Spice Production, Marketing, and Utilization in South Wollo, Ethiopia

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Abstract: Spice crops have been produced and used in Ethiopia from time immemorial. Ethiopia has varied agro ecologies that support the growing of a wide variety of spice crops. Several indigenous and exotic spice crops are cultivated widely in the country by smallholder farmers. The spice sub-sector has immense potential for economic development and poverty reduction in the country. However, the potential of the sub-sector has not been fully exploited and the production and use of the crop has not received sufficient research and extension. Nevertheless, there is very high potential to produce and use spice crops in south Wollo. Farmers are growing different types of spice crops at a very small scale in the region. The climate and soils are suitable for producing the crops. However, farmers' efforts to produce, use, and trade the crop has not been sufficiently supported by extension services. Therefore, a study was conducted in 2004/2005 to elucidate the potential of the production, use, and marketing of spice crops in South Wollo. Data were collected from spice growers, traders and key informants mainly experts from the offices of agriculture. The survey was administered on a total of 545 respondents which includes 480 spice growers, 45 spice traders and 20 key informants using a multi-stage sampling technique. The study analyzed and mapped the potentials, opportunities and constraints of spice production, utilization and marketing in South Wollo. The study also revealed that there is high price variability. Price is not set by the commonly known demand and supply balance, but by traders. The study further demonstrated that spice crops have immense production potential which could contribute to the economic development of the farming community. Hence, it is recommended that spice production, utilization and marketing in South Wollo needs to be strongly supported by research and extension.

Keywords: Culinary; Utilization; Medicinal; Price

1. Introduction

Agriculture remains the main activity in the Ethiopian economy. Agricultural growth is not only required to feed the country, but is also the driving force to generate foreign exchange. About 80 % of Ethiopia's foreign exchange is derived from agricultural exports (Ethiopian Economics Association, 2008). Enhancing agricultural production and export trade is the current strategy followed by the country to curtail the critical capital shortage and to enhance economic growth.

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). Spices are important additives to Ethiopian dishes. The production and use of spices in Ethiopia go back to time immemorial. Ethiopia has become one of the largest consumers of spices in Africa. People use spices to flavor bread, butter, meat, soups, and vegetables. They also use spices to make medicines and perfumes (International Trade Centre, 2010). Ethiopia is a homeland for many spices, such as korarima (*Aframonum korarima*), long red pepper, black cumin, white cumin /bishops weed, coriander, fenugreek, turmeric, sage, cinnamon, and ginger (International Trade Centre, 2010).

The diverse agro ecology in Ethiopia supports growing a wide variety of crops in general and spice crops in particular. Thus, the country hosts several indigenous common and exotic spice crops, which are cultivated widely since time immemorial. Spice crops are produced in various regions of the country and predominantly by smallholder farmers as a cash crop traded primarily in domestic markets, but with increasing success also entering foreign markets. The spice sub-sector has an immense potential for economic development and poverty reduction through creation and expansion of employment opportunities and distribution of income and foreign exchange earnings.

However, except pepper (*Capsicum annum*), spice crops cultivation is traditional, with no or very little research and extension support. Furthermore, the status of spice production and marketing in the country is not well documented.

Currently, there is a growing demand for organic spices in Europe, USA and Japan for food coloring, cosmetics, pharmaceuticals, essential oil derivatives and textile industries. The majority of spices produced in Ethiopia (80%) are consumed domestically. But at the same time, export of spices is developing, which fetches increased foreign exchange earnings. Ethiopia exports specifically ginger and turmeric in the whole form even if importers

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prefer ginger to come in sliced form (International Trade Centre, 2010). Ethiopia also exports, to a limited extent, extracts of ginger, hot pepper and turmeric to Europe for food coloring and flavouring (Vijayalaxmi *et al*., 2014).

In 2009, Ethiopia exported 15,000 Mts of spices with 11 million USD earnings (International Trade Centre, 2010). Despite the vast scale of utilization and foreign exchange earnings from spices and Ethiopia's comparative advantage for producing and exporting spices to foreign markets, little research and extension attention has been given to the production and utilization of spices (International Trade Centre, 2010; Dessalegn, 2015).

This study was conducted to assess the current status of the production, consumption and marketing of spice crops in South Wollo and thus to stimulate research and extension supports to enhance the production, utilization, and marketing of spice crops.

2. Methodology

The study was conducted in 2004/2005 in four purposively selected districts (Debresina, Kalu, Dessie Zuria, Were Ilu) of South Wollo based on current and potential spice production (Figure 1).

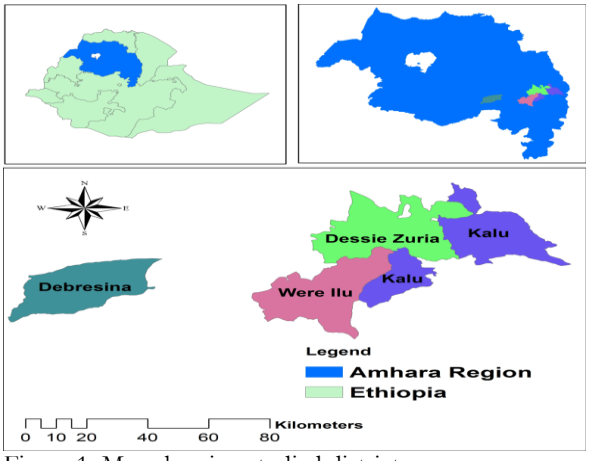


Figure 1. Map showing studied districts.

Data were collected from spice growers and traders and key informants. The survey was administered on a total of 545 respondents: 480 spice growers, 45 spice traders and 20 key informants. The sample size of the study was determined using the formula adopted from Kothari (2004). Multi-stage sampling technique was employed where in the first stage districts and market centers were purposively sampled and in the second stage systematic random sampling was used to collect data from spice producing farmers and traders by using questionnaire. Horticulture experts from the Zone and District Offices of Agriculture were used as key informants. Market data were collected from three purposively selected market centers: Kombolcha market in Kalu district, Mekane Selam market in Debresina district and Segno Gebeya market in Were Ilu district. Secondary data were also collected from unpublished reports from the offices of agriculture. Collected data were analyzed using descriptive statistics.

3. Results and Discussion

3.1. Major Spice Crops Grown in South Wollo

Overall, 12 spice species are currently under production by smallholder farmers in South Wollo (Table 1). Of these, Fenugreek, Capsicum and White and Black cumin are dominant species followed by Coriander, Mustard, Basil and Ruda plant. The study revealed that considerable size of land (3,688 hectares) which accounts to 1.05% of the arable land is covered by spices in South Wollo (Table 2).

A total of 3,353 ton of spices is produced annually in South Wollo, where fenugreek took the lion-share in both area coverage and production followed by capsicum and black cumin (Table 2). Farmers produce spice crops using their indigenous knowledge and thus production and productivity of spice crops is very low where the productivity for most spice crops is not far from 1 t ha^{-1}. The cultivation practices and techniques are based on knowledge that passed from generation to generation, and the production level is low. The result indicated that farmers grow local varieties and never at all use fertilizers or pesticides. Spice production is mainly aimed at catering to local markets.

Table 1. Major spice crops grown in South Wollo and their local uses.

Vernacular name	Scientific name	Plant parts used	Major uses
Chillies and capsicum	*Capsicum spp*	Pod	Culinary, medicinal, coloring agent, essential oil
Alliums	*Allium spp*	Bulbs	Culinary, medicinal
Fenugreek	*Trigonellafoenum-graecum*	Seeds	Culinary, Shamet (local drink made from fenugreek) especially for breast feeding women, child and old persons, bull fattening, protein source, medicinal
Black cumin	*Nigella sativa*	Seeds	Culinary, medicinal, essential oils
White cumin	*Carum copticum*	Seeds,Stem	Culinary, medicinal, essential oils
Coriander	*Coriandrum sativum*	Seeds, leaves	Culinary, medicinal, essential oils
Basil	Ocimum basilicum	Herb	Roasting beef/mutton
Mustard	*Brassica nigra*	Seeds	Culinary, medicinal
Ruda plant	*Ruta graveolens*	Seeds, herbs	Culinary, medicinal
Mint / 'Na-na'	*Montha piperita*	Leaves	Culinary
Thymus /Thyme	*Thymus vulgaris*	Leaves	Culinary
Koseret	*Lippia spp*	Leaves	Culinary

Table 2. Total arable land, production and productivity of spice crops in South Wollo in 2004/2005 cropping season compared to cereals, pulses, oilseeds, and horticultural crops.

Crop	Total arable land (ha)	Total production (Quintal)	Productivity (Quintal/ha)
Cereals	270,130.1	3,361,987	12.45
Pulses	70,758.5	497,133.4	7.03
Oilseeds	4,876.1	21,927	4.50
Vegetables (Potato, Shallot)	2,546.2	251,259	98.68
Spices	3,688	33,526	9.09
Fenugreek	2,577	19,669	7.49
Capsicum	971	13,531	13.94
White cumin	66	336	5.09
Black cumin	74	365	4.93
Total	351,998.9	4,165,832.4	11.83

Source: Annual report of South Wollo Administrative zone agriculture office.

3.2. Crop Management Practices

3.2.1. Land preparation

One of the factors limiting production of spice crops in Ethiopia is sub-optimal agronomic practices. Land preparation has great impact on the yield of spice crops. In terms of management, farmers give prior attention to food crops (cereal, pulse and oilseeds) while giving little attention to spice crops production. Spices are planted mostly at homestead and sometimes in the field. They are often planted in highly fertile soils which are locally called *Gull-meret*. *Gull-meret* is an area with relatively high soil fertility status. Such soils are not suitable to grow major crops like tef as plants will grow vigorously and then lodge. For this reason, farmers often allocate such soils for spice crops. Intentionally, farmers don't prepare their farmland well for most of the spice crops, except for capsicum, alliums, fenugreek, and black and white cumin. Often, tilling the land can take place 2-3 times extending from April to July (Table 3).

3.2.2. Planting

More often than not, spice crops production is called women's activity, as women are mostly involved in spice production, thus women are doing the land preparation as most spices are grown at homegarden. Method of planting for all the spice crops, except capsicum, is done by broadcasting. Spices are grown either in the main rainy season or under irrigation. Planting time for rain-fed production usually extends from the first week of July to first week of August. Fenugreek is often planted on heavy clay soil from end of August to mid of September (Table 3). Planting time for irrigated spice crops is done from November to December.

3.2.3. Weeding

Spice crops are usually hand weeded 2-3 times from mid August to first week of September. Recommendations on critical weeding period for different spice crops are not available. Farmers believe that weeding right after rain shower or on cloudy days will favour powdery mildew outbreak in fenugreek. Thus, they advise avoiding weeding in fenugreek just after the rain shower or during cloudy days (high humidity).

3.2.4. Major pests

Spice crops are not seriously affected by either pre-harvest or postharvest pests. Occasionally, fenugreek and black and white cumin are affected by powdery mildew, rust, root rot, aphid, boll worm and cut worm. Powdery mildew is a major yield limiting factor in fenugreek followed by frost and boll worm.

3.2.5. Irrigation

Farmers use irrigation mainly for Alliums and Capsicum. They irrigate Capsicum every week up to the time the crop sets pods. Capsicum demands high irrigation frequency during transplanting, flowering and pod setting periods. Irrigation should be terminated during January to avoid frost damage.

3.2.6. Fertilizer application

Mostly, spice crops are grown on loam soil (*Gul-meret*) and thus application of either mineral or organic fertilizers causes lodging and reduce seed yield. Moreover, basil and capsicum are usually cultivated around homestead on soils which often receive farmyard manure. Hence, most of the farmers do not apply either mineral or organic fertilizers. In line to this assessment, fertilizer application on ginger and turmeric was not effective (Paulos, 1986).

3.2.7. Harvesting

Harvesting of spice crops is usually practiced manually using family labor, mostly by housewives. Though time of harvesting varied from location to location, it is usually done from November to January.

Fenugreek is harvested by uprooting the plant, and threshing and winnowing on threshing floor. Capsicum has an indeterminate maturity and is harvested by selectively hand picking when the pod turns to red. Black cumin has determinate type of maturity and thus harvesting is done once. Harvesting is practiced by uprooting the plant and tying in bundles and then putting upward, until the plant has completely dried. Thereafter, the plant is threshed and winnowed to separate the seeds from impurities. In white cumin, the whole aboveground plant part is harvested, sun dried and threshed along with stems and leaves. Appearance of red pod is an indication of maturity in coriander. Harvesting coriander is practiced by uprooting the plant and sun dried and then threshed. Basil has an indeterminate maturity. If it is over matured shattering will seriously affect the yield of the crop. Therefore, timely harvesting of basil is very critical. Basil is harvested either by uprooting the whole plant or by cutting the seed-bearing part.

3.2.8. Packaging and storage

Spices are stored for a long time without deteriorating in quality, may be due to their antimicrobial content. Suitable packaging practices for processed spice products are highly essential. Generally, the basic principles of proper packaging and storage involve retention of suitable moisture level, storage under clean, cool, and well-ventilated area, free from any incidence of storage insect pests, rodents, as well as other domestic animals (Bhagya *et al*., 2015).

Spice crops are not susceptible to storage pests and diseases if they are sun dried properly. In South Wollo spices are stored in the house for household consumption, marketing and seed. Spices are stored in different locally constructed storage structures like *Gotera/Gushgusha* (storage structures made either from mud or bamboo), sacks, pots, and metal barrel. Per the guidelines of the American Spices Trade Association, it is essential to use sacks for packing pepper dried to 10 to 11% moisture level (Mukherjee, 2009). Producers are required to use new and clean sacks that are dry and free from any contaminant. To prevent moisture re-absorption during storage, it is recommended to use wooden planks for stacking the pepper containing sacks at least 30 cm away from the walls. Likewise, both dried ginger and turmeric should also be packed in new and clean bags.

3.3. Consumption and utilization

Farmers in South Wollo use most spice crops for flavouring food. This study revealed that the major spices used in flavoring food are cardamom, ginger, turmeric, cinnamon and clove. Spice crops produced in their farms are mostly used for home consumption and for marketing when they produce excess of home consumption.

Spices do have different uses; they are added to foods and beverages to improve the quality of flavor, aroma and color. Local dishes and beverages are often flavored using either single spice or by combining different spices (Table 4). Their combined effect improves the aroma and color of the food. The level of consumption of spices by households depends on their economic status. A household having better economic status uses spices in their daily food intake while poor households often do not use spices as they cannot afford the high price of spices. Spices also have high medicinal values. Traditionally, from time immemorial, farmers are treating different diseases using different spices and herbs. For instance, black cumin mixed with honey is believed to cure stomachache. Coriander is also one of the ingredients in treating serious coughing. The survey result indicated that women are not advised to consume excessive amount of mustard, as it is believed to have a sterility side-effect. The group discussion also depicted that fenugreek in the form of drinking (*Shamet*) is believed to reduce the sexual interest of men. Similarly, other researchers reported that spices play an important role in pharmaceutical industry. The active principle present in the spices will act against human diseases and cure many of them like hypocholesterolemic, antidiabetic, anti-inflammatory, anti-arthritic, anticarcinogenic and also act as antioxidants (Bhagya *et al*., 2015). It is also reported that spices like turmeric, red chilli, and saffron are used as natural colorant in textile industry (Mukherjee, 2009).

Agronomically, fenugreek is a leguminous crop; it is used as a soil fertility rotation crop. It improves soil fertility by fixing atmospheric nitrogen through its root nodules. In addition, its straw is used as animal feed and for mattress making and compost preparation.

Table 3. Cropping calendar for some of the spice crops in South Wollo.

Spice crops	Management practices	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
	Land preparation				XX	X	XX	X					
Fenugreek	Planting							XX	XX	X			
	Weeding								XX	X			
	Harvesting	XX	X									X	X
	Land preparation				XX	X	XX	X					
Black	Planting							XX					
cumin	Weeding									X	X		
	Harvesting											X	XX
	Land preparation				XX	X	XX	X					
White	Planting							XX					
cumin	Weeding									X	X		
	Harvesting	XX											X
	Land preparation						XX	X					
Basil	Planting							X					
	Weeding/Hoeing								X			XX	X
	Harvesting										X	X	

Note: XX and X denote high and low intensity of physical operation, respectively.

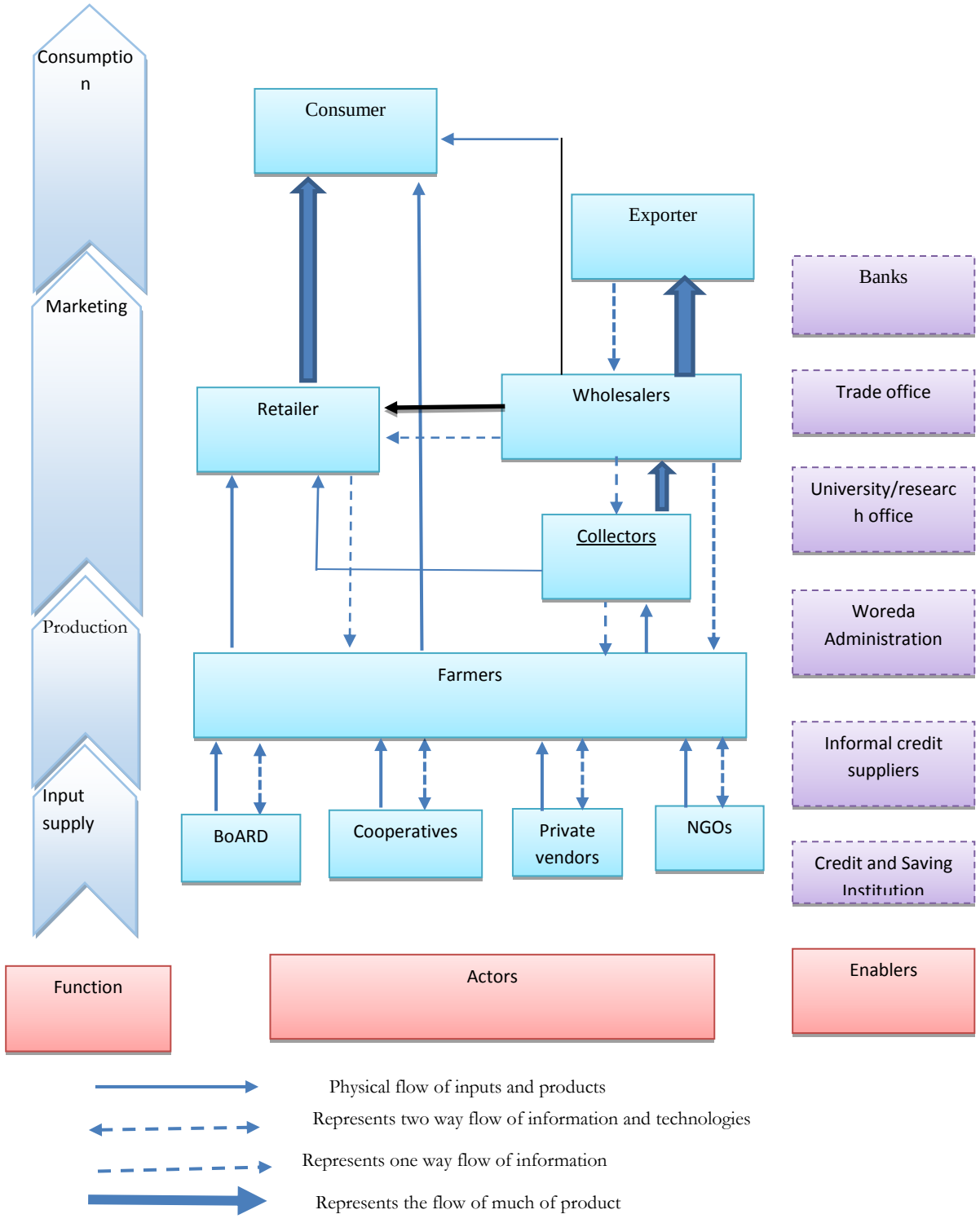
3.4. Spice Market and Value Chain

Spices are produced by smallholder producers mainly for home consumption and as cash source. The value chain actors for spice crops are smallholder farmers, wholesalers, retailers and consumers (Figure 2). The demand for spice crops is increasing at a medium rate (4%) per annum for local market (Unpublished, 2005). The price of major spice crops is characterized by variability in major markets. The minimum price for spice crops is observed in Mekane-Selam where infrastructure and market services are poor. On the other hand, maximum price for spice crops is observed in Kombolcha where infrastructure and market services are relatively well organized and developed. Price for spice crops is determined by traders using the demand, supply and price information as compared to producers in remote areas. Moreover, the result indicated that there is less integration of markets for spice crops.

The price of spices at Kombolcha fluctuates less compared to Mekane-Selam and Segno Gebeya markets (Table 5). The high fluctuation in the latter markets is due to the fact that most producers supply their product at the time of harvest. At this period, most producers are obliged to pay their tax and credit and thus they sell spices to cover these costs. Therefore, the price of spices at harvesting time, which is from November to January, is very low. Scarcity of spices is usually observed in Mekane-Selam and Were Ilu throughout the year. Demand for spices is high from April to June as most women prepare *Shiro* and *Berbere* for the summer season. Consequently, the price of spices is high in these months. In Kombolcha, traders are the most benefiting value chain actors and are benefiting from spice crops as they have access to price information and have better storage facilities. Furthermore, the availability of storage facility relatively stabilizes the price of spices for most of the year. Ethiopia exports ginger, turmeric, pepper, black pepper, korarima, black cumin, coriander and fenugreek in their dried forms and/or as oleoresin or essential oils extract, thereby fetching some foreign currency to the country (Roukens *et al.*, 2005; Masresha, 2010).

Table 4. Spice crops utilization and ways of preparation.

Spice crop	Used as ingredient in	Ways of preparation
Fenugreek	Bread	Washed, roasted and milled with wheat and maize
	Injera	Washed, roasted and milled with cereals
	Shamet (drink)	Boiled, sun dried and milled
	Butter refinement	Roasted, ground with mortar and pestle and added to butter
White cumin	*Shiro*	Roasted mildly, mixed and milled with pulses
	Berbere	Roasted mildly, mixed and milled with pepper
	Butter refinement	Roasted mildly, ground with mortar and pestle and then added to butter
Black cumin	*Berbere*	Roasted mildly, mixed and milled with pepper
	Bread	Mixed with wheat and maize dough
	Stomach-ache	Mixed with garlic and honey
	Butter refinement	Roasted mildly, ground with mortar and pestle and then added to butter
Basil	*Berbere*	Roasted mildly and milled with pepper
	Shiro	Roasted mildly and milled with pulses
	Butter refinement	Roasted mildly, ground with mortar and pestle and then added to butter
	*Alicha wot (*green*)*	The stem and the leaves are added to *Alcha wot*
Coriander	Bread	Roasted mildly, ground with mortar and pestle, added to wheat and maize dough
	Berbere	Roasted mildly, and milled with pepper
	Shiro	Roasted mildly, and milled with pulses
Mustard	*Berbere*	Roasted mildly and milled with pepper
	For raw meat	Mustard flour mixed with pepper powder
	Bokolt	Mustard flour mixed with sprouting faba bean
Ruda plant ("Tena-Adam")	*Shiro*	Ruda plant seeds mixed with garlic, ginger and ground with mortar and pestle. Thereafter, pulse would be added with those mixed spices and ground with mortar and pestle. Finally, sun dried and milled.
	Berbere	Ruda plant seeds mixed with garlic and ginger, and ground with mortar and pestle. Thereafter, pepper would be added with those mixed spices and ground. Finally, sun dried and milled.
	Butter refinement	Ruda plant seeds mixed with garlic and ginger, and ground with mortar and pestle and added to butter.
	Tea	Ruda plant flowering buds and leaves at green stage would be added to tea
Garlic	*Berbere*	Peeled garlic, ruda plant seeds and ginger are mixed and ground with mortar and pestle. Then, pepper is added to the mixed spices and then ground together. Finally, sun dried and milled.
	Shiro	Peeled garlic, ruda plant seeds and peeled fresh or wetted dry ginger are mixed and ground with mortar and pestle. Thereafter, roasted pulses are mixed with those mixed spices and ground. Finally, sun dried and milled.
	Butter refinement	Peeled garlic is mixed with ruda plant seeds and peeled ginger and the mixture ground with mortar and pestle to be added to butter.
	Wot	Peeled garlic is mixed with ginger and ground with salt then sun dried.



Note: BoARD = Bureau of Agriculture & Rural Development.

Figure 2. Market channel and chain for spices

Table 5. Minimum, maximum and most frequent price (Birr/Kg) of some spices at Kombolcha, Mekane-Selam and Segno Gebeya markets.

Market name	Frequency	Fenugreek	White cumin	Black cumin	Basil	Coriander
	Minimum	14.00	5.25	7.00	1.75	2.10
	Mode	15.75	7.00	8.75	2.63	2.80
Kombolcha (Kalu)	Maximum	17.50	9.63	10.50	3.50	2.80
	Minimum	2.63	1.40	3.50	1.40	0.70
Mekane-Selam	Mode	5.25	2.63	5.25	2.45	1.40
(Debresina)	Maximum	7.00	5.25	8.75	3.50	1.75
	Minimum	3.00	1.75	5.25	1.75	1.75
Segno gebeya	Mode	4.60	3.50	7.00	3.50	2.63
(Were Ilu)	Maximum	6.00	5.25	8.75	5.25	3.50

Table 6. Minimum and maximum variability of spices price (%) from the most frequent price at Kombolcha, Mekane-Selam and Segno gebeya markets.

Market	Frequency	Fenugreek	White cumin	Black cumin	Basil	Coriander
	Minimum	11	25	20	33	25
Kombolcha (Kalu)	Maximum	10	27	17	25	0
	Minimum	50	47	33	43	50
Mekane-Selam(Debresina)	Maximum	25	50	40	30	20
	Minimum	35	50	25	50	33
Segno gebeya (Were Ilu)	Maximum	23	33	20	33	25

3.5. Opportunities and constraints of spice production

Ethiopia is Vavilovian center of origin/diversity of many spices. Amhara Region also has a wide range of conducive environments for spice production. Besides, there is a growing demand for spices within local and foreign markets. This is a good opportunity for the region in general and for South Wollo in particular to invest on spice production.

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.

4. Recommendations

As cash crop, the spice subsector is amongst the important ones that fit within the strategy of commercialization of agriculture. Spices, being cash crop, have high potential of enhancing the purchasing power of the smallholder farmers thus helping in poverty reduction and ensuring food security. However, spice crops production has received little research and extension attention and support. It is, therefore, worth mentioning that spice crops in the country in general and in South Wollo in particular deserve more action from policy makers, researchers and extension. Research should work in developing improved varieties and better agronomic practices to improve the production and productivity of spices. In South Wollo, as fenugreek, capsicum, black and white cumin, coriander and basil are widely grown by farmers, research and extension could start intervention on these spices. Collecting, characterizing and analyzing essential oils and other important ingredients of spices would add value to spice production, so that spices would play great role in improving farmers' livelihoods. Detailed study needs to be done on spice value chain to identify value chain actors and value chain constraints. Strong market linkages need to be established between farmers, retailers, wholesalers and consumers so that farmers could get better price.

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6. References

American Spices Trade Association (ASTA). 1999. Guidelines on quality improvement. http://www.indianspices.com/html/guidequalityimp.htm

Bhagya H. P., Raveendra, Y. C. and Lalithya, K. A. 2015. Mulibeneficial Uses of Spices: A Brief Review. *Acta Scientific International Journal of Food and Nutrition*.1:3-7

Bureau of Agriculture. 2005. South Wollo Zone Agriculture Office annual report, Bureau of Agriculture. Bahir Dar, Ethiopia.

Dessalegn Gachena. 2015. Analysis of Factors Determining the Supply of Ethiopian Cardamom Spice (*Aframomum corrorima*): A Case from Bench Maji Zone of SNNPR, Ethiopia. *European Journal of Business and Management*, 7 (1): 56-63.

Edossa E. 1998. Spices research achievements and experiences. Research Report No. 33. Institute of Agricultural Research, Addis Ababa Ethiopia, Pp 5-45.

Ethiopian Economic Association. 2008. Report on the Ethiopian Economy: Volume VII. Addis Ababa, Ethiopia.

Girma H., Kifelew, H. and Mitiku H. 2016. Spices Research Achievements, Challenges and Future Prospects in Ethiopia. *Academic Research Journal of Agricultural Science and Research*, 4 (1): 9-17.

International Trade Centre, 2010. Spice Sub-sector Strategy for Ethiopia. Addis Ababa, Ethiopia.

Kothari, C. R. 2004. Research Methodology: Methods and Techniques (2nd Ed.), New Age International Publishers, New Delhi. 401 pp.

Masresha, Y. 2010. Market profile on spices in Ethiopia: a report to UNCATD ITC, Addis Ababa, Ethiopia, Pp 4-35.

Mukherjee, A. 2009. Turmeric as carotenoid source on pigmentation and growth of fantail guppy, Poecilia recticulata. *Proceedings of the Zoological Society* 62.2: 119-123.

Paulos, D. 1986. Response of turmeric (*Curcuma domestica* Val.) and ginger (*Zingiber officinale* Rosc.) to fertilizer treatments. In: Desta B. (eds) Proceedings of the first Soil Science Research Review Workshop, Addis Ababa Ethiopia, Pp 60-61.

Roukens, O., Tadele, W., and Tamrat K. 2005. Export Potential of Ethiopian oleoresins, Ethiopian Export Promotion Agency, Addis Ababa Ethiopia, Pp 13-17.

Sirinka Agricultural Research Center, 2005. Progress report of the center, Woldia, Ethiopia.

Vijayalaxmi, H. and Sreepada H. 2014. An Economic Overview of Ginger Production in Ethiopia. *International Journal of Science and Research*, 3 (12): 2052-2054

Zenebe W. and Bereke-Tsehay, T. 1991. Review of Spices Research in Ethiopia. In: Godfrey, S. A., Bereke-Tsehay T. (Eds) Proceedings of the first Ethiopian Horticultural Workshop, IAR, Addis Ababa, Ethiopia. Pp 343 - 347.