Opportunity and Challenges for Coffee (*Coffea Arabica* L.,) Production in Ethiopia "Review"

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Abstract: The overallaim to write this paper on opportunity and challenges for coffee production in Ethiopia is that Ethiopia is the birth place of coffee and it discovered earlier in the world. The Oromo's in Ethiopia were consuming coffee centuries before the Kaldi legend, and have their own legend of its discovery. Today, coffee is both a part of our social experiences as well as an accepted norm for doing business. Economically, coffee is the second most exported commodity after oil, and employs over 100 million people worldwide. As the county of origin for the crop, Ethiopia produces premium quality coffee. It is the leading producer in Africa, and the 5th in the world, following Brazil, Vietnam, Colombia and Indonesia. If we consider Arabica alone, Ethiopia is the 3rd largest producer after Brazil and Colombia. Ethiopia has enormous potential to increase coffee production as it is gifted with suitable elevation, temperature, soil fertility, indigenous quality planting materials, and adequate rainfall in coffee growing belts of the nation.Despite the wealth of ecological advantages and coffee diversities, the national average coffee yield level is low by the world standard. This could be attributed to several factors, including climatic variation inappropriate agronomic practice, predominant use of unimproved local coffee landraces, as well as conventional husbandry and processing practices and price fluctuation, which seriously hampers the overall national coffee production and productivity of the smallholder farmer in the country.Areas that are currently suitable for Arabica coffee need adaptation and mitigation tactics in order to withstand the livelihood of farmers depending on Arabica coffee production.

Keywords: Opportunity, challenges and Coffee production.

1. Introduction

Coffee is the most popular soft drink in the world. Over 2.25 billion cups are consumed every day(Gole, 2015). Its popularity and volume of consumption are growing every year, and coffee shops are the fastest growing part of the restaurant business. Today, coffee is both a part of our social experiences as well as an accepted norm for doing business. Many business managers, scientists, politicians, and people of all walks of life relax having a cup of coffee during breaks in between meetings, busy research works and routine daily activities. Economically, coffee is the second most exported commodity after oil, and employs over 100 million people worldwide (Tefera A. and Teddy T., 2013). According to FAO statistics (www.fao.org/faostat/en/), report global coffee production area covered around 11,120,498ha in 2019.

There are over 120 species of coffee (genus *Coffea*). However, the only two species of economicimportance: Arabica coffee (*Coffea arabica)* and Robusta coffee (*Coffea canephora*)(Gole, 2015).Ethiopia is the homeland and center of genetic diversity of Arabica coffee (*Coffea arabica* L., Rubiaceae) (Vavilov 1951).Mesfin Amaha (1991) suggests that Ethiopia is not only thenative home of Arabica coffee but also the country that has shown the use of coffee to the world. Arabica coffee is the most widely consumed, dominating over 70% in volume of production and over 90% of traded value globally. More than 80 developing countries mainly earn their foreign currency from coffee. For Ethiopia, coffee is the most important export commodity, with a share of 20-25% of the entire foreign exchange earnings. At least 15 million people also directly or indirectly trust on coffee for their livelihood (Ministry of Trade 2012 &Tefera A. and Teddy T., 2013).

As the county of origin for the crop, Ethiopia produces premium quality coffee. It is the leadingproducer in Africa, and the 5thin the world, following Brazil, Vietnam, Colombia and Indonesia. If we consider Arabica alone, Ethiopia is the 3rd largest producer after Brazil and Colombia (ICO 2015). Ethiopia also has the largest highland area suitable for Arabica coffee production and, hence has the potential to be a foremost producer in both quality and quantity.

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Ethiopia has huge potential to increase coffee production as it is endowed with suitable elevation, temperature,soil fertility, indigenous quality planting materials, and sufficient rainfall in coffee growing belts of the country. Coffee is a shade loving tree that grows well under the large indigenous trees such as the *Cordia Abyssinica*and the Acacia species. The main coffee growing regions are found within Oromia Region and Southern Nations, Nationalities, and Peoples' Region (SNNPR), with modest production in Amhara Region and minor output in Benishangul-Gumuz Region(Moat et al., 2017). Ninety five percent of Ethiopia's coffee is produced by small holderfarmers from less than twohectares of land whereas the remaining five percent is produced on modern commercial farms.In Ethiopia; coffee had been still paysthe Lion's share in its nationwide economy being the leading source of foreign exchange earnings. The Government of Ethiopia is encouraging coffee production, with a plan of doubling production, while improving quality through improvement of processing and post-harvest handling. Coffee production is expanding in non-traditional coffee producer areas as well.Despite Ethiopia's enormous potential for increasing coffee production, average per hectare yield remains verylow at 0.65 tons per hectare (www.fao.org/faostat/en/). The objective of this paper isto shows thepotential of Ethiopia for coffee production, to identify the major factors that cause low coffee yieldand its mitigation strategy in Ethiopia.

2. Review Literature

2.1. Origin, history and culture of coffee

2.1.1. Legend of coffee discovery

There are several stories and legends about its discovery. A very common legend about its discovery is that of Kaldi and his dancing goats. The story tells that a young Ethiopian goat herder named Kaldi, who lived around the year AD850 seen to his amazement, that after chewing the bright red berries, his goats pranced around in an unusually exuberant way. Out of curiosity, he tried a handful of the berries that were growing on the bushes nearby. Feeling a novel sense of elation, Kaldi realized that there was something exceptional about this fruit and, filling his pockets, rushed back to his wife to share his discovery. 'They are heaven sent!' she declared, 'you must take them to the monastery.' Kaldi offered the cherries to the chief monk, telling the miraculous influence they had, and his goats. On hearing the story and the cherries' extraordinary properties, the monk threw them onto the fire denouncing them to be the work of the devil. In minutes later, the monastery began to fill up with the wonderfulsmell of roasting beans and other monks gathered to examine. Raking the spitting and popping beans from the ashes, they were placed in a pot and covered with hot water to preserve their freshness.That evening, the monks sat up drinking the ironic and fragrant beverage and vowed that they should drinkit daily to help with their nightly prayers. Words of the magical properties of coffee cherries spread far and wide. The habit of drinking coffee spread all over Arabia, the Mediterranean, and gradually Europe and the rest of the continent(Gole, 2015). Though the legend of Kaldi, his goats and the monks says that coffee was discovered as astimulant and as a beverage on the same day, it is far more likely that coffee beans were masticated as a stimulant for centuries before they were made into a beverage.
Oromos in Ethiopia were utilizing coffee centuries before Kaldi, and have their own legend of its finding. Once upon a time, the supreme sky God 'Waqa' punished one of his devotedmen with death. The followingday, Waqa visited the burial place, and tears dropped of his eyes. A plant developed from the soil watered by Waqa's tears, and that was coffee. It is believed that all other plants are watered by rain, but coffee is with tears of God that was why the plant coffee is always green. In Oromo culture green denotesas fertility through which a supreme God, Waqa manifests himself to the people. Hence, coffee has special value in Oromo culture (Gole et al., 2015).

2.1.2. Domestication and distribution

According to Luxner (2001) the domestication and use of coffee in Ethiopia dates back some 2000years ago. Some legends of its early consumptions even date it back, around 1000 BC (Illy and Illy 2015). During the early period of domestication, coffee was only used as food by the native Oromo people. Coffee becomes known to the rest of the world only during the beginning of the last millennium. It was first brought by traders to Yemen around year 600 (Illy and Illy 2015). The Arabs developed its present use as liquor, and the culture of drinking coffee reached Turkey and Syria during the late 1400s and early 1500s. This habit of drinking coffee gradually spread to the rest of the world, leading to an increased interest in producing it as a commodity on a large scale(Gole et al., 2015). The Dutch first introduced coffee plantations to Java in 1690 and it gradually spread to other parts of the word, especially Latin America (Haarer, 1962). Today, Latin American countries are the major producers of Arabica coffee.

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2.1.3. Coffee production systems in Ethiopia

Arabica coffee grows over a wide range of agro-ecological zones inEthiopia (Senbeta & Denich, 2006). Across these coffee growing regions, it is common to observe different coffee production systems. On the basis of management, vegetation, structural complexity, agronomic practices, coffee production systems in Ethiopia may be grouped into four; namely: forest coffee (8-10%), semi-managed forest coffee (30-35%), cottage or garden coffee (50-57%) and modern coffee plantation (5%) (Kufa et al., 2011). Forest coffee is a wild coffee grown under the shade of natural forest trees, and it doesn't have a defined owner.The only management practice in the forest system isaccess clearing to allow movement in the forest during harvesting time (Gole *et al.* 2001).Forest with wild Arabica Coffee occurs in the southeastern and southwestern highlands ofEthiopia mainly at altitudes between 1000 and 2000 meter above sea level(Wolde-Tsadike and Kebede, 2000). According to Paulos Dubale and Demil Teketay (2000) Wild animals and birds are the major agents for disseminating seeds within the forest community assist spontaneous regeneration. Themean yield of forest coffee has been estimated to be200-250 kg/ha (PaulosDubale and DemelTeketay, 2000).Ethiopian coffee is mainly produced by small-scale farmers using traditional farming practice and thus considered as organic and known for its superior quality(Kufa et al., 2011).

Semi-forest coffee production system is mainly found in Illubabor, Jimma, Keffa, Sheka, BenchiMaji and Westwellega administrative zones.According to MoARD (2007), it was estimated that semi-forest coffee occupies nearly 136,000 hectares (34%) of the total area of coffee in the countryand its average yield has been calculated to be around 400-500kg/ha(PaulosDubale and DemilTeketay, 2000).Garden coffee is found primarily in the Eastern and Southern part of the country (Sidamo, Gedeo, North Omo, Gurage Zones, Hararghe, and Arsi Bale). This production system is increasing as it is currently beingintroduced in South West Ethiopia (Wolde-Tsadik and Kebede, 2000). Plantation coffee is planted by the government or private investors for export purposes. In this production system, almost allmanagementpractices like improved seedlings, spacing, proper mulching, using mineral fertilizer and manure, weeding, shade regulation and pruning are practiced. According to Belachew, K and Teferi, (2015) report percent share of Commercial Farms from total Production was 20.2, 11.4and 16.9 for year 2011 – 2013 respectively. The production volume of commercial farms reached 531,038 tons in 2013. Currently 135 private investors were engaged in small to large scale coffee productions with total area coverage of 114,525 ha in Ethiopia(Belachew, K and Teferi, 2015).

The first three production systems have been practiced for centuries by smallholder farmers, and therefore, are considered as **'traditional'coffee production systems** (Gole *et al.* 2001). Modern plantation coffee production system was only introduced around 100 years ago in eastern part of the country, Gololcha district of Arsi zone (Gole, 2015).Generally, the areas ofplantations and home-gardens are increasing. Areas covered by coffee production are estimated to be about 758,523 ha with a production of about 482,561 tons of green coffee(CSA, 2019).

2.2. Opportunity for coffee production in Ethiopia

2.2.1. Earlier and traditional modes of coffee consumption in Ethiopia

The former use of coffeewas as food, rather than as beverage. For instance, there are evidenceswhich show that Oromos started consuming coffee as energy food long time before its current popular usage(Gole, 2015). There are also other traditional beverages consumed locally, than the popular mode of consumption known worldwide. The traditional food includes***coffee ball, buna qalaa***and***qori,***whereas traditional drinks are ***quti***, *hojja* and chamo(Teketay, 1999). According to Gole, (2015) report Chamo is prepared from fresh coffee buds or young leaves. The leaves are boiled with ginger, cardamom and chili pepper to produce a hot beverage that is consumed in the mornings and believed to have medicinal values in protecting malaria in southern Ethiopia.

2.2.2. Coffee culture in Ethiopia

Ethiopians are coffee drinkers, ranked as one of the most coffee consumers in Sub-Saharan Africa. Almost half of production (55-60%) is locally consumed(Kufa, 2017).Today, the culture of drinking brewed coffee is deep-rooted and widespread, known almost amongall ethnic groups in Ethiopia. It is a social drink, and is normally shared with neighbors. Every time coffee is made, it is freshly roasted. Coffee ceremony canbe organized at any time of the day if a guest comes, on mourning, conflict arbitration or other communal events(Gole, 2015).Coffee ceremony is

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considered to be the most important social event in many communities and itis a sign of respect, friendship to be invited to a coffee ceremony. Guests at a ceremony may discuss issues such as politics, community and gossip. There are also consecrations for ceremony's performer and praise for the brews she produces.

An interesting new development in Ethiopian major cities regarding coffee consumption is the appearance ofsmall roadside shops selling coffee to passengers. The small roadside shopswork coffee in a traditional manner. Currently large number of people engaged in serving boiled coffee with its ceremony. This massively materialized activity specially in creating job opportunity for women being strong income source for the livelihood of the family(Aseffa, 2019).They have emerged and flourished in Ethiopia's major towns, growing very popular coffee drinkers who are irritated by the escalating price and deteriorating quality of coffee worked in cafes and coffee shops. The inflated local coffee prices have also pushed some consumers, particularly those residing in non-coffee growing areas, to boil and drink the skin of a coffee grain as a substitute for normal coffee(Tefera A. and Teddy T., 2013).

2.2.3. Genetic diversity

Ethiopia is well noted center of origin and diversity for many domesticated crops including Arabica coffee. The natural genetic diversity or genepool of economic plants has three distinct categories, namely: the primitive cultivars or landraces of traditional agriculture, the advanced cultivars produced by plant breeders in the last 100 years, and the wild species related to domesticated cultivars (Teketay and Tigneh 1994).The besthope for crop improvement lies in the progenitors or wild relatives of the cultivated plants thatharbor rich genetic resources for tolerance against abiotic (drought, cold, heat, salt, solar radiation), and biotic (pathogens, parasites, competitors) stresses (Nevo 1998). In this regard, the Ethiopian Arabica coffee genepool represents the most important and diversified genepool of this species.Vast agro-ecology and genetic variability in Ethiopia creates opportunity to have different distinct coffee quality characters. Even though Ethiopia is known for its coffee quality in world market for its unique flavor; it has not benefited from the enormous potential of its specialty coffees as expected(Sualeh et al., 2021).To use thus coffee gene pool in breeding programs, researchers have collected a total of around 11,691 Arabica coffee germplasm accessions from different coffee growing areas throughout Ethiopia(Gole et al., 2015).The availability of high genetic diversity is fundamental for any crop improvement program for useby the plant breeders. In the absence of genetic diversity, any improvement endeavor is time consuming, expensive and with little success. Because of this high genetic diversity, coffee breeding programs have been striving to identify disease tolerance, drought resistance, and low caffeine varieties. A number of studiesrevealed that the forest coffee system supports high functional diversity in terms of disease tolerance and pest resistance (Adugna *et al.* 2005), and drought tolerance (Beining *et al.* 2005; Kufa 2006).Therefore, a diverse coffee gene pool is of paramount importance for breeding. Particularly, cross breeding of cultivars and wild genetic material leads to results above average due to heterosis effects. In this regard, the Ethiopian wild coffee populations provide highly diverse genetic material for future coffee breeding and selection.

2.2.4. Agro ecology

Over 50% of African highland areas above 1500m are found in Ethiopia. The highlands also receivehigh rainfall. The country has the largest highland plateau suitable for coffee production. The Ethiopian Institute of Agricultural Research (2008) estimated that there are 4.48 million hectare of highly suitable and 17.63 million hectares of moderately suitable areas for coffee production inEthiopia. Mesfin Amaha, (1991) also describe the country has a total of 22, 350, 000 hectares of potential coffeeproducing land.This gives ample space in which areas of coffee production can shift, in response of the negative effects of climate change. Currently, only around 800,000 hectare is under coffee production in Ethiopia.Good indigenous knowledge of coffee production, the existence of improved variety of coffee, hopeful practices of coffee productivity package were an opportunity for coffee production in Ethiopia.

In Ethiopia in general and in the aforementioned potential coffee growing areas in particular the local utilization of coffee and in turn motivates to produce coffee at large come into view. Thus this call technology generation, support and enhancing of coffee production in those areas where coffee is not produced as major crop having production potential and thus is a good opportunity to produce coffee at large for commercial farms as well as small holder farmers in Ethiopia(Aseffa, 2019).

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2.3. Challenges for coffee production in Ethiopia

2.3.1. Poor Agronomic practices for coffee production

Naturally, Arabica coffee grows as an understory tree/shrub in the montane rainforests of Ethiopia at altitude between 550-2600m, with the most suitable range being 1500-1800m. Coffee performs well in optimum average annual temperature of 18-24^{0}C with contrasting seasons (Gole2003). Areas suitable for coffee should also receive an average rainfall of 1000 – 2000 mm/year. Coffee is a shade living plant due to its forest origin. Hence, agronomic practice for coffee production includes shade management, beside key activities like propagation and planting, pruning, weed control, soil fertility management, pest and disease control and irrigation. Delivering such agronomic practice is too much poor in miner coffee growing areas of Benishangul gumuz & Amhara regional statesand coffee is growing too much populatedas shown in figure1 planted mainly with eucalyptus.Even in major coffee growing areas of Gedeo farmers earn lower yield due to inappropriate management practice (Wolde et al., 2017). Even if the population density depends on the management practice, environmental conditions, the age of the plant and the morphological nature of variety it should be planted at least one square meter. According to Tesfaye et al., (2001) report coffee yield and canopy diameter significantly increased when population density decrease with increasing number of bearing heads.

Almost all Ethiopian coffee farmers do not use fertilizers and pesticides except on commercial farms. The Ministry of Agriculture does not encourage the practice of applying any chemicals in coffee farmlands. Alimited number of growers who use fungicides despite the presenceof Coffee Berry Disease (CBD), Coffee Wilt Disease (CWD), and Root Rot Disease (RRD) in major coffee growing areas(Tefera A. and Teddy T., 2013).

The Ethiopian coffee farm management system and the agronomic practices are traditional. Furthermore, extension services providers to small holder farmers are insufficient. GOE doesn't have a specialized institution that provides extension support for coffee production alone.A study conducted in west Harage by Gebermedin & Tolera(2015),indicates that Coffee was mostly grown as anintercropping system with diverse crops like sorghum (7.2%), maize (67.1 %,) haricot bean (5.9%) and rarely with *Khat edulis* (3.5%). The results of the study showed that farmers of the area grow coffee landraces which are low yielder and poor in their resistance towards disease, pests and drought resistance. According to this author productivity of coffee decreased from year to year, due to lack of improved varieties. He further explains the result due to severe disease influenceespecially Coffee Berry Disease on coffee production; farmersare forced to replace their coffee farm with *Khat edulis*which is not affected by disease and highly drought resistance than coffeeand it is the most competing cashcrop regarding land allocation with coffee currently in the study area.Wolde et al., (2017) also reported that productivity of coffee decreased from time to time, due to lack of improved varieties and insufficient supply of input for coffee productivity package enhancement.

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Figure 1. Coffee grown in wonbera area.

2.3.2. Shifting coffee by khat

Khat (*Cata edulis*) is increasingly competing with coffee for farmlands particularly in the eastern part ofthe country in the Hararge region(Abu Tefera and Teddy Tefera, 2013). It is a fresh leaf that is chewed as a stimulant in many towns in Ethiopia and in neighboring countries. Khat is a growing demand in major Ethiopian towns and countries such as Somalia, Kenya and Yemen; those countries import Khat from Ethiopia(Tefera A. and Teddy T., 2013). Khat is a crop with relatively high resistance to drought, disease, and pests. It can be harvested three or four times a year and generates better income for farmers than other cash crops including coffee. Several small scale farmers in the Hararge region have switched from coffee production to Khat production. The fact that coffee farms are being changed into Khat farms has offset newly planted coffee farms in other regions resulting in a very marginal increase in overall size of area planted to coffee during the current millennium.

2.3.3. Price Volatility

Global coffee production differs from time to time according to the weather conditions, disease and other factors,resulting in a coffee market that is inherently unstable and characterized by wide fluctuations in price. This price volatility has significant penalties for those who depend on coffee, making it hard for growers to forecast their income for the coming season andfinancial plan for their household and farming needs. When prices are low, farmers have neither the incentive nor resources to invest in good maintenance of their farms by applying fertilizers and pesticides or replacing old trees. When prices fall below the costs of production, farmers struggle to put adequate food on the table and pay medical bills and school fees a major reason for children taken out of school to contribute to the family income by working on the farm or in the informal sector and a decline of market prices leadsthem to discourage to adopt all coffee productivity packages(Wolde et al., 2017).Therefore the volatility of coffee markets incombination with poor production infrastructure and services have sunk the majority of coffee producers in developing countries in low-input-low-output cycles and structural poverty (Tora Bäckman, 2009).

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2.3.4. Climate variability

As climate change becomes a more spotlighted subject in the international community, research about its impact should be rapidly increases. Climate change is predicted to have a variety of effects; one impact is that it can extremely hurt crop productions. The issue of climate change has become more threatening to food security and sustainabledevelopment of any nation to the totality of human existence. About 66% of the total areas of Ethiopia fall within arid and semi-arid climatic zones (MoARD (Ministry of Agriculture and Rural Development), 2007). Nevertheless, agriculture, which is extremely sensitive to climate variability, is the driver ofthe Ethiopian's economy as it accounts for half of Gross Demostic Product (GDP) and 80% of employment (MoA(Minsitry of Agriculture), 1998). The seasonal climatic variability of Ethiopia, particularly rainfall, is influenced by weather systems ofvarious scales; from meso-scales, to the large scale, mainly El Nino-Southern Oscillation (ENSO) related phenomena (NMSA (National Meteorology Service Agency), 1996). The climate of arid and semi-arid region of Ethiopia is characterized by high rainfall variability and unpredictability, strong winds, high temperature and high evapo-transpiration (Mamo, 2005).Historical data from weather stations for Ethiopia provides specific results of the general warming trendand data shows that the mean annual temperature has increased by 1.3°C between 1960 and 2006, at an average rate of 0.28°C per decade (McSweeney et al., 2010), and by 0.3°C per decade in the south western region (Jury & Funk, 2013).

The study concludedby Deressa (2007) indicates that increasing temperatures and decreased precipitation, due to climate change, will have a long-lasting negative effect on Ethiopianagriculture. It has diverse agriculture with a mix of crops and the largest populations of livestock in Africa with stimulants such as coffee are major cash crops in Ethiopia. Some problems that hurt Ethiopian agriculture include drought, insects, disease, and low levels of technology. Climate change will lead to higher temperatures; developed countries can benefit from the higher temperatures for their agriculture. Developing countries like Ethiopia will suffer because their agricultural technology cannot deal with the changes.

Thus, the dependence of Ethiopia on agriculture makes its economy extremely vulnerable to the risks related with climate variability. Furthermore, the probable higher temperature and variable precipitation levels will clearly depress crop yields through direct effects as well as indirect impact by triggering insect pests, diseases and weeds (Gadgil *et al.*, 1998).Researchers say coffee plants are especially vulnerable to climate change because the majority of coffee is grown in developing countries.

Jaramillo *et al.* (2009) discussed that the coffee berry borer, *Hypothenemous hampei*, is one of the main insects that feed on coffee berries. It is one of very few herbivores that feed on coffee because it has tolerance for caffeine. Their research revealed that population growth of *H. hampei* has exponential relationship with temperature. As temperatures rise, the population of coffee's main predator drastically increases.Davis *et al.* (2012) published their research on the effect of climate change on the *Coffeearabica* plant. Their research proved that the plant's growing success is directly linked toaccelerated climate change, but there is a profoundly negative trend in this relationship.At best, they predict there will be a 65 percent decrease in Arabicaproduction by the year2080. Ethiopia, which isthe main African coffee producer, will face serious consequences since coffee exportsaccount for about 33 percent of Ethiopia's export revenue.

Based on Davis *et al.*, (2012) report onoptimum growth and taste, Arabica coffee needs to be in an environment of about 18 to 21 degrees Celsius. Being exposed to temperatures of about 23 degrees or higher can cause the coffee plants to ripen, which affects the taste and quality. Arabica coffee is a unique species because of its climate sensitivity. Since Arabica coffee has such picky temperature requirements, climate change could lead to disastrous impacts on the worldwide coffee industry. Jaramillo *et al.* (2009) stated that even the smallest increases in temperature could cause extensive damage to coffee production. Theirestimationshowed that if climate change continues on its current trend, the suitable land for growing coffee could face a reduction by up to 95 percent. Most coffee is grown in the tropics, which face severe threats of extreme climate change (Jaramillo *et al.*, 2009). Coffee production already is feeling the impact of climate change.

Several studies have determined Ethiopia to be especially prone to the impacts of climate change over the coming years. Deressa (2007) said Ethiopia will experience an increase in temperatures but a decrease in precipitation. This will strongly damage Ethiopia's agriculture especially coffee. Jaramillo *et al.*,(2011) predict that the changes in precipitation will be highly variable. As temperatures rises, Arabica coffee production will decrease. Davis *et al.*,

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(2012) forecast that climate change will lead to increased threats to coffee production in southwest Ethiopia and some of Ethiopia's coffee growing areas are already poorly suited for growing coffee, and it has been impacted by climate change and will continue to be so in the future (Moat *et al*., 2017).

If climate change continues as predicted, coffee production and trade will face difficult situations. With the current trends of climatechange, many optimal coffee growing areas can be sub-optimal in the coming decades (Davis *et al*., 2012).The rises in temperatures and erratic rain fall on wide spread infection of coffee berrydisease may already affecting coffee production in Ethiopian. Rising temperatures and erratic rain fall are threatening sustainable coffee production by enabling outbreak of diseases and infestations of insect pests thatdecrease the quality and yield of coffee berries (Technoserve, 2011). According to Kifle Belachew et al., (2015)climate change not only favors the proliferation of certaindiseases and pests, but also results in the spreading to regions where they were not existed. Thread blight of coffee outbreak was observed in different coffee plantations like at Limmu in 2008, at Bebeka in 2012 and at Limu horizon in 2014. Currently thread blight disease become significantly important disease in coffee growing areas of Ethiopia.

Coffee leaf rust is one danger to coffee growth that has emerged as a result of climate change. The fungus has particularly damaging effects. In the 1860s, coffee leaf rust led to the obliteration of the entire population of coffee in Sri Lanka (Koebler, 2013). Farmers learned that moving to cooler regions at higher elevations could eliminate the presence of this fungus. However, the increasing temperatures and rainfall resulting from climate change has led to coffee leaf rust becoming prevalent at higher altitudes than it used to (Koebler, 2013). Generally localconditions can make a large difference, due to the microclimate, and groundwater levels, while some areas receive greater farming inputs (e.g. irrigation, improved shade).

2.4. Mitigation to climate change

Recent scientific evidence suggests that thefrequency and severity of climatic extremes is increasing, making adaptation an absolute necessity. Adaptations such as shade tree planting for coffee and using recent information on climate variability to develop long term plans for managing them may help reduce the vulnerability of Ethiopian coffee growers to continued changes in temperature and rainfall (Amsalu, A. and Ludi, E. 2010).In order to fight rising temperatures, several researchers argue that coffee plants should be moved to higher elevations where temperatures are usually a few degrees cooler (Jaramillo *et al*., 2011; Davis *et al*, 2012). Unfortunately, this is not a highly feasible accomplishment. Jaramillo et al. (2011) say that in Colombia, Arabica coffee would need to move 167 meters higher in elevation for every 1 degree Celsius increase. Davis *et al*., (2012) say that re-colonizing Arabica coffee plants in Ethiopia is not necessarily a good idea because it will take many years for the plants to become productive again, causing the coffee industry to take a severe hit.

Scientists seem to agree that the best way to preserve Arabica coffee is through the use of shade trees (Jaramillo *et al*., 2009; Jaramillo *et al*., 2011). Shade trees planted near coffee plants have the ability to block out the sun's impact on the plants. They create lower temperatures better suited for Arabica coffee plants.The effect of shade on growth, production and quality of coffee in Jimma areas was reported by Bote and Struik (2010) and the finding confirmed that shade trees protect the coffee plants against adverse environmental stresses. Shade also triggers differences in physiological behavior of the coffee plants. It improves photosynthesis and increases leaf area index, resulting in better performance than possible in direct sun light. Consequently, coffee plants grown under shade trees produce larger and heavier fruits with better bean quality than those grown in direct sun light. Jaramillo *et al*., (2011) also say shade trees can reduced the temperature up to 4 degrees Celsius and the widespread implementation of shade trees in Colombia and Ethiopia, increase the population of *H.hampei*by 34 percent lower than expected. These relatively small steps could provide protection and stability to the struggling Arabica coffee plants.

3. Conclusion

Coffee is the most popular soft drink in the world.Economically, coffee is the second most exported commodity after oil, and employs over 100 million people worldwide. Ethiopia is the homeland and center of genetic diversity of Arabica coffee. It is the leadingproducer in Africa, and the 5thin the world, following Brazil, Vietnam, Colombia and Indonesia.Ethiopia has huge potential to increase coffee production as it is endowed with suitable elevation, temperature,soil fertility, indigenous quality planting materials, and sufficient rainfall in coffee growing belts of the country.The availability of wild coffee genetic resources are important for both national and international

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coffeebreeding programs that aim toenhance productivity, to develop disease resistance, low caffeine content and tolerance to drought, water logging and temperature extremes.

Despite the wealth of ecological and coffee diversities, the national average coffee yield level is low when comparedwith the world standard. This could be attributed to several factors, including climatic variation inappropriate agronomic practice, predominant use of unimproved local coffee landraces, as well as conventional husbandry and processing practices and price fluctuation, which in turn seriously hampers the overall national coffee production and productivity of the smallholder coffee farmer in the country.Hence, it iscrucial to promote the recommended best coffee technologies at each geographical area and production zone. This requires, strong stakeholder linkages at all levels and aggressively transfer the improved coffee varieties, improved agronomic practices, and harvesting and post-harvest management techniques.

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