# Exploring the growth potential of Ethiopia's spices industry: Opportunities for development

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RAISE-FS working paper # 016

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ETHIOPIAN COFFEE AND TEA AUTHORITY

RAISE-FS
Resilient Agriculture for Inclusive and Sustainable Ethiopian Food Systems

# Exploring the growth potential of Ethiopia's spices industry: Opportunities for development

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This paper discusses Ethiopia's potential in spice production, highlighting its cultivation of over 50 varieties, including korarima, cumin, pepper, and fenugreek, primarily by smallholder farmers. Despite favourable agroecological conditions, the sector remains underdeveloped and contributes minimally to the national economy. High domestic demand, driven by population growth and urbanization, results in annual spice imports exceeding $800,000, though some spices are exported. There are opportunities to enhance production, add value, and boost exports by addressing challenges, improving farming techniques, and using suitability maps for focused development.

Keywords: spices, export, production, potential, Ethiopia

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RAISE-FS working paper #016

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Disclaimer:

All maps and spatial analyses presented here reflect old administrative boundaries and may not align with current divisions. For example, this study employs the former Southern Nations, Nationalities, and Peoples' Region (SNNP) boundary for mapping and data aggregation, as the official demarcations for the newly created Southern Ethiopia and Central Ethiopia regions have not yet been publicly released. These maps are intended solely for the purposes of this study and must not be used for legal, administrative, or decision-making purposes. The authors and [SWRE/Specific Institution] disclaim responsibility for any inaccuracies, misinterpretations, or consequences arising from the use of these outdated boundaries.

# Contents

# List of abbreviations and acronyms

| | |
|---|---|
| ARC | Agricultural Research Center |
| BSG | Benshangul Gumuz |
| CHIRPS | Climate Hazards Group InfraRed Precipitation with Station |
| CSA | Central Statistical Agency |
| DZARC | Debrezeit Agricultural Research Center |
| ECS | Ethiopian Commodity Exchange |
| EAA | Ethiopian Agricultural Authority |
| ECTA | Ethiopian Coffee and Tea Authority |
| EIAR | Ethiopian Institute of Agricultural Research |
| ESA | European Spices Association |
| ES | Ethiopian Standards |
| EU | European Union |
| Ha | Hectare |
| GIS | Geographic Information System |
| FAO | Food and Agricultural Organizations of the United Nations |
| FDRE | Federal Democratic Republic of Ethiopia |
| MoA | Ministry of Agriculture |
| MoARD | Ministry of Agriculture and Rural Development |
| MRL | Maximum Residue Levels |
| NARS | National Research System |
| NASA | National Aeronautics and Space Administration |
| SNNP | South Nations and Nationalities Peoples |
| RAISE-FS | Resilient Agriculture for Inclusive and Sustainable Ethiopian Food Systems |
| SRTM | Shuttle Radar Topography Mission |
| SWEP | South West Ethiopia Peoples |
| SWRE | Stichting Wageningen Research Ethiopia |
| t per ha | tone per hectare |
| WHO | World Health Organization |
| WLRC | Water and Land Resource Centre |
| USA | United States of America |

# Summary

Ethiopia is a centre of origin and diversity for spices such as korarima, black and white cumin, long pepper, fenugreek, and bishop's weed. The country produces over 50 kinds of spices on about 222,700 ha of land with an annual production of 244,000 tonnes. While nearly 98% of the produce comes from smallholder farmers, over 90% of the produce is consumed locally for food flavourings, medicine, and in the cosmetics industry. Twenty-three species of spices are produced for both local and export markets.

Globally, demand for spices products is increasing due to their industrial and culinary uses. China and India, which are major exporters of spices, are becoming net importers. The increasing demand and the limited supply both in local and global markets have led to increasing trends in prices.

Various spices grow in Ethiopia due to the country's favourable agroecological setting (highland, mid-altitude, and lowlands) and climatic suitability. Major spices produced in different environments include red pepper, ginger, turmeric, cardamom, black pepper, black cumin, white cumin, coriander, and fenugreek. On top of spices, many medicinal and aromatic plants grow in the country. Though the country is conducive to diverse spice production, its cultivation is not commercially driven. Its area coverage, volume of production, and productivity are also very low. Thus, the contribution of the spices sub-sector to the national economy is minimal. Compared to that of other crops such as cereals, pulses, and oil crops, research efforts in spices including varietal registrations and promotion are also limited.

Ethiopia is one of the largest consumers of spices in Africa. Currently, domestic consumption has shown fast growth because of an increase in income, rapid population growth, and greater urbanisation. To meet the increasing local demand, the country imports over 800,000 USD worth of spices mainly from India, United Arab Emirates, Egypt, China, Costa Rica, and Turkey. Despite importing a great deal of spices, the country also exports some selected spices. The increasing local demand and the growing potential export market for spices create great opportunities for expansion of spice local production and value addition. In order to realise this potential, it is crucial to understand the spice production potential as well as analyse and solve export trade and value addition bottlenecks.

In this regard, this document is aimed at presenting spice sector development prospects and investment opportunities using the specific spices suitability maps, highlights of supportive strategies in areas of promotion of domestic spices production and processing, spices value chain development, governance, and enabling environments.

The availability of suitable agroecology gives investment opportunities for farmers and private sectors to develop the spices subsector. Understanding of the site and spice-specific suitability provides a good guide to facilitate evidence-based decision-making in expanding spice production by farmers and private investors. Improving the understanding of where Ethiopia has a high prospect for expansion of spice production could inform the research system to focus on the development of varieties targeting the agroecologies with high production potential. The focus of the suitability analysis also includes identification of suitable locations for testing, validating, and scaling; guiding development practitioners to foster input/output supply system; and improving the value chain and market linkages for exploiting the economic opportunities. The suitability maps identifying the areas as highly suitable, moderately suitable, and marginally suitable classes were produced for cardamom, black cumin, white cumin, black pepper, coriander, fenugreek, ginger, hot pepper, *korarima*, and turmeric. While area estimations were done by regions, and Zones, *Woredas* that fall under highly suitable areas were identified.

Despite the encouraging signs reported above, the study also revealed that the spice sector is facing several challenges that need to be surmounted for the sectors growth and contribution to the national economy. The challenges span across the value chain including production, post-harvest handling, value addition, marketing, and institutional linkages. It was also learnt that limited technological options such as varieties and poor production practices result in the low level of spice productivity. Poor market linkage, poor post-harvest and processing practices, and limited awareness on the potential for expansion of spice production keep most of the production at a small scale and for local consumption. The lack of customized extension service considering the unique features of the spice seed system and farming system contributes to the challenges for expanding spice production and increasing productivity.

# 1 Introduction

Agroecological diversity in Ethiopia has been a blessing in terms of the opportunity it creates to produce diverse food crops, beverages, and spices. Such agroecological diversity not only derives the high level of biodiversity in the country (EBI, 2022), but it has also made Ethiopia a centre of origin and/or centre of diversity to several spices such as *korarima*, black cumin, white cumin, long pepper, red pepper and fenugreek (Deribe, 2022). Consequently, the production, utilization, and marketing of spices have a long history and tradition in the country. If proper improvement had been made in the sector, it been would have had a huge positive impact on the economy.

According to the Ethiopian Coffee and Tea Authority (ECTA), Ethiopia presently produces over 50 kinds of spices with annual area coverage of 512,782 ha with 869,409.8 t of annual production (ECTA, 2024a). Smallholder farmers produce about 98% of this produce and most of the produces are used in the country for seasoning in traditional cuisines, preparation of traditional medicines and perfumes (Herms, 2015; Tesfa et al, 2017).

As pointed out above, spices in Ethiopia are mainly produced by smallholder farmers for both domestic and export markets. Out of more than 50 kinds of spices produced in the country, 23 of them are exported and the major export items include: turmeric (4754 t which makes up 16% of the total produce exported in 2021); red pepper (2737 t; 1% of the produce); black cumin (747 t; 3.6%), *korarima* (105 t; 0.27%), and Ginger (45 t; 0.03%). The data presented by Herms (2015) is quite comparable. The study reports that about 90% of spice produced in Ethiopia are used domestically. That is reflective of the situation in many parts of the world where spices are in 'captive use' in the countries of origin and the supply for a global market is limited (Herms, 2015).

Global demand for spices is expanding steadily at a rate between 2% and 5% per annum (Herms, 2015). The global market size was estimated to be around 19 billion USD in 2023 and is predicted to grow to 29 billion by the year 2032 (Fortune, 2025). Similarly, the Markets and Markets report (2024) estimated the global spices and seasonings market to grow from USD 21.3 billion in 2021 to USD 27.4 billion by 2026 reflecting a projected growth rate of 5.2% over this period. The rising demand for spices is attributable to versatile industrial and culinary uses such as essential oils, food colouring, flavouring, and aroma as well as the increasing popularity of traditional cuisines. Traditional exporters of spices such as China and India are also becoming net importers (Herms, 2015). This increasing trend in demand and the limited supply in global markets have led to increasing trends in prices as well.

The increasing demand and prices for spices in both domestic and export markets are important drivers to be exploited for the expansion of spice production and the improvement of the livelihoods of smallholder farmers in Ethiopia. The growing demand for spices and the accompanying rise in prices also creates an important commercial farming investment opportunity.

The main purpose of this working pepper is to create evidence-based decision support that can inform value chain actors to promote the production and marketing of major spices in Ethiopia. It also analyses the socioeconomic and market-related situations and outlines strategies with high prospects for spice sector development. To that effect, the document presents the agro-ecological suitability analysis and maps as well as insights for sector development opportunities from domestic use and export markets of major spices. The spice crops included in this paper are cardamom, black cumin, white cumin, black pepper, coriander, fenugreek, ginger, hot pepper, *korarima*, and turmeric.

Investment decisions in spice farming, both for domestic and international market prospects should be informed by a comprehensive analysis of agroecological conditions, the availability of socioeconomic infrastructure, and support services. Keeping that in mind, the paper also seeks to provide an in-depth agroecological suitability assessment, complete with maps. It also provides an assessment of the current production, potential, challenges, and key strategies to support ground-level expansion of the production, processing, and marketing of major spices. In so doing, the study hopes to serve as a guide for investing in major spice crops (ginger, cardamom, black cumin, white cumin black Pepper, coriander, fenugreek, hot pepper, *korarima*, and turmeric) that are highly demanded in the local and export markets.

# 2 Approach

## 2.1 Suitability analysis

### 2.1.1 General description

In this study, Geographic Information System (GIS) technology has been employed to generate maps indicating areas suitable for rain-fed spice cultivation. That is done by integrating various data layers and utilizing spatial analysis methods. Using this methodology, it is attempted to assess the suitability of land for rain-fed spice production focusing on factors crucial for crop development and yield. While conducting the suitability analysis, sets of factors such as climate (rainfall, temperature), topography (slope, altitude), soil factors (soil pH, soil depth, texture, drainage), and land use/land cover have been considered.

Data for each of the factors are prepared as a separate spatial layer. In the preparation of the spatial layer, areas such as parks, large water bodies, and built-up areas were excluded from the analysis using the corresponding data layers to restrict areas that are not relevant to production. Each layer was classified into four suitability categories using criteria ranges relevant to each layer. And the categories identified include Highly Suitable (S1), Moderately Suitable (S2), Marginally Suitable (S3), and Not Suitable (N). Given in Table 1 below is a description of each category.

**Table 1 Categories of FAO land suitability classification**

| Code | Class name | Description |
|---|---|---|
| S1 | Highly suitable | Land having no significant limitations to sustained application of a given use or land with only minor limitations that will not significantly reduce productivity and will not raise inputs above an acceptable level. |
| S2 | Moderately suitable | Land having limitations which, in aggregate, are moderately severe for sustained application of a given use; the limitations will reduce productivity and increase required inputs to the extent that the overall advantage to be gained from the use (although still attractive) will be appreciably lower than what is expected on S1 land. |
| S3 | Marginally suitable | Land having limitations which, in aggregate, are severe for sustained application of a given use and will so reduce productivity or benefits, or increase required inputs, whose expenditure will be only marginally justified. |
| N | Not suitable | Land that cannot support the land use on a sustained basis, or land on which benefits do not justify necessary inputs |

*Sources: FAO, 1976, 1984, 1993*

Through a weighted overlay analysis, these categorized layers were integrated to produce comprehensive suitability maps for rain-fed spice production. Notably, this analysis focused on evaluating climate, topography, soils, and land use/cover, without direct consideration of socioeconomic factors. It is acknowledged that the boundaries delineating suitability classes may necessitate periodic revision and refinement, influenced by advancements in data availability, improvement in technical innovations, and the dynamics in socio-economic conditions (FAO, 1976).

Though socioeconomic factors were not directly incorporated in the land suitability maps, accessibility to key agricultural service infrastructures was mapped separately. That was done to provide insight into what might happen if these factors were considered. Accessibility maps were created using geospatial data of slope, road type (data from Water and Land Resource Centre (WLRC) -https://wlrc-eth.org/), land cover (Kassawmar et al, 2018), and larger settlements (WLRC) representing service centres. Travel times were assigned to different road types (all-weather, dry-weather, others) based on the minimum travel time across all road types for each cell. For areas without roads, walking times were assigned based on the basis of slope conditions (flat = faster to steep = slower) and land cover (difficult to access [e.g., waterbody, forest] = slower to open land = faster). A weighted average method was then used to combine these factors to create

a final travel time for each raster cell without a road. Subsequently, a cell statistic tool was used to identify the minimum travel time (considering both road and without road areas) for each raster cell. Finally, a cost distance analysis using this combined cost surface and settlement locations (as service centres) was used to generate the final accessibility map to service centres.

Furthermore, administrative boundaries and infrastructure (including roads, towns, and other facilities) were superimposed on the final land suitability map to enhance its visual clarity and informativeness.

### 2.1.2 Data

The climate data used for this analysis were long-term rainfall and temperature during the growing period obtained from freely available sources. For rainfall, the CHIRPS (Climate Hazards Group InfraRed Precipitation with Station) data (Funk et al., 2015) was used. Average temperature data was obtained from Worldclim (Fick & Hijmans, 2017). Additionally, the length of growing period (LGP) of MoARD (WBISPP, 2004) was used with a slight modification.

The soil data used in this analysis include soil organic matter content, soil depth, texture, drainage, and pH. These soil properties were extracted from ISDA (n.d) and ISRIC (n.d). Altitude information was obtained from the NASA Shuttle Radar Topography Mission (SRTM) 30m Digital Elevation model (DEM) data. The slope map was then derived from the SRTM-DEM. Land cover data layer (Kassawmar et al., 2018) was used to incorporate shade requirements for optimal growth and yield of some of the shade-loving spices.
All data were resampled to a resolution of 200m, which matches the analysis resolution. Input data in vector format were converted to raster format for compatibility.

### 2.1.3 Criteria selection

Each criterion was evaluated independently and assigned to suitability classes based on predefined ranges/limits established through literature review. The environmental requirements and suitability classes for each spice are determined using relevant literature related to each spice (see Table 2).

**Table 2 Literature reviewed to establish the environmental requirements, and the suitability class limits for each criterion.**

| Spice | Reviewed documents for determining environmental requirements |
|---|---|
| Black cumin | Deribe, 2022; EAA, 2021; EIAR, 2007; FAO, n.d.; FAO, 1984; Hailemichael et al., 2022; Hailemichael et al., 2016; Hailemichael et al., 2010; Hailemichael et al., 2008; Habtewold et al., 2017; Jansen, 1981; MoA, 2018, 2019); MoALR, 2017; MoANR, 2016; Mujiyo et al., 2020; Naidu et al., 2006; Praveena et al., 2019; Santhosh et al., 2019; Sivaramaw et al., 1999; Gashaw, 2020. |
| Black pepper | Addharu et al., 2021; Mujiyo et al., 2020; Praveena et al., 2019; Hailemichael et al., 2016; Hailemichael et al., 2010; Hailemichael & Asrat, 2009; Hailemichael et al., 2008; Naidu et al., 2006; EIAR, 2007; Sivaramaw et al., 1999. |
| Cardamom | Baniya et al, 2009; Deribe, 2022; Hailemichael et al., 2022; Hailemichael et al., 2016; Hailemichael et al., 2008; Jansen, 1981; Mujiyo et al., 2020; Naiduet al., 2006; Parthasarathy, et al, 2011; Perveen et al, 2007; Uma Partap et al, 2014; Worku, 2013. |
| Coriander | Aishwath et al, 2011; EAA, 2021; EIAR, 2007; FAO, 1984; Fikadu et al., 2019; Hailemichael et al., 2022; Hailemichael et al., 2016; Hailemichael et al., 2010; Hailemichael and Asrat, 2009; Hailemichael et al., 2008; Habtewold et al, 2017; Jansen, 1981; MoA (2018 and 2019); MoALR, 2017; MoANR, 2016; Mujiyo et al., 2020; Naidu et al., 2006; Praveena et al., 2019; Santhosh et al., 2019; Sivaramawet al., 1999. |
| Fenugreek | Aishwath; *et al*., 2011; Asefa & Beriso,2022; Bekele, *et al.,* 2020; EAA, 2021; Fentaw *et al*., 2017; Fikreselassie, 2012; Habtewold *et al*, 2017; FAO, 2022; MoALR, 2017; MoANR, 2016; Beriso. *et al.*, 2016 |
| Ginger | Geta & Kifle, 2011; FAO, 2022; Hailemichael et al., 2002; Hailemichael et al., 2008; Hailemicchael & Zena, 2009; Hailemichael et al., 2022; Jansen et al., 1981; Kandiannan et al., 1996; MoARD, 2007; Naidu, et al., 2006; Sharma & Sharma, 2012. |
| Hot pepper | Asfaw, 2020; ECTA. N.d.; EIAR, 2007; Hailemichael et al., 2022; Hailemichael et al., 2016; Hailemichael et al., 2010; Hailemichael & Asrat, 2009; Hailemichael et al., 2008; Mujiyo et al., 2020; Naidu et al., 2006; Praveena et al., 2019; Shamil & Merga, 22022; Sivaramaw et al., 1999; Parthasarathy et al, 2011 |
| Korarima | Deribe, 2022; EAA, 2021; EIAR, 2007; FAO, n.d.; Hailemichael et al., 2022; Hailemichael et al., 2016; Hailemichael et al., 2008; Jafer, 2014; Jansen, 1981; Mujiyo et al., 2020; Praveena et al., 2019; Santhosh et al., 2019; Sivaramaw et al., 1999; Worku 2013. |
| Turmeric | Asfaw, 2020; ECTA. N.d.; EIAR, 2007; Etissa, 1998; Hailemichael et al., 2022; Hailemichael et al., 2016; HHailemichael et al. 2010; Hailemichael et al., 2008; MoALR, 2017; MoARD, 2007; Abdu et al., 22016; Mujiyo*et al.*, 2020; Naidu *et al*., 2006; Parthasarathy et al*,* 22011; Praveenaet al., 2019; Sivaramaw et al., 1999, |
| White cumin | Begum et al., 2021; Deribe, 2022; FAO, n.d.; FAO, 1984; Hailemichael et a*l*., 2010; Hailemichael et al., 2008; Habtewold et al., 2017; Jansen, 1981; Lal et al., 2014; MoALR, 2017; MoANR, 2015; Mujiyo et al., 2020; Naidu et al., 2006; Praveena et al., 2019; Santhosh et al., 2019; Sivaramaw et al., 1999. |

## 2.2 Assessment of spice sector development opportunities

In addition to the suitability mapping and analysis, an assessment of spice sector development opportunities was conducted. That was done to support policymakers make informed decisions in the promotion of spice sector development and provide an investment guide for potential private sector participation in production, value addition, and marketing of spices. This assessment focused on the identification of viable production systems and practices, business opportunities, understanding the value chains, and exploring governance and enabling environment for spice sector development. The assessment was done through literature review, using secondary data from relevant institutions such as the Coffee and Tea Authority and Central Statistics Agency. Discussions with key informants who have experience in the spice value chain were also used as additional data sources.

# 3 Status of spice production and marketing in Ethiopia

## 3.1 Current spice production in Ethiopia

As cash crop, spices have immense potential to develop the Ethiopian economy by improving smallholder farmers, creating employment opportunities, distribution of income, and foreign exchange earnings (Hordofa & Tolossa, 2020). As noted earlier, diversified species grow in Ethiopia as a result of the country's agroecological setting (highland, mid-altitude and lowlands) and climatical suitability. Spice cultivation is mainly practiced in the forests of Gamo Gofa, Debub Omo, Kaffa, Ilubabor, Sidamo, and Welega areas (Afeto et al, 2023). Seed spices are cultivated in Amhara, Oromia, Southern nations, and Gambella regions (EMI, 2015). In Ethiopia, more than 50 spice spices are produced. Out of these spices, 23 are mainly cultivated for export market (ECTA, n.d). The major spices produced under different environments are used for food seasoning, medicinal, and for income generation (see Table 3). Though the country is conducive for spices production, not only its cultivation is subsistence, but its area coverage, volume, and productivity are very low. It can thus be said that the contribution of the spices sub-sector to the national economy is minimal; it is below 1 percent (Asfaw, 2020).

**Table 3 Major spices produced in Ethiopia with common, Amharic and Latin/scientific names**

| Names | | | Names | | |
|---|---|---|---|---|---|
| **Common** | Amharic | Latin | Common | Amharic | Latin |
| **Black pepper** | Qundo berbere | Piper nigrum | Korarima | Korarima | Afromomum Corrorima |
| **Cardamom** | Hel | Elettaria Cardamomum | Long pepper | Timiz | Piper capense |
| **Coriander** | Dembelal | Coriandrum sativum | Pepper (red & hot) | Berbere | Capsicum annum |
| **Cumin (black)** | Tikur Azmud | Cuminum cyminum | Pepper (chili) | Mitmita | Capsicum sp. |
| **Cumin (white)** | Nech Azmud | Nigella sativa | Turmeric | Erd | Curcuma domestica |
| **Fenugreek** | Abish | Trigonella foenum-graecum | Vanilla | Banila | Vanilla planifolia |
| **Ginger** | Zinjibel | Zingiber officinale | | | |

Ethiopia produces many spices, yet limited data exists on production trends. According to data from the Ethiopian Coffee and Tea Authority, most spices exhibit inconclusive and fluctuating production patterns (Figure 1). However, ginger, hot pepper, and korarima show increasing trend whereas production levels for the majority of spices declined in 2020 compared to the previous year.

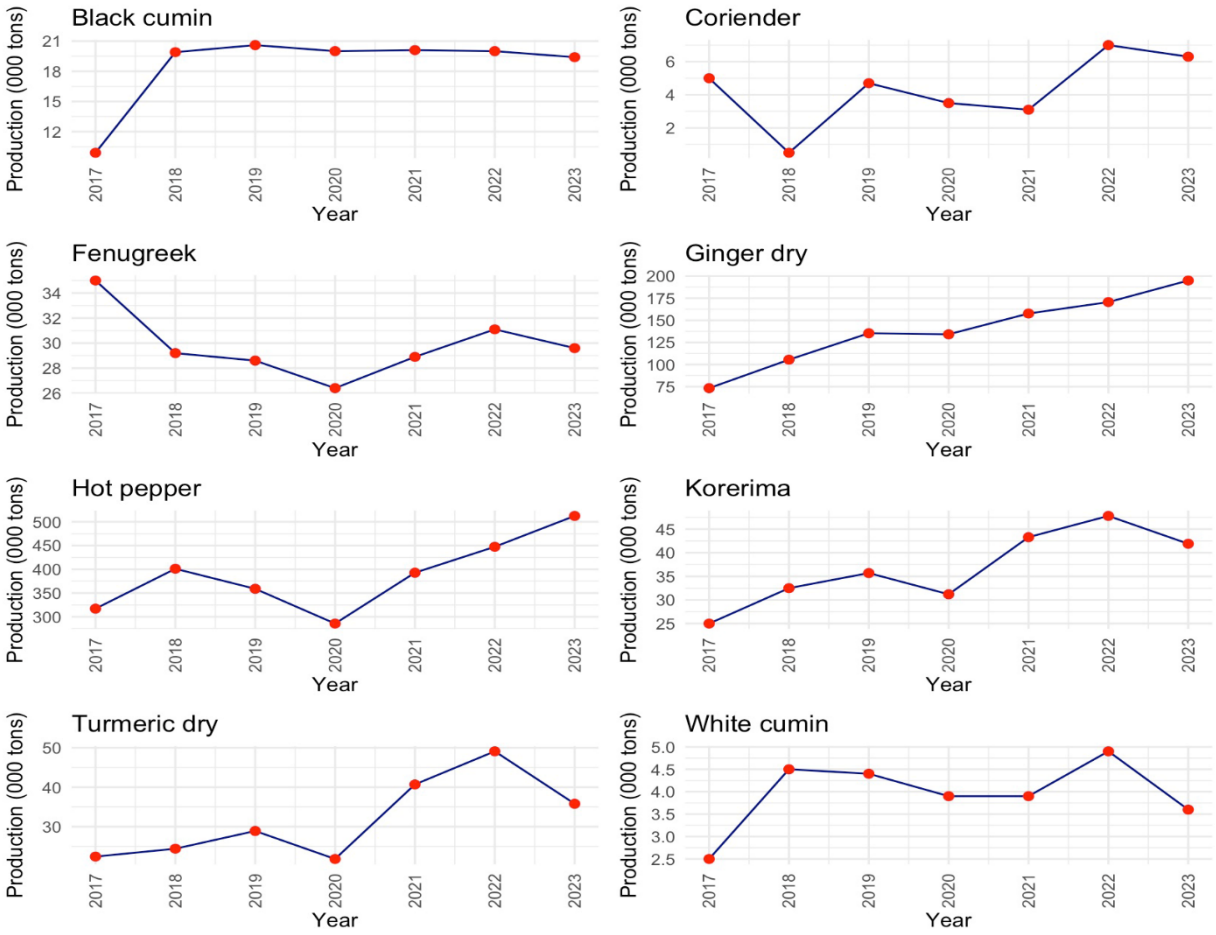


**Figure 1 Production trend for selected spices (based on data from ECTA (2024a)**

**Black pepper:** This spice is typically vining plant and requires support to climb on for best production. The support can be live plant, non-live materials such as concrete or dead log. Currently, most of the production takes place along the lowland forest coffee belt in the Southwestern region where commercial farms mostly use Grevillea as the supporting trees.

**Cardamom** is one of the most important spices with huge potential for domestic use and international market. Cardamom is grown both on farm fields and in the wild forest. In 2022 Ethiopia produced about 47,000 t as per the data from the Ethiopian Coffee Tea and Spices Authority.

**Coriander**: Ethiopia produced around 7,000 t of coriander in 2022 with a productivity of 2.1 t per hectare as per the data collected from the Ethiopian Coffee Tea and Spices Authority. The spice is also exported in small volumes.

**Black cumin:** Ethiopia produces both white and black cumin, but the latter is dominant in production volume. The annual average production of black cumin seed is close to 20,000 t and the national average of black cumin productivity is 1.4 t per hectare.

**Fenugreek:** This is a key seed spice produced and largely used in Ethiopian dishes. It is one of the few spices for which CSA data is available. As shown in Table 4 below, the average area, production, and average productivity of fenugreek over the recent five years in Ethiopia have been about 31,000 ha, about 40,000 t per year, and 1.27 t per ha, respectively (see Table 4).

**Table 4 Area (ha) and production (tonnes) of fenugreek in Ethiopia**

| Year | Area (ha) | Production (t) | productivity (t per ha) |
|---|---|---|---|
| 2021/22 | 30,146 | 35,328.3 | 1.17 |
| 2020/21 | 42,344 | 50,747.2 | 1.20 |
| 2019/20 | 27,595 | 37,672.9 | 1.37 |
| 2018/19 | 22,344 | 28,830.0 | 1.29 |
| 2017/18 | 32,587 | 43,637.4 | 1.34 |
| **Average** | **31,003.2** | **39,243.16** | **1.27** |

***Source:*** CSA, (2018, 2019, 2020, 2021, 2022)

**Hot pepper (Green/Red):** This is one of the widely grown and important spice vegetable crops for domestic use and the international market. While the total area of peppers (Green and red) cultivated during the 2021/22 Meher cropping season was 171,011 ha, the total production for the same period was 317,295.1 t (EAA, 2022). There are several factors that negatively affect hot pepper production in Ethiopia and the major ones are lack of sufficient extension services, diseases (wilt and blight), lack of improved seeds, lack of access to the market centre, and others like bird attacks (Ibsa, 2019 cited by Bekele, 2022).

**Korarima**: Ethiopia's annual average production of Korarima in 2020/21 was 38,660 t and from this, 105 t of dried capsules were exported. It grows in southwest coffee growing forest areas of Ethiopia. This spice is herbaceous, and the capsules have black seeds widely used in preparation of different tradition cuisine. As one of the major spices in the country, Korarima is considered as a potential substitute for the Indian cardamom and is endemic to the rainforests of the country, particularly in the southwest region (ECTA, n.d.; Hailemichael et al., 2008).

**Turmeric:** It is s one of the most important spices for domestic use and the international market. Its production in Ethiopia is, however, quite limited. Turmeric production in Ethiopia is mainly concentrated in the southwest part of the country (Sheka, Bench Sheko, and Kaffa zones). Recently, though, major ginger-producing areas including the Wolayta zone have joined these areas shifting the land to turmeric production because of ginger bacterial wilt and attractive demand for turmeric (Kifelew et.al. 2018). The SNNP (including the current SWEPP) Region had contributed 76% of Ethiopia's turmeric production that increased from 2,000 t in 2008 to 12,000 t in 2013 and 2014.

**White cumin**: This spice is attached to Ethiopia at least as a centre of diversity. It is mainly cultivated around Gondor, Bure, Mersa, Bale, Gojam, Shewa, and Wolo. For household-level consumption, it is also grown in different parts of the country (Habtewold et al., 2017). This spice is preferred by most farmers, especially in the Northern part of Ethiopia, because of the possibility of producing it in arid and semiarid regions, its nature of tolerance to drought, and absence of serious pests (Habte old et al., 2017). On average about 4,000 t of white cumin is produced annually in Ethiopia.

## 3.2 Spice production systems

Spices are produced in a range of production models and cropping systems including smallholder's cultivation, agroforestry, crop rotation, intercropping, multi-storied cropping, and high-density multispecies cropping systems.

**Smallholder's spice production system:** Smallholder farmers dominate spice production in Ethiopia. To maximize land use and diversify income sources, they often intercrop spices with other crops. Some allocate small parcels of land to produce spices for household consumption and/ or local markets. This model is often practiced in small landholdings and with traditional farming methods. Research and development institutions tried to promote improved cultivation and postharvest handling practices that involve the use of improved varieties, quality seeds or healthy planting materials, improved agronomic practices, good harvesting practices, and safe postharvest handling. Improved practices can boost spice productivity and production and reduce postharvest losses. This is particularly the case in Ethiopia's major spice crops such as pepper, ginger, turmeric, black cumin, and korarima (Hordofa, T., & Tolossa, T. 2020). It was, for example, found that nitrogen fertilizer rate and time of application optimized at three equal split applications of 115 kg N ha-1 in Southwestern Ethiopia improved the yield and quality of turmeric (Mekonnen & Garedew, 2019). Having reviewed about 12 spices including Fenugreek, capsicum, white cumin, black cumin, and coriander that are cultivated in south Wollo, Tesfa et.al. (2017) highlighted the importance of management practices (e.g., land preparation, planting, weeding, fertilizer application, irrigation harvesting, control of pest and disease and

storage) for improving yield and quality. Depending on the type of spice, additional management may be required such as shade for shade-loving spice plants.

**Multistorey agroforestry and intercropping systems:** These systems are practices of growing more than one crop spices at the same time in the same place. They integrate spice cultivation with tree crops, providing shade and improving soil health. This model enhances biodiversity and sustainability, and it is common in Ethiopia. Spices such as pepper and cardamom are typical spices commonly grown under the canopy of larger trees. Added to that, shade tolerant spices like *Aframomum corrorima* and *Piper capense* are cultivated as indigenous wild species in the Sheka, Kaffa, and Bench Maji forests (Furo, et al, 2020).

Such practice is common in other countries as well. Perennial spices like black pepper, vanilla, small and large cardamoms, and annuals such as ginger and turmeric which are shade tolerant are suited to intercropping in coconut, as well as in agroforestry systems (Thankamani et al. 2024). In Zanzibar's Spice Islands of Tanzania, the cultivation of polyculture spice agroforests featuring clove trees, turmeric, and black pepper enables families to obtain resilient sources of food and firewood. Such practice also maintains a nutritious diet and helpful for generating income. In Bangladesh, spice plants are grown under a range of trees that provide firewood or fruits (Islam, 2024). In India as well, spices are often grown under the canopy of larger trees in agroforestry systems. Cardamom is, for example, cultivated under nitrogen-fixing alder trees (Sharma, 2024). The Inga agroforestry in Honduras also allows families to grow organic cash crops (vanilla, rambutan, cocoa, turmeric, allspice, black pepper, and pineapple) (Hands & Potter, 2024).

**Contract farming**: This kind of farming involves agreements between farmers and companies to produce specific quantities of spices at negotiated marketing modality. And the agreement may include fixing prices; buying at prices on the marketing date in the nearby markets; or buying at a certain percentage above the Ethiopian Commodity Exchange (ECX) or the nearby market price. There are some experiences of contract farming with the production of red pepper, ginger, and turmeric. Similar experience has also been witnessed in connection with seed spices. This model intends to provide farmers with a guaranteed market and price, thereby reducing financial risks. It also facilitates the use of improved varieties and practices that ensure better productivity and quality.

**Community-based farming:** This type of farming involves smallholder farmers working together in cooperatives or associations to produce and market spices. This model is commonly practiced with spices like coriander, cumin (black and white), fenugreek, and helps in pooling resources, sharing knowledge, producing to the scale of the market, ease of extension services and accessing markets.

**Organic spice production:** Organic spice production is characterized by the cultivation of spices without the application of synthetic fertilizers, pesticides, and preservatives. It does not also undergo and without fumigation or irradiation. As a result, it is one of the successful production models. Ginger, turmeric, clove, pepper, cinnamon, nutmeg, and mustard seeds are major spices that organically produced. An increasing demand for organic spices in the global market is the major driver for organic spice production globally; the organic spice market size has grown tremendously in recent years. It is estimated to grow from $29.1 billion in 2023 to $31.73 billion in 2024 and is projected to reach to $45.08 billion in 2028 (Market Research Report, 2024). Organic farming has been successfully implemented for several spice varieties, particularly black pepper, ginger, turmeric, and large cardamom, especially in India's Northeastern states (Thankamani et. al., 2024).

## 3.3 Research efforts and achievements in recent years

As a whole, the research attempt made so far on spices is very limited and it is a recent phenomenon in Ethiopia (Fikadu et al., 2019). And that is because of limited technological development and advancement, knowledge, and information sharing among subsector actors.

**Variety development**

Although Ethiopia's spice sector has huge potential; the research effort aimed at addressing various challenges for improving productivity is limited. Relatively speaking, variety development is one of the major areas that have got research focus so far. In connection with that several research institutions in Ethiopia have released several high-yielding and disease-resistant/tolerant varieties (see Tables 5-8). It is, however, worth noting that the level of effort hasn't been similar for all spices. Moreover, the effort made to scale up the developed technologies is still limited.

**Black cumin:** As shown in Table 5, below, ten improved black cumin varieties have been released in Ethiopia so far for mid to high-altitude areas of the country by federal and regional agricultural research centres.

**Table 5 List of released black cumin varieties in Ethiopia**

| No | Varieties | Altitude | Rainfall | Released by | Yield (t/ha) | | Year released |
|---|---|---|---|---|---|---|---|
| | | | | | Research field | Farmers' field | |
| **1** | Darbera | 1650-2004 | 120-400 | Sinana | 1.5 - 1.9 | 1.1 | 2006 |
| **2** | Aden | 1800-2500 | - | Kulumsa | 0.9 - 1.6 | 0.8 - 1.1 | 2009 |
| **3** | Dershye | 1800-2500 | - | Melkassa | 0.9 - 1.6 | 6.8 - 1.2 | 2009 |
| **4** | Gemechis | 1650-2400 | - | Sinana | - | - | 2016 |
| **5** | Urgesa | 1650-2400 | 120-500 | Sinana | 1.7- 2.7 | - | 2021 |
| **6** | Likie | 1500-2400 | 892-1147 | Kulumsa | 1.1 | 0.95 | 2021 |
| **7** | Qeneni | 1650-2400 | 550-750 | Sinana | 1.7 - 2.3 | 1.2 - 1.8 | 2019 |
| **8** | Kenna | 1650-2400 | 550-757 | Sinana | 1.5 - 2.1 | 1.2 - 1.7 | 2019 |
| **9** | Silingo | 1800-2500 | 980-1200 | Tepi & Kulumsa | 1.4 | - | 2017 |
| **10** | Sooressaa | 1650-2400 | - | Sinana | | | 2016 |

***Source**: EAA (2021); MoA (2018, 2019,); MoNAR (2016): Crop Variety Register: Issue Numbers 24, 22, 21, 20 & 19; Mengistu et al., (2017)*

**Black pepper**: Only two varieties (Tato and Gacheb) were released in 2007 by Jimma Agricultural Research Centre.

**Cardamom**: Only one variety, Gene, was registered in 2007 showing the very limited varietal option available for producers.

**Coriander**: Though Ethiopia is a centre of primary diversity for coriander (Mengesha et al., 2010), the current knowledge about its biology, variety development, and agronomy is neither complete nor conclusive. Seven Coriander varieties, namely Derara, Gadisa, Batu, Tulu, INDIUM 01, and Denknesh have been released so far for mid to high-altitude areas of the country by Federal and Regional agricultural research centres (see Table 6).

**Table 6 List of released Coriander varieties in Ethiopia**

| Variety | Altitude | Rainfall | Yield (t/ha) | | Released by | Year released | Adaptation area |
|---|---|---|---|---|---|---|---|
| | | | Research | Farmers' | | | |
| **Derara** | 1650-2400 | 120-500 | 1.9 – 3.0 | - | Sinana | 2021 | Bale HL & similar area |
| **Gadisa** | 1650-2400 | 550-750 | 1.5 | 1.2 - 2.1 | Sinana | 2019 | Sinana, Goro, Ginir & similar areas |
| **Batu** | 1600-1800 | 760 | 0.8 | 0.7 | Adami Tulu | 2018 | Mid altitude areas |
| **Tulu** | 2000-2500 | 2300 | 1.4 | 1.2 | Adami Tulu | 2018 | High altitude areas |
| **Denknesh** | 1800-2500 | 890-1500 | 2.6 | - | Tepi, & Kulumsa, | 2017 | Mid and High-altitude areas |
| **INDIUM 01** | 1600-2300 | 750-2000 | 1.3 | 1.0 | DZARC | 2008 | Low to mid altitude areas |
| **Walta-I** | 1650-2004 | 120-400 | 1.0 2.4 | 0.5 | Sinana | 2006 | Mid and High-altitude areas of Bale |

***Source:** EAA (2021); MoA (2018, 2019,); MoNAR (2019); MoRAD (2007): Crop Variety Register Issue Numbers 11, 24, 22, 21, 20 & 19; Mengist, et al (2017).*

**Fenugreek**: The area under fenugreek cultivation and production has fluctuated over the past five years. As indicated in Table 7, federal and regional research centres released ten improved varieties between 2005 and 2022 for different agroecologies.

### Table 7 List of released Fenugreek varieties by Federal and Regional research centres

| Variety | Breeder/ Maintainer | Yield (t/ha) | | Year of release |
|---|---|---|---|---|
| | | Research field | Farmer's field | |
| Chala | Debrezeit RC | 0.9 - 1.8 | 0.8 – 1.5 | 2005 |
| Ebbisa | Sinana RC | 1.6 - 1.6 | 1.9 -1.9 | 2012 |
| Hunda-01 | Sinana RC | 1.2 – 2.2 | 0.5 -0.6 | 2006 |
| Wereilu | Sirinka RC | 1.1 - 2.1 | 1.2 | 2016 |
| Jamma | Sirinka RC | 1.2 - 2.3 | 1.1 | 2016 |
| Burqaa | Sinana RC | 2.2 | | 2016 |
| Bishoftu | DZARC/EIAR | 1.0 | - | 2017 |
| Arganne | Sinana RC | 1.5 – 2.6 | 1.5 – 2.6 | 2021 |
| Chafe | Tepi and Debrezeit ARC | 1.3 | 1.2 | 2021 |
| Turu | Tepi and Debrezeit ARC | 1.2 | 1.1 | 2021 |

***Source:*** *MoA (2015), MoRAD (2005, 2006) MoLAR (2016, 2017), EAA (2021): Crop Variety Register: Issue Numbers 8, 9, 15, 24, 20 & 19; Mengistu, et al. (2017); Abdu et al (2016)*

**Hot pepper:** As shown in Table 8, so far, 29 varieties of hot/red pepper have been developed by the National Research System (NARS) and the Private sectors.

### Table 8 List of hot pepper varieties released in Ethiopia

| Varieties | Altitude | Rainfall | Yield (t/ha) | | Released by | Year released |
|---|---|---|---|---|---|---|
| | | | Research field | Farmer's field | | |
| **Addis** | 1400-1900 | 800-1200 | 25.0 | 15.3 | Melkasa ARC | 2022 |
| **Oda Gibe** | 1250-1700 | 800-1100 | 15.5 -20.0 | 11.7-13.2 | Bako ARC/ORARI | 2021 |
| **Jajo** | 1400-1650 | 1000-2100 | 10.3 -14.3 | 8.5 -12.3 | Haro Sabu ARC/ORARI | 2021 |
| **SERENADE EXPLORER** | <1800 | - | 68.2 | 47.0 | Hazera Seeds Ltd/Greenlife Tradung | 2021 |
| **Chala** | 1550-2000 | - | 20.6 | - | Melkasa ARC/EIAR | 2020 |
| **Gebaba/Rivival** | 1550-2000 | - | 23.3- | - | Melkasa ARC/EIAR | 2020 |
| **ERTA ALE RZ** | <2400 | - | 50.5 | - | Rijk Zwaan Zaadteelt en Zaadhendel BV/Reliable Hort-Consult PLC | 2019 |
| **Oshima F1** | 1000-2000 | 800-1200 | 58.0 | | East West Seed International –Thailand/ Cropsave Trading PLC | 2019 |
| **ILANGA RZ F1** | <2000 | | 34.9 | - | Zaadteelt en Zaadhendel BV/Reliable Hort-Consult PLC | 2019 |
| **STARLET RZ F1** | <2000 | - | 43.4 | - | Zaadteelt en Zaadhendel BV/Reliable Hort-Consult PLC | 2019 |
| **Austin** | 1400-2100 | 710-860 | 23.3 | - | Hazera Seeds Ltd/ GreenlifeTrading PLC | 2019 |
| **Red Jet RZ F1** | 1200-2500 | 800-1200 | 50.0 - 51.2 | 30.0-38.2 | JoyTeck PLC/ Zaadteelt en Zaadhendel BV | 2018 |
| **Amando** | 750-2400 | - | >45.0 | | Bayer Trade Representative office | 2017 |
| **MEXITIZO RZ F1** | 1400-2100 | - | 19.7 | 12.1 | Zaadteelt en Zaadhendel BV/Reliable Hort-Consult PLC | 2016 |
| **Kume** | 1200-1800 | 700-1000 | 6.4 -8.0 | 51-59 | Bako ARC/ORARI | 2015 |
| **Dinsire** | 1200-1800 | 700-1000 | 5.6 – 6.7 | 5.0-5.8 | Bako ARC/ORARI | 2015 |
| **Dame** | 1200-1800 | 700-1000 | 5.7 -7.8 | 5.9-6.6 | Bako ARC/ORARI | |
| **Vigro F1** | 500-2250 | - | 28.7 | 22.8 | Markos PLC | 2015 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Harbada F1** | 500-2250 | - | 24.3 | 20.0 | Markos PLC | 2015 |
| **Serano** | 300-2500 | - | 20.0-40.0 | 30.0-50.0 | Mekamba PLC | 2015 |
| **Sahem** | 1000-2500 | - | 44.2 | 28.9 | Syngenta Seeds B.V./ Syngenta Agroservice AG Ethiopia | 2013 |
| **Saidah** | 500-2500 | - | 52.9 | 29.0 | Syngenta Seeds B.V./ Syngenta Agroservice AG Ethiopia | 2013 |
| **CAPSI** | 300-2000 | 300-850 | - | - | Vibha Seeds Ethiopia PLC | 2012 |
| **SPICY** | 300-2000 | 300-850 | - | - | Vibha Seeds Ethiopia PLC | 2012 |
| **SCH-925 F1** | 300-2000 | 300-850 | - | - | Vibha Seeds Ethiopia PLC | 2012 |
| **SUPREME** | 300-2000 | 300-850 | - | - | Vibha Seeds Ethiopia PLC | 2012 |
| **Serenade** | 300-2000 | - | 14.4 | 94 | Hazera Seeds Ltd/GreenlifeTrading PLC | 2011 |
| **Oda Haro** | 1400-2200 | 830-1559 | 12.5(dry) | 11 (dry) | Bako ARC/ORARI | 2005 |
| **Melka Zala** | 1200-2200 | 900-1300 | 17-27 (Dry) | 17-27 (Dry) | MARC/EARO | 2004 |

***Source:*** *MoRAD (2004, 2005, 2006) Crop Variety Register, Issue Numbers 7, 8, 9; MoA (2011, 2016) 14, 16 and MoNAR (2015) 18 to 25.*

**Korarima**: There was no improved cultivar until the two improved Korarima varieties (Bench Maji-1 and Kaffa-1) were released in 2021 by Tepi and Jimma Agricultural Research Centres of the Ethiopian Institute of Agricultural Research (EAA, 2021). Korarima production/productivity is very low due to lack of improved variety. Its production is declining mainly as a result of the destruction of the plant's natural habitat. Dried capsule yield (t/ha) remained 0.5 - 0.8 with local landraces whereas the recently released varieties can give up to a maximum of 1.5 t/ha (EAA, 2021).

**Turmeric**: Only two improved varieties (Dame and TEPI-1) have so far been registered. While Dame (the first variety) was registered by Jimma Agricultural Research Centre (JARC) in 2007, TEPI-1 (the second variety) was released in 2017 by Tepi National Spices Research Centre (TNSRC) formerly known as the Tepi Agricultural Research Centre (TARC).

**White cumin**: Despite its potential for the country, little attention has been given to improving the productivity of Ethiopian caraway; other than collecting and preserving indigenous germplasm nothing more has been done (MOARD, 2003 cited by Hussein, 2013). So far, only two varieties, Dembia-1 and Takusa-1, have been released in 2017 by the Gonder Agricultural Research Centre of Amhara Region Agricultural Research Institute/ARARI (MoALR, 2017).

***Management practices:***

Apart from variety development, there has been some research that focused on designing management practices aiming at optimizing cultivation techniques to improve yield and quality. Such research includes providing recommendations for agronomic practices, including population density, intercropping, and soil fertility management. In that regard, there have been some efforts in exploring pest and disease management practices aiming at identifying and controlling insect pests and diseases affecting spice crops as well as post-harvest management and processing techniques (Kifle et. al., 2023).

## 3.4 Emerging domestic processing and marketing of spices

### 3.4.1 Current spice processing and manufacturing

Spices processing and manufacturing in Ethiopia is still at its infant stage. For the most part, the processing is done by Small and Medium Sized Enterprises (SMEs) or at the household level. In general, most spices are dried and milled or heated and ground. Brief descriptions of processed spices are given below:

**Black cumin**: This spice is mostly dried and powdered as an ingredient in the local chili blends. There are also many small and micro enterprises that are extracting essential oil from the seed and selling it in the local market. There are also a couple of big companies doing oil extraction from this spice for the export market.

**Black pepper**: Processing this spice involves sun-drying the black pepper berries for 7-8 days or more, until 11% moisture content is achieved.

**Cardamom**: is dried by directing hot air from a furnace, by spreading on a heated surface, or under sunlight. In cardamom marketing, the colour and appearance of the capsules are the major quality criteria.

**Coriander:** Coriander is mostly dried and used in baking breads. It is also used as herbal in food seasoning or flavouring. The spice can also be used to extract essential oil but this form of processing is not widespread in Ethiopia.

**Fenugreek**: While this spice is only cleaned before being exported, for local use, it is also heat treated and then milled for various uses.

**Hot pepper:** The processing of hot pepper in Ethiopia is labour-intensive involving several layers of mixing and processing. Small, micro and large-scale processing of this spice is done in Ethiopia and high volume of processed hot pepper is export every year.

**Korarima**: First the sun-dried, red ripe capsules with black or dark brown edged seeds inside are collected and cleaned. To accentuate the aroma, the seeds are heat treated, powdered and used in the preparation of various foods.

**Turmeric**: Turmeric processing starts with washing with water to remove the dirt and root hair to develop and maintain its desired deep-yellow-orange colour, turmeric is cured. The curing involves boiling fresh rhizomes in water, sun drying it and finally polishing or peeling it. That is done to obtain the inherent yellow colour and remove the bitter constituents from the corkish surface. There are a number of factors that contribute to the deterioration of the spice quality and that includes: packaging materials, humidity, sunlight, insects, aeration, method of boiling, and sorting of mother & finger rhizomes. It is essential to carefully consider/manage these factors for standardizing the local market and tapping into the underutilized export potential.

**White cumin**: similar to black cumin white cumin seeds are directly used in bakeries and they are heat treated then powdered. They are then added to different blends of spices or foods.

### 3.4.2 Trends in Ethiopian spice market

Spices are sources of income for producers, processors and traders involved in production, processing, and marketing. And as pointed out earlier, they also serve as source of income for many rural households in Ethiopia.

Ethiopia is one of the largest consumers of spices in Africa. Over 95% of the spice produced in the country is consumed domestically. Currently, domestic consumption has shown fast growth due to increases in income, rapid population growth, and greater urbanization (Fanta & Tesafa, 2018). There is also a growing demand from local traders, essential oils and oleoresin extraction companies, and pharmaceutical product manufacturers. To meet the ever-increasing local demand, the country imports over 800,000 USD worth of spices mainly from India, United Arab Emirates, Egypt, China, Costa Rica, and Turkey (https://oec.world/en/profile/bilateral-product/spices/reporter/eth).

The production and export of spices in Ethiopia have been fluctuating due to security issues and financial and marketing difficulties. Despite its significant production potential, Ethiopia imported spices worth USD 827,000 in 2022, making it the 140$^{th}$ largest spice importer globally. To meet the growing local demand, the country primarily sources these imports from India (USD 306,000), the UAE (USD 202,000), Egypt (USD 115,000), China (USD 112,000), Costa Rica (USD 60,600), and Turkey (USD 3,010).

Ethiopia exports a variety of spices, including ginger, pepper, turmeric, coriander, cumin, fenugreek, cardamom, cinnamon, and clove. In 2022 alone, the country’s spice exports totalled USD 4.2 million, ranking it as the 59$^{th}$ largest exporter globally (OEC, 2024). Major export destinations included India (USD 1.34 million), Egypt (USD 619,000), the USA (USD 419,000), the UAE (USD 273,000), and Canada (USD 225,000). In 2022, spices ranked 65$^{th}$ among Ethiopia's most exported products. The fastest-growing export markets for Ethiopian spices took place between 2021 and 2022 the recipients were Egypt, Pakistan, and Germany (OEC, 2024). In what follows, we give brief details of the most common items exported to different places.

**Black cumin**: Out of the 20,600 tonnes of black cumin production in 2020/2021, 747 tonnes were exported. Ethiopian black cumin seed is exported to Saudi Arabia, Israel, Malaysia, France, Pakistan, Austria, the United Republic of Tanzania, Germany, and Indonesia (Export Genius, 2016). It is exported in dry forms or

essential oils, bringing in foreign revenue for the country as a whole. As a result, black cumin's role in increasing the national economy through import substitution and/or export has become undeniable (Hailemichael et al., 2016). Ethiopian black cumin seeds have a higher concentration of the monocyclic phenolic chemical thymol, reaching up to 50%. Compounds in cumin make it a useful healthcare and medicinal industry source (Yimer et al., 2019). The seed essential oil, on the other hand, has a higher thymoquinone value and that means that it will have more opportunities to be used in the cosmetics business because high thymoquinone in oil assures the use of oil in the cosmetics sector (Thilakarathna et al., 2018).

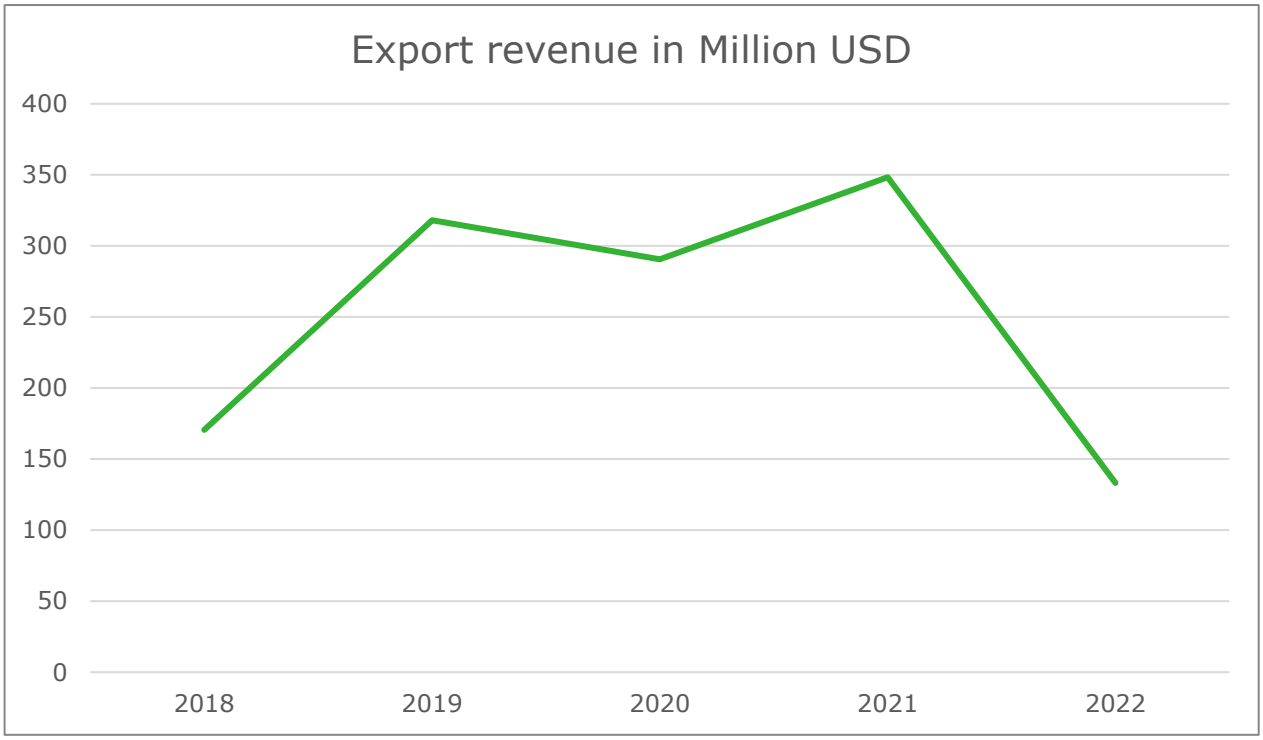


**Figure 2 Spice Export Trend in Ethiopia**

**Black pepper**: Currently, most of the production of black pepper is done by commercial farms but the introduction of the spice to smallholder farmers has recently picked up pace due to high international market demand. It is sold either in seed or powder form in the local markets, where farmers dip the harvest in boiling water and then sun dry it before bringing it to the market. The powder form is used to spice up several local and international dishes by food processors. Commercial farms producing black pepper mainly steam and dry the seeds and sell them for international buyers.

**Cardamom:** Cardamon is one of the most important spices with huge potential for domestic use and international market in the country. The dried or fruit form of the spice is exported to various destinations. In 2022, the country exported close to 450 t. While its powder or seed form is the major form used locally, cardamom can also be processed into essential oil.

**Coriander**: Coriander is considered both as herb and spice. Whereas both the seed and leaves of coriander are sold in the local market, it is the seed that is exported. The spice is also sold in powder form to season cooking. While the reason for the low production in recent years is not explained by evidence, a drop in production is observed with the export of the commodity missing from the record after 2019. However, locally, the spice is still sold to consumers in local markets and retail outlets.

**Fenugreek**: Fenugreek, which is considered both as spice and pulse, is among the highly produced spices in Ethiopia. In 2021, the production of the spice grew over 50,000 t from 25,000 t in 2015/16, doubling in five years. Because the spice is considered medicinal among the community, it is highly demanded in the local markets. The recent increase in the number of farmers producing the spice as well as production area per farmer shows the response to increased market demand. In addition to being consumed as a drink on its own, the flour of fenugreek is added as an additive to "Injera", soup, and porridge. Since People are aware of the cleansing nature of the spice, they incorporate it into their meals.

**Ginger:** Over, the last two decades (2004 – 2022), Ethiopia has exported 86,820 t of ginger. Out of this, 95% of the export was done in the first decade (2004 – 2013). The export has, however, has after which substantially declined during the second decade (2014 – 2022) (Kifle, et al., 2023). This was because of the

significant decrease of production due to the devastation of ginger production by ginger bacterial wilt in 2011 and subsequent years (Habtewold et al., 2015; Hunduma et al., 2016).

**Hot Pepper**: Hot pepper is the leading spice produced in Ethiopia in the form of Capsicum or chili pepper. Although it can be consumed in raw, flack, or powdered form, it is exported as ground or crushed form. It is among the staples in the country and hence has high local demand. The country produced over 290,000 t of red pepper in 2021 (CSA, 2021). When compared with the 170,000-t production in 2015, this is a major increase. A few factors have contributed to this significant growth in production primarily there has been in increase in (mainly local) demand which has led to expansion of farmland used for pepper production and a shift of farmers from the production of other crops. The fact that the spice is seen promising as a major cash crop has also been another contributing factor for its increase in production.

**Turmeric**: Ethiopia is one of the biggest producers and exporters of turmeric in Africa. While the bulk of the production is consumed domestically, only a small portion is exported to neighbouring countries (Sudan, Kenya, Djibouti, and Egypt), Asia, the Middle East, and the USA (ECTA. N.D). According to ECTA, Ethiopia produced 28,850 t of turmeric in the 2020/21 season. Of this amount, 4,754 t (approximately 16.48% of the total production) were exported. This is higher than the average annual export of 3,204 t. The Ethiopian turmeric variety is preferred in Southern EU and the USA, and interest in Northern Europe is emerging (Herms, 2015). Ethiopian turmeric has the potential for a smallholder-driven investment model for various reasons (Herms, 2015).

### 3.4.3 Trends in international spice markets

Though very small, locally extracted essential oils of black pepper, ginger, turmeric, cardamom, and long pepper proved to meet the international market requirements. The quality parameters of the Ethiopian spices also meet international standards. Nevertheless, Ethiopia’s international market share has stagnated at less than 1% for the last decade. That is mainly because of the production decline of ginger and quality and the food safety issues in red pepper and turmeric (Fanta & Tesafa, 2018; Getaw et al, 2024; Titus & Wojtek, 2020).

Since 2021, an increasing trend for spices demand has been observed worldwide. According to the Markets and Markets (M&M) report (2024), the global spices and seasonings market was estimated to grow from USD 21.3 billion in 2021 to USD 27.4 billion by 2026 reflecting a projected growth rate of 5.2% over this period. Key factors driving this increase include a rising demand for convenience foods, greater use of spices and seasonings as natural preservatives in meat and poultry products and shifting consumer preferences towards spicier food options (Market Research Report, 2024).

Due to increased demand from countries like the EU, USA, and India for higher quality spice products, the export of spices, particularly pepper, ginger, and turmeric, has in recent years experienced a decline. The quality and food safety concerns from these major consuming countries demanding higher compliance to standards from producing nations have put pressure on producing countries like Ethiopia. This challenge calls for immediate action to improve the quality and food safety standards of spices by employing hygienic procedures while producing, processing, packaging, transporting, storage, and marketing.

# 4 Challenges and opportunities for spice sector development

## 4.1 Challenges in the spice sector

There are different factors hampering spice production in Ethiopia. The challenges span across the components of the value chain including production, post-harvest handling, value addition, marketing, and institutional linkages.

### 4.1.1 Production

Major problems in the spice production sector include employing millennia-old crop production and management technologies; lack of improved varieties with their management practices; very low awareness of available improved technologies; limited supply of seeds, seedlings, and cuttings (root and above-ground plant parts as planting materials). In addition to these, lack of access to fertilizer and pesticides, and finances pose important challenges in terms of rising production costs and stagnating productivity growth. Additionally, the following are key challenges worth addressing to make the best out of the sector's potential spice in Ethiopia: The absence of spice-targeted extension service and capacity-building efforts to major actors (producers, traders, transporters, processors, exporters); the prevalence of diseases and insect pests; wild animal damage; destruction of shade trees; planting on marginalized/degraded lands; and low yield and poor quality of the produce (Shimelis, 2021; Hibistu, 2020; Shimelis and Temesgen, 2020).

### 4.1.2 Post-harvest handling

The use of crude post-harvest operations and technologies are potential threats to the low-quality of spices in the country. Some of the important challenges that need stakeholders' attention are: lack of efficient and affordable processing and packaging facilities; limited access to finance for acquiring processing and packaging equipment; weak investment in promotion and marketing; poorly developed infrastructure; low knowledge and skill base of processing, packaging, and storing actors; and lack of expertise in spices processing areas are (Shimelis, 2021; Tewabe, 2020, Shimelis and Temesgen, 2020).

### 4.1.3 Food safety

Spices are prone to multiple food safety hazards which potentially affect the health of consumers and income from export. As discussed below, hazards are physical impurities, microbial contaminants and chemical residues. Mindful of these hazards, the European Union (EU 2019/1793) has, for instance, put additional control measures in place for spices imported from Ethiopia. For fear that spices imported from Ethiopia might be contaminated, importers take various precautionary measures. Currently, there is 50% control of red pepper and various other spices for the presence of aflatoxins before entering the market. The country has also received warnings from several importing countries indicating the food safety hazards identified on exported products.

**Physical hazards*:*** Physical hazards could be **soil particles** or **plant parts** that should not be present in the spices produced. The Ethiopian Standard ES 6838:2021 indicates that "*berbere"* should "be free from any impurities" and be "prepared from the pericarp and the seeds of the pepper fruit" (ESA, 2021). The European Spices Association (ESA) sets a maximum level of 1% of material that could be present. Physical hazards may occur due to drying the produce on the ground or other dirty substrate. Alternatively, improper handling and cleaning of the spices, use of sub-standard packaging materials, and storage facilities can result in physical hazards. These impurity levels could, however, be brought down to the levels of standards by employing good handling and processing practices.

**Microbial contamination*:*** Microbial contamination takes place mainly through **fungi** (e.g. *Aspergillus* spp.) and **bacteria**. Specifically, ES 6838:2021 indicates that the pathogenic bacteria *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* spp. should be absent.

A study on a variety of spices purchased in the market (Bedada et al., 2018) found that some of the samples tested contained fungi, yeast, coliforms or *S. aureus*, but no *Salmonella* spp. The study further revealed that over 10% of the samples contained too high levels of microbial contamination. Conditions during harvest, drying, processing, and storage can highly affect the development of microbial contamination. It is worth noting that hygiene is an important factor in minimizing contamination.

**Chemical hazards*:*** Chemical hazards are pesticide residues, mycotoxins and heavy metals. The maximum residue levels (MRL) of pesticides should comply with the Codex Alimentarius or be in accordance with the MRLs set by the country of destination. Exceedances of the MRLs can occur when good agricultural practice (GAP) is not followed. This can, for instance, happen when not adhering to the pre-harvest interval, or if non-registered pesticides are used. Alternatively, it can occur when there is cross-contamination during picking and harvesting, drying, threshing, transporting or in storage.

The occurrence of mycotoxins specifically aflatoxins is a serious threat to the production and trade of spices. The maximum levels (ML) are indicated in Table 9 below.

**Table 9 Maximum levels of aflatoxin (AF) B1 and total and Ochratoxin (OC) A of selected spices**

| | Ethiopia ES 6838:2021 | | | EU (2006) EC 1881 | | |
|---|---|---|---|---|---|---|
| | AF B1 | sum AF | OC A | AF B1 | sum AF | OC A |
| Red pepper | 5 | 10 | 15 | 5 | 10 | 15 |
| Ginger | --* | -- | -- | 5 | 10 | 15 |
| Turmeric | -- | -- | -- | 5 | 10 | 15 |
| Mixtures | -- | -- | -- | 5 | 10 | 15 |

** No limit set yet*

***Source:*** *Authors' compilation*

In a study conducted by Aberedew and Ayelign (2023), samples of powdered red pepper collected from markets in Addis Ababa contained levels of both aflatoxin B1 and total aflatoxin above the ML. Samples of red pepper collected in 2023 from farm-stored produce (Taddesse et al, forthcoming) also showed 100% and 98% positive for total aflatoxin and ochratoxin A 92% and 88% above the ML, respectively.
The main causes for high levels of mycotoxins are poor handling practices, especially failure to dry the produce adequately and storing them under moist conditions. For red pepper, the practice of wetting the produce before selling it to enhance colour, prevent breakage and thereby obtain a better price contributes to the development of mycotoxin producing fungi.

A study done on post-harvest spoilage of turmeric taken from zones in southwestern Ethiopia in 2020 and 2021 indicated the presence of *Aspergillus* spp., *Penicillium* spp., *Fusarium* spp., and *Rhizopus* spp. was found in samples of dried and stored turmeric (Jibat & Alo, 2023). The study also highlighted that the percentage of incidence ranged from 15.1% for *Fusarium* spp. to 45.2% for *Aspergillus* spp. In 2018, the Ethiopia-Netherlands Trade for Agricultural Growth project collected over 40 samples of turmeric from various locations in the southern region of Ethiopia. The samples tested for the presence of aflatoxin showed that 13 of the 40 samples had aflatoxin levels that exceeded the EU standards for maximum levels (unpublished data).

Heavy metals that should be managed in spices are arsenic, mercury, lead and cadmium with specific levels for "berbere" of 0.5, 0.1, 1 and 0.5 ppm resp. (ES 6838:2021).

**Adulteration*:*** The Ethiopian Food and Drug Administration define adulteration as "the addition of any foreign substance or ingredient to food or replacing the content of the product with another substance to increase the mass or weight of a product and enhance its value" (paraphrased in Haji et al 2023, p 7535). Adulteration can take place by mixing varieties or below standard or spoiled pods, salt, clay or synthetic additives such as Sudan red dye, or through the reintroduction of moisture (Fanta & Tesafa, 2018; Haji *et al*., 2023).

In sum, it is not uncommon in Ethiopia to see unscrupulous actors adulterate spices and their products for the pursuit of higher profits using the gap in food safety standards, regulatory measures and enforcement (Getaw et al., 2024).

### 4.1.4 Lack of customized services and poor linkage between private and public institutions

The weak role of the private commercial investors in spices production, weak business linkage among stakeholders in the chain including farmers, traders, and processors, and loose macro-level regulatory and enforcement institutions are challenges that thwart the development of the sector. In addition to these, lack of extension services, lack of use of appropriate modern technologies in farm management, drying, and storage are important challenges (Hibistu, 2020; Shimelis, 2021).

### 4.1.5 Environmental and Land Use Competition

Deforestation and competition from other land use for land potentially challenge the production of particularly shade- loving spices. This could potentially cause the displacement of spices by other crops. As is the case for other crops, climate change and variability as well as associated risks such as outbreaks of diseases and pests are major challenges affecting the expansion of spice production. Spices have climate thresholds that need to be fulfilled to achieve best productivity. Areas identified as suitable for spice production optimally provide the requirement. Climate change has the potential to alter the climate of an area which could significantly affect the suitability of the area for the existing spices sometimes to the extent of pushing the spice out of production. Therefore, strategies aiming at promoting the production and marketing of spice in Ethiopia need to consider climate adaptation and mitigation options.

### 4.1.6 Markets

Despite the high demand for spice products both locally and internationally, their marketing is constrained by many intermingled challenges. The major challenges are the perishability of the products, insignificant value addition due to knowledge, skill, and facility limitations, and shortage of marketing credit and export finance. Another major challenge is the low volume of the spice product. That is coupled with poor product quality and irregular supply; remoteness of the production areas; long chain with multiple intermediaries; use of poor storage facilities; lack of market access and price incentive specifically for producers; price volatility with unfair distribution of profit among actors. On top of that, constraints hindering the development of spice marketing in Ethiopia also include weak business linkage with few international market destinations; lack of market research, promotion, and information exchange between producers, traders, and consumers; weak regulatory framework and regulation to take legal action on adulterators, middlemen and unlicensed traders. Moreover, poorly developed infrastructures (road, transport, storage, telephone, electric power, water, market) in areas where spices are largely produced are also found to be affecting the spice market in the country (Tewabe, 2020; Goshme D. & Ayele T., 2019).

There is limited commercial awareness of high-value international markets. There also exists a significant gap between the expectations of international buyers in high-end markets like the EU, the US, and Japan and the practices of smallholder farmers. These farmers often lack awareness of international market requirements. Unfortunately, local collectors and traders primarily assess products based on basic sensory characteristics such as size, colour, and moisture, which diminishes any incentive for smallholder farmers to meet international standards. Factors such as low educational levels, information asymmetry, and the substantial size of domestic and regional markets further render international norms abstract for these farmers.

Transaction costs in the local spice trade are considerable. Smallholders typically sell small quantities, often just a few kilograms, to local collectors and village traders, who act as multiple intermediaries. These traders often lack adequate storage facilities and packaging materials, leading to issues like adulteration with lower-quality substances. When local collectors and traders wash the spices, they often use poor-quality water, which can compromise quality rather than improve it. The high transaction costs in this local market result in local prices that are often comparable to global prices for turmeric, ginger, and chili. Wholesale traders targeting export markets face significant challenges in sourcing under these conditions and may end up selling their stocks in the local market, leading to instances of contract defaults. When global prices rise, the likelihood of contract defaults increases. Although no formal statistics are available, industry experts believe that the rate of contract defaults in Ethiopia far exceeds the international norm of 25% (Herms, 2015).

## 4.2 Opportunities for spice sector development

### 4.2.1 Production and Productivity Improvement Opportunities

There are enormous gaps in demand and supply both from the national and international markets. Thus, the subsector has a high potential for expanding employment opportunities from production to processing, improving export earnings and livelihoods of value chain actors. To bridge the demand gaps, production volume and productivity should increase significantly, and the quality has to improve to the international market requirements. This could be realized by exploiting the country's agroecological diversity and favourable climatic conditions; by (i) diversifying spice crops that could grow in the different environments by varying producer categories (small-, medium- and large-scale farmers); (ii) incorporating the suitable spice crops into the different cropping systems (intercrop and under, alley, mixed, sole cropping); (iii) increasing availability of inputs (improved seeds, seedlings and cuttings, fertilizer, pesticides and credit); and (iv) improving access to implements for soil tillage, modern harvesting and processing technologies, and storage facilities. The accumulated experience of farmers in spices production, processing, and marketing which could be enhanced through minimal capacity-building efforts are some of the opportunities for increasing production and productivity (Wondimnew, 2024; Hibistu, 2020, Shimelis and Temesgen, 2020; EMI, 2015).

The advances in the use of decision support products and tools including suitability mapping provide opportunities for farmers and private sectors to identify areas of high potential and expand the area of production of spices of their interest. Therefore, the suitability maps produced for the ten major spices (for details see section 5) are bases for starting the analysis of farmwork up on which production and market opportunities, and strategies could be overlayed to guide the spice sector development.

There is a huge yield gap between the actual yield and the potential yield of all spices associated with suboptimal input use, poor management practices, climate-related production risks, and associated pest and disease prevalence. Such a yield gap is an opportunity for intensification through the use of improved innovations and practices.

### 4.2.2 Value addition and marketing opportunities

The availability of raw materials for processing, packaging, and marketing and the high domestic and international demand create good spice sector value-addition opportunities. The attractive government incentives for investment in spices production, processing and marketing such as payroll tax exemptions, equipment follow-up tax exemptions, and tax holiday regime (income tax exemption) for a period of 1-6 years to investors establishing a new business depending on the location. More specifically, a 30% income tax deduction for three consecutive years after the tax holiday period for investments in areas with poorly developed infrastructure, and loss carry forward credits specified under Regulations No. 84/2003) are unexploited opportunities for spices subsector development (EMI, 2015). A similar tax incentive package (income tax and customs duties tax exemptions) was prearranged under Directive No. 941/2022 to encourage reinvestment in expansion or upgrading using their profits (Shimelis, 2021; Tewabe, 2020; EMI, 2015).

The diversity of spice crops and the increasing local and international market demand for processed and value-added products open up a high potential for local value addition, branding and commercialization of spices. Moreover, the favourable policy environment for enhancing the export of spices, and the facilitated bank loans through capital financing, lease financing for machinery and equipment purchase; working capital loan and export financing are rewarding chances waiting for investment endeavour (EMI, 2015; IAC, 2015).

# 5 Suitability for spice sector development

## 5.1 Agro-ecological suitability of major spices in Ethiopia

As a result of differences in prevailing bio-physical conditions across zones, *woredas*, and *kebeles*, there is considerable spatial variation and limited understanding of the extent and level of suitability. Improving the understanding of where Ethiopia has a high prospect for expansion of spice production could inform the research system and producers to focus on the development of varieties targeting the agroecologies with high potential for production. It can also be helpful to identify suitable locations for testing, validating, and scaling; guide development practitioners to foster input/output supply systems; and improve the value chain and market linkages for exploiting the economic opportunities.

### 5.1.1 Black cumin

The land suitability analyses and mapping results for black cumin revealed that most of the highly suitable areas are concentrated around the central part of Oromia, the Southern and southwestern part of Amhara, areas around Lake Tana and the Central Ethiopia highlands (Figure 3). The highly, moderately, and marginally suitable lands in the country cover 5.8 (5.12%), 12.56 (11.09%), and 2.96 (2.61%) million ha, respectively. The land suitability for black cumin, along with the identified potential *woredas* within each relevant zone and region, is detailed in *Annex 2*. In terms of regional distribution, Oromia, Amhara, SNNP (Southern Nations, Nationalities and Peoples), Benishangul Gumuz (BSG), Tigray, Sidama and SWEPP regions possess the largest combined area of highly and moderately suitable land, with 10.27 (31.78%), 3.80 (24.47%), 1.71 (27.02%), 1.4 (27.85%), 0.69 (13.09%), 0.28 (41.85%) and 0.13 (3.32%) million ha, respectively.

The Oromia region has extensive areas of highly suitable lands with about 3.05 (9.42%) million ha. That is followed by Amhara, SNNP, BSG, Sidama, Tigray, and SWEPP with 1.59 (10.20%), 0.70 (10.98%), 0.18 (3.50%), 0.13 (19.76%), 0.12 (2.34%), and 0.03 (0.75%) million ha, respectively. With respect to the moderately suitable areas, Oromia, Amhara, BSG, SNNP, Tigray and Sidama regions have 7.22 (22.35%), 2.21 (14.23%), 1.02 (16.04%), 0.57 (10.75%) and 0.15 (22.10%) million ha, respectively.

With a high proportion (41.85%) of highly and moderately suitable areas for black cumin relative to the region's total area, the Sidama region ranks first in terms of suitability for the production of the spice. Its overall contribution relative to the country's total area is, however, only 0.25% of highly and moderately suitable areas.

The actual land available for black cumin production could, in fact, be lower since some areas might be limited by other socioeconomic factors. Nevertheless, this suitability analysis reveals the potential for expanding black cumin production to new areas. This is particularly important given the good market opportunity for black cumin although the current production area in the country is generally small.

As a result of differences in bio-physical conditions across zones, *woredas*, and *Kebeles*, there is considerable spatial variation in suitability. Large areas of East and West Gojjam, Dembia and Takusa districts of Central Gondar zone in the Amhara region; Southwest, West and North Shoa, Horogudru Welega, West Arsi, Arsi/ Shirka, Goro and Ginnier/Bale zone and Jimma areas in Oromia; Halaba, Siltie, Guraghe, Wolaita in Southern and Central Ethiopia, and Sidama show high suitability for black cumin production.

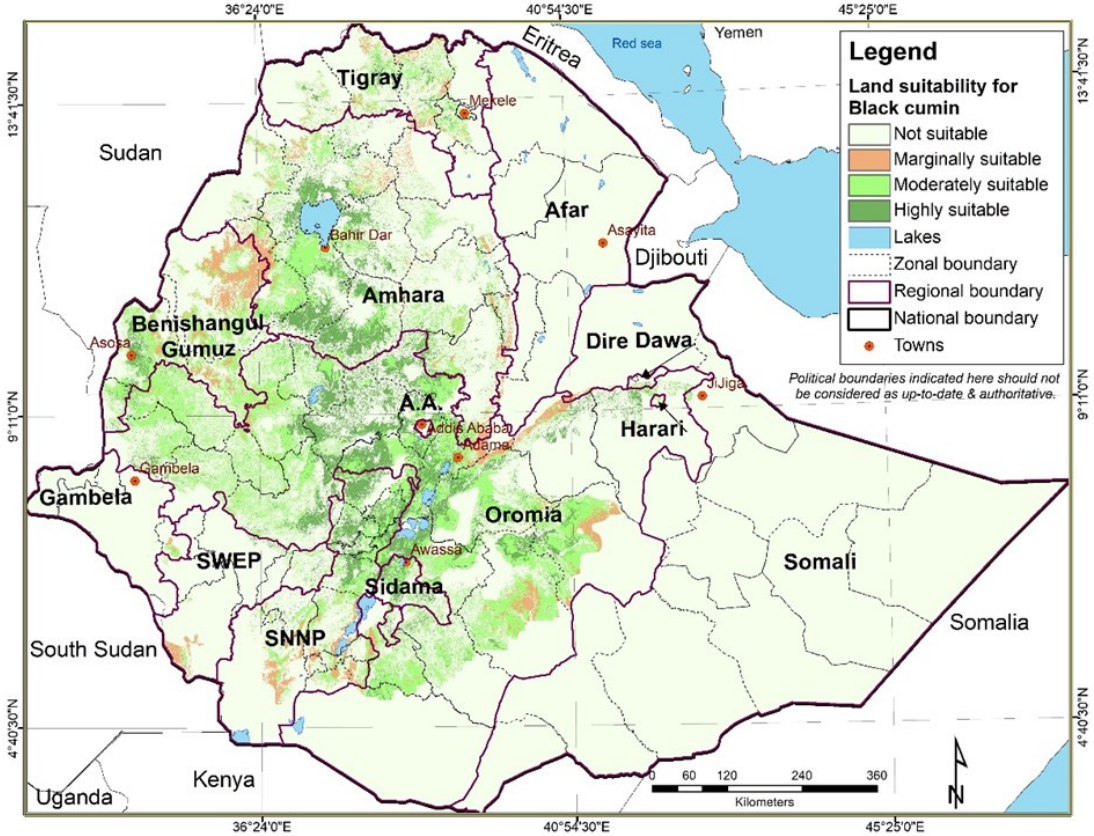


**Figure 3 Land suitability map for black cumin production**

### 5.1.2 Black pepper

Large areas of SWEPP, west Oromia, Benishangul Gumuz, and South Ethiopia are highly suitable for black pepper production (see Figure 4). The area of highly and moderately suitable land for black pepper in the country covers 16.24 million ha, representing 14.32% of the total area of the country. Oromia, BSG, SWEPP, Gambela, Southern Ethiopia, and Amhara regions possess the largest combined area of highly and moderately suitable land, with 6.06 (18.76%), 3.68 (73.04%), 2.01 (51.25%), 1.78 (%), 1.58 (28.05%) and 1.00 (6.45%) million ha, respectively. The Oromia region has extensive areas of highly suitable lands with about 1.37 (4.24%) million ha. That is followed by SWEPP, BSG, SNNP, Gambela, and Amhara regions with 1.15 (29.5%), 0.81 (16.05%), 0.63 (9.95%), 0.32 (10.19%), 0.09 (0.056%) million ha, respectively.

Based the combined area of highly and moderately suitable classes, Oromia ranks first with 6.06 million ha. That is followed by BSG, SWEPP, SNNP, Gambela, and Amhara with 3.68, 2.01, 1.78, 1.58, and 1.00 million ha, respectively. However, to assess the extent of suitability accurately, the total area of each region needs to be known. For example, BSG and Gambela region take first and second place with 73.04% and 50.32% proportions for combined highly and moderately suitable areas of black pepper relative to their respective total area. However, relative to the country's total area, their contribution is only 3.25 and 1.39% highly and moderately suitable areas. *Annex 3* summarizes the land suitability for black pepper production and identifies potential *woredas* and promising zones for its promotion.

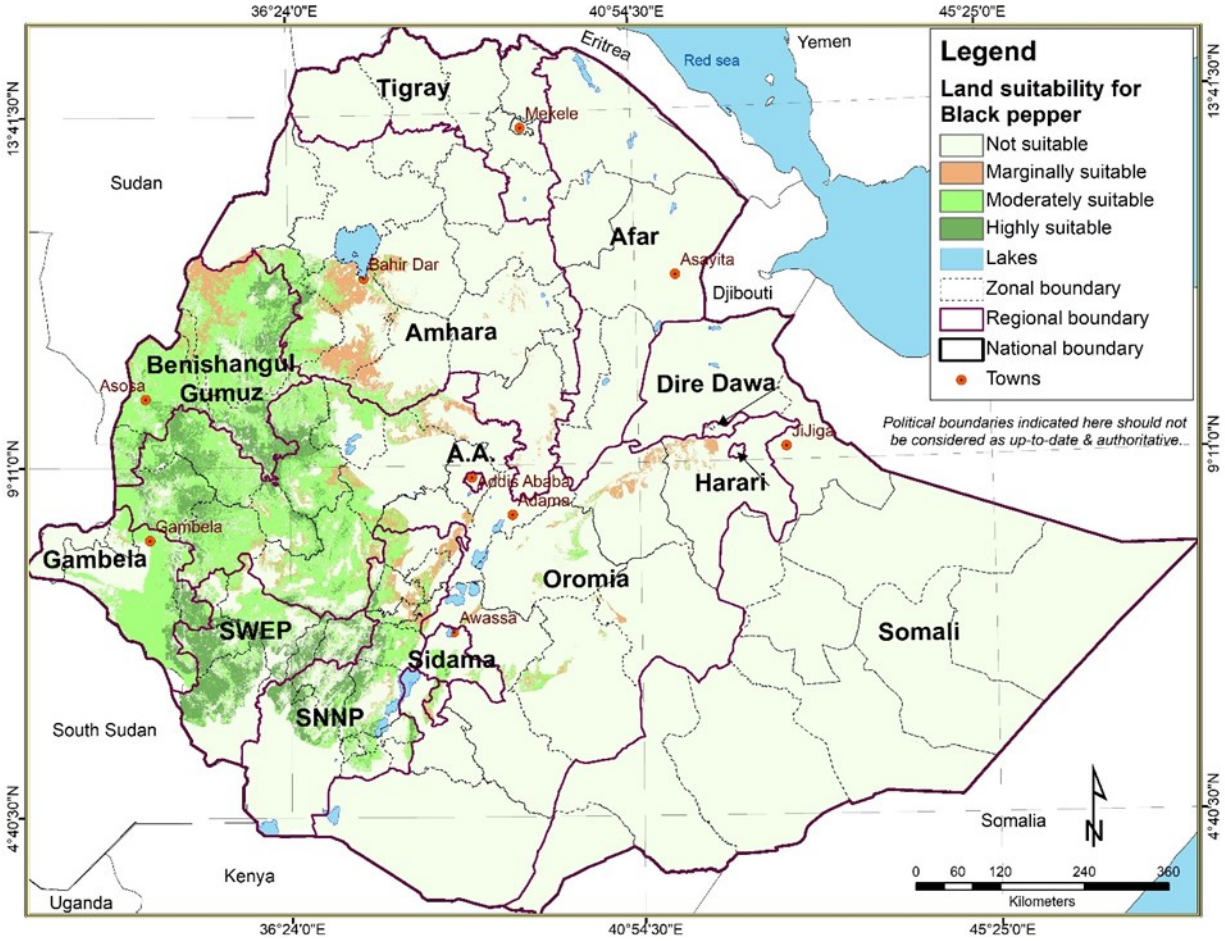


**Figure 4 Land suitability map for black pepper production**

### 5.1.3 Cardamom

Large areas of west Oromia, Central Ethiopia, SWEPP and some parts of BSG regions show high levels of suitability for cardamom production (Figure 5 and *Annex 4*). The highly, moderately, and marginally suitable lands in the country cover 6.43(5.68%) 10.79(9.53), and 7.77 (6.86%) million hectares (ha) of the total area of the country, respectively. This combined area covers 17.22 million hectares (ha), representing 15.21% of the total area of the country. In terms of regional distribution, Oromia has extensive areas of highly suitable lands with about 3.79 (11.73%) million ha, followed by Southwest Ethiopia (SWEPP), Benishangul Gumuz (BSG), SNNP (Southern Nations Nationalities and Peoples), Gambela, and Amhara with 1.29 (33.04% of the region), 0.68 (13.4%), 0.29 (4.61%), 0.19 (6.05%) and 0.18 (1.16%) million ha, respectively. With respect to the moderately suitable areas, Oromia, SWEPP, BSG, SNNP, Gambela, Amhara, Tigray and Sidama regions have 3.64 (11.25%), 1.97 (39.08%), 1.77 (27.85%), 1.56 (10.05%), 0.97 (24.67%), 0.59 (18.72%), 0.2 (29.65%), 0.1 (1.94%) million ha (percentage relative to the region's area), respectively.

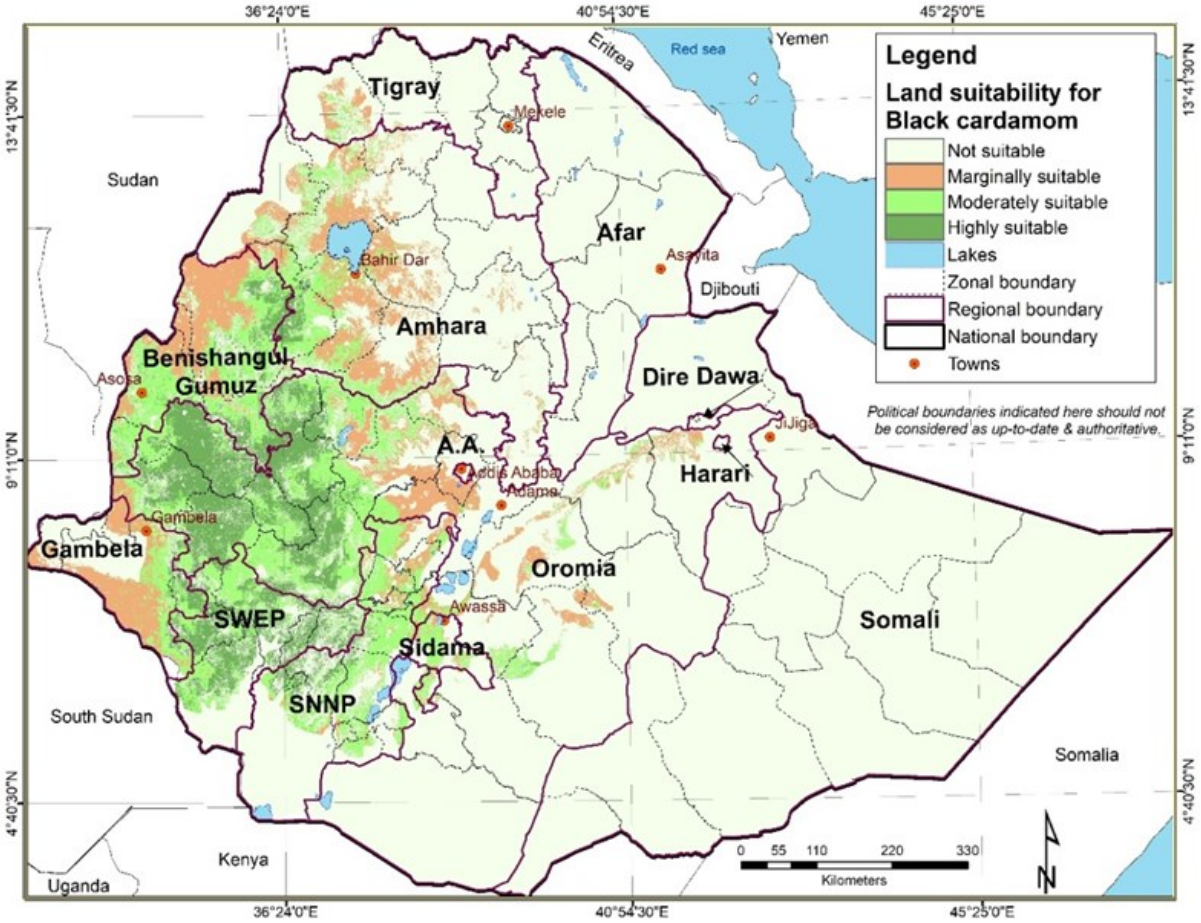


**Figure 5 Land suitability map for cardamom production**

The land suitability for cardamom, along with the list of identified potential *woredas* within each relevant zone and region, is provided in *Annex 2*. Oromia, BSG, SWEP, SNNP, Amhara, Gambela and Sidama regions are identified to have large, combined area of highly and moderately suitable land accounting for 7.43 (22.98%), 2.64 (52.48%), 2.26 (57.72%), 2.06 (32.45%), 1.74 (11.21%), 0.78 (24.76%) and 0.2 (29.77%) million ha, respectively. Implementing complimentary interventions aimed at improving limiting factors on moderately suitable areas would have huge potential for developing the area into highly suitable area. However, it is important to note that the limiting factors are site-specific. And so are the interventions required to improve the level of suitability. At a national level, West Oromia, BSG, SWEP, and SNNP regions show the highest potential contribution for cardamom production. However, in terms of regional strategic perspective, SWEPP and BSG could give much attention to this spice because it has the potential to expand into about 58 and 53% of the regions' areas.

### 5.1.4 Coriander

As shown in Figure 6 below, the highly suitable land is dominantly identified in the central Oromia, Central Ethiopia Region, Southern Amhara, and areas around Lake Tana, and Central Tigray. The combined area of highly and moderately suitable land for coriander in the country is 23.49 million ha, representing 20.74% of the total area of the country. Oromia, Amhara, SNNP, BSG, SWEPP and Tigray regions possess the largest combined area of highly and moderately suitable land, with 11.80 (36.51%), 4.92 (31.60%), 2.44 (38.50%), 1.55 (30.66%), 1.31 (33.45%) and 1.02 (19.33%) million ha, respectively. The result reveals that Oromia has extensive areas of highly suitable lands with about 2.11 (6.54%) million ha. That is followed by Amhara, SNNP, BSG, and Tigray with 1.48 (9.48 %), 0.80 (12.58%), 0.63 (9.95%), 0.32 (6.26%), 0.19 (3.53%) million ha, respectively. With respect to the moderately suitable areas, Oromia, Amhara, and SNNP regions take first to third places with 9.68 (29.97%), 3.44 (22.12%), and 1.64 (25.92%) million ha, respectively. SWEPP, BSG, Tigray, and Sidama regions follow with 1.25 (32.08%), 1.23 (24.4%), 0.83 (15.8%) and 0.21 (30.76%) million ha, respectively.

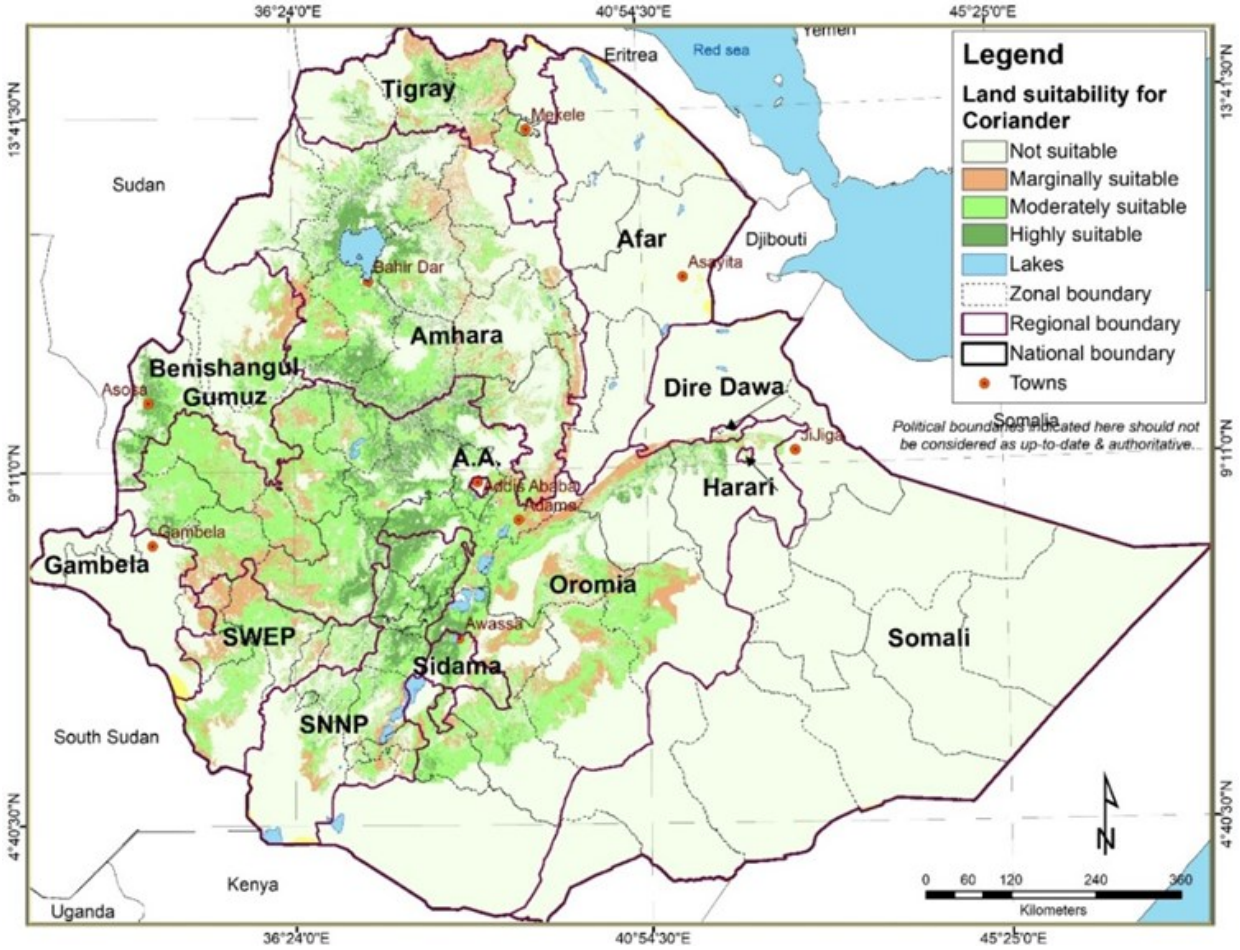


**Figure 6 Land suitability map for Coriander production**

The land suitability for coriander, along with the list of identified potential *woredas* within each relevant zone and region, is provided in *Annex 5*. Considering the combined area of highly and moderately suitable classes, Oromia ranks first with 11.80 million ha (36.51%). That is followed by Amhara, SNNP, BSG, SWEPP, and Tigray with 4.92 (31.60%), 2.44 (38.50%), 1.55 (30.66%), 1.31 (33.45%) and 1.02 (19.33%) million ha, respectively. Assessing the extent of suitability with accuracy, and interpretation of percentages, however, requires considering the total area of each region. For example, the Sidama region is small in terms of area coverage. The highly to a moderately suitable area for Coriander in Sidama accounts for 51.43% of the region, however, it covers only 0.3% of the national share.

The potential for expanding coriander production to new areas is high. Although the current production area in the country is generally small, there is still an opportunity given the good market potential for coriander. This analysis reveals that coriander is suitable to varying degrees in different regions, indicating potential for expanding its production nationwide. Central Oromia, Southwestern Amhara, areas around Lake Tana, and Central Ethiopia, in particular, show high suitability.

### 5.1.5 Fenugreek

As can be shown in Figure 7 below, as a whole, Central Amhara, Central Oromia, Central Ethiopia Region, Sidama and Northern part of SWEPP and Central Tigray show high potential for fenugreek production. The highly and moderately suitable land for fenugreek in the country is estimated to be 18.63 million ha, accounting for 16.45% of the total area of the country. Amhara, Oromia, SNNP, Tigray, and SWEPP regions possess the largest area of highly suitable land, with 2.44 (15.69%), 2.23 (6.92%), 1.15 (18.19%), 0.2 (3.9%) and 0.19 (4.98%) million ha, respectively. For moderately suitable classes, Oromia has extensive areas with about 6.62 (20.48%) million ha. That is followed by Amhara, SNNP, South West Ethiopia, and Tigray regions with 3.20(20.57%), 0.70 (11.02%), 0.69 (17.68%) and 0.58 (10.96%) million ha, respectively.

The land suitability for fenugreek, along with the list of identified potential *woredas* within each relevant zone and region, is provided in *Annex 6*. Considering the combined area of highly and moderately suitable classes, Oromia ranks first with 8.85 million hectares. That is followed by Amhara, SNNP, South West Ethiopia, Tigray, and Sidama with 5.64, 1.85, 0.89, 0.78, and 0.38 million hectares. However, as pointed out earlier, assessing the extent of suitability with accuracy requires taking the total area of each region into account. Relative to its area, the Sidama region, for example, takes the first place with a high proportion (55.7%) of highly and moderately suitable areas for fenugreek. However, it contributes only 0.33% areas relative to the total area of the country.

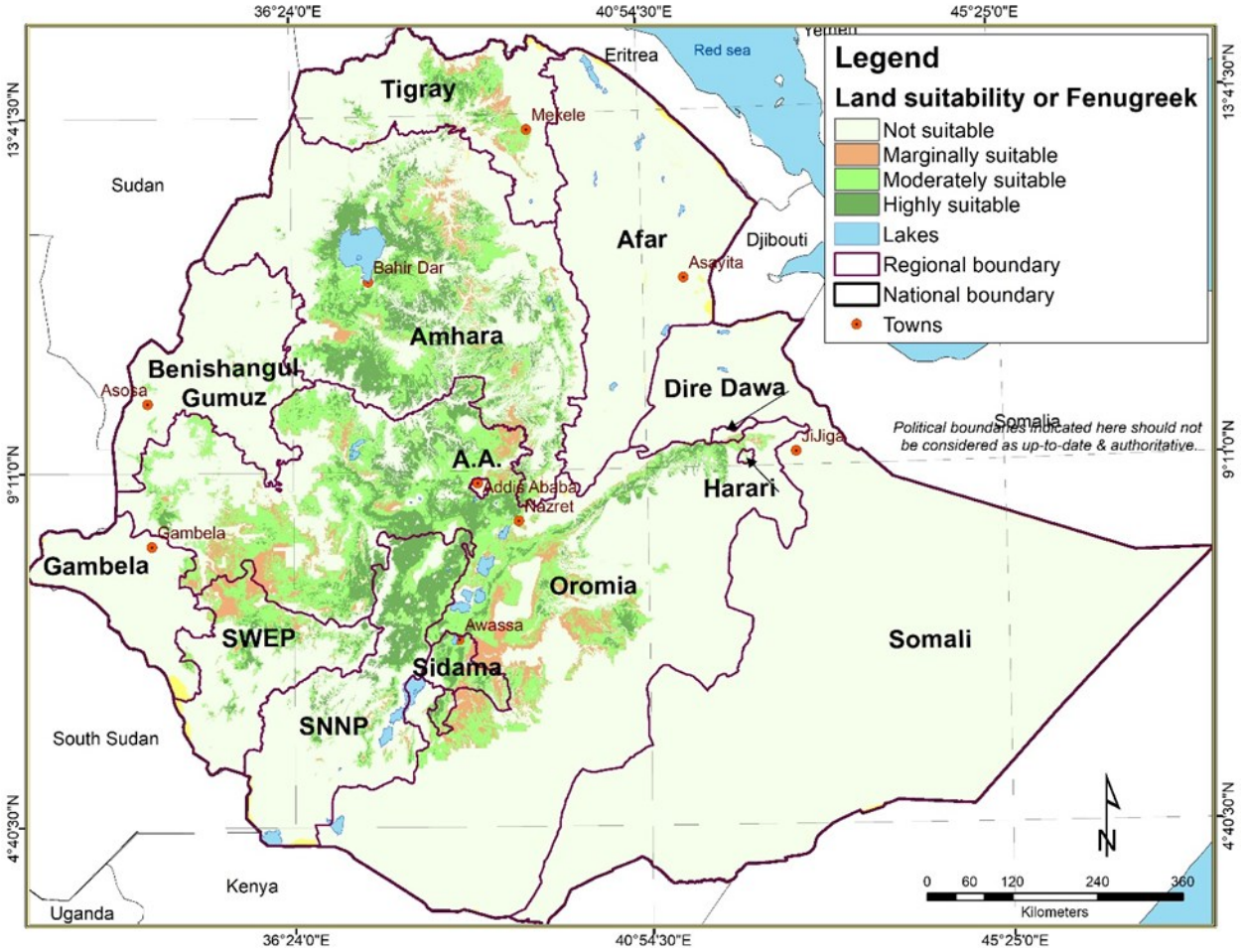


**Figure 7 Land suitability map for fenugreek production**

### 5.1.6 Ginger

The highly, moderately, and marginally suitable lands in the country account for 7.44 (6.57 %), 12.98 (11.46%), and 7.21 (6.36%) million hectares, respectively. The areas that fall within the highly suitable and the moderately suitable classes together represent 18.03% (20.42 million ha) of the total area of the country.

As shown in Figure 8 below, in terms of regional distribution, Benishangul Gumuz (BSG), Oromia, South-West Ethiopia Peoples (SWEPP), Southern Nations Nationalities Peoples (SNNP) and Amhara regions have the largest spatial coverage of highly suitable land, with 2.33 (46.17%), 2.09(6.46%), 1.52(38.79%), 0.58(9.20%), 0.53(3.40%) million hectares in the same order. For moderately suitable classes, Oromia has extensive areas with about 4.44(13.75%). That is followed by Amhara, BSG, SNNP, and SWEPP regions with 2.25 (14.43 %), 2.12(42.13%), 1.60(25.28 %) and 1.04 (26.55%) million hectares, respectively.

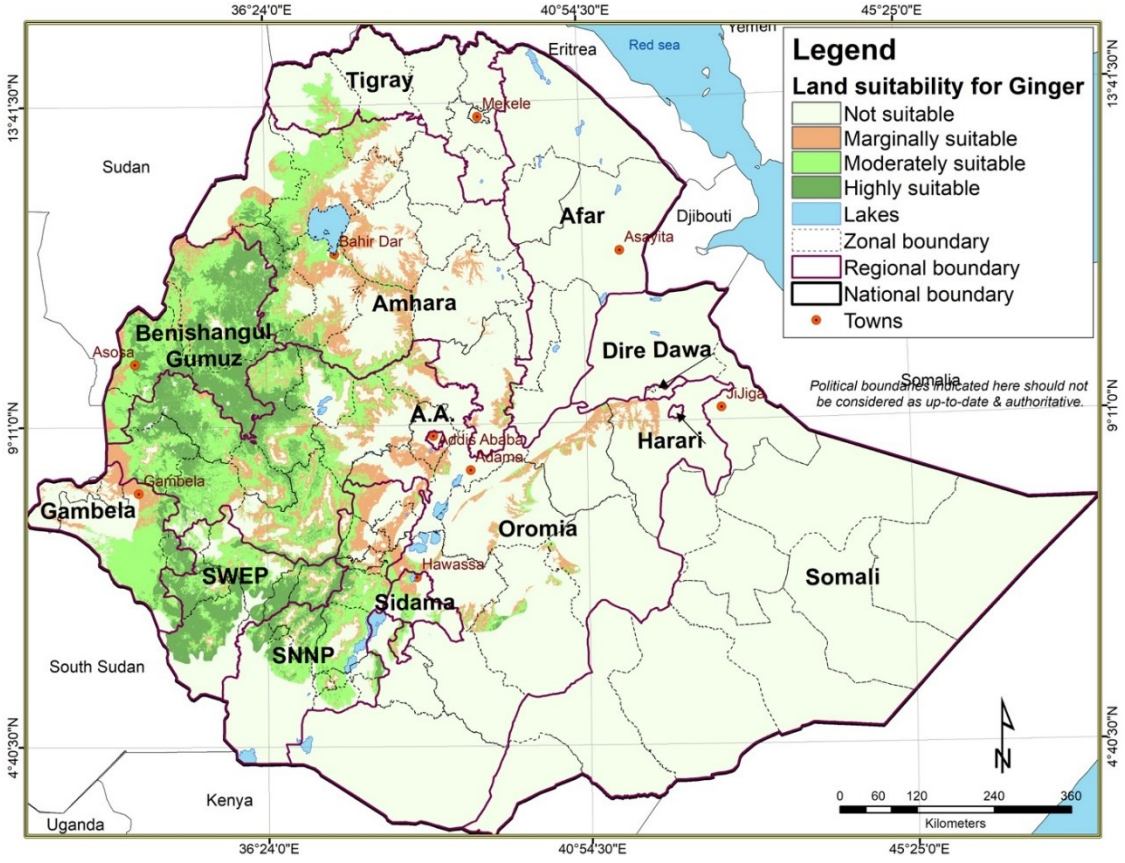


**Figure 8 Land suitability map for Ginger production**

In general, considering the highly and moderately suitable classes combined areas, Oromia stands frist with 6.53 million hectares. BSG, Amhara, SWEPP, SNNP, and Gambela follow in that order. In terms of percentage coverage of the total areas of respective regions, BSG comes first with a significantly high proportion (i.e. 88.29%). That is followed by SWEPP (65.34%), Gambela (45.11%), SNNP (34.47 %), Sidama (24.56 %) and Oromia (20.21 %). While examining the extent of suitability, it is thus important to consider not only the area coverage per region but also the total area of the respective regions.
In terms of the availability of improved ginger varieties, the Jimma Agricultural Research Centre of the Ethiopian Institute of Agricultural Research (EIAR) has released two varieties: Yali and Boziab. Both varieties were released in 2007 (MoA, 2019).

Awi Zone has the most suitable area in the Amhara region. Kamashi, Metekel, and Assosa are zones that stand out in BGR with very high potential for Ginger production in the region. In Oromia, East Wolega, West Wolega, Kelem Wolega, and Horogudru Wolega are zones that have huge potential for Ginger production. It can be said that almost all zones of SWEPP have a high potential for ginger production. The spatial variation in biophysical features within zones has created variations in suitability for ginger of the different *woredas*. The most suitable *woredas* within each zone are provided in Annex 7. It is, however, worth noting that detailed analysis at the *Kebele* and sub-*Kebele* level may be required for making operational decisions.

### 5.1.7 Hot pepper

As indicated in Figure 9, western BSG, some parts of southern Sidama and central Regions show high suitability for hot pepper. The highly and moderately suitable land for hot pepper in the country is 16.83 million ha, representing 14.86 % of the total area of the country. Oromia, Amhara, BSG, SNNP, Tigray, and Gambela, regions possess the largest combined area of highly and moderately suitable land, with 6.81 (21.06%), 3.67 (23.6%), 3.01 (59.71%), 1.91 (30.11%), 0.74 (14.08%), 0.25 (37.06%) and 0.15 (3.81%), million ha, respectively. The result shows that Oromia has extensive areas of highly suitable lands with about 1.82 (5.64%) million ha, followed by Amhara, BSG, SNNP, Tigray, and Gambela with 1.56 (9.99%), 1.04 (20.56%), 1.09 (17.12%), 0.26 (4.89%), 0.06 (1.89%) and 0.17 (25.14%) million ha, respectively.

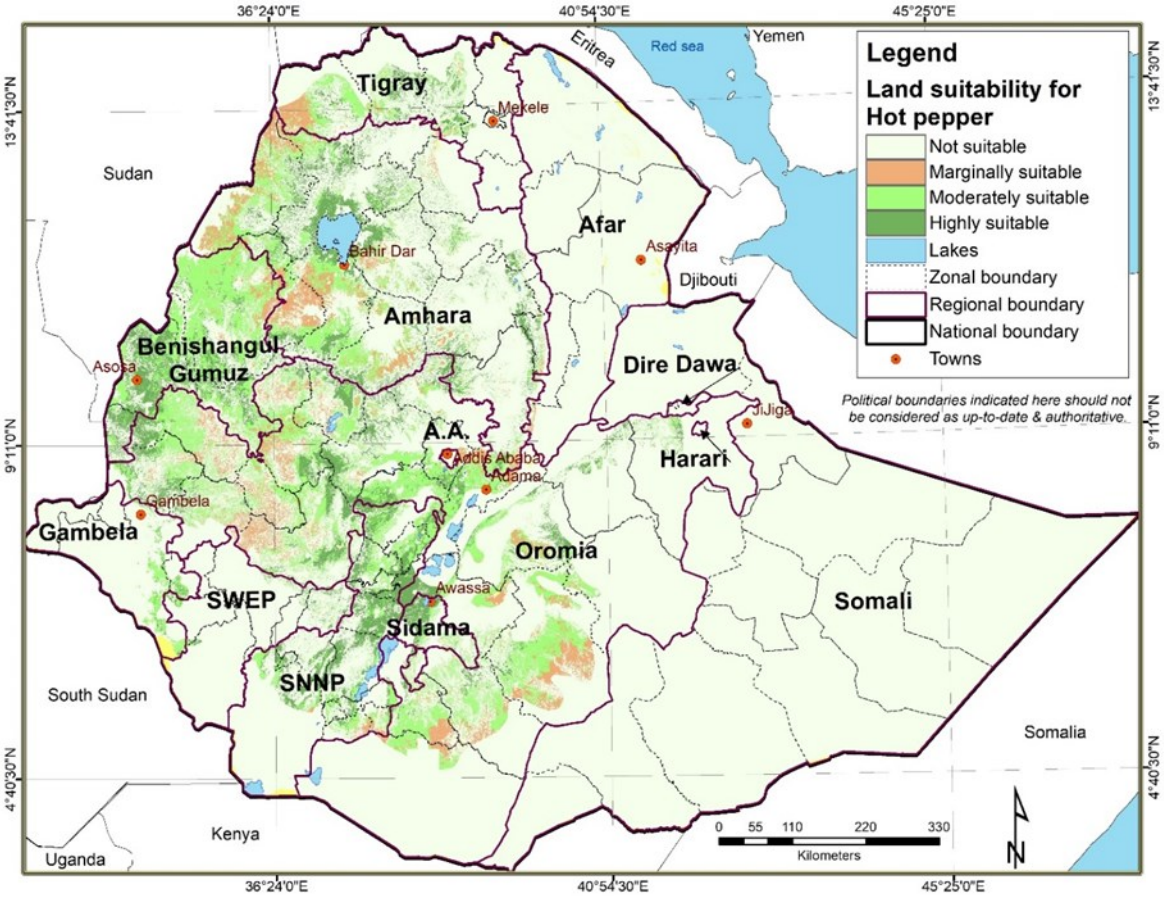


**Figure 9 Land Suitability Map for Hot Pepper Production**

The land suitability for hot pepper, along with the list of identified potential *woredas* within each relevant zone and region, is provided in *Annex 8*. When the combined areas of highly and moderately suitable classes are considered, Oromia ranks first with 6.81 million ha. Then Amhara, BSG, SNNP, Tigray and Gambela follow with 3.67, 3.01, 1.91, 0.74 and 0.27 million ha, respectively. However, to communicate the extent of suitable areas accurately, suitable areas are presented as percentages relative to the total area of each region as well as relative to the zone. For example, BSG and Sidama regions take first and second places with 59.71% and 37.06 % proportion for combined highly and moderately suitable areas of hot pepper relative to their respective total area. Still, their contribution relative to the country's area is only 2.66% and 0.22% highly and moderately suitable areas.

The actual land available for hot pepper production could be lower because some areas might be occupied by or equally suitable for other land uses. Nevertheless, this suitability analysis reveals the potential for expanding hot pepper production to new areas. This is particularly important given the good market opportunity for hot pepper. This analysis reveals that hot pepper is suitable to varying degrees in different regions, indicating the potential for expanding its production nationwide. As presented in Table 8 the federal, regional, and private companies had released 29 improved hot pepper varieties until 2022.

### 5.1.8 Korarima

The land suitability analyses and mapping results for Korarima are presented in Figure 10 and *Annex 9*. The results reveal that the highly, moderately, and marginally suitable lands cover 6.52 (5.76%), 12.28 (10.84%), and 8.18 (7.22 %) million ha of the total area of the country, respectively. The combined area of highly and moderately suitable land for Korarima in the country altogether covers 18.81 million ha, representing 16.61% of the total area.

In terms of regional distribution, Oromia has extensive areas of highly suitable lands with about 4.44 (13.73%) million ha. That is followed by SWEPP, Amhara, BSG, SNNP and Gambela with 0.97 (24.69%), 0.42 (2.69%), 0.3 (5.95%), 0.26 (4.04%), and 0.11 (3.5%) million ha, respectively. Oromia, Amhara, SNNP, BSG, SWEPP, and Sidama regions have 4.76 (14.73%), 2.14 (13.75%), 1.8 (28.35%), 1.75(34.79%), 1.21(31.03%), and 0.27(39.17%) million ha moderately suitable areas, respectively.

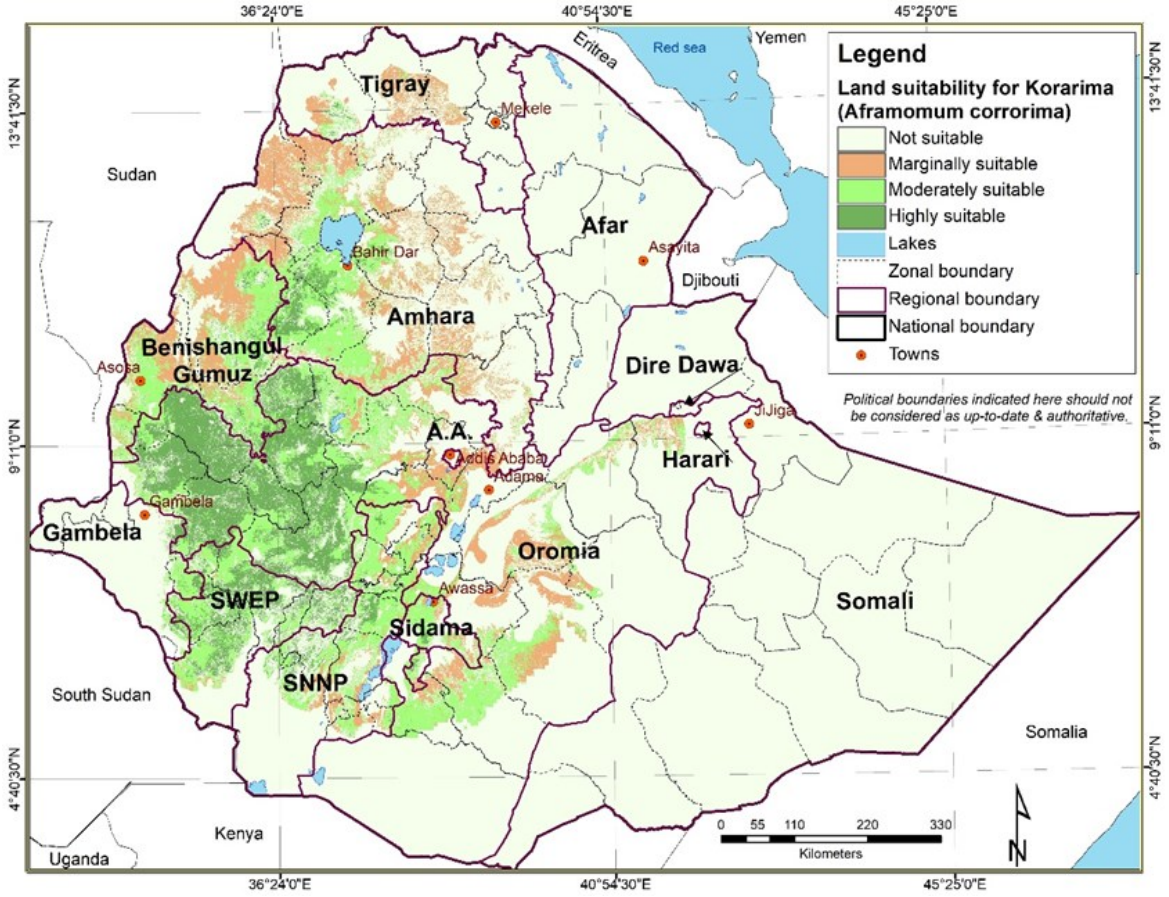


**Figure 10 Land suitability map for Korarima production**

The land suitability for korarima, along with the list of identified potential *woredas* within each relevant zone and region, is provided in *Annex 2*. Oromia, Amhara, SWEPP, SNNP, BSG, and Gambela regions possess the largest combined area of highly and moderately suitable land, with 9.20 (28.46%), 2.56 (16.43%), 2.18 (55.72 %), 2.05 (32.39%), 2.05(40.74%), and 0.36 (11.32%) million ha, respectively. Evaluating the extent of suitability with accuracy requires quantifying the total area of each region. Despite being placed at a lower rank with respect to area cover, the SWEPP region, for example, takes the first place with a proportion of 55.72% combined highly and moderately suitable areas for Korarima. Whereas Sidama (41.24%), BSG (40.74%), SNNP (32.39%), Oromia (28.46%), and Amhara (16.43%) regions follow in that order, regions with smaller total areas contribute generally a smaller percentage of suitable areas relative to the country.

### 5.1.9 Turmeric

The combined area of highly and moderately suitable land for turmeric production in the country is 13.39 million ha, representing 11.82% of the total area of the country. Oromia, Benishangul BSG, Amhara, SNNP, SWEPP, and Gambela regions possess the largest combined area of highly and moderately suitable land, with 4.79 (14.84%), 2.64 (52.36%), 1.89 (12.15%), 1.46 (23.00%), 1.23 (31.56%), and 1.08 (34.39%) million ha, respectively. The result also shows that Oromia has extensive areas of highly suitable lands with about 2.23 (6.89%), million ha, followed by BSG, SWEPP, SNNP, Gambela, and Amhara regions with 1.3 (25.89%), 0.85 (21.69%), (0.6) 19.59%), 0.49 (15.74%) and 0.3 (1.91%) million ha, respectively.

The land suitability for turmeric, along with the list of identified potential *woredas* within each relevant zone and region, is provided in *Annex 11*. When the combined area of highly and moderately suitable classes is considered, Oromia ranks first with 4.79 million hectares. BSG, Amhara, SNNP, SWEP, and Gambela regions follow with 4.79, 2.64, 1.89, 1.46, 1.23 and 1.08 million ha.

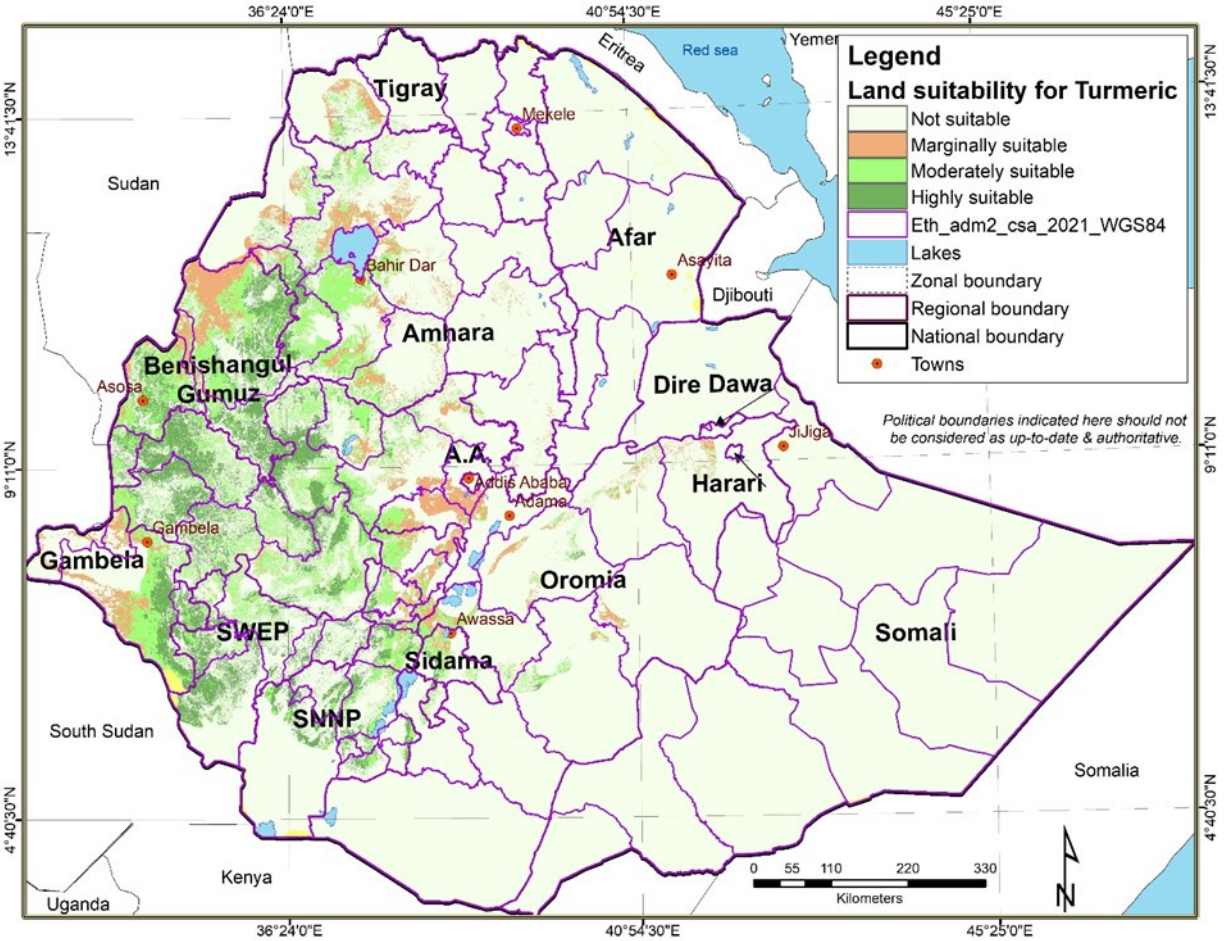


**Figure 11 Land Suitability Map for Turmeric Production**

### 5.1.10 White cumin

Presented in Figure 12 and *Annex 10* are the land suitability analyses and mapping results for white cumin. The result revealed that the highly, moderately, and marginally suitable lands in the country cover 5.46(4.82%), 14.00(12.36%), and 3.18(2.81%) million ha, respectively. In terms of regional distribution, Oromia, Amhara, BSG, SNNP, Tigray and Sidama regions possess the largest combined area of highly and moderately suitable land, with 9.34(28.90%), 4.32 (27.77%), 2.24 (44.53%), 1.98 (31.18%), 1.00 (19.0%) and 0.28 (40.87%) million ha, respectively.

The result also reveals that Oromia has extensive areas of highly suitable lands with about 2.32(4.82%), million ha. That is followed by Amhara, SNNP, BSG, Tigray, and Sidama with 1.81(7.19%), 0.74(11.64%), 0.34(11.63%), 0.13(6.78%) and 0.06(2.38%) million ha, respectively. With respect to the moderately suitable areas, Oromia, Amhara, BSG, SNNP, Tigray and Sidama regions have 7.01(21.71%), 2.51(16.13%), 1.9 (37.74%), 1.24 (19.55%), 0.88 (16.65%) and 0.22 (32.69%) million ha, respectively.

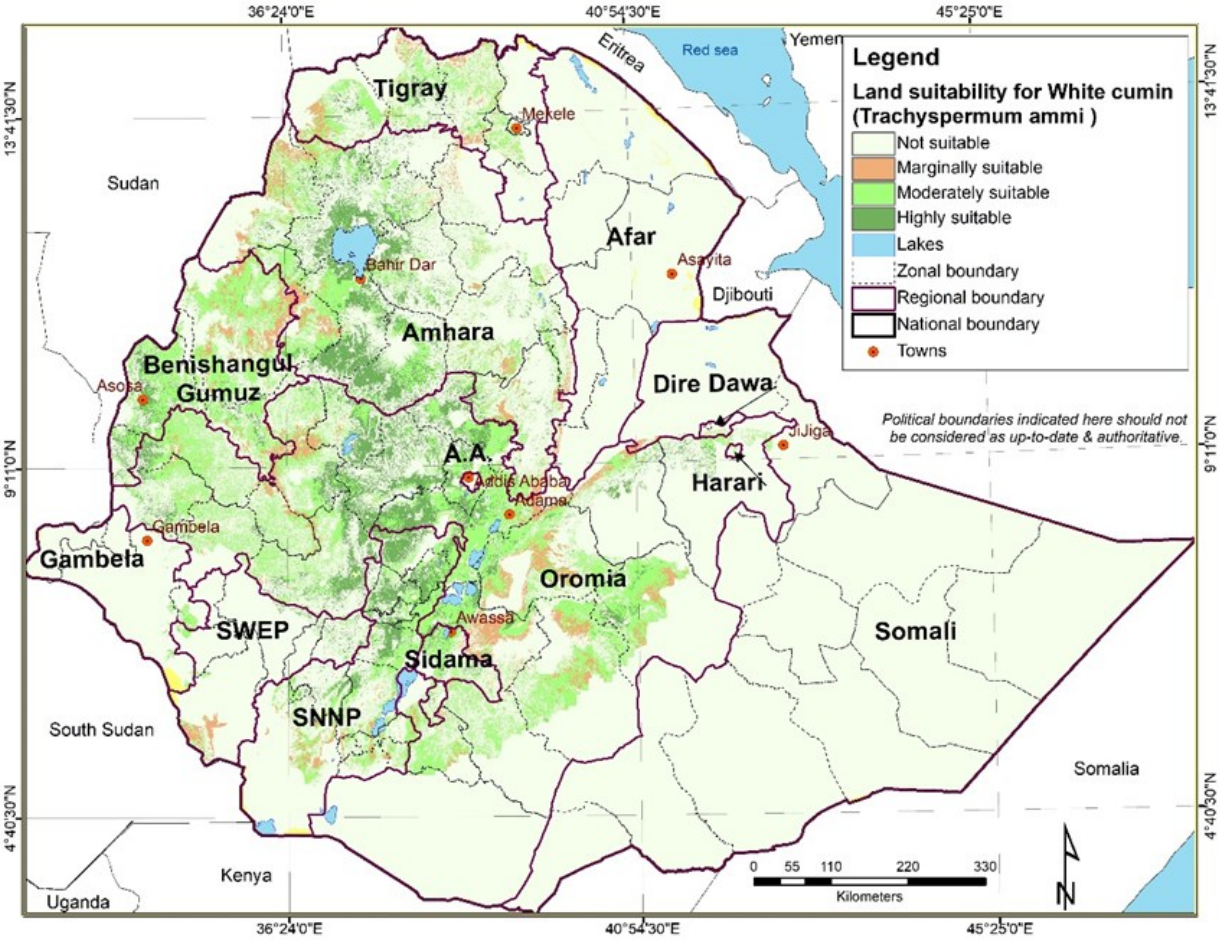


**Figure 12 Land Suitability Map for White Cumin Production**

The land suitability for hot pepper, along with the list of identified potential *woredas* within each relevant zone and region, is detailed in *Annex 2*. To evaluate the extent of suitability accurately, the total area of each region has been considered. Despite having a relatively smaller total area, the BSG region, for example, takes ranks first with a proportion of 44.53% combined highly and moderately suitable areas for white cumin. Sidama (40.87%), SNNP (31.18%), Oromia (28.9%), and Amhara (27.77%) regions follow in that order.

# 6 Socio-economic suitability

## 6.1 Accessibility

When examining the productivity of a given crop, spices in this case, examining the issue of accessibility is very important. Areas identified as agroecologically suitable for various spice production could provide the expected productivity and production if only other socioeconomic factors that affect the input-output supply system are accessible. Access to key agricultural inputs and services required for production depends on how close an area is to input and service centres (Farrow et al. 2011). Figure 13 provides results of accessibility modelling considering travel time to the marketplace and roads as proxies for access to essential inputs and services. The map also highlights areas with easy to difficult range of accessibility conditions.

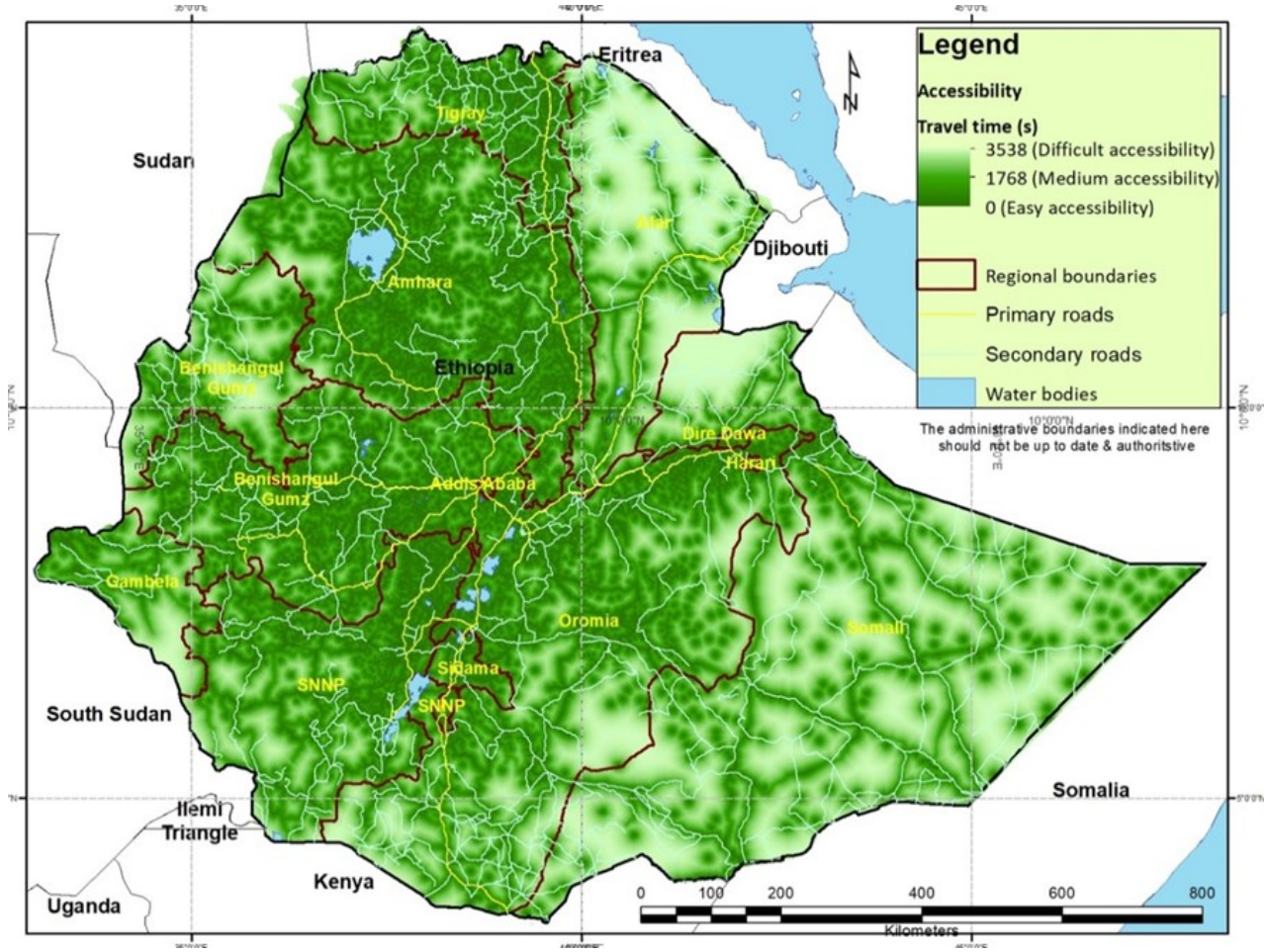


**Figure 13 Map of Travel Time as Proxy for Access to Essential Inputs and Services**

Generally speaking, it can be said that the northeastern, and southeastern covering large areas of Ethiopia including Afar and Somali, as well as large areas of western and southwestern areas of Ethiopia including Benishangul Gumuz, Southwest, and Gambella regions show long travel time to roads and market centres. Most of the North-eastern and south-eastern areas are not biophysically suitable for spice production implying that accessibility has not much implication for spice production expansion.

However, some areas with high to medium difficulty levels of accessibility have overlapped with highly to moderately suitable areas of spice production. For example, other than the eastern part of the Sidama region which shows medium accessibility implying that fenugreek is less affected by accessibility, most of the highly and moderately suitable areas for fenugreek are found in highly accessible areas.

Accessibility could potentially limit scaling of (i) black pepper, cardamom, Korarima, and turmeric in most of Benishangul region, south-eastern parts of Gambela, and southwestern parts of Southwest Ethiopia region; (ii) black cumin, coriander, hot pepper, white cumin in large areas of Benishangul and southeastern Oromia, where bio-physical conditions range from moderate to highly suitable. However, it is important to recognize that areas with difficulty to access will influence the overall suitability condition even for areas deemed highly suitable based on biophysical factors. This implies that scaling strategies to expand spice production could also include strategies that improve accessibility.

## 6.2 Spice Farmer Segmentation in Ethiopia

Globally, spice production can be segmented into various categories based on some characteristics (e.g., speciality of the spice, scale of operation**,** focus of farming*)*. Segmentations could be based on the *speciality of the spice* that farmers mostly produce. That refers to market-oriented production in which farmers decide to specialize on selected spices that provides the producers with comparative market or processing advantage. It could also be based on *scale of operation* where farmers differ based on the scale at which they produce spice. The scale spans from small scale using small plots to relatively large-scale commercial farms by private farms or group of farmers. The *focus of Farming* practice is also another area for farmers' segmentation. While some farmers focus on organic production practices that offers them additional price incentives from the growing market for health-conscious community, others follow conventional methods involving the use of inorganic inputs.

The segmentation of Ethiopian spice farmers shares a lot of commonalities with the global practice. The majority of the current spice production is performed under smallholder farming which can be characterized by *small-scale, backyard spice production*. Most Ethiopian farmers have the culture of cultivating selected spices in their backyards mostly for household consumption. Additionally, they often bring a portion of their harvest to the local markets. This allows them to generate income for buying various necessities or to barter the spices directly for goods they desire.

Community-based production is another form of spice production that is widely practiced. In areas where spice production is already a common practice by many farmers, there initiatives that encourage farmers to organize themselves into unions or associations that agree to produce similar spice and follow similar production practices. Production of that kind is mostly market oriented. Some experience is available with seed spices around the Shirka area in the Arsi Zone.

There is also an increasing interest in the private sector to be involved in spice production. These types of producers mostly try to address the value chain i.e. they tend to be involved in the production, value addition, and export/marketing.

Farmers segmentation could also be driven by geographical location. Depending on how suitable a particular area is to produce high quality spice the spice could easily be a brand name. A popular brand that can be cited as an example in that regard is the "Halaba's Berbere" i.e. the "Pepper from Halaba area".

## 6.3 Competing crops

Farmers' production decisions in the light of optimization of farm income are subject to several alternative uses of the land as well as constraints posed by food security, long-term sustainability, and resilience. This is because, biophysically, the land could be highly suitable for a number of crops. However, decisions are made, therefore, taking into account other biophysical requirements such as

rotation, agroforestry, and/or intercropping. Alternatively, key socioeconomic drivers including inputs required, market availability, culture, profitability compared with alternative uses and so on can be considered. The maps of suitability analysis (see section 5.1) show that the areas identified as highly and moderately suitable for most spices have a considerable overlap for multiple crops. This means most spices compete for land, particularly in central, southwestern, western, and northwestern parts of Ethiopia. Furthermore, spice production in these areas competes with the current farming system dominated by cereals and pulses. The actual production decision on a plot of land needs to, therefore, be informed by a detailed understanding of the viability of the business model taking into account the available alternatives. This calls for building the capacity of the extension service in such a way that it would provide optimal enterprise choice support for farmers and private sectors.

# 7 Strategies and measures for spice sector development

## 7.1 Varietal testing, demonstration, and popularization

Given the agroecological diversity of the country where one can find production potential diversities even with a *kebele*, testing available technologies for each of the identified potential areas is very crucial. Adaptation of the technology is tested and validated for its suitability. The next step to take is demonstration of the technology by agricultural researchers and extension experts to showcase the performance along with the different practices required in the use of the technology. Demonstrations are often undertaken with selected model farmers who have goodwill among the community and experiences in influencing other farmers. The number of participating farmers along with the size of land for demonstration varies by spices type. Following the demonstration of the technology, popularization activities follow. In this situation, the main role of agricultural researchers is the provision of the technology. Extension experts on their part should take the lead in selecting target farmers and disseminating the technology with the required extension service. Target farmers are often selected among those farmers from other *kebeles* and *woredas* who had a chance to visit the demonstration fields.

For most of the released varieties of spices, the releasing agricultural research centres have been engaged in varietal development, adaptation, demonstration, and popularization in nearby areas. The national variety register indicates that Tepi, Sinana, Debre Zeit, Jimma, Melkassa, Gondar, Adame Tulu, and Sirinka Agricultural Research Centres are the research centres that have so far released varieties for the different spices (EAA, 2022). However, given the importance and wider coverage of potential areas for spice production, there is a need to involve other agricultural research centres under Ethiopian Institute of Agricultural Research (EIAR) and Regional Agricultural Research Institutes in the testing, demonstration and popularization of the different varieties of spices as per the identified highly suitable areas for these 10 major spices: hot pepper, ginger, black cumin, white cumin, fenugreek, coriander, black pepper, korarima, turmeric and cardamom.

Including Tepi, Sinana, Debre Zeit, Jimma, Melkassa Gondar, Adame Tulu and Sirinka that released the different varieties of spices, the main role of the agricultural research centres will be: (i) multiplication and provision of initial technology for the other research centres; (ii) provision of backstopping support mainly in production practices; (iii) generation of improved production practices like IPM, post-harvest management that improves safety and processing innovations together with participating research centres; and (iv) engagement in further testing, demonstration, and popularization in suggested target suitable *woredas*. The main role of participating centres will be testing, demonstrating and popularizing of the identified suitable varieties of spices. Engaging further in developing improved practices as per the agroecological condition of the target suitable areas is another key role awaiting the participating research centres.

Presented in the sub-sections that follow are the lists of the responsible agricultural research centres along with highly suitable mandate zones by region. With the recognition of the need for a comprehensive approach in promoting the production of new crops, especially spices that need special skill and knowledge in agronomic practices and disease and pest control techniques, only highly suitable areas are targeted. With that in mind, lists of zones and research centres under each region are presented in Tables 10 to 19.

### 7.1.1 Black cumin

Black cumin variety development has been undertaken by Sinana, Kulumsa, Melkassa, and Tepi Agricultural Research Centres. The majority of the varieties were released by the Sinana Agricultural

Research Centre of OARI. Further testing, demonstration, and popularization need to be done in new highly suitable areas.

**Table 10 Suggested research centres for testing, demonstration and popularization of black cumin innovations**

| Region | Research centre | Zones having highly suitable areas for black cumin |
|---|---|---|
| Oromia | Holeta, Kulumsa, Ambo ARC, EIAR; Sinana, Bako/Haro Sebu ARC, OARI | South West Shewa, West Shewa, Finfine Sp. North Shewa, East Shewa, Horo Gudru Wellega West Arsi, Arsi, Jimma, East Wellega, Kelem Wellega, West Hararge, East Bale |
| Amhara | Adet & Gondar ARCs | East Gojam, West Gojam, Central Gondar, South Gondar, Awi, North Shewa, North Gondar, South Wello |
| SNNP (Central Ethiopia & South Ethiopia) | Worabe ARC, CEARI; Areka ARC, SEARI | Halaba, Siltie, Guraghe, Hadiya, Kembata Tembaro, Wolayita, Yem, Gedeo, Basketo |
| BSG | Assosa ARC, EIAR | Assosa, Mao Komo |
| Sidama | Hawassa ARC, Wondo Genet/Awada ARC | Sidama |
| Tigray | Mekelle ARC, TARI | North Western, Central, South Eastern |
| SWEPP | Tepi ARC, EIAR | Dawuro, Kaffa |
| Dire Dawa | Dire Dawa University, Haramaya University | Dire Dawa rural |

### 7.1.2 Black pepper

Some cultivars of black pepper were tested in Tepi and Bebeka areas. Two varieties of black pepper, Gacheb and Tato were released by Jima Agricultural Research Centre of EIAR (EAA, 2022; MoA, 2018). Commercial farms are producing black pepper. Based on the suitability of the environment, it is suggested that other centres test, demonstrate, and popularize black pepper innovations.

**Table 11 Suggested research centres for testing, demonstration and popularization of black pepper innovations**

| Region | Research Centre | Zones with highly suitable areas |
|---|---|---|
| Oromia | Jimma ARC, EIAR; Bedele, Haro Sebu ARC, OARI | Kelem Wellega, West Wellega, East Wellega Ilu Aba Bora, Buno Bedele, Jimma, H. G. Wellega |
| SWEP | Tepi ARC, EIAR, Bonga ARC | Bench Sheko, Konta, Mirab Omo, Dawuro, Sheka, Kaffa |
| BSG | Assosa/Pawe ARC | Kamashi, Mao Komo Sp., Metekel, Assosa |
| SNNP | Worabe & Areka ARCs | Basketo, Gofa, Wolayita, Gamo, Derashe, Amaro, Yem, South Omo, Alle, Ari, Hadiya |
| Gambela | Abobo ARC, EIAR, Tepi ARC | Majang, Agnewak |
| Amhara | Adet ARC, ARARI | Awi, West Gojam |
| Sidama | Hawassa ARC | Sidama |

### 7.1.3 Cardamom

Two ecotypes of cardamom, Mysore erect type of panicle and Malabar prostrate type of panicle were introduced to Ethiopia in the late 1970s. After introduction, multiplication of the planting materials was

made at Tepi, Bebeka, and Jimma. Adaptability and evaluation studies continued at Tepi, Bebeka, Jimma, Metu, Mugi, and Wonago. It has been proven that cardamom can be produced in Ethiopia with globally acceptable quality standards. However, the efforts made so far are limited and it needs further introduction of cardamom genotypes, testing, demonstration, and popularization to realize the potential benefits.

**Table 12 Suggested Research Centres for testing, demonstration and popularization of cardamom in different regions of Ethiopia**

| Region | Research centre/Institute | Zone with highly suitable areas |
|---|---|---|
| Oromia | Haro Sebu, Bedele, Bako, OARI | West Wellega, Ilu Aba Bora, Buno Bedele, East Wellega, Kelem Wellega, Jimma, and Horro Guduru Wellega |
| SWEP | Tepi, EIAR, Bonga | Konta, Bench Sheko, Dawuro, Sheka, Kaffa and Mirab Omo |
| Benshangul Gumuz | Assosa, Pawe ARC, EIAR | Kamashi, Metekel, Mao Komo Sp., Assosa |
| South Ethiopia | Areka & Jinka, SEARI | Basketo, Gofa, Wolayita, Gamo, and Ari |
| Gambela | Tepi, Abobo, EIAR | Majang and Agnewak |
| Amhara | Adet, ARARI | Awi, West Gojam |
| Tigray | Mekelle, TARI | Western zone |

### 7.1.4 Coriander

Some varieties of coriander have already been released by Sinana, Adami Tullu, Kulumsa, and DebreZeit Agricultural Research Centres. These varieties can be verified and promoted in other suitable areas. Further testing, demonstration, and popularization activities for the areas with high potential are also important.

**Table 13 Suggested research centres for testing, demonstration and popularization of coriander innovations**

| Region | Research Centre | Zones having highly suitable areas for coriander |
|---|---|---|
| Oromia | Holeta, Jimma ARC, Haro Sebu/Bako ARC, Jimma Univ. | SW Shewa, West Shewa, North Shewa, H.G. Wellega, Jimma, Finfine Sp., West Arsi, Kelem Wellega, East Shewa |
| Amhara | Adet/Gondar ARC | West Gojam, East Gojam, Central Gondar, S. Gondar N. Gondar, Awi |
| SNNP | Areka ARC | Halaba, Hadiya, Guraghe, Siltie, Wolayita, K. Tembaro Yem Special, Basketo |
| BSG | Assosa ARC | Mao Komo Sp., Assosa |
| Tigray | Mekelle ARC | NW Tigray, Central Tigray, W. Tigray |
| Sidama | Hawassa ARC | Sidama |
| SWEP | Tepi/Bonga ARC | Dawuro, Kaffa |

### 7.1.5 Fenugreek

So far, some fenugreek varieties have been released by Sinana, Debre Zeit, Sirinka, and Tepi Agricultural Research Centres. Further testing, demonstration, and popularization of fenugreek innovations by other centres are required in new but suitable areas.

**Table 14 Suggested research centres for testing, demonstration and popularization of fenugreek innovations**

| Region | Research Centre | Zones having highly suitable areas for fenugreek |
|---|---|---|
| Amhara | Adet, Gondar, Debre Berhan ARCs of ARARI | West Gojam, South Gondar, East Gojam, Central Gondar, South Wello, North Shewa, N. Gondar, Awi |
| Oromia | Holeta & DebreZeit, Jimma ARCs of EIAR; Sinana ARC, OARI, Jimma Univ. | S W. Shewa, West Shewa, Finfine Sp., North Shewa, Jimma, East Shewa, H. G. Wellega, W. Hararge, Kelem Wellega, Arsi, West Arsi, East Wellega, E. Hararge, East Bale |
| SNNP | Areka ARC, SEARI | Wolayita, Halaba, Gedeo, Gamo, Basketo, Derashe, Alle Gofa |
| SWEP | Tepi/Bonga ARC | Dawuro, Kaffa, Bench Sheko |
| Tigray<br>Sidama | Mekelle ARC<br>Hawassa ARC | Central, N. Western, Western<br>Sidama |

### 7.1.6 Ginger

Ginger variety evaluation has been conducted by Jimma and Tepi Agricultural Research Centres. Some ginger varieties have also been released by the Jimma Agricultural Research Centre of the EIAR. Farmers in the 'ginger belt' around the Hadero and Bombe areas are using locally available varieties. The disease complex has been threatening ginger production in Central and South Ethiopia regions. Testing, demonstration, and popularization of ginger innovations in new areas can help in getting economic benefits from this spice.

**Table 15 Suggested research centres for testing, demonstration and popularization of ginger innovations**

| Region | Research centre | Zones having highly suitable areas for ginger |
|---|---|---|
| Benshangual Gumuz | Assosa ARC, EIAR | Kamashi, Metekel, Assosa, Mao Komo Special |
| Oromia | Bako & Haro Sebu ARC, OARI | West Wellega, East Wellega, Kelem Wellega, Ilu Aba Bora, Buno Bedele, Horo Guduru Wellega, Jimma, West Shewa |
| SWEP | Tepi ARC, EIAR | Konta Special, Bench Sheko, Dawuro, Mirab Omo, Sheka, Kefa |
| SNNPR (now Central Ethiopia & South Ethiopia) | Worabe ARC, CEARI; Areka & Jinka ARCs, SEARI | Central Ethiopia: Kembata Tembaro, Hadiya<br>South Ethiopia: Basketo, Gofa, Amaro, Wolayita, South Omo, Gamo, Gedeo, Burji, Derashe, Alle, Konso |
| Amhara | Adet & Gondar ARCs, ARARI | Awi, West Gojam, Central Gondar, West Gondar, East Gondar |
| Gambela | Abobo ARC, EIAR | Majang, Agnewk |
| Sidama | Hawassa ARC | Sidama |

### 7.1.7 Hot pepper

Hot pepper research has been ongoing, and several varieties have been released by Melkassa, Bako, Haro Sabu Agricultural Research Centres and private companies. The efforts made should extend to the potential areas, especially in the highly suitable areas with available cultivation areas. In addition to variety development, other production practices like IPM (Integrated Pest Management) and post-harvest management that improve safety and processing innovations have to be developed/adapted, demonstrated, and popularized.

**Table 16 Suggested research centres for testing, demonstration and popularization of hot pepper innovations**

| Region | Research centre | Zones having highly suitable areas for hot pepper |
|---|---|---|
| Oromia | Melkassa, EIAR, Bako and Haro Sebu of OARI | Kelem Wellega, West Shewa, S. W. Shewa, H. G. Wellega, Jimma, West Wellega, North Shewa West Arsi, East Wellega, Finfine Special, East Shewa |
| Amhara | Adet, Gondar ARC, | Central Gondar, West Gojam, Oromo sp. Zone, South Gondar, North Shewa, Awi, East Gojam, North Gondar and West Gondar |
| Central Ethiopia | Worabe ARC, CEARI | Halaba, Hadiya, Siltie, Guraghe, Kembata Tembaro and Yem Special |
| South Ethiopia | Areka ARC, SEARI | Wolayita, Basketo, Derashe, Gofa and Gamo |
| BSG | Assosa/Pawe ARC | Assosa, Mao Komo Sp., Kamashi and Metekel |
| Tigray | Mekelle ARC, TARI | N. Western, Central and Western |
| Sidama | Hawassa ARC | Sidama |
| SWEP | Tepi ARC, EIAR, Bonga ARC | Dawuro, Konta Special and Bench Sheko |

### 7.1.8 Korarima

There are korarima accessions in field gene bank of the Ethiopian Biodiversity Institute. The accessions can pass through varietal development procedure to release variety and promoted in suitable areas. Tepi Agricultural Research has been involved in collecting and conserving the germplasms.

**Table 17 Suggested research centres for testing, demonstration and popularization of korarima innovations**

| Region | Research Centre | Zones having highly suitable areas |
|---|---|---|
| Oromia | Jimma ARC, EIAR; Haro Sebu and Bako ARCs | West Wellega, Ilu Aba Bora, Buno Bedele, East Wellega, Kelem Wellega, Jimma, H. G. Wellega, West Shewa |
| SWEP | Tepi ARC, EIAR, Bonga ARC | Kaffa, Sheka, Bench Sheko, Dawuro, Konta Sp., Mirab Omo |
| Amhara | Gondar ARC | Awi, West Gojam, South Gondar, West Gondar, Central Gondar |
| BSG | Assosa/Pawi ARC | Kamashi, Metekel, Mao Komo Sp, Assosa |
| SNNP (now Central Ethiopia & South Ethiopia regions) | Worabe ARC, CEARI; Areka ARC, SEARI | Central Eth: Kembata Tembaro, Yem Special, Gurage, Hadiya South Eth: Basketo, Wolayita, Gofa, Gedeo, Burji, Gamo, South Omo & Ari |
| Gambela | Abobo ARC, EIAR | Majang, Agnewak |
| Tigray | Mekelle ARC, TARI | Western |
| Sidama | Hawassa ARC | Sidama |

### 7.1.9 Turmeric

A few genotypes of turmeric have already been introduced, tested, and put under cultivation. Still, further efforts are needed to introduce genotypes and develop varieties with other accompanied innovations.

**Table 18 Suggested research centres for testing, demonstration and popularization of turmeric innovations**

| Region | Research Centre | Zones having highly suitable areas |
|---|---|---|
| Oromia | Jimma ARC, EIAR; Haro Sebu ARC, OARI | Kelem Wellega, East Wellega, Ilu Aba Bora, Buno Bedele, Jimma, Horo Guduru Wellega, West Shewa |
| BSG | Assosa/Pawe ARC, EIAR | Kamashi, Mao Komo Sp., Assosa, Metekel |
| SWEPP | Tepi ARC, EIAR, Bonga ARC | Bench Sheko, Konta Special, Mirab Omo, Sheka, Dawuro, Kaffa |
| SNNP | Areka ARC, SEARI | Basketo, Wolayita, Gofa, Derashe, Konso, Alle, Amaro, Kembata Tembaro, Gamo, Hadiya, Burji, South Omo |
| Gambela | Abobo ARC | Majang, Agnewak |
| Amhara | Adet, Gondar ARC | Awi, West Gojam, Central Gondar, East Gojam |

### 7.1.10 White cumin

Two varieties (Dembia-1 and Takusa-1) of white cumin were released by the Gondar Agricultural Research Centre in 2017. Based on the suitability of the environment, further efforts needed to be made, including testing, demonstration, and popularization, to benefit from white cumin.

**Table 19 Suggested research centres for testing, demonstration and popularization of white cumin innovations**

| Region | Research Centre | Zones having highly suitable areas for white cumin |
|---|---|---|
| Oromia | Holeta, Jimma ARC; Sinana ARC, Jimma Univ. | S.W. Shewa, Finfine Sp., West Shewa East Shewa, North Shewa, H. G. Wellega, West Arsi, Arsi, Jimma, East Wellega, West Hararge, Bale, Guji |
| Amhara | Adet & Gondar ARCs, ARARI | East Gojam, West Gojam, Central Gondar, South Gondar, North Shewa, Awi, North Gondar, South Wello |
| SNNP | Areka ARC; Worabe ARC | Halaba, Siltie, Hadiya, Guraghe, Kembata Tembaro, Wolayita, Yem Special, Gedeo, Basketo |
| Sidama | Hawassa ARC | Sidama |
| Tigray | Mekelle ARC | N. Western, Central, S. Eastern |
| BSG | Assosa/Pawe ARC | Assosa, Mao Komo Sp. |
| SWEPP | Bonga ARC | Dawuro, Kaffa |
| Dire Dawa | Dire Dawa University | Dire Dawa |

## 7.2 Testing, demonstration and popularization of production and Processing technologies

As discussed in great details earlier, in Ethiopia, production of spices rather is limited, and productivity is very low because of limited or no use of improved varieties and as a result of traditional farming practices employed in the country. In order to enhance the production, productivity, and quality of spices, using inputs, improved high-yielding varieties, and processing technologies is essential. To realize this, increasing the availability, accessibility, and affordability of inputs and improved technologies is very important. Introducing, testing, validating, and promoting new processing technologies is crucial for expanding market reach and increasing export and revenue. Focusing on improving the knowledge and skill base of producers, processors, and traders is critical for improving the

processing capability and quality of products. Exerting emphasis on infrastructure development and modernizing the marketing system is equally essential to bring about improved value chain development. Promoting institutional alignment and collaboration; incentivizing local and foreign investment; liberalizing the marketing system and targeting lucrative export destinations are also crucial for enhancing export performance and improving smallholder farmers' income.

## 7.3 Rural Technology Development and Promotion Centres (RTDPC) and Agricultural Innovation and Technology Centres (AITEC)

Rural technology development and promotion centres (RTDPC) were established to develop, multiply, promote, and disseminate post-harvest; improve labour, time, and energy-saving technologies; and introduce innovations for the cottage industries (WIE, 2001). Technological progress and innovation are essential for sustainable development and are major determinants of long-term improvements in production, processing, export marketing, income, and living standards of farmers. To that effect, nine regional, two national, one university, one Federal Research Centre, and one NGO-owned innovation centres consisting of nine metal and wood workshops have been established (see Table 20). The workshops of the Centres are similar in design as well as prototypes and manufactured technologies are very similar. They have the capacity to produce technologies that meet the specific needs of the communities they serve. The Sodo Rural Technology and Promotion Centre have, for example, been producing enset processors and bulla squeezers. The focus of the technology centres in cereal growing areas has on the other hand been, on threshers and shellers.

Recently, two Agricultural Innovation and Technology Centres (AITEC) have also been established in Abergelle and Belessa *woredas* of Tigray and Amhara regions, respectively. The AITECs are of medium-scale, economically self-sustainable farms that act as a regional mechanism for agricultural development, extension, research, capacity building and overall transformation of the agriculture sector. The AITECs were intended to serve as pathways for the integrated introduction and demonstration of innovations and technologies for horticulture, water management, storage, quality, transport, monitoring, and irrigation utilization for crop farming and livestock production (Sinamo, 2019).

In spite of that, there is generally a clear gap in the technologies needed and technologies developed so far by technology developers. Moreover, the total number of technologies developed and transferred is much higher than the technologies used so far. To close the existing gap in the spice subsector, the centres should give due attention to the need assessment before developing any technology. Moreover, technology developers need to involve women farmers from the outset to ensure their participation in choice and to make technologies responsive to the specific needs of women. Besides, in order to avoid unnecessary duplication and wastage of resources, there should be coordination and formal synergy between technology developers and disseminators. To meet the emerging requirements of local and international markets and consumers, the capacity of the existing rural technology development centres has to also be strengthened.

**Table 20 Rural technology innovation centres in Ethiopia that could support spice sector development**

| No | Innovation Centre | Region/ Location | Proximity to spice production zones |
|---|---|---|---|
| 1 | Assela Rural Technology Centre | Oromia/ Arsi and Bale | Seed spices |
| 2 | Bako Rural Technology Promotion Centre | Oromia, Bako | Fruity spices/red pepper |
| 3 | Bahir Dar Rural Technology Centre | Amhara region | Seed spices, rhizome/root, fruity spices, |
| 4 | Kombolacha Rural Technology Promotion Centre | Amhara region | Seed spices |
| 5 | Harar Rural Technology Centre | Harari National Regional State | All spices |
| 6 | Jimma Rural Technology Centre | Oromai Jimma | Rhizome/root, seed spices, fruity spices |
| 7 | Mekelle Rural Technology & Promotion Centre | Tigray Regional State | Seed spices |
| 8 | Mizan Rural Technology Promotion Centre | SNNPRS | Rhizome/root, seed spices, fruity spices, bark |
| 9 | Soddo Rural Technology promotion Centre | SNNPRS | Seed spices, rhizome/root spices |
| 10 | Selam Technical & Vocational Centre (STVC) | Addis Ababa/ NGO | All spices |
| 11 | Basic Metals Industries and Engineering Agency (BMEIA) | Addis Ababa | All spices |
| 12 | Melkassa Agricultural Mechanization Research Centre/ Ethiopian Agricultural Research Organization (EARO) | Melkassa/EARO Oromia | All spices |
| 13 | Home Science and Technology Department of the DEBUB University | Hawassa/ SNNPRS | All spices |

## 7.4 Promoting commercial production and processing

As discussed in the previous section, spice cultivation in Ethiopia is mainly operated by smallholder farmers because of lack of information, extension support, lack of technology use, lack of market linkage and lack of road access and other infrastructure in the suitable agroecologies for the majority of spice production. As a result, the spice subsector has so far been underdeveloped and non-commercialized. Nevertheless, there is, however, a huge potential for spice commercialization both in connection with smallholder commercial and large-scale commercial farms. Unsurprisingly majority of farmers produce spices for marketing at various levels of intensity and specialization. These categories of farmers are on the verge of graduation and can be commercialized through improving the availability and accessibility of innovations, finance, and extension support, including business planning, financial literacy, access to service and processing centres as well as market information delivery. The large-scale commercial farms are attracting mechanization, capital, and knowledge investment into the area. Large scale commercialization of spices production is expected to be accompanied by intensification, product diversification and specialization, export marketing, economic growth, and urbanization of the areas.

Commercializing spice production and processing is essential to bring new products or services to the local and international markets through production diversification and value addition. And it is important to enhance specialization in spices production, processing, distribution, marketing, and sales. The surplus production increases product volume, diversity, quality, and marketability giving an opportunity to reach more export destinations thereby improving the country's hard currency earnings. Investment in processing helps to maintain product quality and safety in accordance with international standards. Commercialization is expected to play a role in improving the relationship between commercial and smallholder farmers through the out-growers scheme. Such kind of farmer-company relationships

ensure market access, input, finance and technology supply, and knowledge sharing. Commercialization opens the eyes of small-scale entrepreneurs and encourages youth and women engagement in the different segments of the value chain. Moreover, the development of commercial farms contributes to changes in the demography and socio-economic status of the people leading to economic integration. It is, for example, well known that the commercialization of cotton, sugar cane, citrus, banana, and horticultural crops had encouraged establishments of villages and towns like Wonji, Merti Jeju, Methara, Amibara, Sile, Woyito, Dasenech, Abobo, Humera, Maycadra, etc. Commercialization, therefore, requires a carefully designed strategy that includes infrastructure development, environmentally sustainable production, processing, marketing, and stakeholders' engagement.

Spices with an opportunity for commercialization include red/chili pepper, ginger, turmeric, coriander, black pepper, cardamom, cinnamon, cumin, and fenugreek. Decision on which spice crop to grow whether at small-holder commercial or in large scale commercial farm level is dependent on the agroecology, availability of improved technologies, ease of production management, minimized production cost, access to market information, marketability and profitability of the commodity (Abdu et al 2016). Seed spice production areas are highly suitable for mechanization and engaging precision agriculture to optimize crop management. Moreover, it is important to note that the following are the main drivers for commercializing spices in the country: the availability of arable- and/or forestland, suitable climatic conditions; labour force, improved varieties with high-yielding potential and quality parameters; processing technologies; indigenous knowledge; and favourable policy environment. At the same time, commercialization requires infrastructure (power, communication, water, road/transportation), improved technologies including mechanization, skilled human power, information, peace, and socioeconomic stability. In sum, in order to attract commercial producers and investments in spices production, processing and marketing, it is essential to give emphasis to infrastructure development; modernize and liberalize the marketing system; improve access to market centres; and incentivize local and foreign investment.

## 7.5 Spice value chain development

Spices have various value chains. While some spices with few actors like white cumin are characterized by short value chains, other spices such as hot pepper have longer chains. Farmers, traders (small, medium, and large scale), processors, exporters, and consumers are major actors of Ethiopian spices. These actors store the produce(s) for some time before passing it to another actor. On the other hand, there are facilitators of the value chain such as brokers, Ethiopian commodity exchange, and development organizations supporting the sector. Thirdly, we have the enabling environment set and managed by institutions such as the Ministry of Agriculture, the Ethiopian Coffee & Tea Authority, the Ethiopian Institute of Agricultural Research, the Ethiopian Agricultural Authority, the Ministry of Trade & Regional Integration, the Ministry of Industry, and Ethiopian Food & Drug Authority. These offices ensure the value chain actors are operating within the framework set for the sector ranging from a consumer protection perspective to overall national interest.

A close look at the coordination of actors in Ethiopia currently reveals that there are a few farmers' cooperatives and unions that are working on collection and sales of spices. These cooperatives are mainly located in the South Western and Amhara regions. While there are no formal entities for coordinated spice traders, there is an association for processors and exporters of spices called Ethiopian Spices, Herbs and Aromatics Growers, Processors and Exporters Association (ESHAGPEA) which also includes producers' unions as members. There is also another association named Ethiopian Pulses Oilseeds and Spices Processors and Exporters Association (EPOSPEA) that hosts spice exporters

As stated above, the production of spices has not been given sufficient attention over the past years. There were only a handful of research centres working on the development of production technologies; only limited extension service and inputs were made to farmer; and the availability of post-harvest handling knowhow and technology was rather limited. These are in fact problems affecting the production aspect. Similarly, Ethiopia has a long way to go on the processing aspect of the spices as well. All this, should not, however, dim the emergence of manufacturing companies in the country that are producing spice-based foods, cosmetics and medicinal ointments. Although not yet high in the

foreign currency earning list of the country, the export of spices has, encouragingly, shown promising leads in the past couple of decades.

An effective operation of a value chain relies on smooth functioning of its processes and the responsible actions of key players and governing bodies. Unfortunately, here has been weak linkage and coordination among value chain participants in Ethiopia. Distribution of power has also been uneven. More elaborately, inefficiencies identified within the chain include insufficient collaboration and coordination; limited awareness regarding quality, market, and price information exchange; and an unfair distribution of profits among the actors. To enhance the efficiency of value chains, it is crucial to strengthen collaboration and alignment among actors and to organize platforms at various levels. Key actions include supporting farmer organizations, particularly in spice production areas; building the capacity of producers and service providers such as extension workers, input suppliers, and transporters; establishing market linkages between producers, processors, manufacturers, and international buyers; and promoting direct investment, local value addition, and exports.

### 7.5.1 Strengthening farmer organizations and building capacity of service providers

The spices sub-sector has a long-established platform under the Ethiopian Pulses, Oilseeds, and Spices Processors and Exporters Association (EPOSPEA). It aims at bringing members together bi-annually or annually and discusses common challenges that require advocacy and/or policy reform. The association works towards improving competence of spice exporters in the international market by providing up-to-date local and foreign market information and market trends. Nevertheless, because of the absence of permanent income, the performance of the spice's platform has been weak. It has failed to organize meetings and annual workshops and discharge its responsibilities.

Farmers' organizations in the spice sector require practical support to access improved inputs, advanced production and post-harvest technologies, market information, and opportunities for exploring new markets. These organizations can also be capacitated in quality assurance and certification. That would enable them to access niche markets for their products. Since most of the spices produced in Ethiopia are produced organically, they can also work towards having their member farmers certified for organic farming. Farmers' organizations in the spice sector may also aim for their members operating under contractual agreements. With that aim, they can facilitate and follow up on the delivery that is conducted on behalf of their members. For these and similar exploration of opportunities, it would be essential for the organizations to receive capacity building support on business development and financial management.

Service providers, on the other hand, require support in accessing finance to build their capacity to serve a wide range of farmers. The enabling environment should also incentivise actors by proving inputs and services to spices farmers given the high potential of the sector. Extension workers, who render assistance to farmers, on their part need capacity building support on production techniques and technologies, harvesting and post-harvest handling mechanisms for various spices on situation basis.

### 7.5.2 Creating local downstream market linkages and promoting local value addition

The local value addition in Ethiopia has been increasing in recent years. While the "*Baltina"* setup has been there for decades, in recent years, there is an increase in product diversity with some ready-to-eat recipes. That includes the use of various spices with herbs for production of high standard cosmetic products. This being the case, there still remains a lot to be done to facilitate the linkage between producers and processors. When there is synergy between the two, it is easier to ensure that the required quality product is produced and what is produced gets fair price and is locally processed.

Local processors are mostly seen struggling to access working space, finance, technologies and business development skills. Lack of access to these support areas keeps many processors as small and micro enterprises with possible off seasons where they do other activities to make ends meet. Grading, cleaning, drying, grinding, and packaging are typically performed under substandard conditions and mostly by hand. Additionally, transitioning to organic production and certification presents a challenge; although many farmers grow organic crops, the same equipment is often used for both conventional and

organic crops. This practice is not compliant with organic certification standards and can result in crops failing to qualify for certification. For those businesses that are in the medium to large spectrum, the challenge is mostly related to accessing enough volume of quality inputs for their operation. This can be resolved with contract farming set ups, ground-level support is still needed. With that kind of support, it is possible to ensure that the production practice, harvesting, and post-harvest handling are done up to standard.

### 7.5.3 Creating linkages to international markets and promoting export

The international market for spices has high potential for a country like Ethiopia where over 50 types of spices are produced. Even then, there is still a challenge because there is a significant gap between the expectations of international buyers in high-end markets (e.g., the EU, USA, and Japan) and the practices of smallholder farmers. These farmers often lack awareness of international market requirements. As mentioned earlier, local collectors and traders mainly evaluate products based on basic sensory characteristics such as size, colour, and moisture. As a result, smallholder farmers have little motivation to meet the stringent standards expected in global markets.

For Ethiopian exports, products are evaluated on various parameters, including colour, weight, size, purity, moisture, and container conditions, primarily at warehouses and ports of departure or entry. Contaminant checks, such as for aflatoxin, are also commonly conducted at ports of entry. While public authorities like the Ethiopian Food and Drug Administration (EFDA) oversee the regulation, inspection, and testing of food products destined for export, many international buyers and exporters opt for private inspection companies. These private firms are often favoured due to their superior equipment, skilled personnel, and greater efficiency. The issue of traceability is also another challenge faced by exporters when they look to export to high-end markets like the EU. As most exporters purchase their stock from collectors or wholesalers, it is difficult for them to prove the origin of their products.

### 7.5.4 Promoting investment and product development

Given the high untapped potential in the spices sector, it is imperative to promote the sector in order to attract foreign investors to the country. Investors can be incentivised to engage in the management of a nucleus farm and the contracting of farmers around them as out-growers. They can also add value to the supply of various small to medium scale machinery for production, harvesting, and processing. Foreign investors can also bring in international expertise in product development in the shear of value addition.

For the promotion of the spices sector to international investors, various business opportunity reports need to be developed. The reports need to outline the opportunities in the sector, the incentives put in place to support businesses, and the feasibility of investing in Ethiopia. The Ethiopian Coffee and Tea Authority has, in fact, developed a new spice strategy aimed at overcoming challenges in the sector and utilizing existing potential and opportunities which is a step forward in the right direction. Parallel to this, the government should still put in place the necessary infrastructure to facilitate the operations of investors around high potential production areas.

## 7.6 Governance and enabling environment

As indicated in section 5.3, introducing and promoting new agricultural enterprises, especially for crops like spices, demand strict processes along with the value chain development from start up to the end. And the processes include: (i) testing and validation of available technologies in the identified suitable areas (*woreda* and *kebele*); (ii) demonstration and popularization of the technologies (once tested and validated for adaptability); (iii) promotion of production considering both small scale and commercial farmers; (iv) market creation for local, regional, national and export markets; and (v) proactive follow up and creation of enabling environment such as the recently developed spice marketing and quality directives by ECTA (ECTA, 2024b) for the whole value chain development (see **Error! Reference source not found.**). What follows is a brief description of these processes.

A) **Testing and validation**: The overall responsibility of testing and validation is for agricultural research centre(s) and HLI found in the zone and *woreda* where suitability of the respective spices is identified. Since there is a need for accessing initial materials required for testing and validation, the national research coordinating centre, along with the respective regional agricultural research institutes, will be in charge of ensuring access to initial technologies.

B) **Demonstration and popularization**: Following the adaptation tests, the demonstration and popularization will be the responsibility of agricultural research centre(s) and higher learning institutes (HLI) found in the zone and *woreda* together with the *woreda* and selected *kebele* level offices of agriculture.

C) **Promotion of production**: This activity demands ensuring availability of required seed and planting materials, which demands the full engagement of zonal and *woreda* offices of agriculture by promoting local seed businesses and capacitating local farmers and commercial farmers. *Woreda* and *kebele* offices of agriculture will promote the production of respective spices through the prevailing extension services and capacity-building activities.

D) **Market creation**: Market creation is the most important component of the promotion of the respective spice production. To that end, all relevant actors from federal, regional, zonal, and *woreda* levels need to engage in market creation at all levels including export markets.

**E) Sustainability compliance, reporting, and traceability:** The use of sustainable and regenerative agriculture practices has become a competitive edge in the increasingly eco-sensitive global farm business industry. Many important end markets for spices and herbs, such as the European Union, have adopted different directives and regulations which demand compliance with sustainable environmental and agricultural practices, traceability as well as food safety standards. Local markets have also become increasingly sensitive to food safety issues. These realities call for the adoption of sustainable production systems and practices in spices production at the farm level. Sustainable Agricultural Practices (SAPs) are being widely conceptualized to include not only good agronomic practices but also economic and developmental aspects. And these aspects include food safety, community participation, inclusivity, optimal and regenerative resources use, profitable farming ventures as well as the use of innovative value addition practices that ensure sustainability (SSI-I, n.d). Good agricultural practices recommended for each spice crop differ from crop to crop. Despite that, there are some commonly recommended practices irrespective of crop types. Such practices involve enhancing soil health through the use of integrated soil fertility management options; enhancing plant health through the use of integrated pest management options; limiting the use of environmentally unfriendly herbicides and pesticides; and employing integrated nutrient management options such as minimum tillage, cover crops, intercropping and crop rotation. Good post-harvest handling practices are also crucial in commercial spices production especially for export markets. One of the most important impediments to Ethiopia's spice export market is, in fact, poor post-harvest handling of produce (Herms, 2015).

F) **Overall governance of the promotion:** Experiences gained from other crops like rice indicate that there is first a need to design a national strategy for the spices sector research and development that needs to clearly indicate what needs to be done, and who needs to engage along with the detailed implementation strategy (Alemu & Thompson, 2020). For this, there will be a need to set up a national task force with the responsibility of the developing the stated strategy along with the follow up of its implementation. Similarly, there is a need to set up regional task forces. The members of the task force need to be from the relevant primary stakeholders indicated in **Error! Reference source not found.** below.

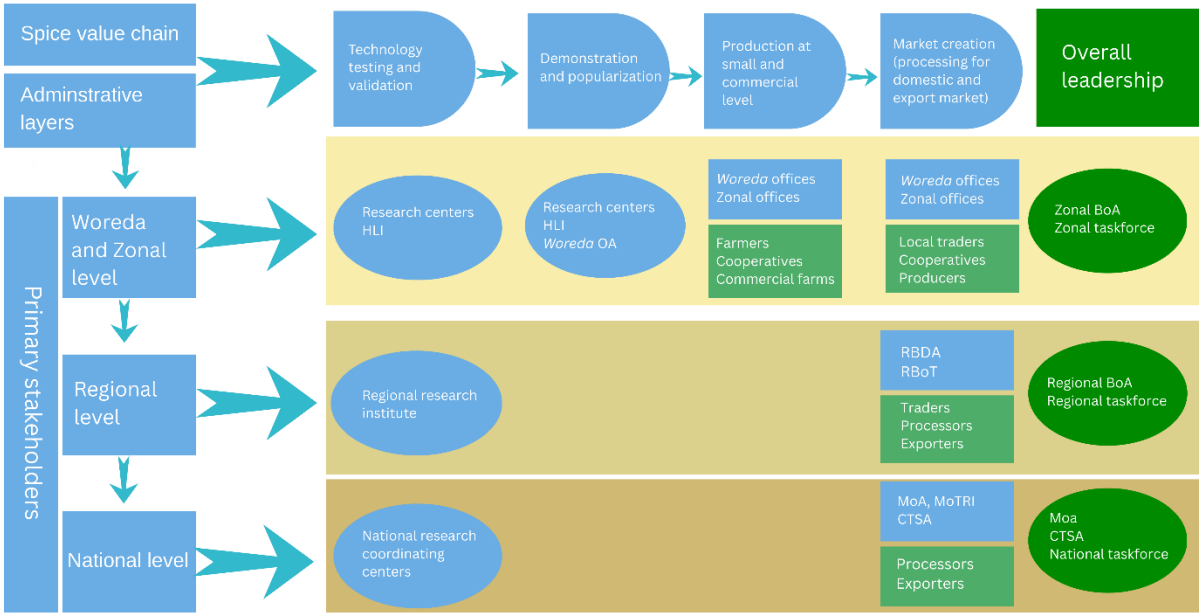


**Figure 14 Governance System for Spices Value Chain Development**

The implementation strategy needs to balance top-down and bottom-up process. That is because a potential of given sector cannot be realized through plans undertaken in top-down fashion alone. It is worth noting that many past initiatives have failed in realising local potential due to top-down planning, which often leads to unrealistic plans and unrealisable quota systems that in turn lead to excessive pressure on local implementers, false reporting, and ultimate failure of otherwise promising starts (Berhanu, 2012; Demeke et al 2021; Leta et al, 2017). This calls for the adoption of a balance of bottom-up and top-down planning. Bottom-up planning involves considering not only local potentials but also considers the realization of local implementation capacity. It also entails the involvement of farmers and other stakeholders at the grassroots level, who are directly or indirectly involved and are affected by the implementation of the development plan.

Apart from bottom-up planning, it is important that all relevant stakeholders at local and higher levels are brought together in innovation platforms. Such platforms can be used to discuss and solve important operational, policy, and institutional bottlenecks towards the realization of spice potential in different geographical locations. These could take several forms that involve local-level operational platforms and higher-level strategic platforms. In some cases, based on specific conditions, meso-level platforms could be crucial. Involved at the local or operational level platforms are actors at the *woreda* level such as the office of agriculture, *woreda* administration, cooperatives, farmers, traders, financers as well as NGOs and other private actors. The issues to be discussed and solved at this level often involve local-level problems in the spice value chain such as sustainable and good agricultural practices, input provisions and financing mechanisms, cooperatives and other market mechanisms, market infrastructure and market information, product assembly, post-harvest handling as well as compliance to local and international consumer and safety standards.

At the meso level, the actors to be involved may include support service-giving actors at zonal and regional levels such as the zonal department of agriculture and related zonal offices. Other actors also include knowledge institutions such as universities, research centres, private businesses and TVETs, financial institutions such as banks as well as large scale operating private actors which are involved in product assembly, processing and marketing. This level of platforms often serves as a bridge between the operational and strategic platforms. They are often engaged in articulating local level demands and necessities as well as providing suggestions on possible technological and institutional solutions to be adopted for problems emerging at local levels.

The strategic level platforms, on the other hand, involve higher-level actors with policy and other strategic decision-making capacities. High profile institutions such as the Ministry of agriculture, regulatory authorities, Coffee and Tea Authority, the Ministry of Trade, knowledge institutions, financial

organizations as well as associations of private sector are actors involved at the level of strategic platforms. Their primary topics of discussions are policy bottlenecks and other flaws that need to be fixed in the general enabling environment or important incentive structures that need to be in place to promote the specific spice sector in the country.

# 8 Conclusion and the way forward for spice sector development

## 8.1 Concluding remarks

Korarima, red pepper, ginger, turmeric, black cumin, and cardamom stand out as Ethiopia's six pivotal spices. Their significance is twofold. Domestically, they are increasingly incorporated into the culinary fabric of Ethiopian culture. Internationally, their demand is increasing. This growing interest underscores Ethiopia's role as a key spice producer, catering to both local preferences and global market trends.

Ethiopia's agricultural landscape holds a vast and largely untapped potential for the cultivation of high-value spices, presenting an opportunity for economic growth and diversification. The land suitability analysis for spices such as cardamom, black cumin, black pepper, coriander, fenugreek, hot pepper, korarima, turmeric, and white cumin has revealed extensive areas conducive to production, primarily due to favourable climatic, soil, and topographic conditions. This detection paves the way for a significant increase in spice production, which can serve both domestic and international markets.

The implementation of land suitability mapping serves as a robust planning and decision support tool, guiding stakeholders in identifying optimal growing regions, zones, and districts. This strategic approach can lead to the expansion of spice cultivation beyond the current niche, fostering a more diverse and resilient agricultural sector. The accessibility of these potential areas to key agricultural services is a critical factor for successful production expansion and should be considered while developing plans.

Including smallholders and commercial farmers, development partners, and policymakers, stakeholders can leverage this mapping to explore opportunities for value addition, market linkage, and product development specific to each spice. Knowledge institutes situated in regions with high production potential are encouraged to validate these map results and support the scaling of spice production. The task of these institutes includes the adoption of existing varieties, improved agronomic management practices, and efficient input/output supply systems.

With agricultural research centres and universities established in every administrative zone, there exists a significant potential to facilitate the testing, verification, and scaling of spice cultivation within diverse agroecological zones that are recognized as suitable. The infrastructures at the research centres and universities provide a solid foundation for advancing spice production techniques and enhancing agricultural practices across the regions.

Coordinated efforts among research centres, universities and other stakeholders can significantly contribute to economic empowerment and enhance livelihoods, while also promoting environmental and societal resilience. The collective goal is to transform Ethiopia's agriculture into a more productive and sustainable system, capitalizing on the country's rich resources to meet both local and global demand for these valuable spices.

## 8.2 Key Stakeholders and their Role

The spices sub-sector engages multiple stakeholders which fall under three categories of chain actors: main actors, enablers or influencers, and supporters.

- **Main actors**: Main actors are individuals or organizations that own the raw or processed product at least once during its move along the chain, from production until it reaches the final consumers. The main actors include farmers, village collectors, aggregators, wholesalers,

retailers, processors (including "Baltinas"), manufacturing plants (oleoresin milling and oil extraction), exporters, and the final consumers, both local and international.

- **Enablers or influencers:** In the spices supply chain management process, there are five groups of enablers or influencers:
  - *Disease free and certified planting material producers:* These producers include institutions with a role in the production of early generation and certified disease-free seeds, seedlings and planting material such the EIAR, RARIs and public and private seed enterprises.
  - *Organisational infrastructure developers:* Developers included in this group are those institutions with a role in designing regulatory frameworks, policies, production and marketing strategies, and standards, providing certificates (Ministries of Agriculture (MoA) and Ministry of Trade (MoT), the Ethiopian Coffee and Tea Authority (ECTA), the Ethiopian Conformity Authority (ECA), Ethiopian Food and Drugs Authority (EFDA), and Ethiopian Agricultural Authority (EAA).
  - *Technology and system developers:* These include building state- of- the-art IT systems for data collection, analysis, and information sharing (ECX, MoT).
  - *Strategic alliance creators*: These play a role in building and managing coordination and collaboration among actors (MoT, ECTA, EXC, platforms, NGOs); and
  - *Human resource management*: these engage in building cross-sectional teams and process through improving competence and efficiency of staff by assigning qualified personnel or via capacity building trainings (MoA, MoT, ECTA, ECX authority, ECX, research institutes, and NGOs).
- *Supporters*: Supporters are service providers such as input sellers, labourers, transporters, cleaners, storage service providers, legal institutions (police and court), and brokers.

Efficient functioning of the value chain is dependent on the proper operation of chain processes and the responsible action of major actors and mandated institutions. However, it is important to acknowledge that, presently, the linkages and coordination among value chain actors are weak and with disproportionateness of power. Inefficiencies identified in the chain included: a lack of collaboration and coordination; weak awareness of quality, market and price information exchange, and unfair distribution of profits among actors.

## 8.3 Key actions going forward

- Along with *Woreda*-based bottom-up planning, the use of agro-ecological suitability maps could be adopted at local levels to help public and private stakeholders make informed decisions to invest in the untapped spices potential in Ethiopia.
- Government authorities at meso and macro levels could potentially play a supportive role in terms of adoption and facilitation of agro-ecological suitability-based *woreda* bottom-up planning. This can help the establishment of specific spice belts and site and spice-specific scaling strategies and pathways in the country, facilitating value chain development.
- In addition to the suitability maps mainly developed using biophysical conditions, it is imperative to analyse existing and missing enabling conditions, as well as socioeconomic-related bottlenecks such as access to inputs, finance, market, institutional setup and other services. That can bring about successful scaling and expansion of spice production, processing, and marketing in Ethiopia.
- The fact that research and extension support services for spice production are very limited is one of the bottlenecks of the sector (Deribe, 2022; Tesfa et al 2017). This calls for a concerted effort to support the smallholder farmers, who are the majority of spice producers at present. These efforts may include supplying improved varieties of spices that are disease resistant/tolerant, better yielding, and improving good quality for domestic and export markets demands. In addition to these, research and extension support needs to focus on crop husbandry and post-harvest handling of the products that is because poor agronomic practices and post-harvest handling were often identified as the major hurdles for the export of spices produced in Ethiopia (Herms, 2015).

- The spice sector is women and youth-friendly venture that can create tremendous value chain inclusion opportunities for these and other segments of the society. Semi-processing activities for some of the exportable spices such as quality seed production and distribution, transportation, assembly, cleaning, boiling, drying, extracting essential oils, and packaging are labour-intensive activities that can engage a great number of currently unemployed women and youth and Small and Medium Sized Enterprises (SMEs). There is thus a need for value chain analysis and inclusive value chain development efforts in the spice sector.
- Private sector friendly policies and incentives specific to the spice sector need to be in place. That will promote spice crops planting material multiplication, spice production, processing and marketing related food system activities.
- It is important to explore opportunities for SMEs to bring sustainable engagement in the input supply system as well as value addition of the spices focusing on the areas where a high level of suitability is identified.
- Existing multi-stakeholder platforms aimed at promoting spices production and solving the multifaceted challenges of the sector seems to be ad hoc and inconsistent. This calls for identifying and interlinking the main stakeholders such as the Ethiopian Coffee and Tea Authority, the Ministry of Agriculture, the Ethiopian Institute of Agricultural Research, Federal and Regional Research Centres the regional Bureaus of Agriculture, HLIs, TVETs, other governmental and non-governmental organizations as well as the private sector. These bodies can contribute to realizing the spice production of the country through concerted efforts to solve the innovation challenges of the sector. EIAR and other knowledge institutes such as universities can play significant roles in steering and spearheading the expansion of spice production and the transfer of knowledge and skills to farmers, the private sector, and other stakeholders. They can do this because they are in a better vantage point in terms of initial facilitation of the emergence of multi-stakeholder innovation platforms until champions emerge among them.
- Land suitability analysis is an essential component of sustainable agricultural planning. To enhance the reliability and applicability of this approach, it is crucial to integrate such analysis with socio-economic and market considerations, particularly for spice crops.
- Comprehensive field validation of identified suitable and moderately suitable areas is necessary. More specifically, it is impotent to evaluate the adaptability of spice varieties released for different agro ecologies by various research centres. By addressing these issues, the current land suitability maps can better support informed decision-making and promote resilient and productive agricultural systems for sustainable spice crop production in the country.
- Once these suitability maps are generated for different spice species, the next steps involve conducting variety adaptation trials, especially in areas newly identified as highly suitable for cultivation. Such validation is important for selecting suitable and resilient varieties for various spices across different production ecologies with merits of resistance to local pests and diseases, yield potential, farmer preferences, market demand, and quality attributes.
- It is recommended that zonal planners, *woreda* planners, agricultural extension services, research institutions, and development partners use these maps to plan and promote them to farmers and private investors on where to cultivate spices. Furthermore, the approach can be applied to other evidence-based sector development efforts such as for oil crops, cereals, and so on.

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# Annex 1: Weighting and scoring

A weighted overlay analysis was performed to integrate the climate, soil, topography, and land use- related layers thereby generating comprehensive suitability maps for various spices under consideration. The Analytic Hierarchy Process (AHP), an established multi-criteria decision-making approach, was used to calculate weights for the different criteria data layers (Saaty, 1987; Chivasa et al., 2019). The Analytic Hierarchy Process relies on pairwise comparisons that assign values based on the relative importance of each criterion data layer (Annex 1). Criteria were evaluated and assigned numerical scales based on their relative importance to the overall goal. Pairwise comparison scales were assigned through expert consultation. These data layers were assigned weights to reflect their relative importance for crop growth and combined through a weighted overlay to produce the overall land suitability map (Annex 2).

### The resulting weights for the criteria based on pairwise comparisons

| | | Cardamom | | Turmeric | | Hot Pepper | | Black pepper | | Korarima | | Fenugreek | | White cumin | | Black cumin | | Coriander | | Ginger | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No | Criteria | Priority | Rank | Priority | Rank | Priority | Rank | Priority | Rank | Priority | Rank | Priority | Rank | Priority | Rank | Priority | Rank | Priority | Rank | Priority | Rank |
| 1 | Rainfall | 15.4% | 1 | 15.8% | 1 | 16.9% | 1 | 15.9% | 1 | 14.8% | 1 | 16.6% | 2 | 16.9% | 1 | 17.5% | 1 | 16.9% | 1 | 16.9 | 1 |
| 2 | Temperature | 14.3% | 2 | 14.9% | 2 | 15.9% | 2 | 15.0% | 2 | 14.0% | 2 | 16.7% | 1 | 16.6% | 2 | 15.9% | 2 | 15.8% | 2 | 14.8 | 2 |
| 3 | Elevation | 10.1% | 3 | 10.8% | 3 | 11.6% | 3 | 10.1% | 3 | 10.0% | 3 | 13.1% | 3 | 9.6% | 3 | 10.0% | 4 | 10.9% | 3 | 14.0 | 3 |
| 4 | LGP | 7.8% | 4 | 9.5% | 5 | 8.9% | 5 | 9.0% | 5 | 8.3% | 4 | 9.9% | 4 | 8.7% | 6 | 8.7% | 8 | 8.1% | 4 | 8.9 | 5 |
| 5 | pH | 7.8% | 4 | 6.6% | 9 | 6.3% | 8 | 9.1% | 4 | 8.0% | 5 | 9.9% | 4 | 9.4% | 4 | 9.2% | 5 | 9.3% | 7 | 7.1 | 8 |
| 6 | RH | 7.3% | 6 | 4.8% | 10 | 7.4% | 6 | 8.4% | 6 | 7.1% | 8 | | | | | | | | | | |
| 7 | Texture | 6.9% | 7 | 8.9% | 6 | 5.9% | 9 | 8.4% | 6 | 7.4% | 6 | 7.8% | 7 | 8.7% | 6 | 8.8% | 7 | 8.2% | 8 | 7.1 | 8 |
| 8 | OM | 6.9% | 7 | 7.4% | 7 | 5.6% | 10 | 7.5% | 8 | 7.4% | 6 | 8.8% | 6 | 9.4% | 4 | 9.2% | 5 | 9.3% | 6 | 10.3 | 4 |
| 9 | Land cover | 6.9% | 7 | | | | | | | 6.2% | 10 | | | | | | | | | | |
| 10 | Drainage | 6.7% | 10 | 10.2% | 4 | 9.6% | 4 | 7.1% | 9 | 6.6% | 9 | 6.0% | 8 | 8.7% | 6 | 10.1% | 3 | 10.1% | 5 | 7.2 | 7 |
| 11 | Depth | 5.7% | 11 | 7.0% | 8 | 7.0% | 7 | 4.7% | 10 | 5.6% | 11 | 6.0% | 8 | 6.5% | 9 | 6.0% | 9 | 6.7% | 9 | 6.5 | 10 |
| 12 | Slope | 4.1% | 12 | 4.2% | 11 | 5.0% | 11 | 4.6% | 11 | 4.6% | 12 | 5.2% | 10 | 5.4% | 10 | 4.6% | 10 | 4.6% | 10 | 7.2 | 6 |
| Consistency Ratio | | 1% | | 1.6% | | 1.4% | | 1.2% | | 1.4% | | 1.5% | | 1.3% | | 1.2% | | 1.4% | | | |

**Legend**

| Rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Colour code | | | | | | | | | | | | |

# Annex 2: Highly suitable proportions of land for black cumin

**Proportion of land under highly suitable (S1) classes for black cumin production by Region and Zone with lists of potential *woredas***

| Region | Area & % of S1 by Region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| Oromia | 3,045,400 | 9.42 | South West Shewa | 44.04 | 0.78 | Waliso, Ameya, Dawo, Wenchi, Seden Sodo, Becho (SW Shewa), Goro (SW Shewa), Kersana Malima, Sodo Daci |
| | | | West Shewa | 31.93 | 0.44 | Ginde Beret, Nono, Ambo Zuria, Dendi, Abuna Ginde Beret, Bako Tibe, Mida Kegn, Adda Berga, Illu GalanDano, Ejere /Addis Alem, Cobi, Toke Kutaye, Meta Walkite, Meta Robi |
| | | | Finfine Sp. | 37.59 | 1.65 | Sululta, Welmera, Sebeta Hawas, Akaki, Bereh, Mulo |
| | | | North Shewa | 25.50 | 0.72 | Dera (OR), Kuyu, Wara Jarso, Wuchale, Hidabu Abote, Yaya Gulele, Degem, Debre Libanos, Gerar JarsoAleltu |
| | | | East Shewa | 25.48 | 0.77 | Dugda, Adama Tulu Jido Kombolcha, Liben Chukala, Bora (OR), Adama, Lome (OR), Ada'a |
| | | | Horo Gudru Wellega | 24.33 | 0.62 | Guduru, Ababo, Choman Guduru, Amuru, Abay Chomen, Jimma Rare, Jarte Jardega, Jimma Genete |
| | | | West Arsi | 16.42 | 0.64 | Shala, Shashemene Zuria, Arsi Negele, Siraro, Heban Arsi, Gedeb Asasa, Dodola, Adaba, Bishan GurachaWondo, Kokosa |
| | | | Arsi | 14.00 | 0.89 | Hitosa, Ziway Dugda, Tiyo, Dodota, Munessa, Merti, Lude Hitosa, Jeju, Shirka Degeluna Tijo, Robe, Bele Gesgar, Sire, Amigna, Seru, Limu Bilbilo, Sude |
| | | | Jimma | 12.98 | 0.73 | Omo Nada, Botor Tolay, Sekoru, Tiro Afeta, Kersa, Nono Benja, Chora, Mancho, DedoShebe Sambo, Omo Beyam |
| | | | East Wellega | 6.35 | 0.27 | Boneya Boshe, Sibu Sire, Gobu Seyo, Kiremu, Wama Hagalo, Gida Ayana, Bila Seyo |
| | | | Kelem Wellega | 5.62 | 0.17 | Sayo, Anfilo, Hawa Galan, Gidami, Lalo Kile, Gawo Kebe, Yama Logi Welel, Jimma Horo |
| | | | West Hararge | 4.64 | 0.25 | Doba, Chiro Zuria, Kuni /Oda Bultum, Habro, Tulo (OR), Gemechis, Goba Koricha, Boke, AncharMesela, Mieso |
| | | | East Bale | 4.24 | 0.33 | Gololcha Bale, Ginir, Seweyna, Lege Hida, Dawe Ketchen |
| Amhara | 1,587,696 | 10.20 | East Gojam | 33.33 | 3.01 | Guzamn, Debre Elias, Hulet Ej Enese, Machakel, Aneded, Baso Liben, Awabel, Enemay, Dejen, Shebel Bernta, Enarj Enawga, Debay Telatgen, Goncha Siso Enebse, Enebse Sarmder |
| | | | West Gojam | 28.94 | 2.52 | Jabi Tehnan, Dembecha, Wemberma, Bure (AM), Yilmana Densa, Gonje, Bahirdar Zuria, Semen Achefer, Debub Mecha |
| | | | Central Gondar | 15.60 | 1.96 | West Dembiya, Gonder Zuria, Alefa, Takusa, West Belesa, East Dembia, Chilga 2, Chilga 1, Lay Armacho, Wegera, Kinfaz Begela, East Belesa |
| | | | South Gondar | 13.50 | 1.22 | Fogera, Libokemekem, Semada, Andabet/ West Esite, East Esite, Ebenat, Farta, Dera (AM), Guna BegemiderLay Gayint, Sede Muja |
| | | | Awi | 5.51 | 0.32 | Ayehu Guwagusa, Guangua, Guagusa Shikudad, Fagta Lakoma, Dangila, Ankasha |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | North Shewa | 5.47 | 0.57 | Minjar Shenkora, Merhabete, Mida Woremo, Ensaro, Mojan Wedera, Basona Worena, Eferatana Gidem, Siya Debirna Wayu |
| | | | North Gondar | 4.87 | 0.21 | Dabat, Debark, Addi Arekay |
| | | | South Wello | 1.97 | 0.23 | Kelela, Wegde, Kalu, Dessie Zuria, Thehulederie, Albuko, Borena /Debresina, Legambo, Kutaber |
| SNNP | 696,100 | 10.98 | Halaba | 46.09 | 0.71 | Wera Djo, Wera, Atote Ulo |
| | | | Siltie | 39.11 | 1.63 | Wulbareg, Lanfero, Sankura, Dalocha, Siltie, Mito, Misrak Azenet Berbere, Misrak Siltie |
| | | | Guraghe | 36.92 | 3.32 | Enemor Ener, Cheha, Abeshege, Muhur Na Aklil, Gedebano Gutazer Welene, Kebena, Sodo, Mareko, EzhaEnor Ener, Debub Sodo, Meskan |
| | | | Hadiya | 35.93 | 2.07 | Gombora, Soro, Lemmo, Gibe, Mirab Badowach, Analemmo, Mirab Soro, Duna, MishaShashogo, Misrak Badawacho, Ameka, Siraro Badawacho |
| | | | Kembata Tembaro | 24.62 | 0.53 | Kacha Bira, Tembaro, Doyogena, Hadero Tunto, Angacha, Kediada Gambela, Damboya |
| | | | Wolayita | 23.95 | 1.70 | Boloso Sore, Sodo Zuria, Damot Sore, Duguna Fango, Damot Pullasa, Damot Gale, Ofa, Boloso Bombe, Bayera Koisha |
| | | | Yem | 16.60 | 0.20 | All *woredas* in Yem |
| | | | Gedeo | 10.11 | 0.22 | Yirgachefe, Churso, Gedeb, Rape, Wenago, Kochere, Dila Zuria, Boloso Bombe, Bayera Koisha |
| | | | Basketo | 7.19 | 0.05 | All *woredas* in Basketo |
| BSG | | | Assosa | 11.97 | 2.74 | Assosa, Bambasi, Homosha, Kurmuk |
| | | | Mao Komo | 7.30 | 0.46 | Maokomo Special |
| Sidama | 133,792 | 19.76 | Sidama | 19.76 | 19.76 | Bilate Zuria, Hawassa Zuria, Dale, Darara, Bensa, Aleta Wendo, Aleta Chuko, Bona Zuria, Shebe DinoBoricha, Hawela, Loka Abaya, Hawasa town, Arbegona, Wondo-Genet |
| Tigray | 123,136 | 2.34 | North Western | 4.39 | 1.04 | Tahtay Koraro, Tsimbla, Zana, Selekleka, Laelay Adiabo, Asgede, |
| | | | Central | 3.87 | 0.70 | Adwa, Endafelasi, Keyhe tekli, Adet, Kola Temben, |
| | | | South Eastern | 2.12 | 0.21 | Saharti, Enderta, Degua Temben, Samre |
| SWEP | 29,196 | 0.75 | Dawuro | 3.53 | 0.39 | Loma, Gena, Disa, Mareka, Zabagazo, Tocha, Tercha Zuriya |
| | | | Kaffa | 1.23 | 0.33 | Adiyio, Gimbo, Gewata |
| Dire Dawa | 4,372 | 4.14 | Dire Dawa rural | 4.47 | 4.14 | Biyoawale, Wahil |

** Percentage contribution relative to the zone; ** Percentage contribution relative to the Region*

# Annex 3: Highly suitable proportions of land for black pepper

**Proportion of land under highly suitable (S1) classes for black pepper production by Region and Zone: lists of potential *woredas***

| Region | Area & % of S1 by Region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| Oromia | 1,370,892 | 4.24 | Kelem Wellega | 32.12 | 0.97 | Gawo Kebe, Gidami, Hawa Galan, Dale Sadi, Sedi Chenka, Anfilo, Lalo Kile, Dale Wabera, Jimma Horo, Sayo, Yama Logi Welel |
| | | | West Wellega | 28.32 | 1.09 | Mana Sibu, Babo, Gudetu Kondole, Guliso, Begi, Ayira, Sayo Nole, Kiltu Kara, Jarso Boji Chekorsa, Nole Kaba |
| | | | East Wellega | 21.45 | 0.91 | Guto Gida, Limu, Gida Ayana, Haro Limu, Sasiga, Diga, Jimma Arjo, Ibantu, Leka Dulecha, Bila Seyo, Sibu Sire, Nunu Kumba, Kiremu, Wama Hagalo |
| | | | Ilu Aba Bora | 16.26 | 0.51 | Darimu, Bure, Metu Zuria, Sale Nono, Bilo Nopha, Alge Sachi, |
| | | | Buno Bedele | 14.26 | 0.27 | Chwaka, Bedele Zuria, Borecha, Dabo Hana, Dedesa, Gechi |
| | | | Jimma | 6.02 | 0.34 | Shebe Sombo, Limu Seka, Mancho, Dedo, Chora, Omo Beyam, Kersa, |
| | | | H. G. Wellega | 5.10 | 0.13 | Abe Dongoro, Jarte Jardega, Amuru |
| SWEP | 1,154,300 | 29.5 | Bench Sheko | 53.82 | 6.37 | Gura-fereda, Debub Bench, Sheko, Semen Bench, Gidi Bench, Shay Bench |
| | | | Konta | 50.63 | 3.05 | Ameya Zuriya, Ella Hanchano, Konta Koyisha |
| | | | Mirab Omo | 32.09 | 12.19 | Surma, Gori Gesha, Maji, Menit Shasha, Menit Goldiye, Bero, Gachit |
| | | | Dawuro | 31.00 | 3.46 | Isara, Disa, Zabagazo, Loma, Tocha, Gena, Kachi, Tercha Zuriya, Mareka |
| | | | Sheka | 21.87 | 1.31 | Yeki, Masha |
| | | | Kaffa | 11.55 | 3.11 | Goba (SP), Cheta, Decha, Chena, Adiyio, Bita, Gimbo, Tullo, Shisho Ande |
| BSG | 808,788 | 16.05 | Kamashi | 33.83 | 6.79 | Mizyiga, Kamashi, Zayi, Dembe, Sedal |
| | | | Mao Komo Sp. | 17.60 | 1.12 | Mao Komo Sp. |
| | | | Metekel | 13.38 | 6.78 | Dangur, Bulen, Mandura, Dibate, Wembera, Pawe, Guba |
| | | | Assosa | 5.94 | 1.36 | Bambasi, Bilidigilu, Assosa, Homosha |
| SNNP | 631,004 | 9.95 | Basketo | 57.65 | 0.37 | All *Woredas* in Basketo |
| | | | Gofa | 30.08 | 2.16 | Zala, Melekoza, Denba Gofa, Uba Debre Tsehay, Melo Gada, Gezei Gofa, O'yida |
| | | | Wolayita | 17.31 | 1.23 | Kindo Koyesha, Ofa, Kindo Daddaye, Boloso Bombe, Damot Sore, Bayera Koisha, Sodo Zuria, Kawo Koisha, Damot Woide |
| | | | Gamo | 15.08 | 1.76 | Kucha, Kucha Alpha, Daramalo, Kemba, Arba Minch Zuria, Gerese, Boreda, Garda Marta |
| | | | Derashe | 13.54 | 0.15 | Derashe Sp, |
| | | | Amaro | 12.22 | 0.31 | Amaro |
| | | | Yem | 8.96 | 0.11 | All*Woredas* in Yem |
| | | | South Omo | 8.57 | 3.14 | Salamago, Malie, Bena Tsemay, Boko Dawula |
| | | | Alle | 7.23 | 0.09 | Alle Special |
| | | | Ari | | | S. Ari, N. Ari, Wub Ari |
| | | | Hadiya | 6.62 | | Soro, Mirab Soro, Gombora |

| | | | | | | |
|---|---|---|---|---|---|---|
| Gambela | 320,368 | 10.19 | Majang | 68.42 | 5.08 | Mengesh, Godere |
| | | | Agnewak | 7.26 | 5.11 | Dima, Gambela Zuria, Abobo |
| Amhara | 87,740 | 0.56 | Awi | 7.70 | 0.45 | Jawi, Guangua |
| | | | West Gojam | 0.91 | 0.08 | Debub Achefer, Semen Achefer |
| Sidama | 5,696 | 0.84 | Sidama | 0.84 | 0.84 | Dara Otilicho, Aleta Chuko, Aleta Wendo |

** Percentage contribution relative to the Zone; ** Percentage contribution relative to the region*

# Annex 4: Highly suitable proportions of land for cardamon

**Proportion of highly suitable (S1) land for cardamom production by Region and Zone with list of potential *woredas***

| Region | Area & % of S1 by Region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| Oromia | 3,790,300 | 11.3 | West Wellega | 67.08 | 2.58 | Ayira, Guliso, Jarso, Sayo Nole, Yubdo, Kiltu Kara, Babo, Homa, Gaji, Boji Chekorsa, Leta Sibu, Mana Sibu, Haru, Lalo Asabi, Nole Kaba, Gimbi, Nejo, Boji Dirmeji, Gudetu Kondole, |
| | | | Ilu Aba Bora | 63.47 | 1.99 | Halu /Huka, Darimu, Ale, Metu Zuria, Didu, Alge Sachi, Dorani, Bilo Nopha, Hurumu, Becho (Ilu Aba Bora), Bure |
| | | | Buno Bedele | 54.88 | 1.03 | Chwaka, Dabo Hana, Borecha, Bedele Zuria, Dedesa, Meko, Dega |
| | | | East Wellega | 53.53 | 2.26 | Sasiga, Guto Gida, Diga, Nunu Kumba, Wama Hagalo, Limu, Ibantu, Gida Ayana, Leka Dulecha, Bila Seyo, Haro Limu, Jimma Arjo |
| | | | Kelem Wellega | 44.67 | 1.34 | Lalo Kile, Dale Sadi, Dale Wabera, Sedi Chenka, Gawo Kebe, Yama Logi Welel, Jimma Horo |
| | | | Jimma | 35.50 | 2.00 | Limu Seka, Limu Kosa, Mena, Goma, Chora, Shebe Sambo, Nono Benja, Kersa |
| | | | H. G. Wellega | 14.73 | 0.37 | Abe Dongoro, Amuru, Jarte Jardega, Horo |
| SWEP | 1,292,796 | 33.0 | Konta | 54.87 | 2.04 | Ameya Zuriya, Ella Hanchano, Konta Koyisha |
| | | | Bench Sheko | 52.65 | 1.57 | Debub Bench, Sheko, Gidi Bench, Gurafereda, Semen Bench |
| | | | Dawuro | 38.93 | 2.68 | Tercha Zuriya, Kachi, Isara, Disa, Tocha, Loma, Mareka, Gena |
| | | | Sheka | 36.80 | 2.21 | Yeki, Masha, Anderacha |
| | | | Kaffa | 30.45 | 0.99 | Gimbo, Decha, Cheta, Gewata, Shisho Ende, Chena, Goba (SP) |
| | | | Mirab Omo | 22.99 | 2.20 | Gachit, Gori Gesha, Menit Goldiye, Menit Shasha, Bero |
| BSG | 675,196 | 13.4 | Kamashi | 27.90 | 4.45 | Mizyiga, Kamashi, Dembe |
| | | | Metekel | 12.42 | 5.00 | Mandura, Pawe, Dibate, Dangur |
| | | | Mao Komo Sp. | 7.75 | 0.39 | Maokomo Special |
| | | | Assosa | 4.41 | 0.80 | Homosha, Bilidigilu, Bambasi, Undulu, Assosa |
| SNNP | 292,228 | 4.6 | Basketo | 54.21 | 0.35 | Basketo SP *woreda* |
| | | | Gofa | 25.87 | 1.86 | Denba Gofa, Melekoza, Gezei Gofa, Melo Gada, O'yida, Zala |
| | | | Wolayita | 7.03 | 0.50 | Kindo Diddaye, Bayera Koisha, Kindo Koyesha, Ofa, Kawo Koisha, Damot Sore |
| | | | Gamo | 4.40 | 0.51 | Kucha Alpha, Kucha |
| | | | Ari | 3.30 | .21 | North Ari, Wub Ari, South Ari, Salamago |
| Gambela | 190,020 | 6.1 | Majang | 47.53 | 3.53 | Mengesh, Godere |
| | | | Agnewak | 3.57 | 2.51 | Gambela, Zuria Dima, Abobo |

| | | | | | | |
|---|---|---|---|---|---|---|
| Amhara | 180,352 | 1.2 | Awi | 17.99 | 1.05 | Guangua, Dangila, Jawi, Banja, Zigem |
| | | | West Gojam | 1.16 | 0.10 | Debub Achefer |
| Tigray | 4,476 | 0.1 | Western | 0.34 | 0.07 | Tsegede |

** Percentage contribution relative to the zone ** Percentage contribution relative to the Region*

# Annex 5: Highly suitable proportions of land for coriander

**Proportion of land under highly suitable (S1) classes for coriander production by Region and Zone; lists of potential *woredas***

| Region | Area & % of S1 by region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| Oromia | 2,114,340 | 6.54 | SW Shewa | 40.71 | 0.73 | Ameya, Waliso, Goro, Wenchi, Seden Sodo, Becho, Tole, Kersana Malima |
| | | | West Shewa | 36.38 | 1.60 | Ginde Beret, Abuna Ginde Beret, Nono, Ambo Zuria, Mida Kegn, Cobi, Meta WalkiteAdda Berga, Bako Tibe, Toke Kutaye, Dano, Dendi, Jeldu, Illu Galan, Ifata, Meta Robi |
| | | | North Shewa | 22.51 | 0.63 | Dera (OR), Kuyu, Wara Jarso, Hidabu Abote, Degem, Yaya Gulele |
| | | | H.G. Wellega | 21.30 | 0.54 | Guduru, Amuru, Ababo, Abay Chomen, Jarte Jardega, Choman Guduru |
| | | | Jimma | 12.74 | 0.72 | Omo Nada, Sekoru, Botor Tolay, Tiro Afeta, Kersa (Jimma), Mancho, Chora (Jimma), Omo Beyam |
| | | | Finfine Sp. l | 12.64 | 0.17 | Welmera, Sebeta Hawas, Sululta |
| | | | West Arsi | 11.29 | 0.44 | Shala, Siraro, Shashemene Zuria, Heban Arsi, Arsi Negele |
| | | | Kelem Wellega | 8.10 | 0.24 | Sayo, Anfilo, Hawa Galan, Gidami |
| | | | East Shewa | 5.26 | 0.16 | Liben Chukala, Dugda, Adama Tulu Jido Kombolcha, Ada'a |
| Amhara | 1,475,000 | 9.48 | West Gojam | 24.77 | 2.16 | Jabi Tehnan, Dembecha, Wemberma, Bure, Bahirdar Zuria, Semen Achefer, Gonje, Yilmana Densa, Quarit |
| | | | East Gojam | 22.39 | 2.03 | Debre Elias, Baso Liben, Guzamn, Michakel, Shebel Bernta, Hulet Ej Enese, Dejen, Awabel, Aneded, Enebse Sarmder, Sedae |
| | | | Central Gondar | 21.81 | 2.73 | West Dembiya, Takusa, Gonder Zuria, Alefa, Lay Armacho, West Belesa, Chilga 2, Chilga 1, East Dembia, Wegera, Kinfaz Begela, Tach Armacho, Tegede |
| | | | S. Gondar | 15.32 | 1.39 | Fogera, Libokemekem, Ebenat, Dera, Semada, Andabet/ West Esite, Farta, Sede Muja, East Esite |
| | | | N. Gondar | 8.38 | 0.37 | Dabat, Addi Arekay, Debark |
| | | | Awi | 3.21 | 0.19 | Guangua, Ayehu Guwagusa |
| SNNP | 797,812 | 12.58 | Halaba | 51.62 | 0.80 | Wera Djo, Wera, Atote Ulo |
| | | | Hadiya | 38.18 | 2.20 | Gombora, Soro, Gibe, Shashogo, Lemmo, Mirab Badowach, Mirab Soro |
| | | | Guraghe | 36.90 | 3.32 | Enemor Ener, Cheha, Abeshege, Kebena, Muhur Na Aklil, Enor Ener, Gedebano Gutazer Welene, Ezha, Mareko |
| | | | Siltie | 34.53 | 1.44 | Wulbareg, Sankura, Dalocha, Siltie, Lanfero, Mito |
| | | | Wolayita | 34.35 | 2.44 | Sodo Zuria, Boloso Sore, Damot Pullasa, Duguna Fango, Damot Gale, Damot Sore, Ofa, Kindo Koyesha |
| | | | K. Tembaro | 23.24 | 0.50 | Tembaro, Hadero Tunto, Kacha Bira |
| | | | Yem Special | 19.38 | 0.23 | Yem SP *Woreda* |
| | | | Basketo | 18.42 | 0.12 | Basketo SP *Woreda* |
| BSG | 315,336 | 6.26 | Mao Komo Sp. | 22.05 | 1.40 | Maokomo Special |
| | | | Assosa | 19.21 | 4.39 | Assosa, Bambasi, Homosha, Kurmuk, Menge |

| | | | | | | |
|---|---|---|---|---|---|---|
| Tigray | 185,472 | 3.53 | NW Tigray | 8.17 | 1.94 | Tahtay Koraro, Selekleka, Laelay Adiabo, Zana, Tsimbla |
| | | | Central Tigray | 4.23 | 0.77 | Adet, Tahtay Mayechew, Kola Temben |
| | | | W. Tigray | 2.89 | 0.73 | Welkait, Kafta Humera, Awra |
| Sidama | 139,960 | 20.67 | Sidama | 20.67 | 20.67 | Bilate Zuria, Hawassa Zuria, Dale, Darara, Aleta Chuko, Shebe Dino, Loka Abaya, Boricha, Bensa, Hawela |
| SWEP | 53,728 | 1.37 | Dawuro | 7.56 | 0.84 | Gena, Zabagazo, Loma, Disa, Mareka |
| | | | Kaffa | 1.26 | 0.34 | Gimbo, Adiyio |

** Percentage contribution relative to the zone; ** Percentage contribution relative to the Region.*

# Annex 6: Highly suitable proportions of land for fenugreek

**Proportion of land under different suitability classes of S1 for fenugreek production by Region and Zone; lists of potential *woredas***

| Region | Area & % of S1 by Region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| Amhara | 2,441,480 | 15.69 | West Gojam | 33.91 | 2.96 | Jabi Tehnan, Dembecha, Wemberma, Bure, Debub Mecha, Gonje, Debub Achefer, Bahirdar Zuria, Semen Achefer, Quarit, Yilmana, Densa, Dega Damot, Sekela, Mecha |
| | | | South Gondar | 33.67 | 3.05 | Ebenat, Semada, Libokemekem, Fogera, Dera, Sede Muja, East Esite, Lay Gayint, Mena Meketewa, Andabet/ West Esite, Farta, Guna Begemider, Tach Gayint |
| | | | East Gojam | 30.44 | 2.75 | Hulet Ej Enese, Debre Elias, Guzamn, Aneded, Baso Liben, Awabel, Enebse Sarmder, Shebel Bernta, Dejen, Sedae, Enarj Enawga, Enemay |
| | | | Central Gondar | 21.38 | 2.68 | West Dembiya, West Dembiya, Gonder ZuriaTakusa, Alefa, West Belesa, Chilga 1, Chilga 2, Wegera, Kinfaz Begela, East Dembia, Lay Armacho, East Belesa |
| | | | South Wello | 13.23 | 1.57 | Kelela, Tenta, Kalu, Kutaber, Wegde, Dessie Zuria, Mekdela, Thehulederie, Sayint, Were Ilu, Ambasel |
| | | | North Shewa | 10.29 | 1.07 | Minjar Shenkora, Merhabete, Ankober, Tarema Ber, Basona Worena, Hagere Mariam |
| | | | N. Gondar | 9.95 | 0.44 | Dabat, Debark, Addi Arekay, Janamora, Telemt |
| | | | Awi | 8.49 | 0.50 | Dangila, Ayehu Guwagusa, Guangua, Ankasha, |
| Oromia | 2,234,768 | 6.92 | S W. Shewa | 56.39 | 1.01 | Ameya, Waliso, GoroSodo Daci, Kersana Malima, BechoWenchi, Dawo, Tole |
| | | | West Shewa | 30.57 | 1.34 | Mida Kegn, Abuna Ginde Beret, Toke Kutaye, Ambo Zuria, Cobi, Adda Berga, Meta Walkite, Nono, Bako Tibe, Ginde Beret, Jeldu, Dano, Ifata |
| | | | Finfine Sp. | 26.71 | 0.37 | Sebeta Hawas, Akaki, Welmera, Sululta |
| | | | North Shewa | 20.82 | 0.59 | Dera, Kuyu, Hidabu Abote, Wara Jarso, Degem, Yaya Gulele, Wuchale, Gerar Jarso |
| | | | Jimma | 17.23 | 0.97 | Omo Nada, Sekoru, Tiro Afeta, Kersa, Botor Tolay, Mancho, Omo Beyam, Nono Benja, Dedo, Mena, Chora, Seka Chekorsa, Limu Kosa |
| | | | East Shewa | 13.05 | 0.40 | Ada'a, Lome, Liben Chukala, Dugda, Gimbichu, Adama |
| | | | H. G. Wellega | 8.70 | 0.22 | Amuru, Guduru, Choman Guduru, Jarte Jardega, Abay Chomen |
| | | | W. Hararge | 7.61 | 0.41 | Habro, Chiro Zuria, Kuni /Oda Bultum, Doba, Tulo, Goba Koricha, Anchar, Gemechis |
| | | | Kelem Wellega | 5.65 | 0.17 | Sayo, Anfilo, Hawa Galan, Gidami |
| | | | Arsi | 5.53 | 0.35 | Hitosa, Aseko, Merti, Tiyo, Lude Hitosa, Shirka, Tena |
| | | | West Arsi | 5.48 | 0.21 | Siraro, Shashemene Zuria, Heban Arsi, Arsi Negele, Shala, Nenesebo |
| | | | East Wellega | 5.02 | 0.21 | Bila Seyo, Sibu Sire, Ibantu, Boneya Boshe, Gobu Seyo, Kiremu |
| | | | E. Hararge | 4.21 | 0.33 | Kersa, Meta, Goro Gutu, Deder, Girawa, Kurfa Chele, Bedeno |
| | | | East Bale | 2.43 | 0.19 | Ginir, Gololcha Bale |
| SNNP | 1,153,844 | 18.19 | Wolayita | 65.33 | 2.72 | Sodo Zuria, Boloso Sore, Damot Gale, Damot Pullasa, Damot Sore, Duguna Fango, Damot Woide, Kindo Koyesha, Humbo, |
| | | | Halaba | 56.09 | 3.23 | Wera, Wera Djo, Atote Ulo |
| | | | Gedeo | 54.05 | 1.16 | Yirgachefe, Wenago, Kochere |
| | | | Gamo | 50.89 | 0.61 | Kucha, Boreda, Kucha Alpha, Gerese, Mirab Abaya |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Basketo | 50.25 | 4.52 | Basketo SP *Woreda* |
| | | | Derashe | 41.11 | 2.92 | Derashe Special |
| | | | Alle | 32.30 | 0.50 | Alle Special |
| | | | Gofa | 27.30 | 0.59 | Gezei Gofa, Melekoza |
| SWEP | 194,832 | 4.98 | Dawuro | 9.63 | 1.08 | Gena, Zabagazo, Loma, Isara |
| | | | Kaffa | 7.47 | 2.01 | Decha, Shisho Ande, Chena, Bita, Tullo, Adiyio |
| | | | Bench Sheko | 5.89 | 0.70 | Shay Bench, Semen Bench |
| Tigray | 204,964 | 3.9 | Central | 11.11 | 2.02 | Tahtay Mayechew, Laelay Maychew, Adet, Kola Temben, Adwa, Naeder, Keyhe tekli, |
| | | | N. Western | 6.37 | 1.51 | Tahtay Koraro, Selekleka, Zana, Tsimbla, Laelay Adiabo |
| | | | Western | 1.19 | 0.30 | Welkait |
| Sidama | 123,536 | 18.24 | Sidama | 18.24 | 18.24 | A. Wendo, Bensa, Hawassa Zuria, Aleta Chuko, Bilate Zuria, Darara, Dale, Loka Abaya, Bona Zuria, Boricha, Shebe Dino, |

**Percentage contribution relative to the zone; ** percentage contribution relative to the Region*

# Annex 7: Highly suitable proportions of land for ginger

**Proportion of land under different suitability classes for ginger production by Region and Zone; lists of potential *woredas***

| Regions | Region | | Potential Zones | | List of *woredas* |
|---|---|---|---|---|---|
| | Area (ha) | % | Zone | % | |
| Amhara | 529,476 | 3.40 | Awi | 30.03 | Jawi, Guangua, Ayehu, Guwagusa and Dangila |
| | | | West Gojam | 9.09 | Wemberma, Bure, Debub Achefer, Semen Achefer, Jabi Tehnan, Dembecha, Bahirdar Zuria |
| | | | Central Gondar | 3.49 | Alefa, Takusa and Tach Armacho, chilga |
| | | | West Gondar | 3.38 | Quara and Adagn Ager Chaqo |
| | | | East Gojam | 0.48 | Debre Elias and Aneded |
| BSG | 2,326,464 | 46.17 | Kamashi | 66.23 | Kamashi, Mizyiga, Dembe, Zayi and Sedal |
| | | | Metekel | 50.43 | Pawe, Mandura, Bulen, Dangur, Dibate, Wembera and Guba |
| | | | Assosa | 30.89 | Bilidigilu, Homosha, Kurmuk, Bambasi, Sherkole, Undulu, Menge and Assosa |
| | | | Mao Komo Special | 3.89 | Mao Komo Special |
| Gambela | 382,196 | 12.16 | Majang | 71.17 | Mengesh and Godere |
| | | | Agnewak | 9.82 | Gambela Zuria, Dima and Abobo |
| Oromia | 2,088,396 | 6.46 | West Wellega | 47.03 | Guliso, Babo, Mana Sibu, Ayira, Kiltu Kara, Gudetu Kondole, Boji Chekorsa, Jarso (West Wellega), Yubdo, Begi, Homa, Sayo Nole, Leta Sibu, Gaji, Boji Dirmeji, Lalo Asabi, Gimbi, Haru, Nejo and Nole Kaba |
| | | | East Wellega | 34.02 | Guto Gida, Sasiga, Diga, Kiremu, Limu, Wama Hagalo, Haro Limu, Gida Ayana, Nunu Kumba, Leka Dulecha, Bila Seyo, Jimma Arjo, Sibu Sire, Ibantu, Boneya Boshe and Wayu Tuka |
| | | | Kelem Wellega | 29.64 | Lalo Kile, Gawo Kebe, Dale Sadi, Sedi Chenka, Dale Wabera, Jimma Horo, Sayo, Yama Logi Welel, Gidami, Hawa Galan and Anfilo |
| | | | Ilu Aba Bora | 24.10 | Darimu, Bure, Bilo Nopha, Metu Zuria, Ale, Didu, Sale Nono, Halu /Huka and Alge Sachi |
| | | | Buno Bedele | 19.81 | Chwaka, Borecha, Bedele Zuria, Dabo Hana, Dedesa, Meko and Gechi |
| | | | Horo Gudru Wellega | 17.03 | Abe Dongoro, Amuru, Jarte Jardega, Horo Buluk and Abay Chomen |
| | | | Jimma | 10.96 | Shebe Sombo, Limu Seka, Mancho, Omo Beyam, Omo Nada, Nono Benja, Chora, Kersa, Dedo, Goma, Seka Chekorsa, Limu Kosa, Mena and Gumay |
| | | | West Shewa | 1.10 | Bako Tibe, Dano, Illu Galan and Nono |
| Sidama | 8,512 | 1.26 | Sidama | 1.25 | Aleta Chuko, Dara Otilicho, Dara, Bona Zuria, Bensa, Chabe Gambeltu and Loka Abaya |
| SNNP | 583,188 | 9.20 | Basketo | 63.18 | Basketo SP *woreda*, |

| | | | | | |
|---|---|---|---|---|---|
| | | | Gofa | 41.90 | Denba Gofa, Melekoza, Melo Gada, Zala, Uba Debre Tsehay, Gezei Gofa and O'yida |
| | | | Amaro | 19.21 | Amaro |
| | | | Wolayita | 16.41 | Kindo Daddaye, Boloso Bombe, Kindo Koyesha, Bayera Koisha, Kawo Koisha, Damot Sore, Ofa, Boloso Sore, Sodo Zuria, Duguna Fango and Damot Woide |
| | | | Kembata Tembaro | 12.43 | Tembaro and Hadero Tunto |
| | | | South Omo | 7.38 | South Ari, North Ari, Salamago, Wub Ari, Boko Dawula and Malie |
| | | | Gamo | 5.81 | Kucha Alpha, Kucha, Gerese, Kemba, Daramalo, Garda Marta and Boreda |
| | | | Hadiya | 4.10 | Mirab Soro and Soro |
| | | | Gedeo | 3.54 | Dila Zuria, Wenago and Kochere |
| | | | Burji | 2.55 | Burji Special |
| | | | Derashe | 2.25 | Derashe Special |
| | | | Alle | 1.83 | Alle Special |
| | | | Konso | 1.43 | Karat Zuria and Kena |
| SWEP | 1,517,536 | 38.79 | Konta Special | 74.34 | Konta |
| | | | Bench Sheko | 51.42 | Gurafereda, Debub Bench, Gidi Bench, Sheko, Semen Bench and Shay Bench |
| | | | Dawuro | 44.78 | Gena. Zabagazo, Tercha Zuriya, Isara, Disa, Loma, Kachi, Tocha, Mareka and Mari Mansa |
| | | | Mirab Omo | 42.71 | Bero, Gori Gesha, Menit Goldiye, Menit Shasha, Gachit, Surma and Maji |
| | | | Sheka | 25.66 | Yeki, Masha, Anderacha and Tepi |
| | | | Kefa | 20.27 | Cheta, Goba (SP), Decha, Gewata, Chena, Tullo, Bita, Gimbo, Adiyio and Shisho Ande, |

# Annex 8: Highly suitable proportions of land for hot pepper

**Proportion of land under highly suitable (S1) classes for hot pepper production by Region & Zone: lists of potential *woredas***

| Region | Area & % of S1 by Region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| Oromia | 1,822,452 | 5.64 | Kelem Wellega | 18.58 | 0.56 | Gidami, Sayo, Hawa Galan, Anfilo, Jimma Horo, Gawo Kebe |
| | | | West Shewa | 17.70 | 0.78 | Dano, Ginde Beret, Nono, Abuna Ginde Beret, Bako Tibe, Illu Galan, Mida Kegn, Cobi, Ambo Zuria |
| | | | S. W. Shewa | 17.14 | 0.31 | Ameya, Goro (SW Shewa), Waliso, Kersana Malima |
| | | | H. G. Wellega | 15.86 | 0.40 | Abay Chomen, Ababo, Amuru, Jarte Jardega, Guduru |
| | | | Jimma | 12.04 | 0.68 | Omo Nada, Nono Benja, Botor Tolay, Chora, Kersa, Sekoru, Tiro Botor Tolay, Omo Nada, Nono Benja, Chora, Kersa, Sekoru, Tiro Afeta, Mancho, Shebe Sombo |
| | | | West Wellega | 10.85 | 0.42 | Gudetu Kondole, Begi, Mana Sibu |
| | | | North Shewa | 10.17 | 0.29 | Dera,Wara Jarso, Kuyu, Hidabu Abote, Gerar Jarso |
| | | | West Arsi | 9.99 | 0.39 | Siraro, Shala, Shashemene Zuria |
| | | | East Wellega | 8.68 | 0.37 | Gudetu Kondole, Begi, Mana Sibu |
| | | | Finfine Special | 8.02 | 0.11 | Sebeta Hawas, Akaki |
| | | | East Shewa | 7.38 | 0.22 | Liben Chukala, Ada'a, Dugda, Boset |
| Amhara | 1,555,004 | 9.99 | Central Gondar | 25.54 | 3.20 | West Dembiya, Takusa, West Belesa, Alefa, Gonder Zuria, Tach Armacho, Masero Denb /Central Armacho, Kinfaz Begela, Tegede, Lay Armacho, East Belesa, East Dembia, Chilga 2, Chilga 1 |
| | | | West Gojam | 13.83 | 1.21 | Bahirdar Zuria, Jabi Tehnan, Semen Achefer, Wemberma, Dembecha, Bure (AM), Gonje |
| | | | Oromo sp. | 13.77 | 0.34 | Dewa Cheffa, Artuma Fursi, Jilye Tumuga, Dewa Harewa |
| | | | South Gondar | 11.33 | 1.03 | Fogera, Libokemekem, Dera, Ebenat, Sede Muja, Tach Gayint, Lay Gayint, Farta |
| | | | North Shewa | 8.54 | 0.89 | Merhabete, Minjar Shenkora, Mida Woremo, Antsokiya, Eferatana Gidem, Ensaro, Kewet, Tarema Ber, Ankober |
| | | | Awi | 8.46 | 0.49 | Jawi, Guangua, Ayehu Guwagusa, |
| | | | East Gojam | 8.41 | 0.76 | Baso Liben, Debre Elias, Guzamn, Shebel Bernta, Hulet Ej Enese, Awabel, Enebse Sarmder, Aneded, |
| | | | North Gondar | 6.26 | 0.28 | Dabat, Addi Arekay, Debark, |
| | | | West Gondar | 6.08 | 0.66 | Adagn Ager Chaqo, Quara, Metema |
| SNNP | 1,085,688 | 17.12 | Halaba | 60.25 | 0.93 | Wera, Wera Djo, Atote Ulo |
| | | | Wolayita | 48.89 | 3.48 | Sodo Zuria, Duguna Fango, Humbo, Boloso Sore, Kindo Koyesha, Ofa, Damot Woide, Damot Pullasa, Damot Gale, Abela Abaya, Boloso Bombe |
| | | | Hadiya | 35.76 | 2.06 | Shashogo, Misrak Badawacho, Gombora, Soro, Gibe, Mirab Soro, Mirab Badowach, Ameka |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Basketo | 31.15 | 0.20 | Basketo SP *woreda* |
| | | | Derashe | 27.45 | 0.30 | Derashe Special |
| | | | Siltie | 26.23 | 1.09 | Sankura, Wulbareg, Dalocha, Lanfero, Siltie, Mito, Misrak Siltie |
| | | | Guraghe | 24.82 | 2.23 | Abeshege, Enemor Ener, Cheha, Kebena, Muhur Na Aklil, Enor Ener, Sodo, Debub Sodo, Mareko, Misrak Meskan |
| | | | Gofa | 21.47 | 1.54 | Zala, Uba Debre Tsehay, Denba Gofa, Melekoza, |
| | | | Kembata Tembaro | 21.16 | 0.45 | Tembaro, Hadero Tunto, Kacha Bira, Adilo, Damboya |
| | | | Gamo | 21.05 | 2.46 | Kucha, Boreda, Kemba, Daramalo, Arba Minch Zuria, Mirab Abaya |
| | | | Yem Special | 9.65 | 0.12 | Yem SP *Woreda* |
| BSG | 1,035,936 | 20.56 | Assosa | 44.42 | 10.16 | Assosa, Sherkole, Bambasi, Bilidigilu, Kurmuk, Menge |
| | | | Mao Komo Sp. | 40.21 | 2.55 | Maokomo Special |
| | | | Kamashi | 15.97 | 3.21 | Zayi, Dembe, Sedal, Kamashi, Mizyiga |
| | | | Metekel | 9.14 | 4.63 | Wembera, Bulen, Guba, Dangur, Dibate |
| Tigray | 257,180 | 4.89 | N. Western | 9.32 | 2.21 | Tsimbla, Tahtay Koraro, Tselemti, Zana, Asgede, |
| | | | Central | 9.18 | 1.67 | Abergele, Endafelasi, Tanqua Melashe, Kola Temben |
| | | | Western | 3.47 | 0.88 | Welkait, Kafta Humera, Awra |
| Sidama | 170,252 | 25.14 | Sidama | 25.14 | 25.14 | Hawassa Zuria, Bilate Zuria, Dale, Darara, Loka Abaya, Aleta Chuko, Wondo-Genet, Shebe Dino, Boricha, Hokko, Hawela |
| SWEP | 84,012 | 2.15 | Dawuro | 10.84 | 1.21 | Disa, Zabagazo, Loma, Gena |
| | | | Konta Special | 3.11 | 0.19 | Ameya Zuriya, Ella Hanchano, Konta Koyisha |
| | | | Bench Sheko | 2.26 | 0.27 | Gurafereda |

**Percentage contribution relative to the Zone; ** Percentage contribution relative to the region*

# Annex 9: Highly suitable proportions of land for korarima

**Proportion of land under highly suitable (S1) classes for korarima production by Region and Zone: lists of potential *woredas***

| Region | Area & % of S1 by Region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| Oromia | 4,437,068 | 13.73 | West Wellega | 72.23 | 2.77 | Mana Sibu, Babo, Gudetu Kondole, Sayo Nole, Gimbi, Guliso, Ayira, Nole Kaba, Nejo, Jarso, Haru, Kiltu Kara, Boji Dirmeji, Lalo Asabi, Boji Chekorsa, Yubdo, Begi, Gaji, Leta Sibu |
| | | | Ilu Aba Bora | 66.40 | 2.09 | Darimu, Sale Nono, Alge Sachi, Metu Zuria, Bure, Didu, Becho, Ale, Yayu, Hurumu, Dorani, Halu /Huka, Bilo Nopha |
| | | | Buno Bedele | 65.65 | 1.24 | Bedele Zuria, Chora, Dabo Hana, Borecha, Dedesa, Gechi, Chwaka, Meko, Dega |
| | | | East Wellega | 60.63 | 2.56 | Gida Ayana, Sibu Sire, Sasiga, Limu, Guto Gida, Haro Limu, Ibantu, Kiremu, Wama Hagalo, Nunu Kumba, Bila Seyo, Jimma Arjo, Leka Dulecha, Diga |
| | | | Kelem Wellega | 48.48 | 1.46 | Gawo Kebe, Gidami, Dale Sadi, Lalo Kile, Dale Wabera, Hawa Galan, Yama Logi Welel, Anfilo, Jimma Horo |
| | | | Jimma | 46.39 | 2.62 | Limu Kosa, Nono Benja, Chora, Goma, Kersa, Gera, Shebe Sambo, Omo Nada, Tiro Afeta, Mena, Mancho, Dedo |
| | | | H. G. Wellega | 7.46 | 0.44 | Abe Dongoro, Amuru, Jarte Jardega, Jimma Genete, Horo |
| | | | West Shewa | 10.75 | 0.47 | Dano, Nono, Jibat, Liban Jawi, Ginde Beret, Illu Galan, Bako Tibe, |
| SWEP | 965,936 | 24.69 | Kaffa | 34.05 | 9.18 | Gimbo, Decha, Gewata, Shisho Ande, Bita, Adiyio, Chena, Saylem, Goba (SP), Gesha, Cheta, Tullo |
| | | | Sheka | 29.70 | 1.78 | Yeki, Anderacha, Masha |
| | | | Bench Sheko | 28.26 | 3.35 | Gurafereda, Debub Bench, Shay Bench, Sheko, Semen Bench, Gidi Bench |
| | | | Dawuro | 28.09 | 3.14 | Isara, Tocha, Disa, Gena, Loma, Zabagazo, Kachi, Mareka |
| | | | Konta Sp. | 22.73 | 1.37 | Konta |
| | | | Mirab Omo | 15.45 | 5.87 | Maji, Gori Gesha, Menit Shasha, Menit Goldiye, Gachit, Surma |
| Amhara | 418,264 | 2.69 | Awi | 23.86 | 1.39 | Guangua, Dangila, Jawi, Ayehu Guwagusa, Ankasha, Fagta Lakoma, Banja, Guagusa Shikudad |
| | | | West Gojam | 11.02 | 0.96 | Debub Achefer, Debub Mecha, Mecha, Semen Achefer, Sekela, Jabi Tehnan, Bahirdar Zuria, Bure |
| | | | South Gondar | 2.32 | 0.21 | Dera, Fogera, Farta, East Esite |
| | | | West Gondar | 0.53 | 0.06 | Quara, Metema |
| | | | Central Gondar | 0.51 | 0.06 | Alefa, Tegede |
| BSG | 299,920 | 5.95 | Kamashi | 13.76 | 2.76 | Mizyiga, Kamashi, Zayi, Dembe, Sedal |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Metekel | 5.20 | 2.63 | Dibate, Bulen, Dangur, Wembera, Mandura, Pawe |
| | | | Mao Komo Sp | 4.01 | 0.25 | Maokomo Special |
| | | | Assosa | 1.30 | 0.30 | Bilidigilu, Bambasi, Assosa, Homosha |
| SNNP | 256,284 | 4.04 | Basketo | 29.85 | 0.19 | Basketo SP *Woreda* |
| | | | Wolayita | 17.83 | 1.27 | Kindo Koyesha, Damot Sore, Boloso Sore, Sodo Zuria, Ofa, Boloso Bombe, Bayera Koisha, Kindo Daddaye, Kawo Koisha, |
| | | | Gofa | 13.23 | 0.95 | Gezei Gofa, Melekoza, Denba Gofa, Melo Gada, Uba Debre Tsehay, O'yida, Zala |
| | | | Gedeo | 7.86 | 0.17 | Yirgachefe, Wenago, Kochere |
| | | | Kembata Tembaro | 7.05 | 0.15 | Tembaro, Hadero Tunto, Kacha Bira |
| SNNP | 256,284 | 4.04 | Basketo | 29.85 | 0.19 | Basketo SP *Woreda* |
| | | | Wolayita | 17.83 | 1.27 | Kindo Koyesha, Damot Sore, Boloso Sore, Sodo Zuria, Ofa, Boloso Bombe, Bayera Koisha, Kindo Daddaye, Kawo Koisha, |
| | | | Gofa | 13.23 | 0.95 | Gezei Gofa, Melekoza, Denba Gofa, Melo Gada, Uba Debre Tsehay, O'yida, Zala |
| | | | Gedeo | 7.86 | 0.17 | Yirgachefe, Wenago, Kochere |
| | | | Kembata Tembaro | 7.05 | 0.15 | Tembaro, Hadero Tunto, Kacha Bira |
| | | | Yem Special | 4.25 | 0.05 | Yem SP *Woreda* |
| | | | Burji | 3.05 | 0.07 | Burji Special |
| | | | Gamo | 2.31 | 0.27 | Kucha Alpha, Kucha, Kemba, Gerese, Daramalo, Boreda |
| | | | Guraghe | 2.06 | 0.19 | Cheha, Enemor Ener, Abeshege, Kebena, Enor Ener |
| | | | Hadiya | 1.73 | 0.10 | Mirab Soro, Soro, Mirab Badowach, Duna, Gombora |
| | | | South Omo & Ari | 1.65 | 0.60 | South Ari, Salamago, North Ari, Wub Ari, Boko Dawula |
| Gambela | 109,924 | 3.50 | Majang | 15.73 | 1.17 | Godere, Mengesh |
| | | | Agnewak | 3.31 | 2.33 | Gambela Zuria, Dima, Abobo |
| Tigray | 23,940 | 0.46 | Western | 1.80 | 0.46 | Welkait, Tsegede, Awra, Kafta Humera |
| Sidama | 14,008 | 2.07 | Sidama | 2.07 | 2.07 | Aleta Chuko, Aleta Wendo, Dara Otilicho, Loka Abaya, Dale, Darara, Wonosho, Dara, Chire |

** Percentage contribution relative to the zone; ** Percentage contribution relative to the Region; H.G. Wolega = Horo Guduru Wolega*

# Annex 10: Highly suitable proportions of land for white cumin

**Proportion of land under highly suitable (S1) classes for white cumin production by Region and Zone: List of potential *woredas***

| Region | Area & % of S1 by Region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| Oromia | 2,985,992 | 9.24 | S.W. Shewa | 53.10 | 0.95 | Waliso, Ameya, Becho, Dawo, Tole, Kersana Malima, Seden Sodo, Wenchi, Goro, Sodo Daci |
| | | | Finfine Sp. | 43.32 | 0.60 | Sebeta Hawas, Sululta, Welmera, Akaki, Bereh |
| | | | West Shewa | 35.28 | 1.55 | Ginde Beret, Ambo Zuria, Dendi, Nono, Mida Kegn, Abuna Ginde Beret, Adda Berga, Ejere /Addis Alem, Bako Tibe, Dano, Cobi, Toke Kutaye, Illu Galan, Meta Walkite, Meta Robi |
| | | | East Shewa | 27.93 | 0.85 | Dugda, Adama Tulu Jido Kombolcha, Liben Chukala, Gimbichu, Bora, Ada'a, Adama, Lome |
| | | | North Shewa | 25.33 | 0.71 | Dera, Kuyu, Wara Jarso, Wuchale, Hidabu Abote, Degem, Yaya Gulele, Debre Libanos, Gerar Jarso, Aleltu |
| | | | H. G. Wellega | 21.80 | 0.55 | Guduru, Choman Guduru, Amuru, Ababo, Abay Chomen, Jimma Rare, Jarte Jardega, Jimma Genete |
| | | | West Arsi | 16.92 | 0.66 | Shala, Shashemene Zuria, Arsi Negele, Siraro, Heban Arsi, Gedeb Asasa, Dodola, Kokosa |
| | | | Arsi | 13.67 | 0.87 | Hitosa, Ziway Dugda, Tiyo, Munessa, Dodota, Lude Hitosa, Degeluna Tijo, Jeju, Shirka, Merti, Robe, Bele Gesgar, Sire, Limu Bilbilo, Amigna, Sude |
| | | | Jimma | 11.74 | 0.66 | Omo Nada, Sekoru, Tiro Afeta, Kersa, Botor Tolay, Chora, Mancho, Nono Benja, Dedo, Omo Beyam, Gera, Seka Chekorsa, Shebe Sambo |
| | | | East Wellega | 4.90 | 0.21 | Boneya Boshe, Sibu Sire, Gobu Seyo, Kiremu, Gida Ayana, Wama Hagalo, Bila Seyo |
| | | | West Hararge | 4.26 | 0.23 | Boneya Boshe, Sibu Sire, Gobu Seyo, Kiremu, Gida Ayana, Wama Hagalo, Bila Seyo, Boneya Boshe |
| | | | Bale | 3.81 | 0.35 | Gasera, Sinana, Agarfa, Meda Welabu, Goro, Gura Damole |
| | | | Guji | 3.69 | 0.20 | Ana Sora, Uraga, Bore, Haro Walabu, Arda Jila, Odo Shakiso, Adola |
| Amhara | 1,561,844 | 10.04 | East Gojam | 33.34 | 3.02 | Guzamn, Debre Elias, Hulet Ej Enese, Michakel, Aneded, Baso Liben, Awabel, Enemay, Dejen, Shebel Bernta, Enarj Enawga, Debay Telatgen, Goncha Siso Enebse, Enebse Sarmder |
| | | | West Gojam | 28.46 | 2.48 | Jabi Tehnan, Dembecha, Wemberma, Bure (AM), Yilmana Densa, Gonje, Bahirdar Zuria, Semen Achefer, Debub Mecha, Sekela, Dega Damot, Quarit, Debub Achefer |
| | | | Central Gondar | 14.73 | 1.85 | West Dembiya, Gonder Zuria, Alefa, Takusa, East Dembia, West Belesa, Chilga 2, Chilga 1, Lay Armacho, Wegera, Kinfaz Begela, East Belesa |
| | | | South Gondar | 14.00 | 1.27 | Fogera, Libokemekem, Semada, Andabet/ West Esite, East Esite, Ebenat, Dera (AM), Farta, Sede Muja |

| Region | Area & % of S1 by Region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| | | | North Shewa | 5.49 | 0.57 | Minjar Shenkora, Merhabete, Ensaro, Basona Worena, Mojan Wedera, Moretna Jiru, Mida Woremo, Siya Debirna Wayu |
| | | | Awi | 4.79 | 0.28 | Ayehu Guwagusa, Guangua, Guagusa Shikudad, Fagta Lakoma, Dangila, Ankasha |
| | | | North Gondar | 4.29 | 0.19 | Dabat, Debark, Addi Arekay |
| | | | South Wello | 2.32 | 0.28 | Wegde, Kelela, Borena /Debresina, Dessie Zuria, Thehulederie, Kalu, Albuko, Kutaber |
| SNNP | 718,192 | 11.32 | Halaba | 46.22 | 0.71 | Wera Djo, Wera, Atote Ulo |
| | | | Siltie | 44.97 | 1.88 | Wulbareg, Dalocha, Sankura, Lanfero, Siltie, Mito, Misrak Azenet Berbere, Misrak Siltie |
| | | | Hadiya | 37.34 | 2.15 | Gombora, Lemmo, Soro, Gibe, Analemmo, Mirab Badowach, Mirab Soro, Duna, Shashogo, Misha |
| | | | Guraghe | 37.07 | 3.34 | Enemor Ener, Cheha, Muhur Na Aklil, Sodo, Gedebano Gutazer Welene, Kebena, Enor Ener, Mareko, Ezha, Abeshege, Meskan |
| | | | Kembata Tembaro | 26.03 | 0.56 | Kacha Bira, Doyogena, Angacha, Tembaro, Hadero Tunto, Kediada Gambela |
| | | | Wolayita | 24.35 | 1.73 | Boloso Sore, Sodo Zuria, Damot Sore, Damot Gale, Damot Pullasa, Duguna Fango, Ofa, Damot Woide, Bayera Koisha |
| | | | Yem Special | 15.05 | 0.18 | Yem SP *Woreda* |
| | | | Gedeo | 14.79 | 0.32 | Yirgachefe, Wenago, Churso, Dila Zuria, Kochere, Gedeb, Rape |
| | | | Basketo | 6.29 | 0.04 | Basketo SP *Woreda* |
| Sidama | 163,064 | 24.08 | Sidama | 24.08 | 24.08 | Bilate Zuria, Hawassa Zuria, Dale, Bensa, Darara, Aleta Wendo, Aleta Chuko, Shebe Dino, Hawela, Bona Zuria, Boricha, Loka Abaya, Aroresa, Arbegona, Wondo-Genet |
| Tigray | 123,664 | 2.35 | North Western | 5.11 | 1.21 | Tahtay Koraro, Selekleka, Zana, Laelay Adiabo, Tsimbla |
| | | | Central | 3.57 | 0.65 | Adwa, Tahtay Mayechew, Adet, Laelay Maychew, Keyhe tekli |
| | | | SEastern | 1.80 | 0.18 | Saharti, Enderta, Degua Temben |
| BSG | 87,108 | 1.73 | Assosa | 6.41 | 1.47 | Bambasi, Assosa, Homosha, Kurmuk |
| | | | Mao Komo Sp. | 2.66 | 0.17 | Maokomo Special |
| SWEP | 25,772 | 0.66 | Dawuro | 2.90 | 0.32 | Loma, Gena, Disa, Mareka, Zabagazo |
| | | | Kaffa | 1.13 | 0.01 | Adiyio, Gimbo |
| Dire Dawa | 3,296 | 3.12 | Dire Dawa | 3.37 | 3.12 | Biyoawale, Wahil |

** Percentage contribution relative to the Zone; ** Percentage contribution relative to the region*

# Annex 11: Highly suitable proportions of land for turmeric

**Proportion of land under highly suitable (S1) classes for turmeric production by Region and Zone: lists of potential *woredas***

| Region | Area & % of S1 by Region | | Potential Zones | | | Potential *woredas* (listed in a decreasing order area of S1) |
|---|---|---|---|---|---|---|
| | Area(ha) | % | Zone | %* | %** | |
| Oromia | 2,226,528 | 6.89 | Kelem Wellega | 35.40 | 1.06 | Gawo Kebe, Gidami, Hawa Galan, Dale Sadi, Lalo Kile, Anfilo, Sedi Chenka, Sayo, Dale Wabera, Jimma Hor |
| | | | East Wellega | 31.89 | 1.35 | Guto Gida, Sasiga, Gida Ayana, Limu, Wama Hagalo, Nunu Kumba, Diga, Sibu Sire, Haro Limu, Jimma Arjo, Kiremu |
| | | | Ilu Aba Bora | 27.61 | 0.87 | Darimu, Bure, Metu Zuria, Sale Nono, Didu, Ale, Halu /Huka, Alge Sachi, Bilo Nopha |
| | | | Buno Bedele | 24.52 | 0.46 | Chwaka, Borecha, Bedele Zuria, Dedesa, Dabo Hana, Gechi, Mek |
| | | | Jimma | 16.14 | 0.91 | Limu Seka, Chora, Kersa, Shebe Sambo, Nono Benja, Goma, Limu Kosa, Omo Nada, Botor Tolay, Dedo, |
| | | | H. G. Wellega | 10.15 | 0.26 | Abe Dongoro, Amuru, Jarte Jardega, Abay Chomen |
| | | | West Shewa | 4.39 | 0.19 | Dano, Nono, Ginde Beret, Abuna Ginde Beret |
| BSG | 1,304,828 | 25.89 | Kamashi | 37.10 | 7.45 | Mizyiga, Zayi, Kamashi, Demb |
| | | | Mao Komo Sp. | 29.04 | 1.84 | Maokomo Special |
| | | | Assosa | 24.56 | 5.62 | Bambasi, Bilidigilu, Kurmuk, Homosha, Menge, Undulu |
| | | | Metekel | 21.66 | 10.98 | Dangur, Bulen, Wembera, Dibate, Mandura, Pawe |
| SWEP | 848,708 | 21.69 | Bench Sheko | 39.96 | 4.73 | Gurafereda, Debub Bench, Sheko, Shay Bench, Semen Bench, Gidi Bench |
| | | | Konta Special | 25.42 | 1.53 | Konta |
| | | | Mirab Omo | 24.85 | 9.44 | Surma, Gori Gesha, Maji, Bero, Menit Shasha |
| | | | Sheka | 20.75 | 1.25 | Yeki, Masha, Anderacha, Tepi |
| | | | Dawuro | 15.72 | 1.76 | Isara, Disa, Zabagazo, Tocha, Loma, Gena, Kachi |
| | | | Kaffa | 11.08 | 2.99 | Goba (SP), Gimbo, Decha, Gewata, Cheta, Chena, Bita, Adiyio |
| SNNP | 608,360 | 9.59 | Basketo | 39.58 | 0.26 | Basketo SP *Woreda* |
| | | | Wolayita | 22.25 | 1.58 | Kindo Koyesha, Boloso Sore, Sodo Zuria, Boloso Bombe, Ofa, Duguna Fango, Kindo Daddaye, Damot Woide, Hobicha Abaya, Bayera Koisha |
| | | | Gofa | 20.74 | 1.49 | Zala, Uba Debre Tsehay, Denba Gofa, Melekoza, Melo Gada |
| | | | Derashe | 20.09 | 0.22 | Derashe Special |
| | | | Konso | 15.41 | 0.57 | Karat Zuria, Kena |
| | | | Alle | 14.97 | 0.19 | Alle Special |
| | | | Amaro | 13.24 | 0.34 | Amaro |
| | | | Kembata Tembaro | 12.68 | 0.27 | Tembaro, Hadero Tunto, Kacha Bira, |
| | | | Gamo | 12.17 | 1.42 | Kucha, Gerese, Arba Minch Zuria, Daramalo, Kemba, Kucha Alpha |
| | | | Hadiya | 7.41 | 0.43 | Mirab Soro, Soro, Gibe, Mirab Badowach, Amek |
| | | | Burji | 7.13 | 0.15 | Burji Special |
| | | | South Omo | 6.61 | 2.42 | Salamago, Malie, South Ari, Bena Tsemay, Boko Dawul |

| | | | | | | |
|---|---|---|---|---|---|---|
| Gambela | 94,672 | 15.74 | Majang | 54.60 | 4.06 | Mengesh, Godere, |
| | | | Agnewak | 16.60 | 11.68 | Dima, Abobo, Gambela Zuria, Gog |
| Amhara | 297,244 | 1.91 | Awi | 17.89 | 1.04 | Jawi, Guangua, Ayehu Guwagus |
| | | | West Gojam | 3.07 | 0.27 | Debub Achefer, Semen Achefer, Wemberma, Bahirdar Zuri |
| | | | Central Gondar | 2.40 | 0.30 | Alefa, Masero Denb /Central Armacho, Tegede |
| | | | East Gojam | 1.33 | 0.12 | Baso Liben, Awabel |

*Percentage contribution relative to the Zone; ** Percentage contribution relative to the region

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