REVIEW ARTICLE Agricultural Reviews, Volume 43 Issue 2: 186-192 (June 2022)

Spices Production in Ethiopia: A Review

Habtamu Deribe

10.18805/ag.RF-218

ABSTRACT

These papers describe spices production in Ethiopia. There are different Spices and herbs can be categorized based on their flavor and colour *i.e.*, hot (Cayenne pepper, black and white peppers, mustard, chilies) slight flavor (coriander, paprika), aromatic spices (clove, cumin, dill fennel, nutmeg, mace, cinnamon) and aromatic herbs (thyme, marjoram, shallot, basil, bay leaf, onion, garlic). Based on colour (turmeric) and herbaceous (sage, rosemary) or based on their taste such as sweet, bitter, spicy, sour and sharp. Therefore, in Ethiopia Korarima, fenugreek, ginger, long pepper, vanilla, capsicum, black and white cumin, coriander and basil are widely grown by farmers, research and extension could start intervention on these spices. Spice production would play great role in improving farmers' livelihoods. Spices have been used as flavour, colour, aroma, enhancing agents and for preservation of foods. Moreover, more research is needed to improve the production and productivity of spices as well as to the improvement of the life of the farmers and play a role in the country economic growth.

Key words: Challenges, Opportunities, Spice.

A spice is a dried seed, fruit, root, bark or vegetative substance used in nutritionally insignificant quantities as a food additive for the purpose of flavouring and sometimes as a preservative by killing or preventing the growth of harmful bacteria (Masresha, 2010). It also refer to the dried part of a plant that contain volatile oils or aromatic flavours such as, buds (cloves), bark (cinnamon), root (ginger), berries (black pepper), seeds (cumin, coriander).

There are different Spices and herbs can be categorized based on their flavor and colour *i.e.*, hot (Cayenne pepper, black and white peppers, mustard, chilies) slight flavor (coriander, paprika), aromatic spices (clove, cumin, dill fennel, nutmeg, mace, cinnamon) and aromatic herbs (thyme, marjoram, shallot, basil, bay leaf, onion, garlic). Based on colour (turmeric) and herbaceous (sage, rosemary) or based on their taste such as sweet, bitter, spicy, sour and sharp (Embuscado, 2015; Bhattacharyya *et al*., 2017).

Spices have major stake in the production system and in the foreign earnings of the country. Spices have great role in transforming farmers as producers for market instead of producing merely for subsistence (Dessalegn, 2015).

As stated by Habtewold *et al.,* 2017 the production and use of spices is perhaps the most romantic story of any plant product. Spice crops such as korarima cardamom, Ethiopian long pepper, black cumin, bishop's weed, coriander, thyme and fenugreek are also attached to Ethiopia either as a center of origin or diversity. Spices in Ethiopia are also many things and the role they played could be viewed proportionally to the level of their utilization. For centuries, they have been used as one of the major livelihoods and life-giving foods of both the rural and urban populations. Besides, since most of them are labour intensive, small in bulk and so cheap to transport and of high value per unit, they present a special opportunity to hasten both rural and urban development. According to Kifelew *et al*. (2017) among the total seed spices produced in Ethiopia; black cumin, fenugreek and coriander were known to have around 36 and 17% share in area and production, respectively. It was estimated that the Ethiopian spice export trade was below 1% of the country's total export earnings (Yimer, 2010). From a formal survey, korarima seeds, pods, leaves, rhizomes and flowers are used in southern Ethiopia as traditional medicine for human and animal ailments caused by unknown agents and particularly used to treat any part of the animal body upon swelling (Eyob *et al*., 2008).

According to the studies of Hordofa and Tolossa, 2020 Ethiopia has favorable or conducive environments for various spices production due to the presence of varied climatic and agro-ecological conditions, abundant cultivable and irrigable land, with encouraging government policy environment. Spices play an important role as flavouring agents in the diet and are used throughout the world. The spice trade was so important that it was a catalyst in many historical events, discoveries, wars and inventions. It has even been cited as an important element in the spread of knowledge and culture. Some historians have suggested that the lucrative trade of spices was in large part responsible for many important developments in seafaring and

Department of Plant Science, College of Agriculture and Natural resource, Bonga University, P.O. Box 334, Bonga, Ethiopia.

Corresponding Author: Habtamu Deribe, Department of Plant Science, College of Agriculture and Natural resource, Bonga University, P.O. Box 334, Bonga, Ethiopia. Email: habtader@gmail.com

How to cite this article: Deribe, H. (2022). Spices Production in Ethiopia: A Review. Agricultural Reviews. 43(2): 186-192. DOI: 10.18805/ag.RF-218.

Submitted: 11-08-2021 **Accepted:** 11-10-2021 **Online:** 30-10-2021

navigation and the exploration and discovery of many parts of the world.

Ethiopia is one of the ten countries in the world where spices are used the most, in particular in meat-based recipes. Most Ethiopian foods are spiced. Jansen (1981) lists 12 major spice plant species and provides a detailed account of the taxonomy, husbandry, distribution, culinary and medicinal uses and chemistry of these spices. Most of these spice species are grown in home gardens or cultivated as field crops and a few are collected from the wild.

Methodology

Basically, this paper is a review article and it has no direct data which collected from the population, rather it is based on secondary data which conducted previously on spice production, opportunities and constraints by different researchers and reviewers. This paper reviewed the most recent research articles and review papers. Therefore, the review of this article is based on an intensive reading of published and unpublished journals, articles and books. To make the review articles briefer, in addition to narrations, tables and figures were used as reviewing techniques.

Spices production in Ethiopia

Ethiopia is a homeland for many spices, such as korarima (*Aframonum Korarima*), long pepper, Black cumin, white cumin /Bishops weed ('Nech azmud')/, coriander and ginger. As a result, the history of spice use in Ethiopia is an ancient one and spices have always been and remain as basic food items in the diet of the Ethiopian people. A spice is a dried seed, fruit, root, bark or vegetative substance used in nutritionally insignificant quantities as a food additive for the purpose of flavoring and sometimes as a preservative by killing or preventing the growth of harmful bacteria (Masresha, 2010). Spices can be defined as "vegetable products used for flavouring, seasoning and imparting aroma in foods" (FAO, 2005).

Ethiopia is a source country for many spice exports, with a long history of spices. The average land covered by spices is approximately 222,700 ha with production reaching 244,000 tons per year. More than 50 spices are produced in Ethiopia and a total potential for low land spice farming is estimated to be 200,000 hectares (GIT, 2016). In Ethiopia, the production and use of spices is perhaps the most romantic story of any plant product, legendarily known to go back to the times of Queen of Sheba. As Habtewold *et al*., 2017 reported that, spice crops such as korarima cardamom, Ethiopian long pepper, black cumin, bishop's weed, coriander, thyme and fenugreek are also attached to Ethiopia either as a center of origin or diversity. Spices in Ethiopia are also many things and the role they played could be viewed proportionally to the level of their utilization. For centuries, they have been used as one of the major livelihoods and life-giving foods of both the rural and urban populations. Besides, since most of them are labor intensive, small in bulk and so cheap to transport and of high value per unit, they present a special opportunity to hasten both rural and urban development.

The report of Ethiopian Ministry of Industry, 2015 indicated that the major seed spices producing regions include the Amhara and Oromia regions, whereas SNNPRs and Gambella region are dominant producers of lowland spices. Out of the total seed spices grown in Ethiopia, black cumin, ajwain or bishop's weed, fenugreek and coriander were known to have around 36 and 17% share in area coverage and production, respectively (Kifelew *et al*., 2017). According to different studies like, International Trade Centre, 2010; Herms, 2015; Ethiopian Ministry of Industry, 2015; Dessie *et al*., 2019 the various spices cultivated in Ethiopia, chilli pepper was the most commonly produced and consumed spice crop in Ethiopia.

The study of Herms, 2015 the most commonly grown chilli variety in Ethiopia is the *mareko fana* (a pungent long chilli of dark-red appearance) and smaller mitmita chillies, an even hotter, red, small pepper. In the long run, Ethiopian chillies will have promising potential for a smallholder-driven investment model as smallholder farmers need to build experience with intensive post-harvest treatment and local traders need to gain expertise in product grading, whereas commercial production holds the largest prospects in the short run. In Ethiopia, production of chilli was estimated to be 234,000 tons.

Ginger played an important role in primary healthcare. In traditional medicine, ginger finds a wide range of applications. Because of its carminative, stimulant and digestive properties, ginger is commonly used in fever, cough, vomiting, cardiac complaints, constipation, flatulence, colic, swelling, diarrhoea, cholera, diabetes and neurological disorders. Ginger powder, aqueous and ethanol extracts of ginger, oleoresin and active principles of ginger like gingerol, shogaol, paradol, zingiberine, zingerone and zingerol have been found to be biologically active. The efficacy of ginger extracts or active principles of ginger like gingerol and shogaol in lowering serum cholesterol level in relation to atherosclerosis and coronary heart diseases have been investigated by several workers. Dietary intake of ginger reduced the risk of atherosclerosis by virtue of its hypolipidemic and anti atherogenic effects. Ginger is used as an anti-inflammatory drug in the treatment of arthritis. Patients receiving 3-7 g of powdered ginger daily for 56 days had significant reduction in pain and swelling associated with either rheumatoid or osteoarthritis. These spices also produced and consumed as spice crop in Ethiopia (Herms, 2015).

Turmeric is reported to have antioxidant, anti-inflammatory, ant carcinogenic, ant-diabetic and hypo-cholesterol emic properties. The anti-inflammatory, ant carcinogenic and antioxidant activities are clinically exploited to control rheumatism, cancer and oxidative stress related pathogenesis. Cur cumin, derivatives of cur cumin, aqueous and organic solvent extracts of turmeric, turmeric powder, essential oil and Arturmer one were found to be biologically active. Of the various forms/ compounds, the colouring

Table 1: Mean annual production of important spice crops in Ethiopia from the cropping year 2010 to 2020.

List of spice crops	Production (Tons)
Anise, badian, fennel and coriander	2,983.29
Chillies and peppers, dry	182,421.2
Ginger	9,897.14
Hops	31,411.07
Mustard seed	2,561.07
Nutmeg, Mace and cardamom	135.5
Other spices	29,690.8

Source: FAOSTAT (2019).

pigment cur cumin is responsible for most of the medicinal properties. Safety evaluation studies indicate that both turmeric and cur cumin are well tolerated at very high doses without any toxic effects.

According to Addisu (2014), the national productivity of turmeric in Ethiopia was estimated at 2.4 tons per hectare whereas; the productivity of turmeric is very low. Suitable areas and possibility of adoption of the improved cultural practices for turmeric cultivation, there is a high opportunity to enhance the productivity from the existing 3.5 tons per hectare to more than 10.0 tons per hectare (Girma *et al*., 2016). According to studies of Kifelew *et al*., 2017 and Herms, 2015 the white *cuminum cynimum* and black cumin national average productivity was estimated at 0.79 tons per hectare which is very low as compared to other countries.

Importance of spices

Spices have been used as flavour, colour, aroma, enhancing agents and for preservation of foods. The importance of spices in cosmetics, perfumery and personal care is well known from ancient times. The cosmetics and perfumery industries employ the oils of many spices for blending with other volatile and fixed oils to make high-quality perfumes. The toiletries and allied industries also make use of spices and their fragrant oils for manufacture of soaps, toothpastes, talcum powder, aftershave lotions, freshness sachets, toilet waters, powders and hair oils.

There has been increasing studies on the role of spices as natural preservatives and for medicinal purposes. The bioactive compounds from spices have the potential to decrease or inhibit the risk of degenerative diseases such as diabetes, obesity, cancer and cardiovascular diseases (Anderson *et al*., 1999). Antimicrobial properties of spices can be successfully used to control the growth of spoilage and pathogenic bacteria in dairy products. Phenolic compounds of spices are good substitutes for the artificial antimicrobial agents used in food manufacturing. Phenolic compounds such as tea catechins, oleuropein, ferulic acid, ellagic acid and coumaric acid have been found to prevent the growth of some pathogenic bacteria (*Staphylococcus aureus, Salmonella enteritidis* and *Listeria monocytogenes*) and fungi (Bin *et al*., 2011).

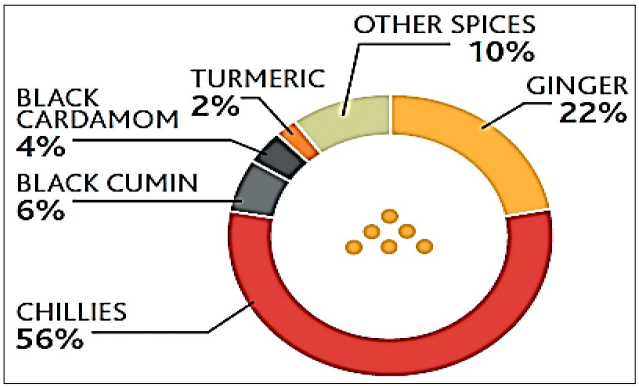

Fig 1: Average spices production shares from 2005 to 2013 in Ethiopia. Source: (Herms, 2015).

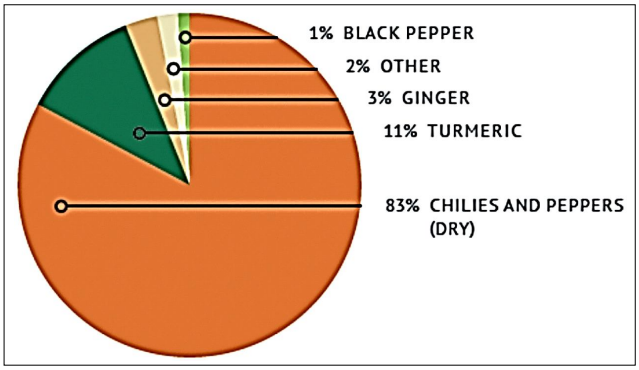

Fig 2: The share of Ethiopian spice production in 2018. Source: (Titus and Wojtek, 2020).

Major challenges in spices production in Ethiopia

Spice yields are low, as cultivation practices are based on traditional knowledge that has been transferred from generation to generation. Smallholder farmers rarely use farming tools or inputs such as pesticides, fertilizers and improved seeds. Moreover, there is a lack of access to electricity and irrigation. The production system is mostly based on rain-fed agriculture. At the same time, farmers' planning is often inadequate and they do not allocate suitable land for the cultivation of spices. In most cases, smallholders are poor and have low levels of education. As a result, their negotiation power is limited and further brought down by a lack of appropriate storage capacity and limited access to finance. Farmers mostly utilize traditional drying techniques, which might be a source of contamination by foreign matter, such as dirt and dust as well as the infestation by insect pests and rodents. Most of the smallholders are the least fortunate farmers with low level of education and training. In addition, the spices production system in Ethiopia is mostly rain dependent. Planning and implementation ability of smallholder farmers is poor since they do not allocate reasonable land for the cultivation and development of the spice sector.

Moreover, there has historically been little investment by the public sector in spice value chains; instead, it has

tended to focus on the development of staple crops and cash crops such as coffee, pulses and oilseeds, which have a higher foreign exchange earning capacity. Moreover, there were not enough extension officers available to improve the agricultural practices of smallholder farmers and connect them to inputs. However, there have been recent positive developments, with both the Government of Ethiopia (GoE) and farmers' unions increasingly recognizing the potential of the spices sector. The well-established coffee production is taken as an example of a supply chain that is well-organized and supported by effective public-private cooperation.

According to the Ethiopia-Netherlands Trade for Agricultural Growth (ENTAG (Ethiopia-Netherlands Trade for Agricultural Growth), 2018), the cultivation of spices by smallholder farmers was typically performed on little plots of land (<0.5 ha) around and inside natural forests. Smallholder farmers barely utilize agricultural inputs, such as pesticides, fertilizers/manures and improved seeds. As reported by Tesfa *et al*. (2017) with the exception of certain spice crops, like Capsicum and *Allium* spp., fenugreek and black and white cumin, farmers do not set up their farm lands well. In general, farmers give little consideration for spice crops, while concentrating mainly on food crops.

As reported by Tariku *et al*., (2016), the problems of spice production were poor management of agronomic practices. The major constraints facing the spices sub sector of Ethiopia cover pre-production, production, processing and marketing stages. Production stages like, low yield varieties in use and lack of need for improved spice agricultural research in existing and new and locally adaptable varieties that offer opportunities for increased yield and meet home and export market demands. Poor quality of final output marketed Weak role of private commercial investors in spices production irregular supply and variable quality of spices produced from forest and agricultural landscape, improve domestication of forest spices and also contribute to up keeping afforestation and environmental protection, Lack of proper post-harvest handling practices and problems of the marketing system in use resulting in significant post-harvest wastage/spillage and product quality deterioration, Lack or shortage of planting material has been also reported as one of the critical problems of ginger production in Ethiopia [MoARD (Ministry of Agriculture and Rural Development), 2008].

According to Kifelew *et al*. (2017), inadequate production technologies developed so far have yet not expanded and not advocated to farmers. As indicated by Yimer (2010), weak role of private business investors in spice production, irregular supply and variable nature of spices produced from forest and agricultural landscape, lack of the use of appropriate modern technologies in farm management, drying, storage and absence of proper spices development strategic interventions were some of factors affecting production of spice crops in Ethiopia.

According to Melanie and Michael (2011), smallholder farmers hardly get improved spice crop seeds adapted to their agro-ecological conditions. Farmers are using unimproved spice seeds, which have low production and also that encourage the spread of plant diseases. A counterfeit/unimproved spice seed sold by corrupt broker's traders is a major problem in various regions of Africa. Small-scale farmers regularly purchase seeds from informal uncertified sources. The commercial formal seed system may advertise a range of hybrid varieties not necessarily best suited to local conditions but are at the expense of traditional varieties. Yousif (2008) pointed out that several problems, including lack of improved seed, recommended fertilizer rate; poor postharvest handling and marketing systems, constrain black cumin production and productivity. According to Kifelew *et al*. (2017), plant diseases, like fusarium wilt, black cumin blight and powdery mildew, are the most significant constraining factors to black cumin production. Aphids and mites are also reported as the major insect pests attacking black cumin.

However, Tesfa *et al*. (2017) reported that both black and white cumin are rarely affected by rust, root rot, aphid and boll and cut worms in South Wollo, Ethiopia. Pressure on the natural habitat, unimproved variety, non-adapted agronomic practices and losses caused due to biotic and a biotic stresses were also previously reported to affect the genetic diversity of cardamom (Korarima) in Ethiopia (Girma *et al*., 2016). Similarly, Gobie (2019) currently reported that lack of improved seeds to satisfy producers demand, lack of advice and technical support, non-timely distribution of fertilizer(s), lack of training for experts and shortage of manuals, publications and guidelines for spice production mainly affect the red pepper production in Ethiopia. According to Dessie *et al*. (2019) the main red pepper production constraints include inadequate agricultural inputs, occurrence of disease and lack of improved and high yielding varieties and shortage of land.

Production of the Ethiopian cardamom and long pepper are going on relatively well though long pepper is only being produced by a few farmers. However, Indian cardamom and black pepper face many challenges, mainly due to drought, light intensity and destruction by wild animals, large distances to the forests and the lack of knowledge on plant care, processing and storage (Agize and Zouwen, 2016). According to Mulatu and Gadisa (2020) the major constraints in production of korarima (Ethiopian cardamom) in the Kafa zone includes disease, animal and pest damage, climate change effect, low productivity of existing varieties, lack of improved korarima cultivation practices and inappropriate post-harvest handling techniques.

Opportunities of spices production in Ethiopia

Ethiopia has extensive experience in spice production. Zemede Asfaw (2001) that Ethiopian people have been using and still are using spices, condiments, additives and herbs in their traditional food system since a long period of time

and have incorporated new crops in to the farming systems and traditional recipes, for which home gardens play pivotal roles. Spices and condiments make a significant proportion of home garden plants in Ethiopia. The home gardens in Ethiopia are either located at the backyards, front yards, side yards or almost encircle the house. There is high availability of land with appropriate climate, water resources and soils for spice cultivation. Moreover, there is a suitable investment policy that promotes foreign direct investments by means of income tax exemption, import duty exemption for machinery and equipment and carried forward losses allowance. Given these opportunities, commercial farming of spices has an untapped potential in Ethiopia.

The increasing demand in developed countries for natural flavours means there is tremendous potential to increase the trade in spices. Spices are added to foods in several forms, such as whole spices, ground spices and spice extracts. As spice extracts are highly concentrated, they are either encapsulated or emulsified in edible bases like salt or dextrose to obtain a uniform dispersion of the extracts in food materials. Extraction of oils and oleoresins is accomplished using a range of methods, including steam distillation, hydrocarbon extraction, chlorinated solvent extraction, enzymatic treatment and fermentation, supercritical CO_2 extraction. Carbon dioxide extraction from solid botanicals is now adopted on a commercial scale. The resulting extracts have no solvent residues and fewer terpenes. Enzymatic treatment and fermentation of raw botanicals also result in higher yields and improved quality of essential oil. More recently, the use of genetic engineering and recombinant DNA technology has resulted in in vitro production of natural esters, ketones and other favouring materials. Cloning and single cell culture techniques are also of benefit to the flavours.

Ethiopia have suitable agro-ecologies, for spice crop production which encouraging government policy environment (Hordofa *et al*., 2020). Spice crops have huge potential for income generation of the farming communities in Ethiopia (Tesfa *et al*., 2017). According to Herms (2015), spices are one of the traditional promising horticultural crops of Ethiopia. Kifelew *et al*. (2017) indicated that spice crops are small in size and so cheap to transport and of high value per unit area although most of the spice works are labor intensive. Hence, spice crops provide a special opportunity to hasten both the rural and the urban community development (Kifelew *et al*., 2017). In Ethiopia, spice crops are used not only to flavor bread, butter, meat, soups and vegetables, but also to make medicines and perfumes [ITC (International Trade Centre), 2010; Tesfa *et al*., 2017; ENTAG (Ethiopia-Netherlands Trade for Agricultural Growth), 2018]. Ethiopia is currently one of the largest consumers of spices in Africa since over 90% spice crops produced in the country are consumed domestically. Fortunately, the domestic consumption has been growing fast due to increases in income, rapid population growth and greater urbanization [ENTAG (Ethiopia- Netherlands Trade for Agricultural Growth), 2018]. The government of Ethiopia is promoting agro-industrial projects and has declared spice crops as focus area for development as spices have a wide possibility of being cultivated in diverse agro- ecological zones of the country and have also a high potential for expansion and diversification of export earnings of Ethiopia (Vijayalaxmi and Sreepada, 2014). The Ethiopian government has developed a package of incentives under Regulations No. 84/2003 for investors to encourage private investment engaged in new enterprises and expansions, across a range of sectors, including the spice subsector [EMI (Ethiopian Ministry of Industry), 2015; ITC (International Trade Centre), 2020].

CONCLUSION AND RECOMMENDATIONS

Though spices have various utilizations, the emphasis given by research and extension activities are very unsatisfactory. Hence, there is lack of awareness on spice production, processing, storage and marketing among producers. Farmers used their traditional farming practices and usually harvest very low yield. Similarly, the marketing system is not managed through organized efforts. Price of spices is not determined by the demand, supply and price information but by individual decision. Individual decision making process of the marketing of spice leads to inefficient and ineffective service of the market. Therefore, farmers are not getting expected benefits from this sector. Hence, a radical change should be undertaken in the system to exploit the benefit from these marginalized crops.

Ethiopia is investing heavily in agro-industrial parks to commercialize production, stimulate local value addition and attract investors. By creating clusters of producers around these parks, it will be easier to reach scale and establish efficient forms of processing and input provision, including pesticides, fertilizers and packaging materials. In Ethiopia, approximately 98% of all spices are cultivated by smallholder farmers living in rural areas of Ethiopia. Spices are predominantly intercropped with coffee, banana and maize and in some instances with sugarcane and teff. Smallholder spice producers are usually organized in small groups or cooperatives, which in turn are organized in cooperative unions that promote spices as part of their 'crop portfolio'. The major spices produced by commercial farmers are ginger, turmeric, chilies and black pepper. The cultivation of spices by smallholder farmers is normally performed on small plots of land (<0.5 ha) around homesteads and in natural forests.

In Ethiopia Korarima, fenugreek, Ginger, long pepper, vanilla, capsicum, black and white cumin, coriander and basil are widely grown by farmers, research and extension could start intervention on these spices. Spice production would play great role in improving farmers' livelihoods.

Spices have been used as flavour, colour, aroma, enhancing agents and for preservation of foods. As noted above, current ginger production is extremely low in the aftermath of the disease complex that decimated production. Nevertheless, all stakeholders are eager and ready to

expand production. Moreover, recent Ethiopian research in organic pesticides is promising and some companies have already asked their out-growers to start planting ginger again therefore, it needs critical attention for the upgrade of the production and productivity of this crop. Once production has recovered, Ethiopia has the potential to become one of the main players on the world market of high-quality (organic) ginger.

Black pepper is also a well-known spice crop in Ethiopia, as it appears that significantly less pesticide is used. Building on this situation, expanding and formalizing organic production to reach the market may be an interesting case for Ethiopian producers and investors. Moreover, it commonly grown in coffee trees is very suitable for intercropping with black pepper. Since coffee farms are already relatively efficient and modern, black pepper production could build on this. In addition, coffee growers are usually large producers compared to farmers in other spice-growing areas, so it would be relatively easy to reach scale and obtain necessary certifications.

Moreover, more research is needed to improve the production and productivity of spices as well as to the improvement of the life of the farmers and play a role in the country economic growth. The existing method to develop new procedures for optimized extraction and refining separation methods of active components from herbs and spices were very important for the further improvement of spice crop production and productivity.

Declarations

Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

REFERENCES

Addisu, A. (2014). Spice, Herbs and Aromatic Plants Sub-sector Platform. In: The 1st Ethiopian Spice Platform Stakeholders Meeting. January 23.

Agize, M. and Zouwen, L. (2016). Spice and medicinal plants production and value chain analysis from southwest Ethiopia. Journal of Pharmacy and Alternative Medicine. 10: 126-144.

Amirdivani, S., Baba, A.S. (2011). Changes in yoghurt fermentation characteristics and antioxidant potential and *in vitro* inhibition of angiotensin-1 converting enzyme upon the inclusion of peppermint, dill and basil. LWT-Food Sci. Technol. (Lebensmittel Wissenschaft-Technol.). 44: 1458-1464.

Anderson, J.J., Anthony, M.S., Cline, J.M., Washburn, S.A., Garner, S.C. (1999). Health potential of soy isoflavones for menopausal women. Publ. Health Nutr. 2: 489-504.

Asale, A. and Ashango, T.B. (2017). Determinants of ginger supply: The case of Boloso Bombe and Kindo Koisha Woredas of Wolaita zone, SNNPR, Ethiopia. International Journal of Research and Innovations in Earth Science. 4(2): 27-36.

Bhattacharyya, S., Chakraborty, C., Moitra, S., Bandyopadhyay, K. (2017). Potential application of milk and milk products as carrier for herpes and spices: A review. Int. J. Eng. Res. Sci. Technol. 6: 113-124.

Bin, S., Yi-Zhong, C., John, D.B., Harold, C. (2011). Potential application of spice and herb extracts as natural preservatives in cheese. J. Med. Food 14: 284-290.

Buke, T., Gresilassie, L. and Bosha, A. (2016). Capacity building on ginger post harvest technologies and marketing. International Journal of Scientific Research and Engineering Trends. 2(1): 2395-566X.

Dessie, A.B., Abate, T.M., Adane, B.T., Tesfa, T. and Getu, S. (2020). Estimation of technical efficiency of black cumin (*Nigella sativa* L.) farming in northwest Ethiopia: A stochastic frontier approach. Journal of Economic Structures. 9(1): 1-14. https://doi.org/10. 1186/s40008-020-00198-1.

Dessie, A.B., Koye, T.D., Koye, A.D. (2019). Analysis of red pepper marketing: Evidence from northwest Ethiopia. Economic Structures 8: 24. https://doi.org/10.1186/s40008-019-0156-0.

Embuscado, M.E. (2015). Spices and herbs: Natural sources of antioxidants- A mini review. J. Funct. Foods. 18: 811-819.

EMI (Ethiopian Ministry of Industry). (2015). Spice Industry Strategic Plan (2015-2025). Spices Industry Strategic Plan, Ethiopia.

ENTAG (Ethiopia-Netherlands Trade for Agricultural Growth) (2018). Reopening the European Spice Market for Ethiopian Exporters. (pp. 1-18).

FAO (Food and Agriculture Organization of the United Nations) (2013). The State of Food Insecurity in the World: The Multiple Dimensions of Food Security.

FAOSTAT (Food and Agriculture Organization of the United Nations, Statistics Database). (2019). Food and Agriculture Organisation of the UN (FAO) Statistics Database: Production, Trade, Supply.

Gebreazgaabher, F.G. and Negash, Z.M. (2015). Analysis of major factors affecting production and marketing of Korarima [*Aframomum corrorima* (Braun) PCM Jansen] in Ethiopia. Journal of Economics and Sustainable Development. 6(19): 72-79.

Geta, E. and Kifle, A. (2011). Production, process and marketing of ginger in Southern Ethiopia. Journal of Horticulture and Forestry. 3(7): 207-213.

Girma, H., Haimanot, M. and Habtewold, K. (2016). In: Search of Spices and Herbs in Ethiopia. Zinjibel in Ethiopia. Tepi National Spices Research Center, P.O. Box 34.

GIT (Gatefarms International Trade) (2016). Ethiopian Spices and Market Potentials.

Gobie, W. (2019). A seminar review on red pepper (Capsicum) production and marketing in Ethiopia. Cogent Food and Agriculture. 5(1): 1647593. https://doi. org/10.1080/233 11932.2019.1647593.

Goshme, D. and Ayele, T. (2019). Factors affecting production and marketing of spices in Ethiopia: A review. International Journal of Forestry and Horticulture (IJFH). 5(2): 14-18. https://doi.org/10.20431/2454-9487.0502002.

Habtewold, K., Demes, F., Tewodros, L., Dejene, B., Haimanot, M. and Wakjira, G. (2017). Seed Spices Production Guideline. Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia.

Herms, S. (2015). Business Opportunities Report Spices# 6 in the Series Written for the "Ethiopian Netherlands Business Event. https://www.rvo.nl/sites/ default/files/2015/11/ Rapport_Spices_Ethiopië. (pp. 1-28).

Hordofa, T.S., Tolossa, T.T. and Yildiz, F. (2020). Cultivation and postharvest handling practices affecting yield and quality of major spices crops in Ethiopia: A review. Cogent Food and Agriculture. 6(1): 1788896. https://doi.org/10.1080/ 23311932.2020.1788896.

ITC (International Trade Centre) (2010). Spice Sub-sector Strategy for Ethiopia. Submitted to the Government of Ethiopia by the Spice Sector Strategy Coordinating Committee. (p. 1-33).

ITC (International Trade Centre). (2020). Spice Sector Investment Profile. Ethiopian Investment Commission. (p. 1-32).

Kifelew, H., Getachew, W., Luleseged, T., Mitiku, H., Bekele, D. and Fikere, D. (2017). Seed Spices Production Guideline: Ethiopian Institute of Agricultural Research. (pp. 1-36). http://www.ublication.eiar.gov.et.

Lupi, A., Mitiku, T., Temeteme, S., Mekonen, B. and Yeziz, B. (2016). Influence of rooting media on nursery performance of Korarima (*Aframomum corrorima*) in Southwest of Ethiopia. Journal of Horticulture. 3(1): 1. https://doi.org/10.4172/ 2376-0354.1000174

Masresha, Y. (2010). Market Profile on Spices in Ethiopia. Addis Ababa, Ethiopia.

Melanie, M. and Michael, J. (2011). Spices and Herbs for Home and Market. Rural Infrastructure and Agro-Industries Division Food and Agriculture Organization of the United Nations. (pp. 1-70).

MoARD (Ministry of Agriculture and Rural Development). (2008). A Proceeding Report on Status and Challenges of Spice Production in Ethiopia. In: Proceedings of the National Workshop in United Nations for Economic Commission for Africa November 6, 2008 Addis Ababa, Ethiopia. (pp. 17-26).

Mulatu, E. and Gadisa, A. (2020). Determinants of production and market supply of Korarima [*Aframomum Corrorima* (Braun) Jansen] in Kaffa zone, Southern Ethiopia. Advances in Agriculture, Horticulture and Entomology, AAHE, 116.

Tariku, H., Kassahun, S. and Gezahegne, G. (2016). First report of ginger (*Zingiber officinale*) bacterial wilt disease in Ethiopia. Research Journal of Agriculture and Forestry Sciences. 4(4): 5-9.

Tesfa, T., Bayu, W., Gashaw, A. and Beshir, H. (2017). Spice production, marketing and utilization in South Wollo, Ethiopia. East African Journal of Sciences. 11(1): 27-36.

Titus, S. and Wojtek, D. (2020). Advance consulting prepared a business opportunity report spices sector in Ethiopia. Ethiopia-Netherlands Trade for Agricultural Growth (pp. 1-32).

Vijayalaxmi, H. and Sreepada, H. (2014). An economic overview of ginger production in Ethiopia. International Journal of Science and Research. 3(12): 2052-2054.

Yimer, M. (2010). Market Profile Spices: Ethiopía. UNCTAD ITC; United Nation Copnference on Trade and Development (UNCTAD-ITC).

Yousif, H.H. (2008). Effect of High Levels of Nitrogen and Phosphorus Fertilizer on Growth, Yield and Yield Components of *Nigella sativa* L. Horticulture Department, College of Agriculture, Duhok University, Iraq. Mesopotamia Journal of Agriculture. 36, 1.

Zakir, M., Hailemichael, G., Seyoum, M. and Addisu, M. (2018). Status of ginger (*Zingeber officinale*) research and production challenges and future prospects in Ethiopia: A review. Academic Research Journal of Agricultural Science and Research. 6(5): 276-290. https://doi.org/ 10.14662/arjasr2018.027.