiopia. *Working Paper*. Washington: IFPRI.
- IFPRI 2010b. Pulses Value Chain Potential in Ethiopia: Constraints and opportunities for enhancing exports. *Pulses Diagnostics*. IFPRI.
- KASSIE, M., SHIFERAW, B., ASFAW, S., ABATE, T., MURICHO, G., FEREDÉ, S., ESHETE, M. & ASSEFA, K. 2009. Current Situation and Future Outlooks of the Chickpea Sub-sector in Ethiopia. Nairobi: ICRISAT and EIAR.
- LAMBERS, H., STUART CHAPIN III, F. & PONS, T. L. 1998. *Plant Physiological Ecology*, New York, Springer Verlag New York Inc.
- NAMVAR, A., SHARIFI, R. S., SEDGHI, M., ZAKARIA, R. A., KHANDAN, T. & ESKANDARPOUR, B. 2011. Study on the effects of organic and inorganic nitrogen fertilizer on yield, yield components, and nodulation state of Chickpea (*Cicer arietinum* L.). *Communications in Soil Science and Plant Analysis*, 42, 1097-1109.
- PABRA. 2006. *PABRA Brochure* [Online]. CIAT. Available: http://www.ciat.cgiar.org/work/Africa/Documents/pabra_brochure.pdf [Accessed 31-08 2012].
- SHIFERAW, B. & TEKLEWOLD, H. 2007. Structure and functioning of chickpea markets in Ethiopia: Evidence based on analyses of value chains linking smallholders and markets. Nairobi: ICRISAT.
- SOPOV, M. 2011. Developing new value-chains for soybean in Ethiopia. Wageningen: Centre for Development Innovation.
- TAVASOLEE, A., ALIASGHARZAD, N., SALEHI, G. R., MARDI, M., ASGHARZADEH, A. & AKBARIVALA, S. 2011. Effects of co-inoculation with arbuscular mycorrhizal fungi and rhizobia on fungal occupancy in chickpea root and nodule determined by Real-Time PCR. *Current Microbiology*, 63, 107-114.



-
- TESFAYE, A. no date. Importance, Potentials and Challenges of Soybean Production in Southwestern and Western Ethiopia. Jimma: Jimma Agricultural Research Center.
- UN-OCHA. 2006. *Ethiopia: Annual rainfall* [Online]. Available: <http://reliefweb.int/node/5631> [Accessed 14-12 2011].
- UNICEF 2009. Tracking Progress on Child and Maternal Nutrition: A survival and development priority. New York: UNICEF.
- USAID 2011. AGP-AMDe First Annual Strategy and Work Plan.
- USDA. 2003. *Annual rainfall in Ethiopia* [Online]. Available: http://www.fas.usda.gov/pecad2/highlights/2002/10/ethiopia/baseline/eth_annual_rainfall.htm [Accessed 14-12 2011].
- WOLDE-MESKEL, E. 2012. Genetic and symbiotic diversity of rhizobia in Ethiopian soils: an untapped biological resource for enhancing N₂-fixation. *Presentation at ISFM Conference 2012*. Nairobi, Kenya.
- WORKU, W. 2008. Evaluation of common bean (*Phaseolus vulgaris* L.) genotypes of diverse growth habit under sole and intercropping with maize (*Zea mays* L.) in Southern Ethiopia. *Journal of Agronomy*, 7, 306-313.



Appendix 1: Agro-ecological zones in Ethiopia



Source: FAO (2006)



Appendix 2: Improved chickpea varieties in Ethiopia

Table 4. Improved chickpea varieties for Ethiopia, their important traits and agro-ecological areas of their adoption.

No	Variety	Year of release	Days to maturity	Growth habit	Seed color	100-seed weight (g)	Planting date	Seed rate (kg ha ⁻¹)	Adaptation area		Yield (t ha ⁻¹)
									Altitude (m)	Rainfall (mm)	
1	DZ 10-4	1974	111–135	Semi-erect	White	10.2	Early September	65–75	1800–2300	700–1100	1.6-2.2
2	DZ 10-11	1974	106–123	Semi-erect	Light Brown	13.0	Early September	70–80	1600–2000	700–1100	1.5-2.8
3	Dubie	1978	110–115	Semi-prostrate	Gray	22.0	Mid August to early September	80–90	1800–2300	700–1100	1.7-2.8
4	Mariye	1985	106–120	Semi-erect	Brown	25.5	Mid August	120–140	1500–2300	700–1300	1.8-3.0
5	Wroku (DZ 10-16-2)	1994	100–149	Semi-erect	Golden	33.0	Mid August	100–120	1900–2600	700–1200	1.9-4.0
6	Akaki (DZ 10-9-2)	1995	97–147	Semi-erect	Golden	21.0	Mid August	90–120	1900–2600	700–1200	1.8-4.0
7	Arerti (FLIP 89-84C)	1999	105–155	Semi-erect	White	25.7	Mid August	100–115	1800–2600	700–1200	1.6-5.2
8	Shasho (ICCV 93512)	1999	90–155	Semi-erect	White	29.9	Mid August	100–125	1800–2600	700–1200	1.6-4.6
9	Chefe (ICCV 92318)	2004	95–150	Semi-erect	White	35.4	Mid August	110–140	1800–2600	700–2000	1.2-4.8
10	Habru (FLIP 88-42c)	2004	91–140	Erect	White	31.7	Mid August to early September	110–140	1800–2600	700–2000	1.4-5.0

Source: Dadi et al. (2005)



List of project reports

1. N2Africa Steering Committee Terms of Reference
2. Policy on advanced training grants
3. Rhizobia Strain Isolation and Characterisation Protocol
4. Detailed country-by-country access plan for P and other agro-minerals
5. Workshop Report: Training of Master Trainers on Legume and Inoculant Technologies (Kisumu Hotel, Kisumu, Kenya-24-28 May 2010)
6. Plans for interaction with the Tropical Legumes II project (TLII) and for seed increase on a country-by-country basis
7. Implementation Plan for collaboration between N2Africa and the Soil Health and Market Access Programs of the Alliance for a Green Revolution in Africa (AGRA) plan
8. General approaches and country specific dissemination plans
9. Selected soyabeans, common beans, cowpeas and groundnuts varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project
10. Project launch and workshop report
11. Advancing technical skills in rhizobiology: training report
12. Characterisation of the impact zones and mandate areas in the N2Africa project
13. Production and use of Rhizobial inoculants in Africa
18. Adaptive research in N2Africa impact zones: Principles, guidelines and implemented research campaigns
19. Quality assurance (QA) protocols based on African capacities and international existing standards developed
20. Collection and maintenance of elite rhizobial strains
21. MSc and PhD status report
22. Production of seed for local distribution by farming communities engaged in the project
23. A report documenting the involvement of women in at least 50% of all farmer-related activities
24. Participatory development of indicators for monitoring and evaluating progress with project activities and their impact
25. Suitable multi-purpose forage and tree legumes for intensive smallholder meat and dairy industries in East and Central Africa N2Africa mandate areas
26. A revised manual for rhizobium methods and standard protocols available on the project website
27. Update on Inoculant production by cooperating laboratories
28. Legume Seed Acquired for Dissemination in the Project Impact Zones
29. Advanced technical skills in rhizobiology: East and Central African, West African and South African Hub
30. Memoranda of Understanding are formalized with key partners along the legume value chains in the impact zones
31. Existing rhizobiology laboratories upgraded
32. N2Africa Baseline report



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33. N2Africa Annual country reports 2011
 34. Facilitating large-scale dissemination of Biological Nitrogen Fixation
 35. Dissemination tools produced
 36. Linking legume farmers to markets
 37. The role of AGRA and other partners in the project defined and co-funding/financing options for scale-up of inoculum (banks, AGRA, industry) identified
 38. Progress Towards Achieving the Vision of Success of N2Africa
 39. Quantifying the impact of the N2Africa project on Biological Nitrogen Fixation
 40. Training agro-dealers in accessing, managing and distributing information on inoculant use
 41. Opportunities for N2Africa in Ethiopia
 42. N2Africa Project Progress Report Month 30
 43. Review & Planning meeting Zimbabwe
 44. Howard G. Buffett Foundation – N2Africa June 2012 Interim Report
 45. Number of Extension Events Organized per Season per Country
 46. N2Africa narrative reports Month 30
 47. Background information on agronomy, farming systems and ongoing projects on grain legumes in Uganda
 48. Opportunities for N2Africa in Tanzania
 49. Background information on agronomy, farming systems and ongoing projects on grain legumes in Ethiopia



Partners involved in the N2Africa project



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