# Importance of Ginger in Ethiopia: recent trends and challenges

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RAISE-FS working paper #008

WAGENINGEN UNIVERSITY & RESEARCH

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

# Importance of Ginger in Ethiopia: recent trends and challenges

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

Addis Ababa, July 2023

RAISE-FS is funded by the Embassy of the Kingdom of the Netherlands in Addis Ababa (grant number 4000004753).

RAISE-FS is a programme hosted by Stichting Wageningen Research Ethiopia

RAISE-FS working paper #008

Publication ID: SWRE-RAISE-FS-23-009

WAGENINGEN UNIVERSITY & RESEARCH

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Kifile A., Bekele A., Tefera T., Alemu D., Koomen I., Diro M., and Nigussie D. 2023. Importance of Ginger in Ethiopia: recent trends and challenges. Stichting Wageningen Research Ethiopia. Addis Ababa.

SWRE-RAISE-FS-23-009

Ginger is one of the most widely used spices as a flavouring agent around the world. It is also an important crop in Ethiopia in terms of production, local consumption, and export, owing to the availability of favourable climatic and edaphic conditions and a long tradition of production. Ginger production, however, is limited to a few pockets in southern Ethiopia and a few areas in southwestern Oromia and north Amhara despite the country's huge potential for ginger production. In recent years, after the ginger bacterial wilt pandemic, production and export were hampered, seriously limiting its economic contribution at household and economy-wide. To resolve the problems, research and development efforts have been made. However, the adoption and implementation of the recommended practices are very limited. This working paper presents a general overview of ginger production and marketing, prevailing challenges, and recommended interventions to revitalize ginger production and marketing.

Keywords: Ginger, Bacterial wilt, Revitalization, Production, Marketing, Ethiopia

This working paper can be downloaded for free at https://doi.org/10.18174/635326



RAISE-FS working paper #008

SWRE-RAISE-FS-23-009

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# Preface

Resilient Agriculture for Inclusive and Sustainable Ethiopian Food Systems (RAISE-FS) is a four-year program funded by the Dutch Embassy in Addis Ababa and hosted by Stichting Wageningen Research Ethiopia based in Addis Ababa, to bring about transformation in the Ethiopian food system. RAISE-FS will develop and implement a demand-driven and interdisciplinary approach to Research for Food System Transformation (R4FST) and as such contribute to the Government of Ethiopia's transformational agenda.

RAISE-FS adopts the food system approach as a Theory of Change (ToC), which helps in analysing the drivers and food system activities that contribute to the transformation of the food system by addressing leverage points, resulting in increased productivity, enhanced value chain performance, and improved human nutrition for food security while minimizing environmental impact and ensuring social inclusion.

The project aims to leverage transformation in Ethiopian food systems, covering the spectrum from food-insecure households and regions, to better-off households that are food-secure and can realize production surpluses, towards commodity commercialization efforts that contribute to rural and urban consumption demands and export.

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# List of abbreviations and acronyms

| | |
|---|---|
| BoA | Bureau of Agriculture |
| EIAR | Ethiopian Institute of Agricultural Research |
| ETB | Ethiopian Birr |
| FGD | Focus Group Discussion |
| GBW | Ginger Bacterial Wilt |
| KII | Key Informant Interview |
| NGO | Non-Governmental Organization |
| RAISE-FS | Resilient Agriculture for Inclusive and Sustainable Ethiopian Food Systems |
| RASFF | Rapid Alert System for Food and Feed |
| SARI | South Institute of Agricultural Research |
| SNNPR | South Nations, Nationalities and Peoples Region |
| USD | United State Dollar |

# Summary

As a global commodity, ginger in Ethiopia plays very important role as export commodity in addition to its domestic utilization. Accordingly, the sector has received due attention by both private and public actors. However, due to several challenges, it's growth and performance were not stable. In recent years, after the emergence of ginger bacterial wilt pandemic, both the production and productivity were hampered seriously limiting its economic contribution at household and economy wide.

Cognizant to this trend, it was important to document the prevailing trends both in terms of the opportunities and challenges in order to come up with relevant intervention options. Accordingly, this working paper documents the general importance of ginger in Ethiopia along with the key trends of challenges and opportunities along with the improvement options. The required information for the working paper was generated considering based on mixed approach covering (i) review of existing literature both published and unpublished, (ii) primary data presented by relevant stakeholders during a national ginger revitalization stakeholders' consultative workshop, (iii) focus group discussions and key informant interviews, and (iv) secondary data from relevant sources.

The importance of ginger in the country is presented covering (i) the agro-ecological suitability and existing potentials, (ii) level of production trends, and (iii) prices, domestic and export market contribution. Ginger is one of the most important spices in Ethiopia, both for domestic consumption and export. The agroecological potential of ginger in Ethiopia is high, as it can grow in various climatic zones and soil types. However, ginger production is limited to a few pockets in southern Ethiopia and a few areas in southwestern Oromia and north Amhara. The production trend of ginger in Ethiopia is fluctuating and declining due to various factors such as pests and diseases, lack of improved varieties, poor agronomic practices, and market constraints. The price of ginger in Ethiopia is also volatile and influenced by seasonal and international market dynamics. The domestic and export market contribution of ginger in Ethiopia is significant. It is among the most important spices for domestic consumption in addition to its contribution to agricultural export. This plays important role in providing income and employment opportunities for many smallholder farmers and traders.

Unlike other crops, ginger requires a unique processing and storage practices that influence the quality and marketability both at domestic and international markets. Ginger is a valuable crop that has many uses in food, medicine and cosmetics. In this paper, the prevailing practices are characterized considering the main processing and storage practices. Therefore, it is important to follow the best practices for ginger production, harvesting, curing, drying and packaging to ensure high quality and long shelf life. Some of the key factors that affect the quality of ginger are moisture content, microbial contamination, insect damage and chemical residues. By adopting appropriate methods and technologies, ginger farmers and processors can improve their income and competitiveness in the markets.

The analysis clearly indicates that ginger faces diverse challenges from production up to marketing in addition to the challenges related with institutional linkages and coordination. The key challenges related to ginger production were identified. Some of the major production challenges include pest and disease management, soil fertility and nutrient management, post-harvest handling and processing, and market access and value addition. The study aimed to address these challenges by conducting a comprehensive analysis of the ginger value chain, identifying the gaps and opportunities for intervention, and proposing recommendations for enhancing the competitiveness and sustainability of ginger production.

The key challenges related to ginger marketing were identified including low production volume, high post-harvest losses, lack of quality standards, limited access to markets and finance, and weak coordination among stakeholders. By addressing these challenges, ginger producers and traders can increase their income and competitiveness, while also contributing to food security and nutrition in the ginger production areas.

The key challenges related to sector coordination and linkages in ginger production were identified. Ginger is a high-value commodity that can contribute to the economic development and livelihoods of smallholder farmers. However, ginger farmers face several constraints such as lack of quality planting material, prevalence of rhizome rot disease, traditional cultivation practices, lack of collective marketing and processing facilities, and low access to information and technology. To address these challenges, a cross-sector collaboration approach is needed, involving actors from the public, private and non-governmental sectors.

Recognizing the stated challenges, there have been a number of efforts made by both public and private actors including disease control and promotion of improved agronomic practices through strong campaign-oriented strategy and extension services. However, still the sector required due attention if it is to be revitalized. The key suggested measures for the revitalization of the ginger sector are (i) promotion of improved agronomic practices including a) adjusting planting time/ dry season planting, b) proper use of cultural practices, and c) proper fungicide use, and (ii) enhancing the sector coordination and linkage through establishment of Ginger Revitalization core group that will take responsibility for timely identification and promotion of relevant interventions from technological solution to quality and market performance improvement, and (iii) development of capacity building system from all relevant value chain actors.

# 1 Introduction

Ethiopia is endowed with suitable agro-ecological conditions for the production of ginger and is the 4th largest ginger-producing country in Africa after Nigeria, Mali and Cameroon. However, ginger production is confined to a few pocket areas in southern Ethiopia, particularly, in the low-lying part of southern Kambata-Tambaro, in some districts of Northern Wolayta including Boloso Bombe and Boloso Sorie districts, in the eastern part of Dawro (Gena Bosa district) and western part of Meirab Badawacho in Hadiya zone. These areas are collectively known as the ginger belt of Ethiopia. In the Southwest Region, in Sheka, Kaffa and Bench Maji zones there are some areas where ginger has been cultivated predominantly by smallholder farmers. Ginger is also produced to a lesser extent in southwestern Oromia and north Amhara.

Regardless of the conducive conditions to expand ginger production across the vast potential areas of the country, limited attention has been given to exploit the comparative advantage of geographic location and the potential of the export market. In addition, little research attention and development endeavour has been made to exploit the production potential of the crop for the benefit of smallholders in particular and for its contribution to the country`s economic growth at large, through foreign currency earning. The spice sector is not structurally organized independently having been incorporated into the Coffee Development Authority. Moreover, ginger is not recognized as a crop by the Ethiopian Central Statistics Agency currently known as Ethiopian Statistical Services (ESS)and hence any sort of basic information including the size of the area harvested and total yearly production for such an economically important export crop is lacking. Government funds allotted for ginger improvement in research institutions particularly, the South Agricultural Research Institute (SARI), which is mandated to do research on ginger production is extremely low.

Currently, the major bottleneck related to ginger production in Ethiopia is ginger bacterial wilt (GBW) and leaf spot disease, which are caused by the bacterium *Ralstonia solanacearum* and the fungus *Phyllosticsta zingiberis*, respectively. As a result of this interrelated disease complex, 80-100% disease incidence was recorded on ginger, which in the last decade caused a nationwide crop loss (Guji et al., 2019). This implies that it is of utmost importance that national attention should be given to ginger research and development.

Since the 2012 production season, when the prevalence of the disease complex occurred, the production, productivity, area coverage, export volume, and export earnings from ginger has shown a significant decline. For better understanding and targeted policy and development measures, it is important to document the prevailing trends both in terms of the opportunities and challenges in order to come up with relevant intervention options. Accordingly, this working paper documents the general importance of ginger in Ethiopia along with the key trends of challenges and opportunities along with the improvement options. The required information for the working paper was generated considering based on mixed approach covering (i) review of existing literature both published and unpublished, (ii) primary data presented by relevant stakeholders during a national ginger revitalization stakeholders' consultative workshop, (iii) Focus Group Discussions (FGDs) and Key Informant Interview (KIIs), and (iv) secondary data from relevant sources.

The following parts of this paper are structured into five thematic issues, where the first part deals with the overview of the importance of ginger in Ethiopia followed by the prevailing practices of ginger processing, storage and marketing as key factors of competitiveness. The third part documents the identified key challenges facing the sector followed by major efforts made by both public and private actors in addressing the prevailing challenges. The final part documents the conclusions and recommendations as the way forward.

# 2 Importance of ginger in Ethiopia

The importance of ginger in Ethiopia is presented targeting (i) the extent of agro-ecological suitability and existing potentials, (ii) trends in the volume of production at national level, and (iii) the trends in domestic prices and ginger export.

## 2.1 Agro-ecological suitability and existing potential

Ginger prefers a warm and humid climate, and a soil that have sufficient water retention and ventilation. The areas in lowlands in Ethiopia fit with the requirements of the crop. The major ginger growing regions in Ethiopia are the South Nations Nationalities People's Regional (SNNPR) State and Southwest Ethiopia Regional State. The crop is also grown in pocket areas of Oromia regional State and specific localities of the Amhara Regional State including East Gojam, West Gojam and Awi zones (Haile Michael et al., 2008). In general, the following conditions are an indication of suitability for ginger production.

**Altitude:** Ginger is cultivated from sea level to an altitude of 1500 m above sea level. In Ethiopia, this altitudinal range matches with lowland areas (500-1500masl) and ginger is predominantly cultivated in these altitudinal ranges.

**Temperature:** Ginger grows well in warm and humid climates and performs well in a temperature range of 19°C- 28°C. Warm sunny days are most conducive but a temperature above 32ºC can cause sunburn, and a temperature below 15ºC can cause crops to stop growing.

**Rainfall:** Ginger can be grown both under rainfed and irrigated conditions. For successful cultivation of the crop, moderate rainfall at planting time until the rhizomes sprout, fairly heavy and well-distributed showers during the growing period and dry weather for about a month before harvesting are necessary (Sasikumar et al., 2008). A rainfall of 1500-3000 mm, well distributed in 8-10 months is ideal. Dry spells during land preparation and before harvesting are required for large-scale cultivation. In areas receiving less rainfall, the crop needs regular irrigation. The crop is sensitive to water logging, frost and salinity and tolerant to wind and drought (Hackett & Carolane, 1982). In Ethiopia, ginger is cultivated under sub-optimal conditions with a total rainfall of often less than 1500 mm per year (Jansen, 1981).

**Soil:** Ginger can be grown in a wide range of soils, however for a good yield the soil should be loose, friable and offer minimum resistance to rhizome development. Well drained soil with of least 30 cm depth is preferred. However, shallow soil can be utilized satisfactorily with application of bedding and mulching. As depth of the soil increases, its suitability for cultivation also increases. Compact clay soils which are subject to water logging or coarse sands without water holding capacity, gravelly soils or those with hard pan are not conducive for the production of high yielding healthy plants (Lawrence 1984 in Kandiannan et al., 1996).

As one indicator of the importance of ginger not only considering the current size of production but also the potential of production expansion, we developed an overall land suitability map that shows where ginger can grow (Nigussie et al., 2023). The suitability map considers the key factors presented above and it is the combined result of the altitude, slope, soil properties, and the climate layers. The Analytic Hierarchy Process (AHP)with in the Multi-Criteria Decision-Making approach was used to identify four suitability classes, namely S1 (very suitable), S2 (moderate suitable), and S3 (marginally suitable) and N (unsuitable). The distribution of the different suitability classes for ginger is presented in Figure 1.

*Table 1 Area of land under different suitability classes for ginger production by region*

| Regions | Highly suitable | | Moderately suitable | | Marginally suitable | | Not suitable | |
|---|---|---|---|---|---|---|---|---|
| | **Area (ha)** | **%** | **Area (ha)** | **%** | **Area (ha)** | **%** | **Area (ha)** | **%** |
| Addis Ababa | 0 | 0.0 | 0 | 0.0 | 768 | 1.4 | 53,147 | 98.6 |
| Afar | 0 | 0.0 | 15,880 | 0.2 | 8,796 | 0.1 | 9,465,441 | 99.7 |
| Amhara | 529,476 | 3.4 | 2,245,016 | 14.4 | 2,356,672 | 15.1 | 10,429,168 | 67.0 |
| BSG | 2,326,464 | 46.2 | 2,122,888 | 42.1 | 435,096 | 8.6 | 154,254 | 3.1 |
| Dire Dawa | 0 | 0.0 | 0 | 0.0 | 248 | 0.2 | 105,274 | 99.8 |
| Gambela | 382,196 | 12.2 | 1,035,428 | 32.9 | 366,028 | 11.7 | 1,358,906 | 43.2 |
| Harari | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 37,156 | 100.0 |
| Oromia | 2,088,396 | 6.5 | 4,443,404 | 13.8 | 2,892,012 | 8.9 | 22,887,044 | 70.8 |
| Sidama | 8,512 | 1.3 | 157,800 | 23.3 | 72,160 | 10.7 | 438,647 | 64.8 |
| SNNP | 583,188 | 9.2 | 1,603,032 | 25.3 | 812,384 | 12.8 | 3,342,706 | 52.7 |
| Somali | 0 | 0.0 | 188 | 0.0 | 1,492 | 0.0 | 31,288,060 | 100.0 |
| SWEP | 1,517,536 | 38.8 | 1,038,664 | 26.6 | 191,112 | 4.9 | 1,164,525 | 29.8 |
| Tigray | 68 | 0.0 | 318,088 | 6.1 | 68,764 | 1.3 | 4,873,210 | 92.6 |
| **Total** | **7,435,836** | **6.6** | **12,980,388** | **11.5** | **7,205,532** | **6.4** | **85,597,538** | **75.6** |

*Source: Authors' estimation*

The result from the land suitability analyses showed that the highly, moderately and marginally suitable lands in the country are 7.44 (6.6 %), 12.98 (11.5%) and 7.21 (6.4%) million hectares, respectively. This implies that considering highly suitable and the moderately suitable classes together represent 18.0% (20.42 million ha) of the total area of the country. In terms of regional distribution, Benishangul Gumuz (BSG), Oromia, South West Ethiopia Peoples (SWEP), Southern Nations Nationalities Peoples (SNNP) and Amhara regions have largest spatial coverage of highly suitable land, with 2.33 (46.2%), 2.09 (6.5%), 1.52 (38.8%), 0.58 (9.2%), 0.53 (3.4%) million hectares in the same order (Table 1).

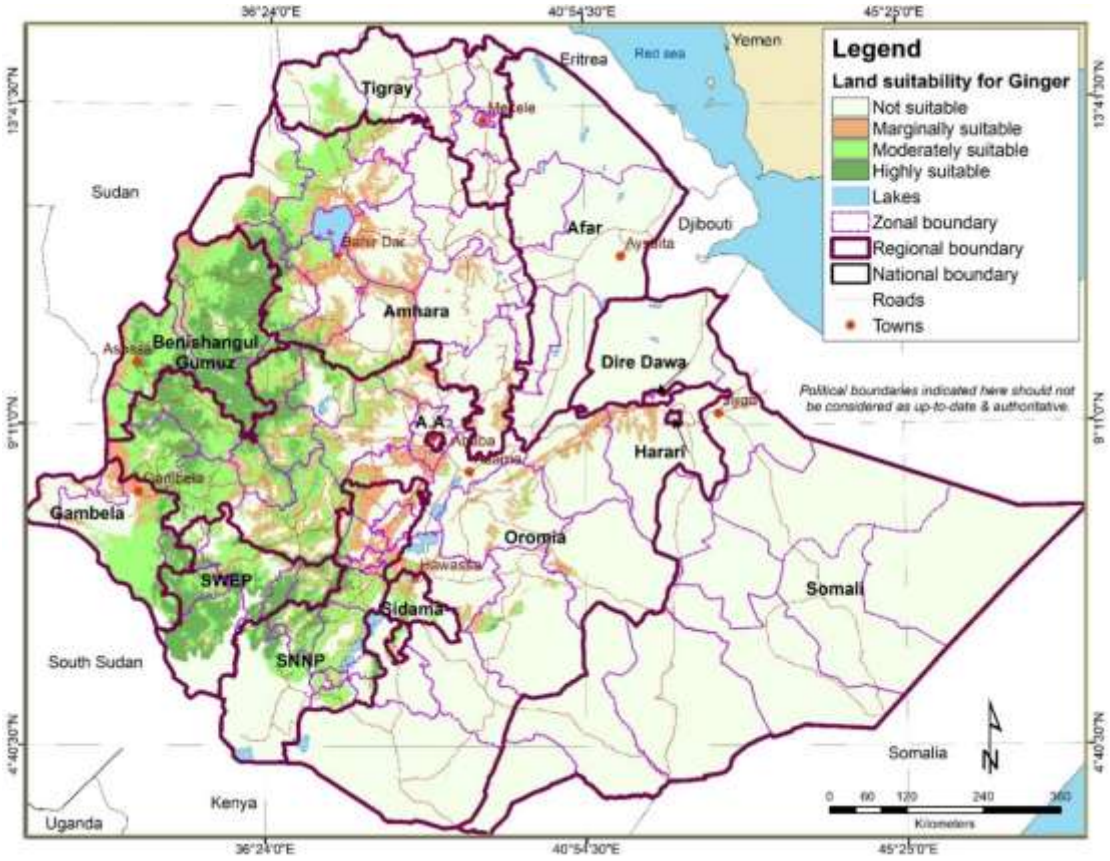


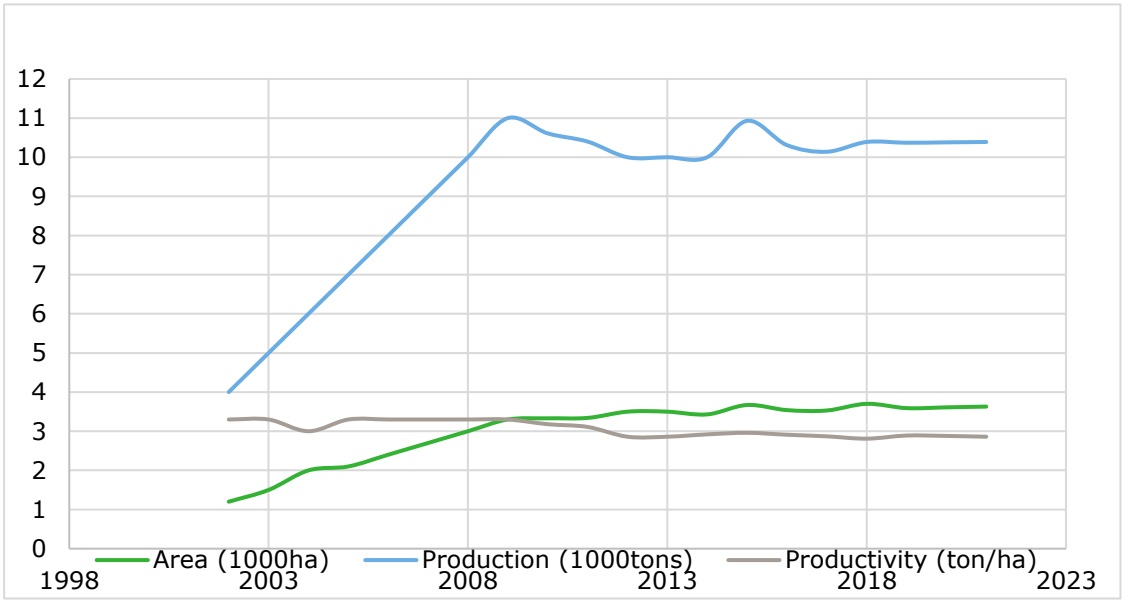

*Figure 1 Land suitability map for ginger production in Ethiopia (Alemu et al., 2023)*

## 2.2 Production

Commercial production of ginger is limited to the SNNPR, particularly in Wolaita and Kambata-Tembaro zones (Hordofa & Tolossa, 2020). Among spice crops, ginger is the second dominantly grown spice in Ethiopia next to pepper (Herms, 2015). According to FAOSTAT (2022), the production trend was in an increasing trend from 2002 to 2009, but subsequently declined (*Figure 2*). Following the occurrence of the

disease complex, the SNNPR bureau of agriculture and agricultural research institutions (both Southern Agricultural Research Institute and Ethiopian Institute of Agricultural Research) recommended the abandoning of the production of ginger for a short period until the pathogen declined. Following the disease outbreak, those areas that produce for the market were highly affected and stopped producing ginger. Other areas that used to produce ginger in small amounts i.e., for the local market only like Tepi and Basketo are now producing considerable amounts, since the damage caused by the disease in those areas was relatively small. However, the production of ginger in Boloso Bome and Hadero areas, known as the ginger belt in the past, is still challenged by high disease pressure despite farmers' effort to control the diseases using different management practices, which are labour and capital intensive. There will most likely be shift in production of ginger to areas where there previously has not been any production.

*Figure 2 Trend in the production area, volume and productivity of ginger in Ethiopia from 2002 – 2022*




*Source: FAOSTAT 2022*

## 2.3 Domestic consumption of ginger

Ethiopians have a tradition of high spices consumption (Hailemichael et al., 2022) including red pepper, ginger, turmeric and many others. Ethiopians' spice consumption is high compared to other cash crop such as coffee and oil seeds. Domestic consumption of ginger in Ethiopia is a significant factor in the country's economy and culture. Ginger is widely used as a spice, a medicine, and a source of income for many farmers and traders. According to the Ethiopian Ministry of Agriculture, ginger production in Ethiopia reached 445,000 metric tons in 2019, making it the second largest producer of ginger in Africa after Nigeria. However, domestic consumption of ginger in Ethiopia is also high, as it is an essential ingredient in many traditional dishes, such as wat, doro wat, and kitfo. Ginger is also valued for its medicinal properties, as it is believed to help with digestion, nausea, colds, and inflammation. Moreover, ginger is often consumed as a tea or a juice, especially during religious fasting periods, when animal products are prohibited. Therefore, domestic consumption of ginger in Ethiopia reflects the diverse and rich aspects of the country's history, culture, and lifestyle.

## 2.4 Ginger export

### 2.4.1 Trends in ginger export volume

In the last two decades (2004 – 2022), Ethiopia exported 86,820 tons of ginger. Out of this, 95% of the export was done in the first decade (2004 – 2013) after which it substantially declined in the second decade (2014 – 2022). It was also observed that 57% of the export was made in the years between 2009 and 2013 (Figure 2).

Ginger export volume has been growing in earlier decades at a positive rate of 15.5% from 2004 – 2013. From 2014 onwards, however, it started declining swiftly at a negative rate of -37.5% per annum. The overall trend revealed a declining trend at a negative rate of -37.2% per annum. The downfall export trend is highly associated with diseases incident in the major ginger production areas. The first bacterial wilt was reported in 2012 (Kifelew et al., 2015) from Benchmaji zone Bebeka coffee state farm, then after it progress to Sheka Zone and cause up to 67% yield loss. In subsequent years, the disease was spread into major ginger production zones including Dawro, Wolayta, Kenbata tenbaro, Hadiya, Gomogofa and Konta that cause yield loss of up to 98% (Kifelew et al., 2015). The ginger export volume shows two distinct trends. The first trend is an increasing one with a minor drop in 2006 and 2011. The second trend is a significant drop starting from 2014. From 2018 onwards, however, the export volume started to raise slowly but was not sufficient to indicate any sign of a breakthrough.

The export value exhibits the same declining trend as the export volume. In 2010, Ethiopia generated USD 24.94 million from exports of ginger. Since then, however, it revealed a swift declining trend (Figure 3) which is the effect of declining export volume associated with bacterial wilt. Figure 3 illustrates Ethiopia's trend of export earnings from ginger which revealed a sharp rise from 2004 – 2011 growing at a rate of 50% per annum while it then started falling swiftly from 2012 onwards declining at a rate of -47% per annum. Overall, the two-decade average trend revealed a declining trend at a rate of -21.6% per annum.

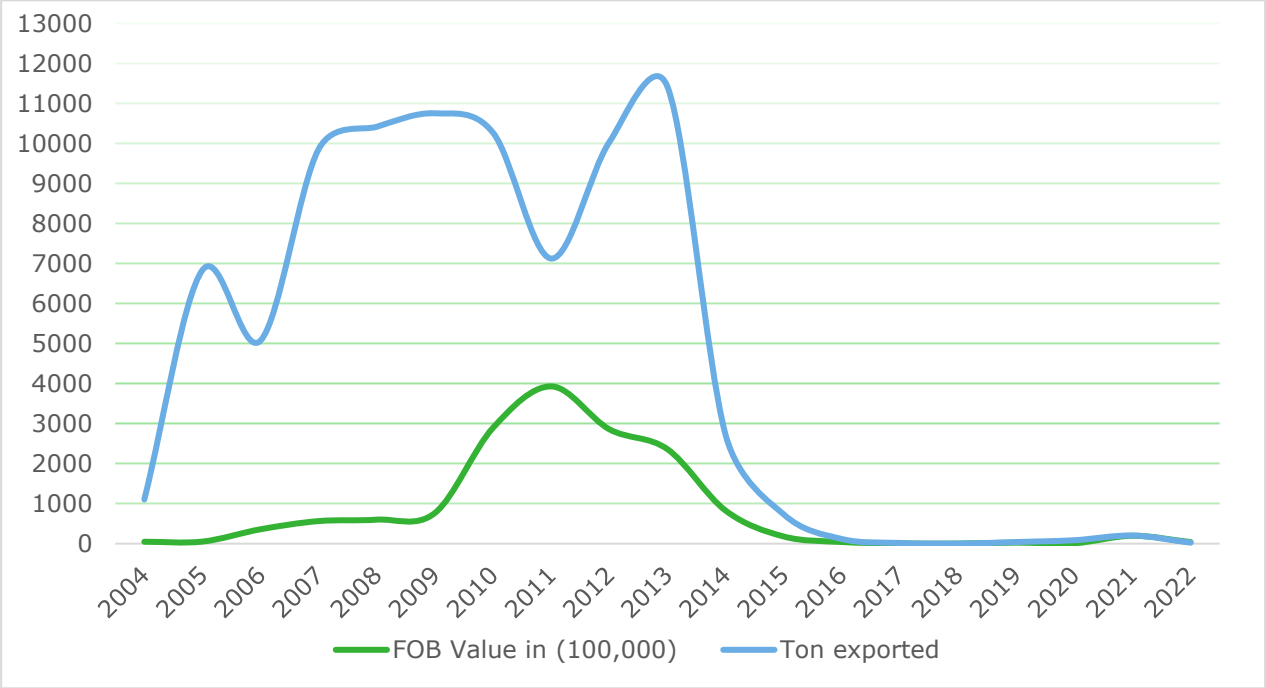



*Figure 3 Ginger export volume and value (ETB) trends 2004 – 2022*

*Source: Ethiopia Revenue and Custom Authority*

### 2.4.2 Price trend of ginger export

In terms of ginger export price, the trend illustrated tremendous fluctuation and instability over years. From 2010 – 2020, it fluctuated substantially with an average trend of negative at a rate of -8. 7% per annum. From 2020 onwards, it started to rise swiftly growing at a positive rate of 34% per annum. Overall average price trend from 2010 – 2022 exhibited a slight fall at a negative rate of -2% per annum. The earning variation is explained by two factors: the export volume and the prevailing market prices. As shown in Figure 4, the price per ton of ginger declined from 2012 to 2017. Recently since 2020 own wards, the price per ton has shown an increasing trend.

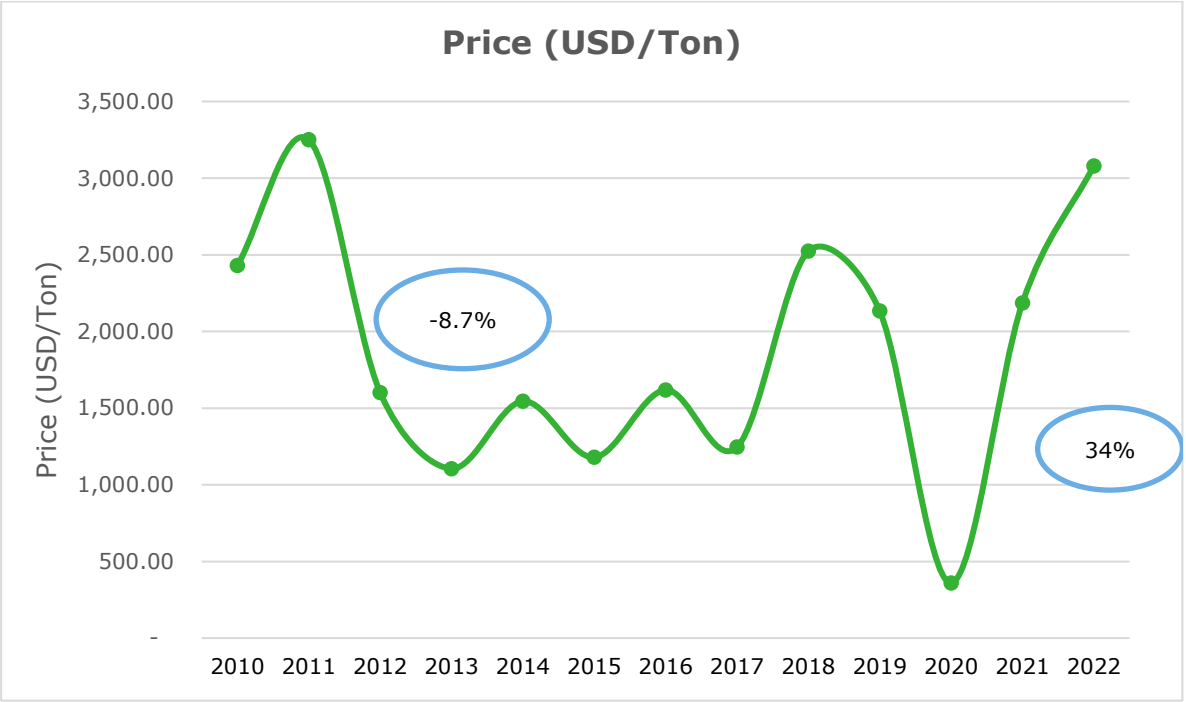



*Figure 4 Price (USD/ton) trends of ginger export in the last decade*

*Source: FAOSTAT 2022*

### 2.4.3 Destination countries for ginger export

In the last two decades (2004 – 2022), Ethiopia exported ginger to 48 countries in the world. In 2004, Ethiopia exported ginger to only six destinations mainly to neighbouring and the Gulf countries but increased rapidly to 17 countries extending to Europe, North and Latin America, South Asia, and the Gulf countries (Figure 5). From 2014 onwards, however, the number of countries importing ginger from Ethiopia started to decline. In the recent year, 2022, Ethiopia exported ginger to only 11 countries of the world because of inadequate domestic production. The largest proportion of ginger was sent to neighbouring country Kenya (41.7%) followed by Canada (23.3%), Taiwan (15%) and United States (13.8%). These four countries alone accounted for 94% of Ethiopia's ginger exports in 2022.

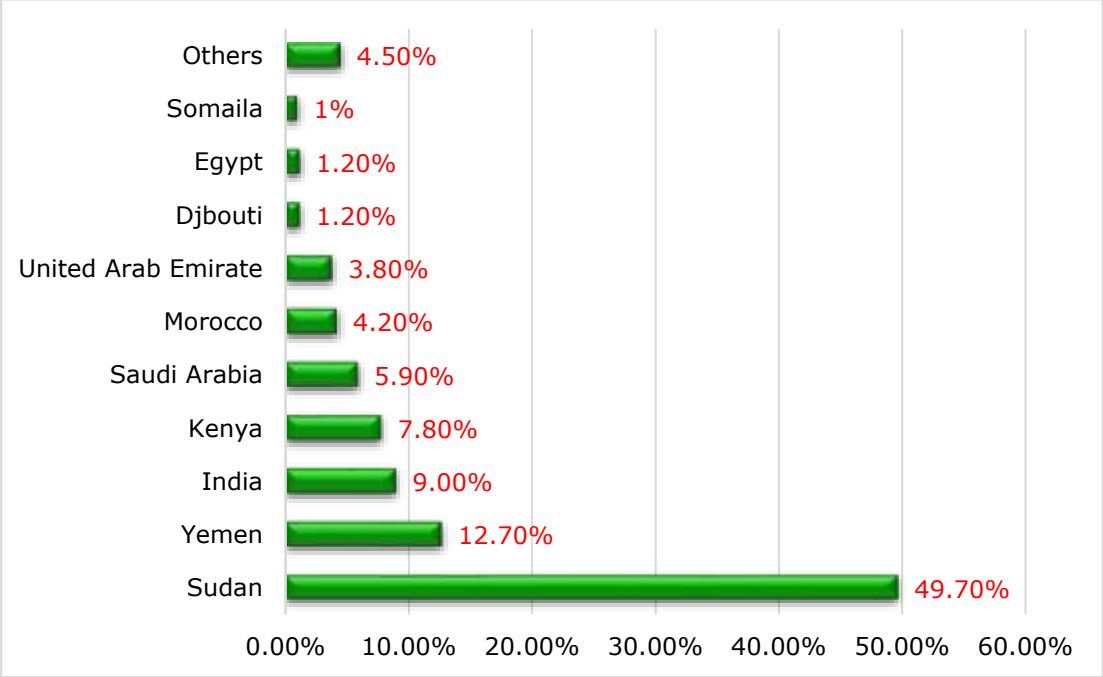



*Figure 5 Destination countries of ginger export in the last two decades, 2004 – 2022*

# 3 Practices in ginger processing and storage: implications for quality and marketing

## 3.1 Processing

Three processing mechanisms are used for ginger in Ethiopia, the first one is the preparation of green ginger, which is mainly consumed fresh in foods and as a flavouring in drinks. The second one is dried ginger which is mainly done by smallholder producers. Studies have shown that dried ginger has been full of impurities and dirties as it is prepared on the ground (Geta and Kifle, 2011; Jayashree et al., 2014). The third one is the extraction of ginger oils, which is most often done by private firms. The two most common processing methods, green and dry ginger and the steps are presented in Figure 6.

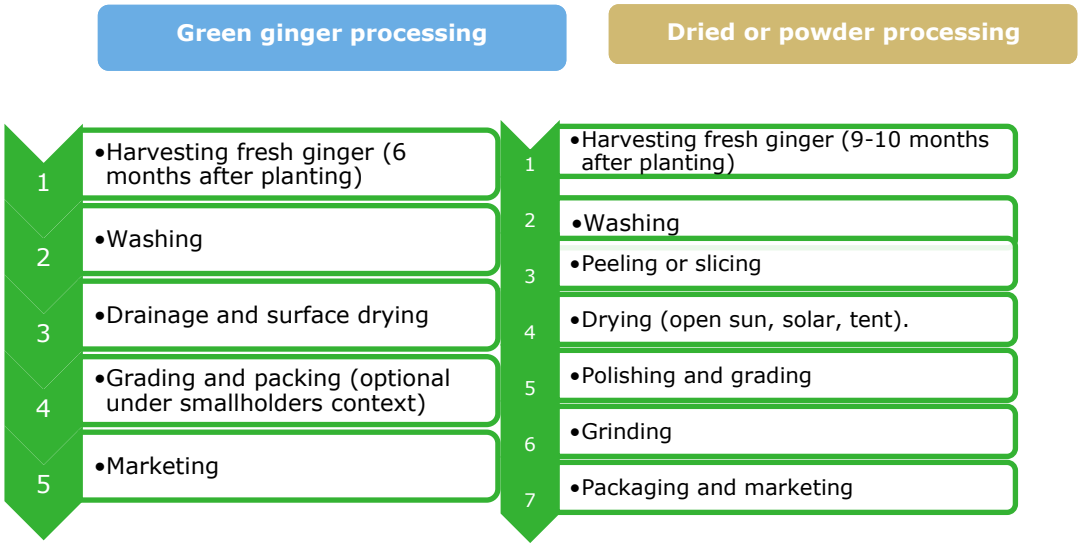



**Figure 6** Green and dried ginger processing typologies

In general, given the important role of processing methods in quality assurance for improved competitiveness not only for domestic market but also the international markets, it is mandatory to modernize the prevailing methods of processing. This can be through (i) awareness creation, (ii) promotion of improved processing techniques and technologies, and (iii) capacity development of ginger value chain actors.

## 3.2 Storage

Ginger rhizomes harvesting can be started about 5 months after planting. At this stage they are immature. The rhizomes are tender and are suitable for fresh consumption or for processing. After 7 months the rhizomes will become less tender and the flavour will be too strong to use them fresh. They are then only used for drying. Matured rhizomes for drying are harvested between 8 and 9 months of age when they have a high aroma and flavour. In Bolsos Bombe, farmers sell out their ginger immediately after harvesting. When markets are unstable and demand fluctuates, farmers dry ginger and store it in their houses to fetch a better price. The post-harvest handling and storage need intervention to preserve quality and safety. The regulation outlined for entering the European market for dried ginger indicated that there were more than 50 notifications of issues, with ginger in the Rapid Alert System for Food and Feed (RASFF) database between 2020 and 2022. The notifications relate to several issues: ethylene oxide residues (used to combat fungi and

bacteria in several ginger producing countries), presence of aflatoxin, presence of Bacillus and Salmonella, presence of lead (CBI, 2022). Thus, if Ethiopian ginger export to be competitive, it will be important to address the quality issues related with storage practices.

## 3.3 Marketing

Ginger marketing includes all the business activities involved in moving ginger from producers to the market centre and ultimately to the domestic and international consumers in the exporting countries. In Ethiopia, fresh and dried forms of ginger are marketed through different marketing channels. However, fresh ginger has been the dominant form in which ginger is marketed in the local market place. Fresh ginger is usually supplied to the market in the rainy season for immediate cash demand. It is also supplied in the dry season as assemblers collect it for re-sell to large traders after sun-drying. Dry season fresh ginger supply also targets local farmers who demand it as planting material. Dried ginger is a favourite product exchanged in large volumes by all market participants at different stages of marketing from local assembling to export market. Dried ginger for this purpose is harvested late when there is a mature rhizome with a full aroma, flavour and pungency (Geta and Kifle, 2011).

After the production of ginger, marketing is the most important function, which involves assembling, processing and distribution. Generally, producers bring ginger to the local markets. Local collectors and regional traders including small local shops in growing areas are engaged in purchasing and bulking from farmers. In some cases, collectors and traders themselves come to production areas to collect ginger. There are also local collectors who are collecting and selling their ginger purchases to local wholesalers and do some sort of processing for value addition. However, the marketing of ginger in these production areas is constrained by low-quality product, poor pre- and post-harvest handling practices, and low product market prices. Moreover, the export market is challenged with the limited volume supplied, the need for aggregation of similar variety (size, maturity etc), and domestic price competitiveness with international prices.

# 4 Major challenges facing ginger production and marketing

The results of the assessment indicate that the key challenges facing ginger production and marketing are related with (i) considerable incidence of ginger diseases, (ii) the poor agronomic practices used by ginger producers, (iii) the poor quality and limited marketable surplus, and (iv) the limited policy and development attention given by policy and development practitioners.

## 4.1 Ginger disease

Before 2012, the only major problems regarding ginger in Ethiopia had been poor pre- and postharvest management practices, out of which shortage of improved varieties and yearly price fluctuations were the most important. Disease and insect pest problems were not deemed a major problem (Geta and Kifle, 2011). In 2012/13 a disease outbreak devastated ginger all over the country irrespective of varieties, local cultivars, locally collected germplasm and introduced varieties from abroad, nursery plants as well as wild races in inaccessible dense natural forests. In Ethiopia, the disease was observed for the first time in southwestern part of SNNPR, at a newly established 980 ha commercial ginger farm in Bebeqa in 2012.

According to Habtewold et al. (2015), during the disease outbreak there was heavy successive rainfall (monthly average, 288 mm), high humidity (> 90%) and warm temperature (maximum average, 27.8$^{o}$C) in the Bebeka area, which occurred from June to August. In the same year, more or less similar weather conditions were noticed throughout the country. Synergetic effect of high humidity and high temperature that existed simultaneously during the disease outbreak generated an ideal condition for the development of the disease and aggravated its effect on ginger production. But it remains still unclear how the disease was spread over the whole country within one year. During an abrupt occurrence of the disease, researchers had two different opinions on the disease complex: some argued that it was Ginger Bacterial Wilt only and others claimed that different pathogenic species co-occurred within the disease complex.

In order to identify the disease, the extent of its incidence and distribution in the region, research institutes both at federal (EIAR) and regional (SARI) levels together with SNNPR Bureau of Agriculture conducted a quick survey collaboratively in almost every major ginger growing parts of the region and to some extent in ginger growing regions of the country. Leaf and rhizome samples were also collected to identify the cause of the disease.

A thorough field assessment associated with literature consultation by team of researchers and experts confirmed that the symptom of the disease was that of GBW. Moreover, an intensive laboratory analysis of the samples conducted at Ambo Plant Protection Research Laboratory illustrated that the causative agent of the disease was *Ralstonia solanacearum* Race 4 biovar 3 (Tariku et al., 2016). Currently every ginger rhizome across the country is latently infected with GBW pathogen and no disease free planting material can be accessed within the country unless cleaned by the tissue culture laboratory technique.

*R. solanacearum* becomes virulent if and only if the ideal conditions for its development prevails, i.e., if >90% humidity and >28$^{o}$C temperature occur simultaneously. *R. solanacearum* is a soil-borne bacterium which colonizes the xylem, causing bacterial wilt in a very wide range of potential host plants (Peeters et al., 2013). In addition to ginger some of its economically important Solanaceous hosts are tomato, potato, tobacco, banana, cowpea, peanut, and papaya. *R. solanacearum* spreads by infested soil adhering to hands, boots, tools, vehicle tires, farm equipment; in water from irrigation or rainfall, and by infected ginger rhizomes. The pathogen enters into roots through wounds created during planting, cultivation, insects, or certain nematodes and through natural wounds where secondary roots emerge. Once inside the host, the bacterium has an affinity for the vascular system, where it multiplies rapidly, filling the xylem with bacterial cells and slime. Once infection is established, the bacterium moves up through the vascular system, the xylem, and finally blocks water transportation, which causes wilting.

Symptoms of GBW occur on the above and underground parts of the ginger plants. Typical symptoms of bacterial wilt such as green wilt followed by yellowing and dwarfing can be observed a few days after infection. Further, symptoms of bacterial wilt include discoloration of the vascular system from pale yellow to dark brown and droplets of milky bacterial ooze exuding from affected tissue. Young shoots and tillers often

become soft and rotten, breaking off easily from the underground rhizome at the soil level. The rotted rhizomes emit a foul smell characteristic of the disease.

However, ginger leaf spot disease, caused by the fungus *Phyllosticsta zingiberis,* is now also becoming a serious problem in ginger culture in Ethiopia since it could be virulent at any wet weather condition, particularly from June to September. Hence, year-to-year incidence is always there where ginger is grown under rain-fed condition. Ginger leaf spot is important disease of ginger due to severe leaf spot and blight it causes in all over ginger producing areas in Ethiopia. The extent of dispersal of ginger leaf spot disease depends upon the intensity of precipitation. High intensity of rain accompanied by wind seems to create conducive conditions for spores to splash greater distances resulting in an increase disease incidence. The disease begins to appear towards the end of June. Later in July when the number of rainy days and total rainfall increase, the disease aggravates and spreads very fast. Ginger plants up to the age of six to seven months are susceptible to this disease. The temperature range of 23 to 28$^0$C with intermittent rain favours disease development. Continuous cultivation of ginger in the same field build-up higher concentrations of inoculum and early infection of the plant reduce the vigour leading to reduction in the rhizome yield.

Initial symptoms of ginger leaf spot first appear on younger leaves as small oval to elongated spots on the leaves. Later on, the spots show a white papery centre and dark brown margins with a yellowish halo surrounding it. The spots increase in size and coalesce to form larger lesions. The affected leaves become shredded and may suffer extensive desiccation. As the plants develops new fresh leaves, these get infected subsequently. The disease is both seed and soil borne. Wet soil conditions, high soil moisture and soil temperature are the most important factors influencing the development of this disease. Severity of disease is more in areas where rainfall is high or rhizomes are planted in heavy clay soil and under poor drainage condition. The infected debris or seed serves as primary inoculum for the disease. Other species such as Soft rot and Yellow diseases/Fusarium yellow, sheath/leaf blight may also co-exist in the disease complex that might cause similar or different symptoms on foliar and/or subterranean parts of the ginger plants.

## 4.2 Agronomic practices

Ginger crop production requires sufficient rainfall distribution (or supplementary irrigation), proper soil type, proper use of inputs including fertilizer, compost, fungicides and timely practice of weed control. Shortage of rainfall, characterized by late onset and early cessation, has been the major challenge that threatens ginger production (Belachew and Fekede, 2020; Asale and Ashango, 2017). For normal growth, development and production of ginger, it needs 8-9 months (Feb/March to Dec/ Jan) of rainfall distributed uniformly across ginger growing season. Most ginger growing belts of southern Ethiopia experience bimodal rainfall distribution pattern, *belg* (February to May) and *meher* (June to September).

It is not advisable to grow ginger year after year in the same location since it is a soil exhaustive crop (FAO, 2019). But in the major ginger growing areas of southern Ethiopia, farmers practice year after year production in the same plot due to land shortage to rotate with other less importance crop in terms of economic terms. On the other hand, perennial planting is common by most ginger growing farmers because of additional rhizome weight gain from already established plants of previous season. The challenge of such production system is that farmers have to apply huge amount of inorganic (not affordable), organic (not available in sufficient amount), or in combination which otherwise soil depletion is overwhelming that results in lower productivity. As a result, ginger production is becoming a well-to-do family business practice that needs sufficient resources by the farmer.

Ginger needs frequent weeding and flicking/ shallow cultivation followed by mulching. Mulching ginger beds with green or dry leaves is important to maintain soil moistures besides its long effect as organic matter. Sengupta et al. (2009) explained the importance of mulching during dry months in conserving soil moisture and enhancing soil temperature for proper germination of the rhizome. Usually, most farmers in Welaita and Kambata-Tambaro frequently cultivate their ginger crop and controls weed effectively, however, mulching of the first-season ginger plot is not a common practice. For perennial ginger, farmers use the first season crop's aboveground dried stem and leaves as mulch during November to January dry period to save the underground rhizome until the *belg* season rainfall starts. Following onset of belg rainfall, farmers cultivate the perennated ginger plot by incorporating the dry season mulch into soil. Mulching ginger leaves and stems for next generation ginger crop can be good for soil moisture, but it can encourage disease & pest build-up of the same crop.

One of the important agronomic practices is planting material and seed selection. Using rhizomes as a sole planting material is bulky and difficult to obtain when one requires them (Hordofa & Tolossa, 2020). Ginger farms should be planted with clean seeds from known sources, described by mature, clean, and disease-free

rhizomes, with 2 - 3 nodes (FAO, 2019). Keeping recording of planting materials, treating rhizomes with different pesticides and other type of treatments e.g. cow urine, and storing the seed in clean and dry places following harvesting can assure the cleanliness of the seed. However, farmers usually plant seed rhizome by getting it from their own previous season crop or purchasing from the local market. The rhizome from the perennial ginger crop cannot be used as planting materials since only a few nodes are found on the rhizome that can grow into the shoot. Farmers have no mechanism to know whether the planting material is free from disease. Additionally, no seed treatment for rhizome is used prior to planting.

## 4.3 Quality and marketing

Currently, ginger production is mainly based on the local cultivar so it is not possible to trace the product type easily. Two varieties have been registered so far in Ethiopia; however, their rhizome is thin and fibrous compared to the locally known Volvo cultivar, as a result, farmers are not interested to produce the released varieties. This calls for the research attention to screen cultivars with thick and less fibrous rhizome type ginger which is preferred by producers and consumers. The other critical issue with ginger marketing is price fluctuation from year to year and from season to season in a given year. It is a common phenomenon that during major harvesting time (November – December) the price is low compared to other months or sold dry or stored to get a premium price. Instead, the prevailing marketing practice is traders negotiate the price with farmers after visiting the ginger farm at the maturity stage and then decide the date of harvesting so that they transport the ginger product directly from the farm to the market centres. If the product destination market is high, then in turn the traders offer better prices for ginger to farmers and vice versa. Recent marketing practices show that traders visit the ginger farm before they decide to buy the ginger because, if the ginger farm is affected by the disease, either they reject to buy or offer a very low price for the product. Interviewed traders explained that ginger that is harvested from the disease-affected area shrinks seriously so that the dry-to-wet ginger weight ratio is 1:8 compared to the morphologically healthy crop farm product with a ratio of 1:4.

The other critical market related issue is processing. As ginger is sun-dried on the ground for two to four weeks and becomes mixed with dirt and impurities. After drying under such conditions, the dry ginger takes the smell of soil and other materials that affects the ginger's normal pungency and taste. Hence, the flavour is less and both local and central markets do not buy such products. Therefore, looking into the innovative drying condition can improve the marketing of ginger. The lack of processing facilities has an effect, especially, on the international market. Since the traditional processing is unhygienic that exposed the ginger quality due to contaminants and the development of mycotoxins. In general, working on the post-harvesting of ginger can improve the current market challenge.

## 4.4 Limited policy and development attention

Even though there is conducive environment for the sector in terms of research and development and there are vast potential areas of the country to expand its production, the attention given to ginger research and development is very limited. This is highly associated with (i) lack of adequate and timely information (data) about ginger production and marketing linked with the fact that ginger is not considered in the national agricultural statistical programs by Ethiopian Statistics Services, (ii) limited participation of members of the national agricultural research systems in ginger research, and (iii) the limited promotion of available ginger innovations through the national agricultural extension program not only in the current production niches but also in the potential areas.

# 5 Efforts to address the prevailing challenges

Recognizing the stated challenges, there have been efforts to address them, which are mainly associated with measures taken to control the major ginger diseases, and also promoting improved ginger specific agronomic practices targeting the current main production areas.

## 5.1 Ginger disease

Management of ginger bacterial wilt is very difficult as it has a wide host range (45 plant families and 250 plant species) and long survival rates in the soil (40 years); it spreads through many ways (seed, water, soil, farm tools); due to the presence of genetically diverse strains of the bacterium (different races and biovars) (EU, 2003; Allen et al., 2005). GBW exists systemically in seed rhizomes both as an active and latent infection (Hayward & Hartman, 1994), which makes its control more difficult. In addition, GBW is a complex disease infecting ginger through all phases of the production cycle, yet no effective control measure has been designed so far (Yang et al., 2012). Different GBW control mechanisms have been attempted but none of the control measures are so far effective.

Global experiences indicate implementation of different strategies for the management of GBW including resistant varieties, heat treatment, chemical control, biological control, bio-fumigation, bacteriophages, and control agents. Breeding for resistance is an important strategy in disease management, but none of the released varieties of ginger are resistant to *R. solanacearum*. This may be due to the lack of genetic variability among ginger accessions since ginger is a vegetatively propagated crop (Prasath et al., 2011).

Heat treatment, which involves soil and ginger seed rhizome solarization as well as hot water treatment has been used to reduce the bacterial inoculum load in soil and in seed rhizome. In soil solarization, polyethylene covers are used to trap sunlight for about 40 days before planting to raise the temperature. In the case of seed rhizome solarization polyethylene covers are also used but prolonged exposure of the rhizomes to hot air (49–50 °C) would also cause damage to the seed rhizomes. Ginger seed rhizomes treatment with hot water at $51^0$C for 10 minutes with neem cake at planting resulted in the lowest disease incidence and highest rhizome yield (Bandyopadhyay and Bhattacharya, 2012). However, the aforementioned methods are less effective and less applicable when it comes to both smallholder farmers and to large commercial production. Various antibiotics and pesticides have been used for GBW management; however, these treatments are less effective under field conditions as the infection is systemic. Many attempts have been made to manage the GBW using biocontrol methods such as bio-fumigation, bacteriophages etc. however, under field conditions, biocontrol methods still remain impractical.

On the other hand, a comprehensive approach, i.e., integrating different strategies has been practiced for the effective management of ginger leaf spot disease. An effective integrated approach mainly focuses on cultural practices, use of disease-free planting material and foliar sprays with fungicides such as metalaxyl or mancozeb. Soil solarization and alternative application of systemic and contact fungicides could effectively minimize the incidence of leaf spot.

## 5.2 Documentation on damage caused by ginger bacterial wilt

Information about the severity of the disease complex and the management practices has been quite scattered, below the current information and knowledge is summarized.

### 5.2.1 Assessment of the level of damage due to the outbreak

Results of field assessment during the disease epidemic in SNNPR revealed an estimated disease incidence of 80-100%, which gave rise to up to 90-100% crop loss (Habtewold et al., 2015; Tariku et al., 2016). After the disease epidemic, both total production (650,049 tons) and area harvested (26,972 ha) (BoARD, 2012) abruptly declined to a negligible level. Consequently, ginger production in the region totally collapsed; the socioeconomic security of farmers, traders and other members of the societies whose livelihoods depended

directly or indirectly on businesses related to the ginger value chain are now extremely endangered. Some previously high-potential areas like Boloso Bombe *woreda* in SNNPR became food insecure. At present leaf spot is becoming the most important disease in the region and elsewhere in the country

### 5.2.2 Farmers' practice

The outbreak of GWD which occurred in 2012/13 in Ethiopia was the first experience for ginger growers in Ethiopia. Not only for the farmers, but it was also a very unusual event even for senior pathologists and higher-level experts. Thus, nobody was able to suggest a ready-made solution to the problem. Just after the disease incidence, ginger production was officially banned by SNNP BoA for an unspecified period in the region to limit the rate of the disease spread and reduce its establishment in ginger rhizomes. However, some farmers continued planting ginger in very small quantities out of the sight of the development agents, with the objective of "nursing the production", (in Amharic እያስታመሙ ማምረት). for example, farmers were using livestock slur to dip seed rhizomes before planting. They also used human and livestock urine, tried some botanicals such as garlic to rub the seed rhizomes. However, the mechanism of disease control with these methods and their effectiveness is still not verified. Farmers also applied fungicides obtained from uncertified sources with a very high amount and frequency. Even though fungicides are not effective to control GBW, farmers claimed that they effectively controlled the disease using fungicides. Most likely other diseases such as ginger leaf spot, were controlled by the fungicides. Research and extension had few recommendations during the initial stage.

During the initial stage, no research recommendation was suggested as the disease complex was a new experience. The extension effort during the initial stage of the disease outbreak was the official prohibition of ginger production in the SNPPR region until a recommendation on the management of the disease is formulated. However, given the banning of production is not a sustainable solution, the extension identified best production practices among the ginger producer and promote it for others through farmers' field days.

## 5.3 Poor agronomic practices

### 5.3.1 Farmers' practices

Farmers are producing ginger under the existing situation including high disease complex, fluctuating climate conditions, high inflation rate, declining soil fertility, and others. To adapt to the climate variation scenario, farmers usually plant the rhizome on well-prepared soil before the onset of the belg season. This is to get the advantage of the first rain, if sufficient this triggers germination and root initiation. However, there is a probability that the first rain is followed by long days without rain, this can cause the rotting of rhizomes. To overcome such problems, some farmers use mulching following planting which may help maintain soil moisture to support germination and root establishment.

The seed source is also challenging for farmers since they cannot easily identify whether the seed is clean from any other diseases and pests. However, still farmers look for the information where to get better strong and healthy seed/ rhizome for planting. Even, some traders are also taking the advantage of seed (healthy looking) business, i.e., buying the first-season ginger rhizome from very distance area where there is less disease pressure and distributing to farmers on cash base. Farmers are also willing to buy healthy looking ginger rhizome seed from traders for ginger production. One of the strategies farmers use in ginger production is perennial planting, whereby in the first season the rhizome does not rot but it becomes more fibrous and is less pungent.

Farmers explained that they usually use a quarter of a hectare to produce ginger, the better off farmers grow ginger on a larger plot of land compared to those smallholder farmers. This is associated with high seed costs, high fertilizer and pesticide prices, and labour costs. For ginger production, farmers intensively use a high fertilizer rate (0.4 t $ha^{-1}$ of NPS and 0.2 t $ha^{-1}$ of Urea) and frequent pesticide application following shallow cultivation. They also apply fungicides at every cultivation of ginger farm to control ginger disease complex, even without observing the symptom of common fungal disease (leaf spot). Farmers believe that application of those fungicides can control disease caused by bacteria. In this regard, frequent application of pesticides on the farm without proper use of personal protective equipment.

Farmers are aware of the importance of irrigation-supported production of ginger for different purposes including timely planting, high production, fertilizer use efficiency, cultivation, and disease management. Some of the farmers who have access to irrigation facilities witnessed the advantage of growing ginger by planting in December to January. Other practices that farmers use is mulching and composting. The problem with this practice is unavailability of organic material sources to produce compost and mulch the soil bed.

Farmers are willing to apply mulching and composting for ginger crop despite its time and labour consumption. This is because the return from small plot is rewarding provided the harvested rhizome is healthy and good prices are set by market for the produce.

### 5.3.2 Research effort and some recommendations

Ginger agronomic related research in Ethiopia is limited to certain areas of ginger production aspects including variety adaptation, identification of rhizome for planting, plant spacing determination, and suitable agro-ecology identification (Hailemichael et al., 2022). Few varieties of ginger have been registered following across location adaptation testing. However, those varieties released are not widely distributed and mostly farmers depend on local cultivars. In some localities like Welaita and Kambata-Tembaro farmers prefer the local cultivar called '*Volvo*' to those officially recommended varieties for production because of large rhizomes that are very marketable.

The other effort by the research is generation of disease-free planting materials using tissue culture and further multiplication of at least two generations. This effort is challenged by lack of ginger seed system that takes the clean seed and multiply for distributions to farmers. Further effort is required to find a way that facilitates farmer's access to clean seed, though soil of most ginger producing areas is contaminated by different ginger diseases.

In the case of irrigation, there has not been any effort in terms of the ginger crop water requirement in a given environment. However, irrigation was suggested as an approach to escape the critical ginger disease development during July to August. Therefore, irrigation is recommended and to plant early in November to December, so that the crop completes its development before the environmental conditions are favourable for disease development during hot humid period.

### 5.3.3 Extension is creating awareness

Given the importance of ginger in the SNNPR regional state, the SNNPR State coffee, tea, and spices authority, under the bureau of agriculture, has applied a lot of effort to support ginger growing farmers. One of the milestones was to prepare a ginger production package manual and training of extension experts, development agents, and farmers. But following the incidence of the ginger disease complex, the bureau of agriculture advised farmers on how to grow ginger in the existence of the disease, and the package was revised considering this context. This includes morphologically health plant selection for seed purpose, growing ginger in areas where there has not been prior production of ginger, use of irrigation to enable early planting, good preparation of the seedbed, use of compost and mulch to maintain soil moisture, skill-based training for both farmers and experts, proper soil fertilization, and use of broad-spectrum fungicides to control fungal diseases.

Many platforms, such as the "Areka Declaration-19" were organized by the bureau of agriculture to create awareness and then discuss & suggest possible strategies to produce ginger in the presence of GWD.

Besides those technical efforts, the authority recognized the importance of joint efforts of different stakeholders working together. Accordingly, measures taken by the authority included:

- ✓ Strengthen research-extension linkage;
- ✓ Use of tissue culture to support the availability of clean planting material;
- ✓ Extending the integrated disease management approach to those areas where the disease incidence is slight;
- ✓ Advising and government on the construction of irrigation facilities;
- ✓ Working on ginger seed supply chain;
- ✓ Encouraging ginger post-harvest processing facilities that may indirectly improve the quality of ginger production.

Besides, awareness creation using different extension communication tools like FM radio, community mobilization campaigns, setting ginger agenda in different political platforms and others have been done by the extension services at SNNPR region level.

# 6 Conclusion and the way forward for revitalization of the ginger sector

Ginger is one of the most widely consumed and is an important crop in Ethiopia in terms of production, local consumption, and also export. However, ginger production is confined to some pocket areas in southern Ethiopia, and very few areas in southwestern Oromia and north Amhara, associated with the availability of suitable climatic and edaphic conditions. The total annual production is estimated to be around 10,000 tonnes from about 4,000 ha of land.

In recent years, the ginger sector has been seriously affected by complex and multifaceted challenges that have resulted in a considerable decline in production and export. This paper presented (i) importance of ginger sector in the country considering the potentials, the trends of production, consumption, marketing, and export of ginger in Ethiopia, (ii) the practices in ginger processing, storage and marketing as key factors for ginger competitiveness, (iii) the key challenges facing the sector since the incidence of the ginger disease, (iv) the efforts made so far by ginger producers and other value chain actors, and (iii) intervention options based on information compiled from available literature and data collected through FGDs and KIIs.

The key challenges identified were related to (i) the serious incidence of diseases, (ii) limited uptake of recommended agronomic practices, (iii) poor processing and marketing practices, and (iv) lack of reliable data for decision-making. There have been research and development efforts to address the stated challenges including the development of recommended practices for ginger disease prevention, and improved practices for ginger processing especially mechanisms for ensuring quality during processing. However, the uptake and implementation of the recommended practices are very limited resulting in a continuous decline in the production and productivity of ginger, which is directly linked to the decline in export earnings and livelihood of producers. Though challenges facing ginger production and marketing are complex, the available research results that have been tested and validated under farmers' conditions show promising options to revitalize ginger production and marketing. The key measures along with suggested implementation strategies to ensure revitalization are presented below:

## 6.1 Disease control related suggested measures

The recommended best practices for the management of the disease complex on ginger that have been tested and validated are:

### 6.1.1 Adjusting planting time/ dry season planting

Start growing ginger in the dry season by planting in December, irrigating the ginger at planting time and during the dry season, and supplementing with irrigation when the *belg* season starts. The basic principle of this practice is to support the ginger crop to escape the critical disease development period during high rainfall & high relative humidity condition in August and September that favours development of the disease complex. If the crop is planted in December and grown under proper irrigation it can mature and get harvested before the onset of critical disease-favouring conditions in August.

### 6.1.2 Improved cultural practices

The use of integrated disease management to manage the disease is an environmentally sustainable approach for any crop disease and pest management.

- Multiplication of disease-free planting material from the ginger meristem. However, there is an argument that the clean planting material should be planted in areas where there has not been ginger production for the last five or more years, which otherwise would result in the reinfection of clean ginger from the tissue culture from the soil.
- Properly loosen the soil bed preparation which can also maintain moisture followed by early planting (especially in Southwestern parts of the country) to grow ginger during the dry season.

- Well-prepared soil compost can be added to the ginger farm that favours development of micro-organisms that have a negative effect on the development of GWD.
- Proper application of compost can also favour ginger crop development by slowly releasing nutrients into the soil and maintaining soil moisture for a longer period.
- Though still experimental, the use of bio-fumigant plants and soil solarization has created a conducive environment for ginger crops while reducing disease pressure.

### 6.1.3 Use of fungicide

Apart from GWD there are additional fungal diseases including ginger leaf spot (*Colletotrichum sp.*), Fusarium wilt of ginger (*Fusarium oxysporum*), and the oomycete Pythium soft rot of ginger. While the use of fungicides such as *metalaxyl* and *mancozeb*, will not control GBW, it will reduce the incidence of the fungal pathogens affecting the crop.

## 6.2 Production expansion for enhanced domestic supply and export

### 6.2.1 Strengthen the national ginger research programme

Given the huge potential in expanding ginger production and productivity, there is a need to expand the number of members of the National Agricultural Research System – NARS (EIAR, RARIs, and HLIs) to engage in ginger research and promotion. The current status in terms of number and distribution of members of the NARS indicates that the fair distribution and availability of these members in the different parts of the country including in the potential ginger agro-ecologies.

### 6.2.2 Active engagement at policy level

Currently, the attention given to ginger in the different regional states within the country is very limited except the relative attention given to it in the SNNPR regional state. Thus, it is important to document properly the importance of ginger along with what needs to be done to enhance the production and its productivity not only in the current production niche areas but also in the new potential areas and engage with relevant stakeholders to ensure that it gets required attention.

### 6.2.3 Development of production, processing and marketing manuals

The existing production manual is focused on disease control mechanisms with limited coverage of the whole production process. A revised manual should be developed and that can inform new practitioners and farmers to engage in ginger production, processing and marketing including how one can access the required technologies (varieties, processing tools and equipment). Thus, it is important to refine and develop a ginger production, processing and marketing manual including considering different local languages.

### 6.2.4 Suggested implementation strategy

Given the need for active engagement of relevant stakeholders with diverse expertise that encompasses diseases and pests, agronomic practice, processing and post-harvest management, market linkage, and stakeholders' alignment, it will be important to establish a Ginger Revitalization Core Group. This group will serve as a platform to facilitate alignment among key stakeholders, broker knowledge co-creation, provide leadership, mobilize resources and influence policy and strategic direction on ginger. The key members of the core group at regional level need to be representatives from GOs, NGOs, Farmers organization and Private sector. Hence at regional level for the SNNPR regional states, it is recommended to have a core group composed of from the following representatives:

(i) Regional Bureau of Agriculture

(ii) Regional Cooperative agency

(iii) Regional Agricultural Research Institute

(iv) The Ethiopian pulses, oilseeds and spice processors and exporters association

(v) Selected farmers' cooperative unions

(vi) Coffee and spices authority

(vii) NGOs working on ginger (Farm Africa, RAISE-FS).

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# Annex

**Annex Table 1.** Export price of ginger 2010 – 2022

| Year | tons | USD | Price (USD $t^{-1}$) |
|---|---|---|---|
| 2010 | 10,267.95 | 24,942,866 | 2,429.20 |
| 2011 | 7,123.85 | 23,150,589 | 3,249.73 |
| 2012 | 10,032.45 | 16,071,882 | 1,601.99 |
| 2013 | 11,415.77 | 12,613,345 | 1,104.91 |
| 2014 | 2,719.52 | 4,201,283 | 1,544.86 |
| 2015 | 731.71 | 862,747 | 1,179.08 |
| 2016 | 116.37 | 188,369 | 1,618.66 |
| 2017 | 16.94 | 21,103 | 1,245.50 |
| 2018 | 1.98 | 4,995 | 2,523.78 |
| 2019 | 40.52 | 86,465 | 2,133.67 |
| 2020 | 85.47 | 30,781 | 360.15 |
| 2021 | 203.30 | 444,355 | 2,185.67 |
| 2022 | 23.98 | 73,851 | 3,079.79 |

Source: Ethiopia Revenue and Custom Authority

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Resilient Agriculture for Inclusive and Sustainable Ethiopian Food Systems (RAISE-FS) is a four-year program funded by the Dutch Embassy in Addis Ababa and hosted by Stichting Wageningen Research Ethiopia based in Addis Ababa, to bring about transformation in the Ethiopian food system. RAISE-FS will develop and implement a demand-driven and interdisciplinary approach to Research for Food System Transformation (R4FST) and as such contribute to the Government of Ethiopia's transformational agenda.