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Comprehensive review of the coffee sector in the Kingdom of Saudi Arabia (CFE/051/2021/1)

*Strengthening MoEWA's Capacity to implement its Sustainable Rural Agricultural Development
Programme (2019-2025) (UTF/SAU/051/SAU)*

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ACRONYMS

4C	Common Code for Coffee Communities
ADF	Agriculture Development Fund
AH	Anno Hegirae
ARAMCO	Arab American Oil Company
CIRAD	Center de Coopération Internationale en Recherche Agronomique pour le Développement
COVID-19	Corona Virus Pandemic, 2019
CQI	Coffee Quality Institute
CRC	Coffee Research Center (<i>proposed</i>)
DOA	Department of Organic Agriculture
FAIRS	Food and Agricultural Import Regulation and Standards
FAO	Food and Agriculture Organization of the United Nations
FNC	Federacion Nacional de Cafeteros de Colombia
FSA	Food Systems Approach
GAS	General Authority of Statistics
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GI	Geographical Indication
GDP	Gross Domestic Product
GI	Geographical Indication
ICO	International Coffee Organization
IFAD	International Food and Agriculture Development
IFOAM	International Federation of Organic Agriculture Movement
JMDA	Jazan Mountainous Development Authority
KACST	King Abdulaziz City of Science & Techonology
KSA	Kingdom of Saudi Arabia
MoEWA	Ministry of Environment, Water and Agriculture
MRL	Maximum Residual Level
NGO	Non-Government Organisation
NRI	Natural Resource Institute
NTP	National Transformation Programme
OTA	Ochratoxin A
PESTEIL	Political, Economic, Social, Technological, Environmental, Institutional and Legal
pH	power of Hydrogen (measure of soil acidity)
SAR	Saudi Arabia Riyal
SCA	Specialty Coffee Association of America and Europe

SDGs	Sustainable Development Goals
SFDA	Saudi Food and Drug Authority
SFVC	Sustainable Food Value Chain
SFVCA	Sustainable Food Value Chain Approach
SIMAH	Saudi Credit Reference Bureau
SME	Small and Medium Enterprises
SMEA	Small and Medium Enterprises General Authority
SO	Strategic Objective
SRADP	Sustainable Rural Agriculture Development Programme
SWOT	Strengths, Weaknesses, Opportunities and Threats
TIMPs	Technologies, Innovations and Management Practices
TOT	Trainer of Trainers
UN	United Nations
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization.
USD	United States Dollar
VC	Value Chain
WCR	World Coffee Research

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EXECUTIVE SUMMARY

Under the auspices of Vision 2030 the Kingdom of Saudi Arabia has focused on agriculture with a view to diversifying the economy and also improving the livelihoods of the rural communities. For this purpose, the Saudi Ministry of Environment, Water and Agriculture in the implementation of its initiatives within the context of the National Transformation Program, and with assistance Food and Agriculture Organization of the United Nations developed a project “Sustainable Rural Agriculture Development Programme “. Coffee development program is within the” project component 1, “Development of coffee Arabica production, processing and marketing”.

In the Kingdom of Saudi Arabia, Arabica coffee is grown in the south-western region comprising of Jazan, Aseer and Al-Baha. The agro- ecological and climatic conditions in this area make it bio- physically suitable for coffee cultivation. Arabica coffee is thought to have originated from Ethiopia to Yemen where it spread to the rest of the world. It is the most important species in term of economic production and is responsible for about 60 percent of the world coffee production. It is mainly grown in Africa, Asia, Central and South America. Coffee has been grown in the kingdom for a long time but between 1962-85 there was a steady growth in production and then due to competition from qat *Catha edulis* and also the oil boom, production declined steadily and farms were neglected. There is a renewed interest in coffee production and currently there is an estimated total acreage of 120 ha producing approximately 100 tonnes of green beans. All these coffee is consumed locally under the traditional Arabic coffee. Due to the high demand, the coffee is sold through informal sector and is not easily found in the local markets. There is also an upsurge in the café based coffee consumption driven by the youthful nature of the population. As such the kingdom imports over 90 000 tonnes of coffee every year in form of green beans, ground and instant coffees. Through the Sustainable Rural Agriculture Development programme, the Kingdom targets to increase production in order to reduce the import bill and diversify the rural economy while improving the livelihood of the rural farming communities.

To understand the current status of the sector, challenges/constraints and gaps, and the way forward, it was necessary to undertake a comprehensive sector review. The objective was to review the sector pointing out its strengths, weakness, opportunities and threats. It also reviewed the current systems under which coffee is grown, weather, soils, practices, scale of production, diversity and success of products, technologies used, regulatory framework, institutional aspects, involvement of youth and women, enabling environment and policies. The food systems approach was used and the methodology involved review of available literature, interviews of key informants and field visits.

It has emerged that the sector is faced with a number of challenges ranging from: lack of systematic data that can be used for planning purposes; lack of a policy and regulatory, framework; inadequate institutional and administrative structure; limited research on the crop; inadequate expert knowledge on the crop; absence of extension services due to lack of expert knowledge; limited value addition and emerging socio-economic concerns. To address these challenges calls for development of policy, legal and institutional framework, enhancing the development of innovations and technologies, compiling reliable and accessible socio- economic data and information, capacity building along the value chain and the improvement of the enabling environment (finance, cooperatives, irrigation water, involvement of women and youth, involvement of the private sector, provision of farm inputs, water harvesting, access roads network , rehabilitation of terraces among others.

1.0 INTRODUCTION AND BACKGROUND

1.1 Geographical review of KSA

The Kingdom of Saudi Arabia occupies about 80 percent of the Arabian Peninsula (the world's largest peninsula lying between latitudes 16° and 33° N, and longitudes 34° and 56° E. It has a total area of approximately 215 000 km². It is bordered in the north by Jordan, Iraq and Kuwait, in the east by the Persian Gulf with a coastline of 480 km, in the southeast and south by Qatar, the United Arab Emirates, Oman and Yemen, and in the west by the Red Sea with a coastline of approximately of about 2 000 km. The country can be divided into four main physiographic units mainly:

- Western Mountains, called the Arabian Shield, with the highest peak at 3 133 meters above sea level and crossed by deep valleys;
- Central Hills, which run close to the western mountains and lie in the centre of the country. Their elevation ranges from 900 to 1 800 meters above sea level;
- Desert Regions, which lie to the east of the Central Hills, with elevations ranging from 200 to 900 meters. Sand dunes are commonly found in these deserts;
- Coastal Regions, which include the coastal strip along the Red Sea with a width of 16 to 65 km.

According to SRADP, 2019, the total land area is approximately 200 million hectares, of which 2.4 percent is arable land while the percentage of the total area of rain-fed permanent grassland is about 1.2 percent. The percentage of forest land is 1.4 percent, while the area of semi-desert grasslands amounts to 70 percent, and cities, villages and roads accounts for 2.3 percent (**Figure 1**).

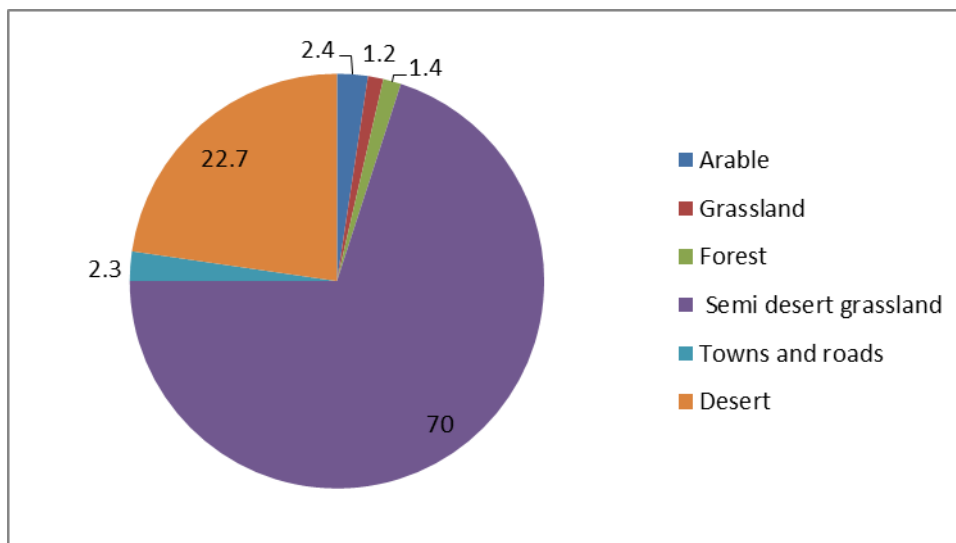


Figure 1: Land use distribution in the Kingdom of Saudi Arabia

Saudi Arabia's geography is dominated by the Arabian Desert, associated semi-desert and shrub land and several mountain ranges and highlands. On the Red Sea coast, there is a narrow coastal plain, known as the Tihamah parallel to which runs an imposing escarpment. The southwest province of Aseer is mountainous, and contains the 3 133 m Mount Al Souda, which is the highest point in the country. The country has a few lakes but no permanent rivers making Saudi Arabia the largest country in the world by area without a permanent river. However, there are many dry river beds or *wadis*. The kingdom is also the home of world's largest contiguous sand desert known as *Rub' al Khali* ("Empty Quarter") in the south-eastern part of the country.

The climate of the Kingdom belongs, in general, to the desert climate characterized by severe drought and low rainfall. The country is mostly arid with hot and dry climate. However, it has distinct climatic regions, South western regions of Najran, Jazan, Aseer and Al Baha which receive 200 to 600 mm annual rainfall. The central and western parts of the country normally receive very scanty rain and experience extreme arid conditions. Long-term average annual precipitation is estimated at about 114 mm/year over the whole country. Because of the dry conditions and relatively cloudless skies, there are great extremes of temperature. Summers are hot with temperatures averaging 45°C but can be sometimes reach over 50°C in July-August. Winters are dry and cool with night temperatures close to freezing. There are cases of frost particularly in the northern parts of the country. Due to the influence of the Red Sea and the Persian Gulf, the western and eastern regions have hot and humid summer months, with maximum temperatures around 45°C, while the winters are mild and warm. Occasionally northward winds produce sand and dust storms that can decrease visibility drastically. In the spring and autumn, the heat is temperate with average temperatures average around 29°C.

The soils of the Kingdom of Saudi Arabia as for all the soils in the Arabian Peninsula, are mostly poorly developed and shallow (De Pauw, 2001). They are formed mostly by physical breakdown of geological materials and subsequent removal, sorting and deposition by wind and rains. In the mountainous region of the south-west there are many alluvial soils deposited during the rainy season. These are usually deep and can sustain a crop through a normal growing period. According to the FAO soil classification (FAO, 1974), the soils in the kingdom fall into five general categories: - lithosols (undifferentiated, very shallow and not suitable for agriculture), arenosols (strongly leached sandy soils, do not retain moisture and unsuitable for agriculture), regosols (calcareous, poorly developed soils, poor physical properties and unsuitable for agriculture), yermosols (very poorly developed soils of the semi desert. Unsuitable for agriculture) and fluvisols (alluvial soils with good fertility and suitable for agriculture).

Due to the scarcity of rainfall and extreme temperatures, a large part of the country is barren and the vegetative cover for crop land, forests and rangeland is confined to specific regions and serves as a precious land resource of flora and fauna. The local plants and grasses have unique characteristics that allow them to adapt to the extreme climatic conditions such as high temperatures in summer and the possibility of completely tree defoliation (High Commission for the Development of AR Riyadh, 2014).

The Kingdom of Saudi Arabia is an extremely water scarce country. Water used in the kingdom comes from ground aquifers, harvested rainwater (run off) and de-salinated water. Of all the extracted groundwater agriculture consumes 87 percent (Napoli *et al.*, 2016). This extraction has continued to deplete the aquifers and the government has put in place measures to reduce extraction by reducing the growing of crops with heavy water demand and substituting them with water productive, high-value-added crops like coffee. Areas that grow coffee have relatively higher rainfall and the harvesting and storage of the runoff maybe be adequate to provide the much needed water for irrigating the coffee trees.

As of 2018, the Saudi population was estimated at 33.4 million people. The Kingdom is thinly populated with a population density of 15 per square km, as compared to the global population density of about 50 per square km. The annual population growth rate is estimated at 2.52 percent. Nearly 82 percent of the population lives in urban areas (SRAD, 2019). Saudi Arabia also has one of the world's youngest populations; 50 percent of its population equivalent to 16.7 million people being less than 25 years old.

Saudi Arabia is divided into 13 administrative regions namely Jawf, Northern Borders, Tabuk, Ha'il, Qasim, Madinah, Makkah, Riyadh, Eastern Province, Baha, Aseer, Najran and Jazan. The regions are further divided into 118 governorates or provinces. This number includes the 13 regional capitals, which have a different status as municipalities. The governorates are further subdivided into sub-governorates.

Most of the land is owned by the government but agricultural land and urban property (*emarah*) can be owned by individuals and a title of ownership is issued. This land can be bought, sold and inherited by individuals. This allows ease of economic development of the land.

1.2 Development priorities of KSA

In 2016, the Kingdom of Saudi Arabia adopted its development plan (Vision 2030), which constitutes an ambitious plan to transform the Saudi economy away from its dependence on oil. The vision is built around three themes, namely a vibrant society, a thriving economy and an ambitious nation. To help achieve the ambitious goals of Vision 2030, several national programmes were developed and launched including the National Transformation Programme (NTP).

The Vision 2030 has five key strategic objectives in the areas of environment, water and agriculture namely reduction of pollution in all its forms; protection of environment from natural hazards; protection and rehabilitation of the natural environment; rural development and food security and sustainable use of water resources. In order to operationalize these strategic objectives, the Ministry of Environment, Water and Agriculture (MoEWA) has formulated 73 strategic initiatives under 18 strategic pillars.

1.3 The Sustainable Rural Agriculture Development Programme

The agricultural sector in KSA is an important pillar of the national economy and a driver for a regionally balanced development. Besides contributing to strengthening food and nutrition security, the agriculture sector plays an important role in expanding and diversifying the economic base, reducing rural poverty, providing employment opportunities and developing and stimulating other sectors. It contributes about 4.2 percent of the non-oil gross domestic product (GDP) and provides about 30 percent of the country food requirements and employs 6.1 percent of the labour force.

According to FAO and MoEWA 2020, the agricultural sector in KSA is dominated by small-scale farmers (producing food crops, fruits, and vegetables), artisanal fishermen, livestock herders and beekeepers. There are estimated 300 000 small agricultural producers in the Kingdom of Saudi Arabia, accounting for 80 percent of the total agricultural holdings (GAS, 2015). The majority of the small producers use traditional farming systems (about 94 percent of the small producers are classified as traditional producers) where the adoption rate of modern agricultural technologies such as improved seeds, modern irrigation systems, fertilizers and pesticides is low and consequently their production and productivity are low.

MoEWA has identified low efficiency in agricultural production and marketing, low efficiency in utilizing the limited agricultural land resources, deterioration of the vegetative cover, high prevalence of plant pests and animal diseases, over-exploitation of marine resources and poor fishing practices, low efficiency in water utilization for agricultural purposes and dependency on scarce and non-renewable water sources, as the main challenges facing the agricultural sector. The agriculture sector also suffers from unsustainable use and poor management of natural resources. Degradation of the land resources, heavy pressure on ecosystems and plant genetic resources are impediments for sustainability of natural resources. Further the inadequate partnership and coordination among sector organizations and agencies and limited sharing of information, knowledge and experiences among sector stakeholders are compounding the adversity faced by the sector and its dependent population.

According to the 2015 agricultural census (GAS,2015), there are 300 000 small agricultural producers in the Kingdom of Saudi Arabia, accounting for 80 percent of the total agricultural holdings. The majority of the small producers use traditional farming systems (about 94 percent of the small producers are classified as traditional producers) where the adoption rate of modern agricultural technologies such as improved seeds, modern irrigation systems, fertilizers and pesticides is low and consequently their production and productivity are low. The sector also suffers lacks for serious private sector investment (small and medium) especially with respect to fisheries and aquaculture. As a result, regions that have relatively high percentage of people living in rural areas, who usually depend on agriculture for their livelihood, are characterized by some underdevelopment indicators such as relatively high unemployment rate, high outmigration rate, high percentage of expenditure on food and low contribution to the non-oil gross domestic product.

The Food and Agriculture Organization (FAO) is providing technical and advisory assistance to the Saudi Ministry of Environment, Water and Agriculture (MoEWA) in the implementation of its initiatives within the context of the National Transformation Program (NTP) 2020. Currently under the Kingdom's Vision 2030 and the National Transformation Programme, the government has re focused on agriculture with a view to diversifying the economy and also improving food security. One of the strategic objectives (SO) of the Vision 2030 is food security and hence the re-focusing on agriculture by the government. The government has put a lot of emphasis on agriculture primarily for food security and also on income diversification. The current Sustainable Rural Agricultural Development Program (SRADP) 2019-2025 is financed to the tune of USD 93 million. The coffee development program is within the "Sustainable Rural Agriculture Development Programme" project component 1, "Development of coffee Arabica production, processing and marketing".

It is under the mandate of this technical cooperation between FAO and MoEWA that this comprehensive assessment of the coffee sector in KSA is undertaken. The objective is to understand the current status of the sector, identify the potential development of the sector, map out the stakeholders, analyse the challenges/constraints and remedial strategies and outline the pathway that will allow the sector fulfil its role towards Vision 2030.

2.0 APPROACH AND METHODOLOGY

2.1 Rationale

The current approach to the development of the agricultural sector is to focus on both internal and external environments which greatly influence the activities, outputs and outcomes. Thus, the coffee sector must not only conform to the national aspirations but also be in tandem with evolving policies while taking advantage of current and emerging opportunities in the national, regional and international arena.

2.2 Objective

The objective is to review the coffee industry in the Kingdom of Saudi Arabia (KSA), highlighting its strengths, weakness, opportunities and threats. It will also review the current systems under which coffee is grow, production and processing practices, marketing, diversity, success of products, regulatory framework, institutional aspects, involvement of youth and women, policy and institutional arrangements, innovation and technology development, input requirements, and support services, roles of public and private sector and contribution of non-farm incomes. The outcome of these consultations, engagements and surveys will provide the information that will enable the coffee sector to contribute toward the targets and aspirations of Vision 2030.

2.3 Scope

The comprehensive analysis covers the agricultural and the non-farm economic activities, infrastructure, rural capital (natural and man-made), private sector participation (including agro processing, trading in input and output markets). The review thus focuses on growth policies, institutions, production mechanisms, non-farm income generation, and increasing efficiency and sustainability of the agricultural production.

2.4 Approach

The agricultural sector is an important driver for rural development but is in itself insufficient to drive the economy and improve the livelihoods of the rural communities. The contribution of the non-farm activities and the interactions therein are equally important. An assessment of the sector helps to understand the interactions between the different enterprises, social dimensions and the environment aspects in a holistic manner.

The farming communities in the coffee growing areas of Saudi Arabia are characterized by having very small land plots, harsh environment, and limited resources and with little growth potential. The farm produce is mainly for subsistence purposes with little for sale. The selling of any surpluses is made more difficult by limited links to organised markets, and limited access to, or complete lack of, any processing, storing, handling, packing or distribution facilities (FAO, 2012). Although coffee is grown for cash, its marketability is hampered by poor road network due to the mountainous terrain of where it is grown. Farming under these conditions is also threatened by increasing prices of inputs and vagaries of climate change. A general assessment of the target sector is therefore crucial for the development of proper strategies and policies (FAO,

2012). Different approaches have been used in the recent past to undertake the sector assessments as highlighted here below: -

The Value Chain Approach: They include the Value Chain (VC) development approach, which analyses the way value is created (or lost) and captured not only by producers, traders, workers, but also by governments and consumers. The approach nonetheless focuses on one particular commodity and therefore tends to overlook the interdependencies of different value chains.

The approach a linear relationship from the farmer to the consumer. The other key players like the input suppliers, service providers, and water suppliers among others are not captured in the value chain approach. At the same time the coffee farmers also grow other crops for food and cash and keep livestock, fisheries and/or forestry activities. The nutritional status of consumers depends on diets made up of multiple commodities (FAO, 2018). The value chain approach is often on the economic and financial aspects, with social and environmental impacts being considered only peripherally if at all (FAO, 2014). For coffee there are broad interactions which include the biophysical resources needs, coffee production in a neighbouring country and other countries exporting coffee to KSA, the resource-use demands of the coffee processors and traders, and consumer behaviour and preferences. The value chain approach that it is more or less a linear approach is not then able to analyse all these interactions.

The Sustainable Food Value Chain Approach (SFVCA): The value chain approach has been improved to a Sustainable Food Value Chain approach (SFVC). SFVC is defined “as the full range of farms and firms and their successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular food products that are sold to final consumers and disposed of after use, in a manner that is profitable throughout, has broad-based benefits for society and does not permanently deplete natural resources” (FAO, 2014). The approach addresses both the value chain actors who have direct ownership of the product and various service providers who provide the required services necessary for the implementation of the value chain activities. It attempts to look at all the possible interactions in the enterprise as it aims at broad-based job creation, income growth and wealth creation. The coffee sector in KSA is a dynamic and complex system with a multiplicity of expectations. The farmers may be growing coffee just to preserve the tradition and thus the economic returns may not be crucial, while others may be aiming for commercial production but for both domestic and export market. Coffee farmers grow their coffee with the threat of cheap coffee from neighbouring countries and the choice of whether to grow coffee or other more lucrative crops. These complexes need to be identified and brought out and the SFVCA is also limited to do this.

The Market Systems Approach: The market systems approach addresses one chain at a time but also tends to be constrained to one market and as such is subject to a similar narrow perspective challenge as the value chain approach (FAO, 2018). Products and by products from one commodity may also end in different market chains but still be interrelated. In KSA, the coffee farmers after drying the cherries, sell them to processors in the local shopping centres. The processors hull the coffee and separate the beans from the husks. The traders are then interested in either the beans or the husks. The coffee beans are mostly sold in network markets with limited amounts sold in the urban coffee markets. The market approach may then not be able to assess the industry as it only focuses on the marketing side.

The Food Systems Approach (FSA): In order to address shortcomings of the aforesmentioned approaches the Wageningen University and Research, developed the Food System Approach. The Food Systems Approach describes the different elements in the food system and the relationships between them (Siemen et al., 2018). It looks on the one hand at all the activities relating to the production, processing, distribution and utilisation of

food, and on the other hand at the outcomes of these activities in terms of food security (including nutrition), socio-economics (income, employment) and the environment (biodiversity, climate).

A sustainable food system approach addresses issues of profitability (economic sustainability); broad-based benefits for society (social sustainability); and impact on the natural environment (environmental sustainability). It is therefore consistent with the United Nations' Sustainable Development Goals (SDGs) (Siemen and Just, 2019). The approach considers the food system in its totality, taking into account all relevant causal variables of a problem and all social, environmental, and economic impacts of the solutions to achieve transformational systemic changes (Siemen and Just, 2019).

Unlike the other approaches which are based maximizing production resources on cause–effect relations, the Food Systems Approach views the behaviour of a system as an interplay of interacting subsystems, in which feedback plays a key role (Siemen et al., 2018). It also highlights policy pathways that do not intervene directly in the value chain itself (Siemen et al., 2018), for example taxes, labour policy, infrastructure, and innovations. It provides insights into opportunities for effective entry points for a longer-term and more comprehensive policy. According to UNEP (2016), use of the FSA helps to produce a number of useful insights. For the coffee industry in KSA application of the FSA in the coffee industry assessment will lead to clear mapping out the available opportunities in the industry, highlighting the important role of the coffee system's socio-economic of the target area, and identification of the non-linear processes that do affect coffee industry.

Siemen and Just (2019) compared several approaches used in system assessments (farming systems approach, sustainable intensification, value chain approach, climate smart agriculture, landscape approaches, circular agriculture and food systems approach) and concluded that the food systems approach is the most comprehensive one in covering the different parts of the food system. The approach has been used effectively in assessing the potato industry in Peru and Morocco, and crop yield gap in Africa (Siemen and Just, 2019). This is therefore the approach that was used in the assessment.

2.5 Methodology

The sector assessment was carried using the Food Systems Approach “from Seed to Sip” and all the economic, social and environmental interactions. Both qualitative and quantitative methodologies were used in the analysis. A literature review on the coffee industry globally and in Saudi Arabia was carried out. This was followed by interviews with key informants from the public and private sector trade both in Riyadh and the coffee growing regions. Field visits were made to Jazan, Aseer and Al Baha and interviews were conducted with coffee farmers and other stakeholders. The discussions were both formal (all sitting down) or while in the coffee farm. Similar interviews were conducted with the regional MoEWA staff, the Jazan Research Centre, Jazan University, coffee processors and traders in the coffee growing governorates and with the IFAD project in Jazan. Visual observations while in-transit, on the farms and at trading centres were made and incorporated in the analysis.

The analysis consisted of a SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats), and stakeholders' analyses. Stakeholders' analysis was also performed to identify all the stakeholders involved or that have an interest in the coffee sector (FAOKSA, 2021). The rationale for stakeholder consultations was to incorporate all views that may have either a positive or negative effect on the coffee sector. In addition, these consultations were expected to create a sense of ownership not only within MoEWA but also among the external stakeholders. The list of the key informants is shown in Annex I.

2.5 Limitations

The coffee sector assessment process was limited by

- a. The outbreak of COVID-19 pandemic in 2020 which adversely affected consultations with some key stakeholders, as the travel ban affected scheduled travels to the coffee growing areas;
- b. Information and data gaps as there is no one-stop-shop with all the data and information on coffee. There is no institutional home for coffee to provide the much needed support;
- c. Coffee farms are far apart and this necessitated driving for long distances which in essence reduced the number of farmers that could be visited and interviewed;
- d. Most farmers do not stay in the farm and hence without prior arrangement, it was not possible to meet the farmers.

3.0 THE COFFEE SECTOR IN KSA

3.1 Eco-climatic requirements for coffee

Coffee belongs to the botanical family Rubiaceae which has over 500 genera and 6 000 species. Only two of these species are responsible for all the world production of coffee namely *Coffea arabica* (Arabica coffee) and *Coffea canephora* (Robusta coffee). Carl Linnaeus, a renowned botanist, who named a large number of plants, believed that the coffee plant came from Yemen hence the name ‘Arabica’ (Davies et al, 2018). The word "coffee" also comes from the ancient Arabic word for coffee "*qahwah*". It was not until the mid- to late nineteenth that it became clear that this was actually a plant from Africa. (Clifford and Wilson, 1985). *Coffea arabica* originated in the wild upland forests of Ethiopia then moved to Yemen (historically the word Yemen is derived from *yamin* in Arabic and refers to all that region to the right of Kaaba in Mecca. It may not necessarily mean the country currently known as Yemen in the fourteenth century, where it was first used for cultivation in full-sun growing systems. From Yemen, two main groups of coffee, the Bourbon and Typica lineages, moved to the rest of the world, where they continue to dominate production (WCR, 2020). All the Arabica coffee grown in the world can be traced to the Yemen germplasm. Most of the coffees from the Ethiopian forests have never been used in coffee breeding programs outside Ethiopia. Yemen is therefore the domestication origin of Arabica coffee. Arabica coffee is the most important species in term of economic production since it is responsible for about 60 percent of the world coffee production (Vossen *et al.*, 2015).

Arabica coffee is a small evergreen tree (not a shrub), capable of reaching 7m in height, with a 3 m spread. Coffee thrives best at altitudes of 1 200-2 100 m above sea level. The optimal temperature range is 15-19°C and day temperatures should not exceed 30°C while night temperatures should not fall below 15°C. Above 25°C photosynthesis is reduced and above 30°C coffee leaves are damaged leading to drying of the tree together with any berries. However, coffee has been found growing and producing at areas with either higher or lower temperatures than this mainly at the “higher latitudes” within the tropics.

Coffee requires loamy soils well supplied with adequate nutrients and a pH range of 4.4-4.5. The soil pH dictates nutrient availability from the soil and therefore is crucial in determining the type and amount of fertilizer (organic and chemical) to be applied to the soil. It is therefore recommended to carry out soil analysis every two years to establish the soil nutrient status and assist in developing soil fertility recommendations.

The flowering, fruiting and growing cycle of Arabica coffee, is controlled by climate which is closely linked to location, and the inherent physiological characteristics of the plant itself (Davis *et al.*, 2018). Rainfall following a period of moisture stress stimulates flowering in coffee (Clifford and Wilson, 1985). In KSA, coffee trees have been observed to flower two or three times a year because of the irregular irrigation regimes and erratic rain showers. The cherry undergoes a growth and maturation period which lasts approximately 36 weeks depending on the weather conditions. On ripening the cherries turn from green to deep red . Some coffee cultivars like *Catuai* have the cherries turning yellow on ripening but this has no effect on cup quality.

3.2 Production trends

The actual origin of coffee in the Kingdom maybe debatable but the ancient tribes of the Khawlan located between Jazan and Yemen, in reference to their great ancestor Khawlan bin Amir, have practised the skills and

techniques of cultivating Khawlan coffee beans for over 300 years (Proctor and Kinani, 2020). The farmers developed the own unique farming systems that was cognice to the environment and farmer needs (the information was gathered after discussing with many key informants and counterchecking the information (Textbox 1). There may exist local differences that may not have been captured).

Textbox 1: Traditional cultural practices for Khawlan coffee

It was mandatory to plant coffee in association with bananas (*Musa* species and papaya (*Carica papaya*) to provide shade to the young coffee seedlings. The spacing was measured as the distance from the shoulder blade of one hand to the tip finger of the other hand of the farmer approximately 1.0m. The hole was dug to a depth of at least 2ft (60cm). Seedlings were collected from the existing coffee farm. After planting a basin was dug around the seedling but the seedling supported with a mound of soil to prevent lodging. Coffee was not supposed to be planted on slopes exposed to either the morning or setting sun locally referred to as “lahg”. The coffee was planted almost at the base of the slope or in the flat areas between two slopes. If at all the coffee had to be planted on a slope, it must be on the one facing west. Deep clay soils were preferred to the rocky and sandy soil. Only cattle manure was to be applied to coffee plants.

Pruning of the coffee trees was prohibited as the bushy nature of the unpruned trees was believed to provide mutual shading and preserve moisture. As such lichens would be found growing on the ground indicating availability of moisture. Consequently, no supplementary irrigation was needed for coffee as the mutual shading by the unpruned trees preserved adequate water for the coffee tree growth and production. Coffee was grown as a purely rainfed crop.

In as much as only the red ripe cherries were to be picked, farmers also harvested the mature but unripe cherries locally known as “shahba”. These were known to impart a special preferred flavour to the coffee.

The harvested coffee cherries were dried on the roof tops without any turning or covering. This allowed rewetting creating a suitable environment for fungal growth. According to the farmers, the fungus infused a special desired flavour to the coffee.

The drying stage was determined by biting the cherry. If it was soft and easily bitten, the coffee needed more drying; if it was brittle and broke with a cracking sound, the drying was complete and dry cherry referred to as “ojoum” were stored in sacks. Coffee was basically for domestic consumption and the farmer would hull only the required amount daily use of approximately 3-4 cups. Occasionally they would sell some coffee for cash, using day to day containers for measuring the quantities, like *sah* (approximately 10-11kg) or *mod* (3-4 kg).

The dry cherry was hulled by pounding using a stone mortar and pestle. The beans were then roasted on a pan to a light brown or brown colour. The roasted beans were ground to a coarse grade using the same mortar and pestle. Coffee “qakwa” brewing was done using a traditional long sprout kettle “dalla” and served in small handles cups. Sharing of coffee is a traditional show of hospitality similar to the kola nut of West Africa or tea “chai” in India. The traditional Arabic coffee was the only preferable preparation method which required a light roasting then adding flavours such as cardamom, saffron, clove and ginger. Coffee husks after some light roasting are boiled in water to make a beverage known as “qishr”. Drinking “qishr” by women helped them to tone their muscles after child birth.

Coffee production reached its highest peak of 386 tonnes in 1982 as shown in Figure 2 (FAO, 2015). Production then started declining and this is attributed to the introduction and growing of qat *Catha edulis*. Farmers are thought to have abandoned coffee growing for qat which had quicker returns and a shorter value chain than coffee. The increasing oil boom could also have contributed to the abandonment of the coffee farms. According to MoEWA, KSA is currently producing about 800 tonnes but as the production and marketing are not well organized, the figures are only rough estimates. The coffee farming is characterized by old trees, low rainfall, lack of technical knowledge, no institutional financing, and no organized farmer groups or cooperatives is challenge. This in addition to the rocky terrain where coffee is grown makes coffee farming very difficult and calls for very innovative approaches. At present, there are about 1 000 coffee farmers in KSA with more than 300 000 coffee trees that produce about 800 tonnes per year (Table 1).

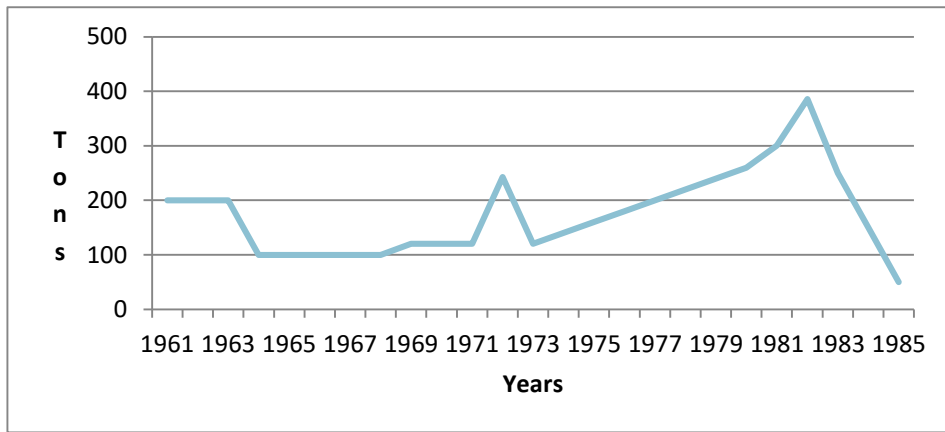


Figure 2: Coffee production in the Kingdom of Saudi Arabia 1961-85

3.3 The coffee growing areas

The south-western region of Saudi Arabia comprising Jazan, Aseer and Al-Baha regions is the home for Arabica coffee production (Figure 3). The South western region is mountainous with steep slopes, receives 200 to 600 mm annual rainfall and has mild temperatures in both summer and winter.

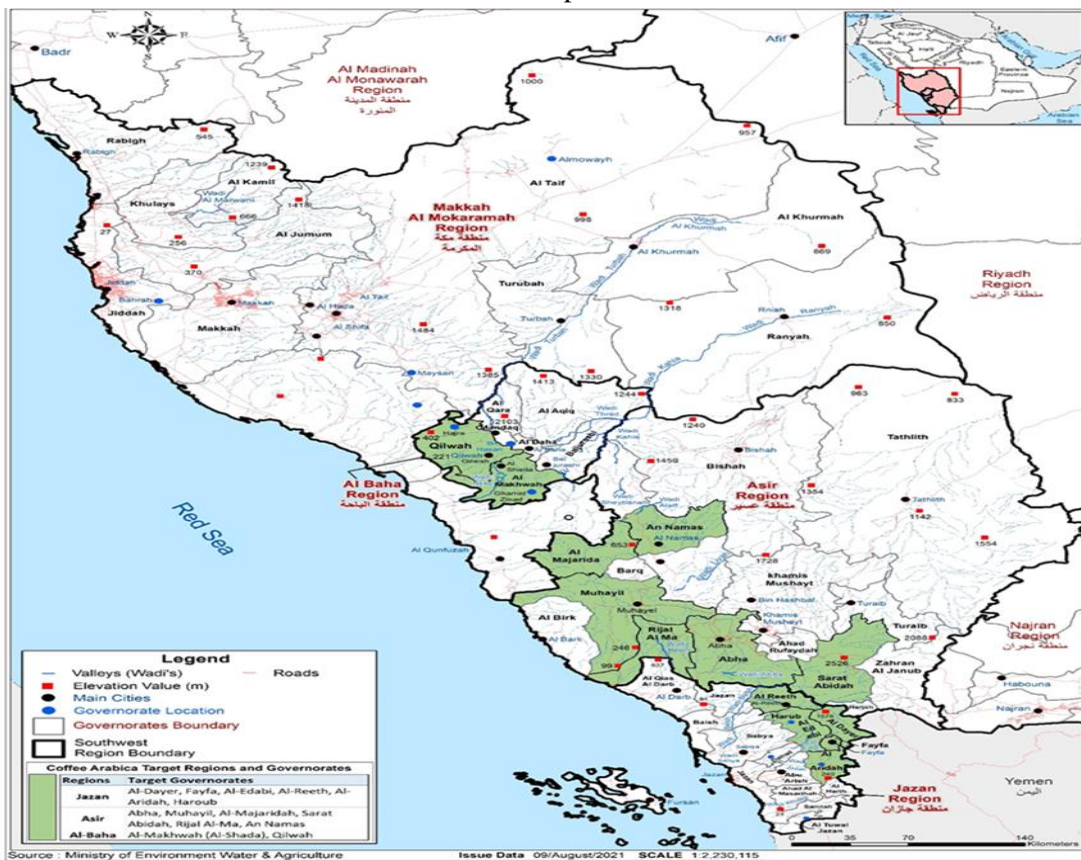


Figure 3: The coffee growing regions and governorates in KSA

The soils consist of lithosols and arenosols in the high elevation and fluvisols in the valleys. The lithosols though shallow and not well developed but with adequate agronomic management adding compost and terracing coffee can thrive. These agro-ecological and climatic conditions in area make it suitable for coffee cultivation and coffee has been grown in this area since 1450. Coffee is thus planted from Assarawat Mountains in Jazan province in the south to Al-Shada mountain- in Al-Baha province in the north, lying between 17 -20°N The estimated number of coffee trees in the various coffee governorates are shown in Table 1.

Table 1: Estimated number of coffee farmers and coffee trees per governorate in 2021

Region	Coffee growing Governorate	No. of farmers	No coffee trees	Total annual production-kg cherry
Jazan	Al –Dayer	919	171 926	489 820
	Faifa	324	51 955	92 872
	El Edabi	132	17 447	14 468
	Al Reith	104	9 993	36 672
	Al Aridhah	79	11 982	31 636
	Harub	32	5 707	20 068
Sub total		1 590	269 010	685 536
Aseer	Abha	Not available	9 361	Not available
	Mahail	Not available	4 061	Not available
	Al Majaridah	Not available	3 121	Not available
	Sarat Abedon	Not available	2 705	Not available
	Rejal Almaia	Not available	1 575	Not available
Sub total			20 823	
Al Baha	Al Makhwah	98	21 000	Not available
Total			310 833	

According to the General Authority of Statistics (GAS, 2015) the Jazan region has about 75 066 ha of arable land and a farm size of 2.70 ha per holding mainly used for crops and livestock farming. The farmers in this region have adopted modern methods of agriculture with about 66 percent of the holdings using fertilizers, 19 percent using pesticides, 14 percent using improved seed and employing 2.3 workers per holding to assist in the farming activities (GAS, 2015).

The maximum temperature ranges between 37.9°C and 19.7°C while the minimum temperatures range between 21.6°C and 29.6°C with a diurnal range of 8.8°C (Figure 4). The rainy period from March to May and a second peak in August. June is the driest month (<1.0mm) (Figure 5). The climate is highly moderated by

proximity to the Red sea and the mountainous range, thus, the weather is more sub-tropical than desert. The maximum temperatures may sometimes go beyond tolerable levels for coffee and signs of sun scorching are observed. More critical monitoring will be undertaken to assess the impact of global warming on coffee production.

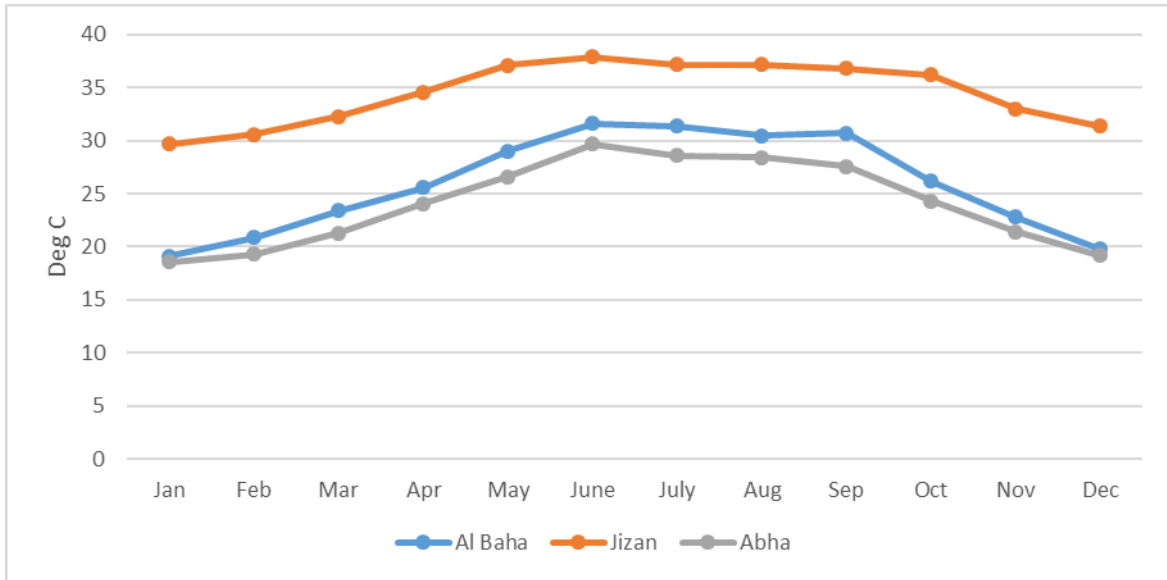


Figure 4: Monthly average maximum air temperatures in the coffee growing regions

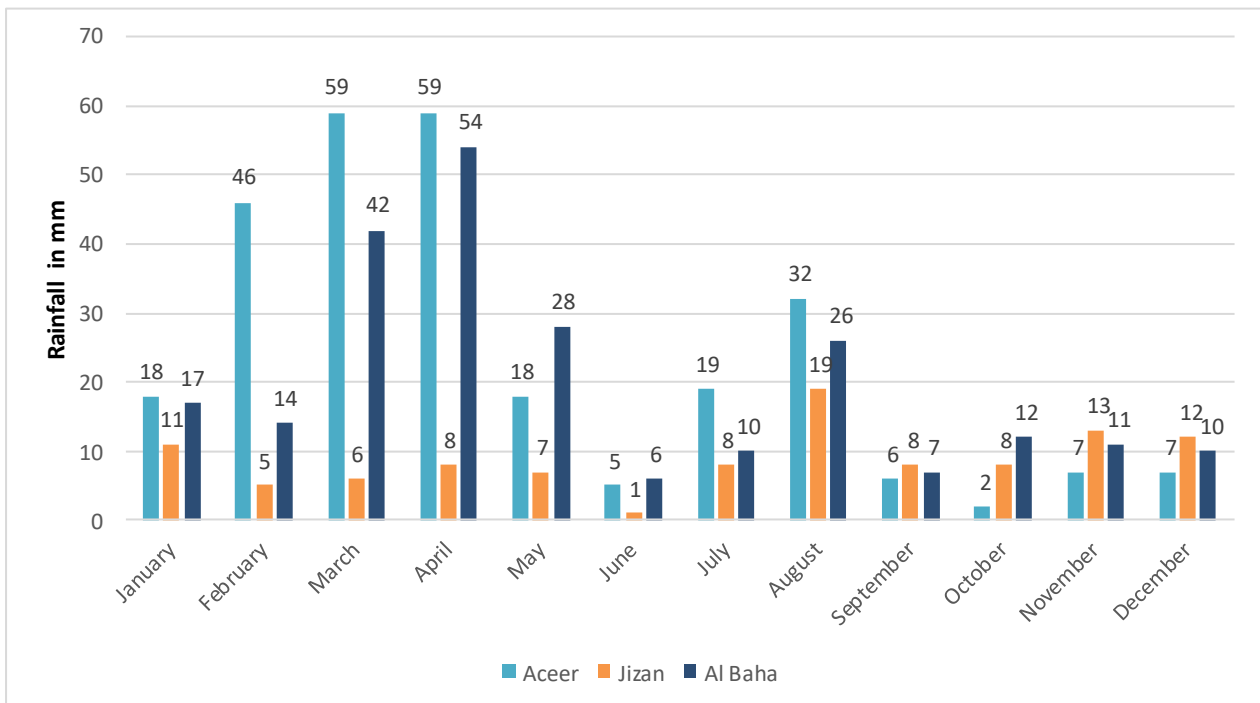


Figure 5: Monthly rainfall (mm) distribution in the coffee growing areas

The soils are sandy-textured soils with low clay content, partially formed surface horizon (uppermost layer) that is low in humus. They are shallow, have excessive permeability (low water holding capacity), low nutrient content, unattractive for rain fed agriculture and requires application of well composted manure to improve the structure and water holding capacity.

Coffee in Jazan is grown in six governorates which have the right conditions for coffee growth namely Al – Dayer, Faifa, El Edabi, Al Reith, Al Aridhah and Harub. The six governorates have approximately 1 600 coffee farmers producing about 70 tonnes of coffee beans per year. The government of Jazan holds an annual coffee festival attracting both local and international coffee stakeholders. The Jazan Mountains Development Authority in the Faifa Mountains has established coffee nurseries with a capacity of producing over 200 000 seedlings per year. The nursery buys fresh coffee cherries from the farmers (SAR 50/ kg) and produces the seedlings. The seedlings are given free to farmers within the Jazan region (through the MoEWA) and are sold at SAR 15/seedling to all other farmers. Farmers as far as Al Baha and Aseer travel to Jazan to collect coffee seedlings indicating the relative importance farmers attach to coffee farming. However, they are unable to get the number of seedlings they request because of low supplies and high demand.

According to the Agriculture Census of 2015 (GAS,2015), the Aseer region has over 50 000 ha of arable land and an average farm size of 0.71 ha. Farmers practise mixed farming, poultry keeping, bee keeping, livestock and crop production. About 70 percent of the famers use fertilizers both organic and inorganic, 16 percent use pesticides and 12 percent use improved seed. Most of the farming activities are carried out by the family labour employing only 0.6 workers per holding on an as-needed basis.

Coffee is grown in the mountainous region (Figure 6) at between 1 000-1 900 m above sea level in the governorates of Abha, Mahail, Maiaridu, Sarat Abedon, and Rejal Almaia



Figure 6: Coffee in terraces Jabal Hada, Aseer

In the mornings the mountains are covered with fog which provides some moisture to the coffee plants, thus reducing moisture stress. The highest point in the country Mount Sawda 3 133 m above sea level is located in

this area. The weather pattern in Aseer is shown in Figure 4 and Figure 5. The maximum day temperatures range between 29.7⁰ C in June and 18.6⁰ C in January (Figure 4). The diurnal range (difference between daily maximum and minimum temperatures) averages 13.2⁰ C. Aseer has a long rainy period of January to May with a rainfall peak in March with 53.3 mm. October is the driest month receiving 2 mm but the rainfall is well distributed throughout the year (Figure 5). It receives on average an annual rainfall total of 278mm.

The soils are very shallow over hard rock and less than 10cm deep (Figure 7). They have poor water holding capacity, extensive water drainage that can cause water stress even during the rainy period, unattractive for rain fed agriculture and requires application of well composted manure to improve the structure and improve water holding capacity.



Figure 7: Soil profile showing the rocky nature of the soils, Aseer

Note

The “A” horizon is the top layer of the mineral soil horizons, often referred to as 'topsoil'. This layer contains dark decomposed organic matter, a source of nutrients for the plant. All the coffee plant feeder roots are found on this horizon.

The “B” horizon is the subsurface soil layer that is immediately beneath the A horizon from which it obtains organic matter chiefly by illuviation and is usually distinguished by less weathering. It is also referred to as the subsoil. Most of the coffee plant anchor roots are in this horizon.

The Agriculture Census, 2015, estimated that there is estimated available arable land of 7 394 ha with an average holding size of 0.61ha. Farmers are involved in livestock (sheep, poultry, bees) keeping and crop production. A higher percentage of holdings have livestock as compared to the other regions and this is attributed to beekeeping. In this region 62 percent of the farmers use fertilizers, 27 percent use pesticides and 11 percent use improved seed. Farmers engage casual labour when needed and on average 1.4 workers per holding. The labour is mainly sourced from foreigners and this poses the problem of capacity building as the labour turnover is very high.

In Al Baha maximum temperatures vary between 31. 6°C and 19.1°C (Figure 4) and a diurnal range of 12°C. The region receives on average total of 155.3 mm distributed throughout the year (Figure 5). The rainfall season is March to May with a peak of 54 mm in April. The soils are very shallow less than 10cm deep, overlain with hard rock, have poor water holding capacity and extensive water drainage that can cause water stress even during the rainy period, are unattractive for rain-fed agriculture and requires application of well composted manure to improve the structure and water holding capacity

The farmers in the three areas are basically in crop (food and cash) production and livestock farming is limited mainly sheep and goat rearing for domestic consumption. Coffee is grown on spaces between rocks (Figure 8) or on man-made terraces. An average farmer has between 20 and 100 coffee trees. For the farmers that keep goats and sheep, coffee benefits from the available manure. A modelling methodology used by Ahmed *et al.*, 2017, indicated the economic viability of producing coffee within the Kingdom, with Jazan as the most viable region. The initial capital involving mainly inputs, water and maintenance of the terraces cost was highest at Al Baha lowest in Jazan.



Figure 8 : Coffee farm Al Shada mountains, Al Baha

3.4 Farming systems in the three coffee growing regions

This being a major agricultural region, farmers do use the available modern technologies for their farming activities. On average in the three regions 38 percent of the farmers use organic fertilizers, 27.6 percent apply inorganic fertilizers, 20.7 percent use pesticides and 12.6 percent use improved seed (Figure 9). A paltry 1.1 percent reported have their soils analysed (GAS, 2015).

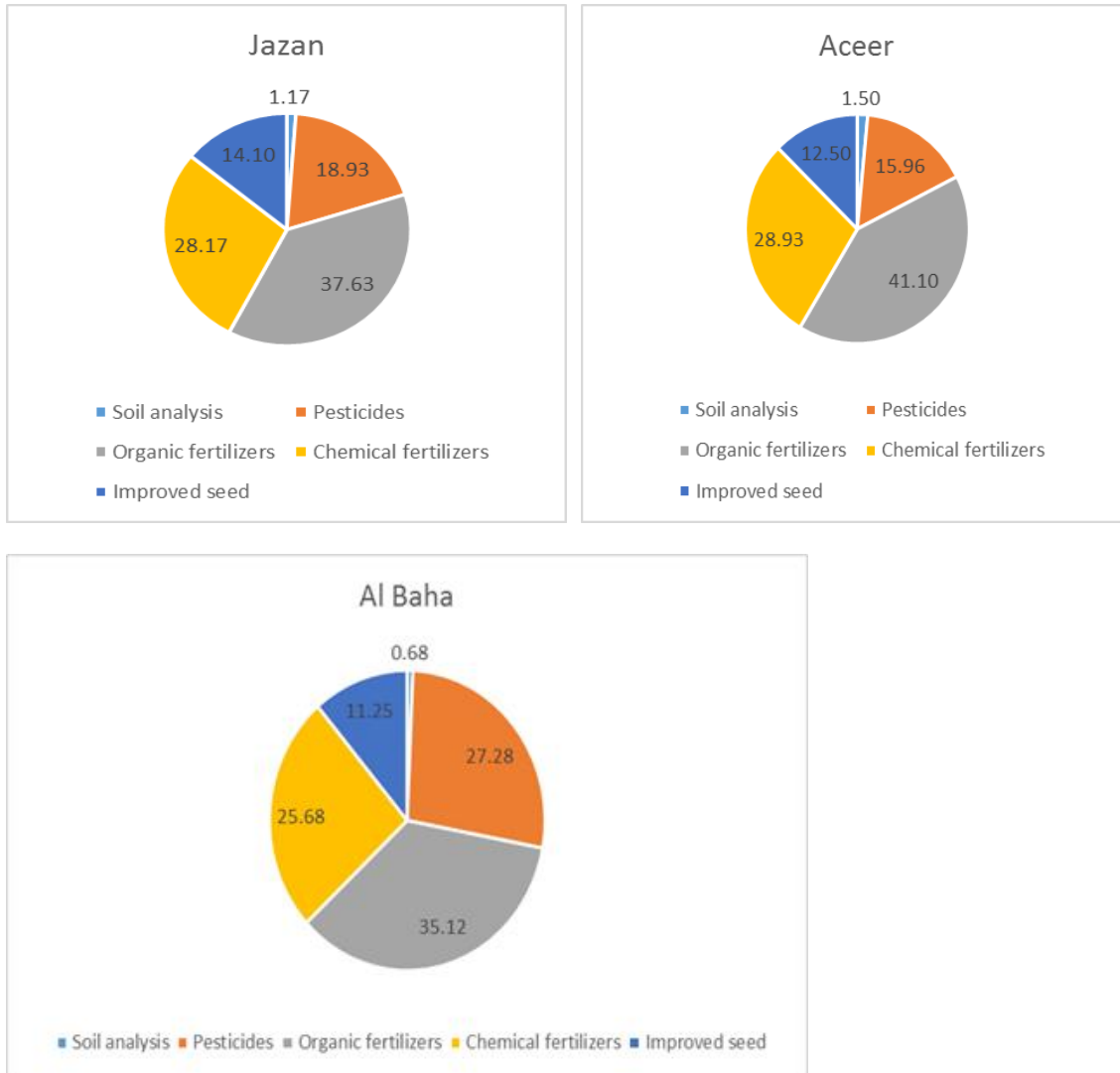


Figure 9: Farm input usage

As mentioned the total annual rainfall is not enough to support coffee production and hence supplementary irrigation is required. More than 40 percent of the farmers depend on rainfall for their farming activities. Those farmers that do irrigate the coffee source the supplementary water from manual and artesian wells (GAS, 2015). Artesian wells are drilled and provide a more sustainable water supply. However, they require a higher initial capital outlay and also deplete the underground water. The manual wells are shallow and tap water from the aquifer just below the sand layer. The wells can also be used to store harvested rainwater. Jazan has the highest number of artesian wells (Figure 10). The government under the NTP 2020 has started to construct concrete water tanks to harvest and store rainwater to be used for irrigating coffee and other crops that the farmer may be growing.

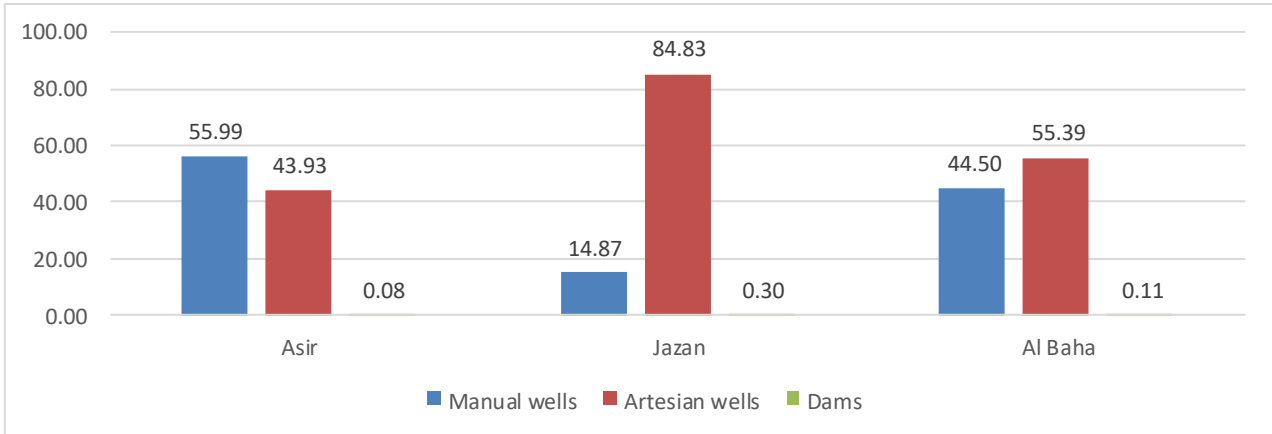


Figure 10: Sources of water used for irrigating coffee

3.5 Agricultural extension services

Agricultural extension describes the services that provide rural people with the access to knowledge and information they need to increase their productivity and improve their quality of life. It includes, but is not limited to, the transfer of knowledge generated by agricultural research using communication channels (NRI, 2014). In the Kingdom of Saudi Arabia (KSA) extension services are provided to growers by the MoEWA through general agricultural administrations, directorates, regional branches.

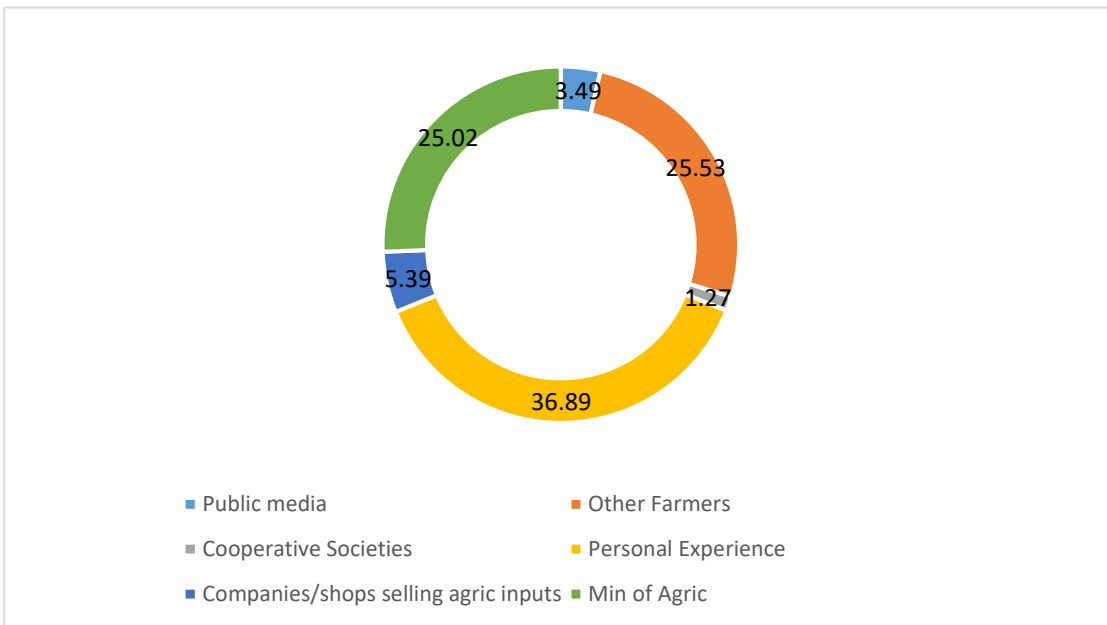


Figure 11: Main sources of information on coffee production and processing (GAS,2015)

According to the agriculture census of 2015, the services from the ministry are not adequate and farmers depend more on their personal experience (36.89 percent), 25 percent on other farmers. Companies and shops

selling agricultural inputs also do provide extension information to the farmers relating to their specific products (Figure 11).

The fact that the literacy levels among the farmers are low (>40 percent illiteracy level) and that the day-to-day operations in the farms are usually carried out by workers do affect the delivery of extension services (Al-Shayaa *et.al.* 2012).

More than 40 percent of the farmers in these coffee growing areas are either illiterate or can only do basic reading and writing (Figure 12). This will have an influence in what form the farmer training and capacity building takes. It also affects how the farmers access and utilize the extension materials and information already available.

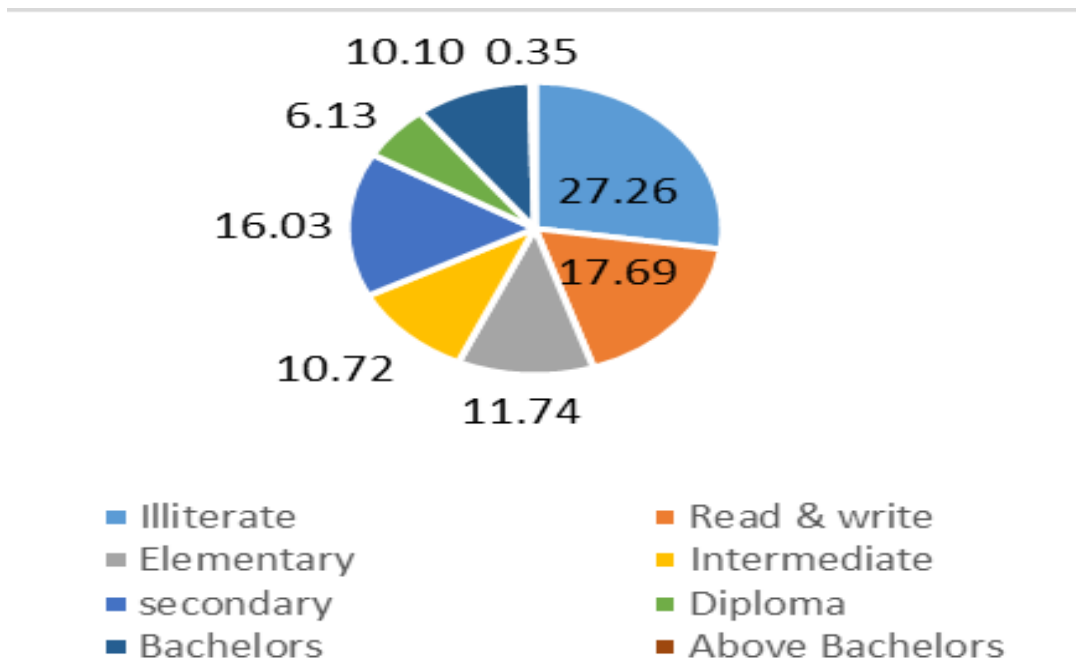


Figure 12: Literacy level of farmers in the coffee growing regions (GAS, 2015)

3.6 Comparative analysis of the coffee growing areas

The physical characteristics and economic environment under which coffee is grown in the region are summarized in Table 2. The analysis of the matrix indicates that growing of coffee is economically viable. For maximizing its production, areas that require improvement or intervention are identified in the SWOT and PESTEIL analysis in subsequent sections of this report.

Table 2: Comparative analysis for suitability for growing coffee

	Jazan	Aseer	Al Baha	Remarks
Total arable land (ha)^a	75,066	53,920	7,394	Adequate land available
Farm size (ha)^a	2.70	0.71	0.61	Allows for small scale farming
Annual total rainfall (mm)^b	106	278	257	Not enough and requires to be supplemented with irrigation
Maximum temperature range °C^b	19.7-37.9	18.6- 29.7	15.1- 31.6	Within range for optimal coffee growing
Diurnal temperature range °C^b	8.8	13.2	12	Within range
Area under coffee (ha)^c	63		1.26	Need to ascertained through a baseline study
Current Productivity/ cherry/ha kg^d	27,980	21,000	25,000	Need to be ascertained
Green coffee yield /ha^c	3,997	3,000	3,571	Need to be ascertained
Productivity kg cherry/tree^d	25.18	18.9	22.05	Need to be ascertained
Number of coffee trees^c	70,000		1,400	Need to be ascertained
Potential land^d	6,884.7	4,589.9	674.1	There is potential to increase this after more terraces rehabilitated
Potential green coffee production tons^c	27,518	13,770	2,407	Can be attained
Capital cost/ ha (‘000\$)^d	180.19	243.6	307.02	Within range
Operational Cost /ha (‘000\$)^d	88.08	84.5	80.98	Within accepted range
Gross Revenue/ha (‘000\$)^d	239.03	202.03	211.16	Indicates coffee farming is profitable
Net Revenue/ha (‘000\$)^d	150.96	117.5	130.8	Indicates coffee farming is profitable
Rate of return on investment %^d	83.78	48.24	42.4	Indicates coffee farming is profitable
Payback period (years)^d	1.2	2.1	2.4	Within acceptable limits

Source: ^a Agriculture census 2015; ^b Climate data, 2020; ^c Key informants; ^d Ahmed *et al.*, 2018

4.0 ASSESSMENT OF THE COFFEE SECTOR IN KSA

As already stated the coffee sector in KSA is very dynamic and complex. Like all complex and dynamic systems, the processes and components within the systems are highly interconnected (Ericksen *et al.*, 2010). Key to systems or complexity analysis is an emphasis on dynamics, interactions and feedbacks, many of which occur at multiple levels among activities, outcomes and drivers, as shown in Figures 13 and 14.

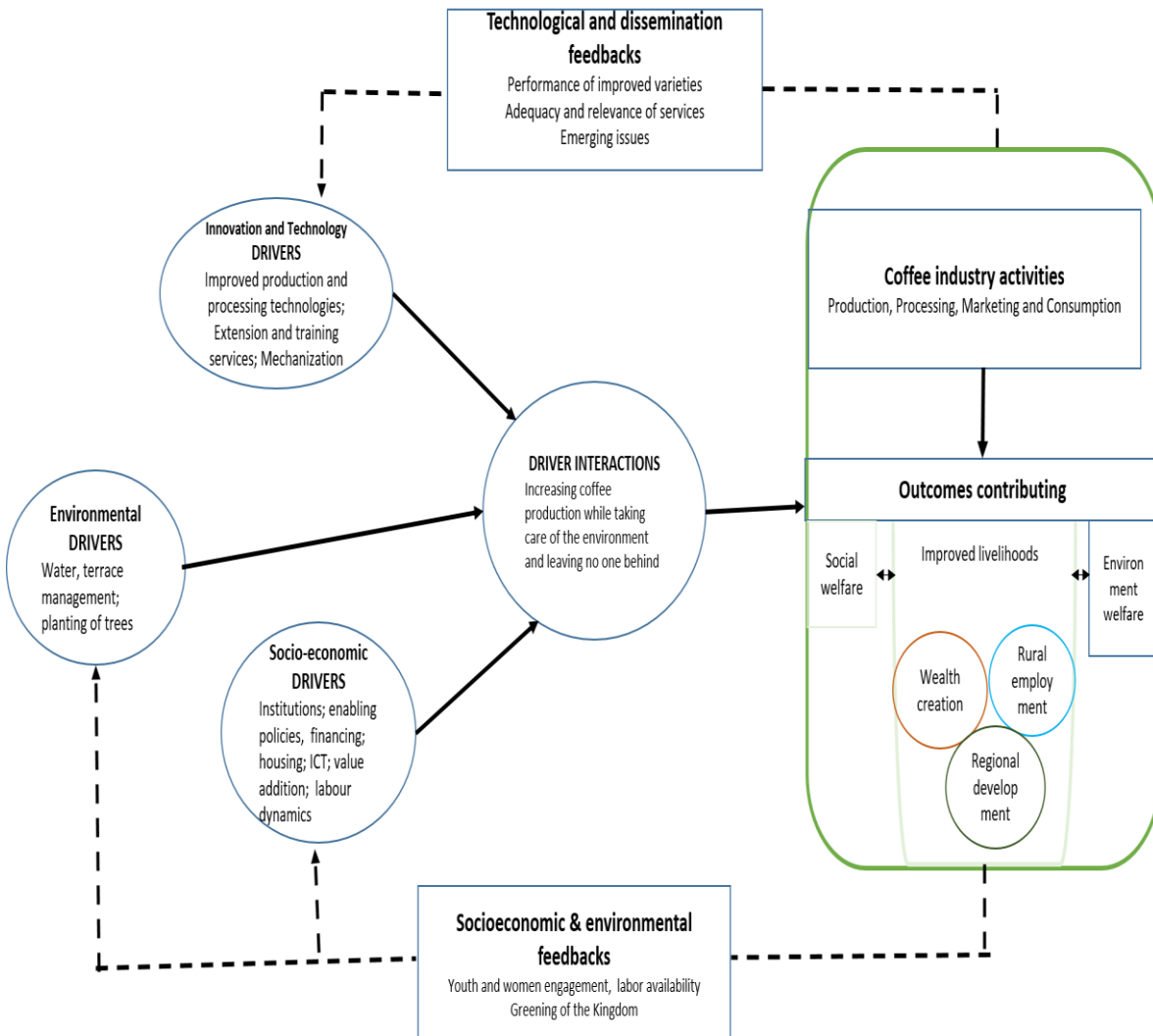


Figure 13: Drivers and feedback mechanisms for the coffee industry in Saudi Arabia

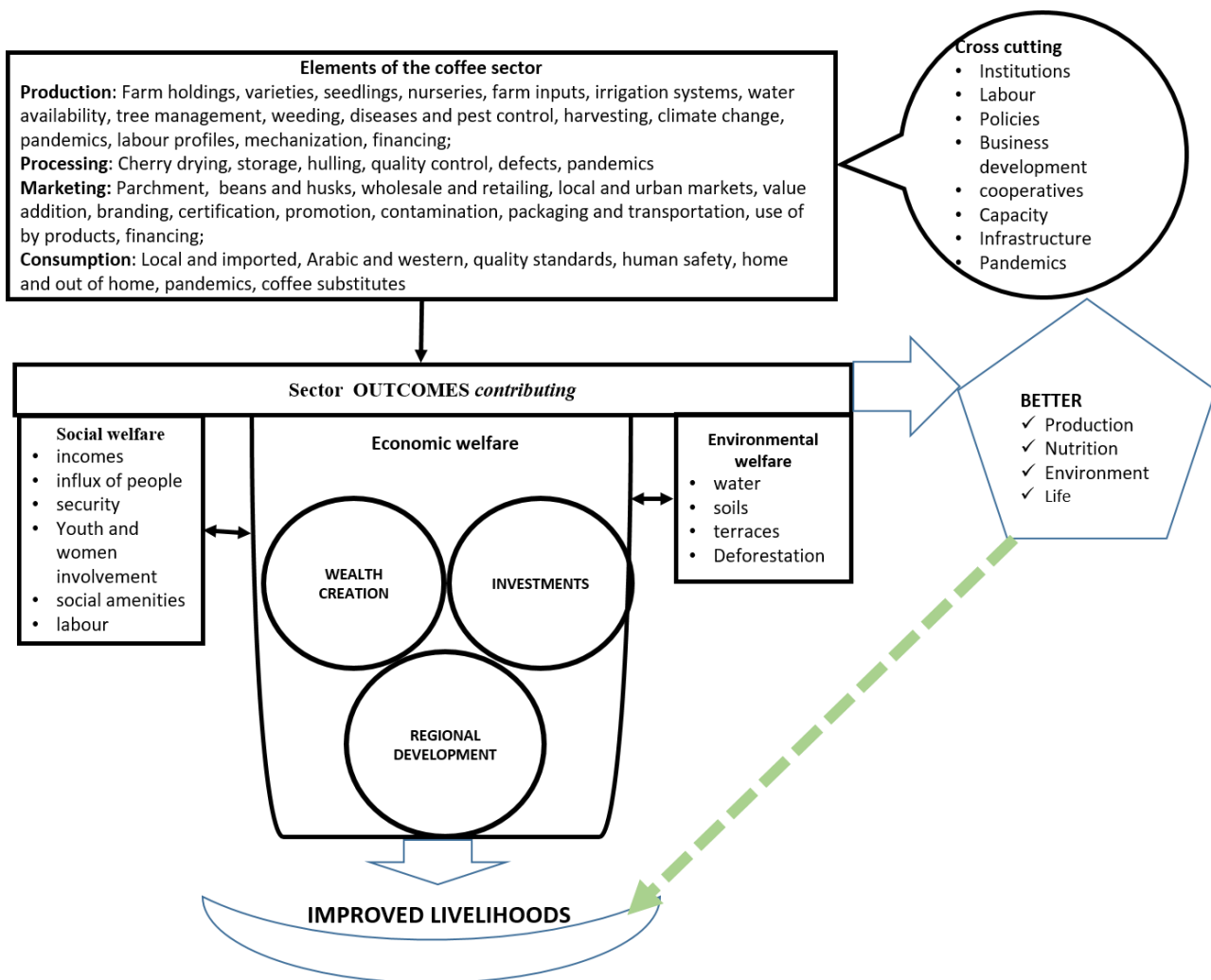


Figure 14: Elements of the coffee systems in Saudi Arabia

These complexities are further confounded by the fact that coffee has been grown by the farmers for long time and over the years many developments, interactions and relationships have taken place like competition with other more lucrative crops (qat *Catha edulis*), influx of coffee from neighbouring country and insecurity.

Textbox 2: Qat cultivation in KSA

Qat (*Catha edulis*) is a flowering evergreen tree that is traditional grown in Ethiopia, Yemen, Saudi Arabia, Kenya and Eritrea. The succulent young tender twigs, leaves and shoots of the tree are consumed raw. The tree and its products are identified by the presence of cathine and cathinone. In the Kingdom of Saudi Arabia, though illegal qat is cultivated in large quantities in all the mountain governorates of Jazan region. It competes with coffee due to its short value chain. The government has put measures to discourage qat growing and support these qat

4.1 Current and planned government coffee policies and initiatives

The coffee sector is affected by several external environmental factors. Understanding these will enable the Kingdom to take advantage of the opportunities and minimize the threats especially from emerging competitive forces.

a. Rehabilitation of terraces and construction of water tanks

At the local level the national political considerations influence the enabling environment and allocation of resources to various competing needs. They also lead to the development of various legislations and regulations which facilitate or limit the operations of any sector. In general, the political developments in the country are currently supportive of the coffee sector. The government has given high priority to coffee under Vision 2030 with a view to diversify the economy base of the country. Under the National Transformation Programme, two initiatives under the MoEWA are aimed at assisting coffee production.



Figure 15: Concrete water tank constructed by MoEWA, Shada Al Baha

The initiative No 13 focussing on rehabilitation of agriculture terraces and application of rain water collection technologies in the south west area of the Kingdom. Under this initiative MoEWA has been constructing concrete water tanks with capacities of 30-120m³ (Figure 15) as well as rehabilitating the coffee terraces (Figure 16). The Ministry also provides drip irrigation equipment to the farmers for all the coffee trees. Initiative number 16 focusses on developing agriculture practices to improve the productivity of vegetables, fruits, dates and other field crops. The Ministry provides free coffee seedlings and operational money till the coffee seedlings start producing.



Figure 16: Renovated terraces, water tank, young coffee and drip irrigation project, Shada, Al Baha

Farmers who opt to grow organic coffee are further compensated for the resultant low yields. This is meant to reduce environmental degradation, and save by reducing the use of pesticides. In order to handle the expectant crop, the Ministry will be constructing a coffee processing factory to hull, sort grade and pack the green beans. A second factory will process the green beans to finished ground coffee both for Arabic and western style coffee brewing methods.

In Jazan farmers have for a long time been growing qat *Catha edulis* a stimulant which is illegal in the Kingdom. The Ministry of Interior in conjunction with MoEWA has taken the initiative to discourage qat growing and replace it with coffee. The government thus provides seedlings and pays qat farmers a total of SAR 210 for each qat uprooted and replaced with coffee. This takes care of cost of coffee seedling (SAR 10), loss of income and care of the coffee seedling.

In an effort to further support the farmers, the government has set up the Agriculture Development Fund (ADF) to provide easily accessible, affordable and flexible finance to assist farmers to procure farm equipment and other operational activities. The Fund is farmer-centric and is able to analyse exogenous factors that may affect repayment of the credit taken by the farmers. Farmers are however wary of taking the loan in case they default and their names are forwarded to SIMAH, the Saudi Arabia Credit Bureau. The Fund's Board of Directors approved lending according to the temporary ownership documents in the various regions of the Kingdom, in line with the sustainable rural agricultural development program and to achieve its development goals in accordance with specific and appropriate controls and in coordination with the concerned government (ADF, 2021). Other agencies supporting coffee farmers include the Arab American Oil Company (ARAMCO) who support through local charity organizations, provision of seedlings, drip irrigation equipment and water tanks. To support agribusiness, the government has set up the Small and Medium Enterprises General Authority (SMEA) known locally as “Monshaat” to organize, support develop and sponsor SMEs with a view of these enterprises increasing their contribution to the GDP from 20% to 35% by 2030.

These initiatives have increased the demand for seedlings and the nursery belonging to the Jazan Mountainous Development Authority (JMDA) may not be able to meet the demand. The Ministry of Environment, Water and Agriculture will be constructing a total of four coffee nurseries in the growing regions.

To support the growth of agricultural based rural agribusiness, the government also set up in 2016, the General Authority for Small and Medium Enterprises “Monshaat” are organize, support, develop and sponsor the SME sector with a view to increase the productivity of these enterprises and increase their contribution to the GDP from 20% to 35% by 2030. The authority is set to support coffee-based agribusiness in the coffee areas which will result in value addition, engagement of youth and women, job creation and general improvement of the rural livelihoods, all in tandem with the aspirations of Vision 2030. Other policies and legal instruments that affect the coffee sector include the Agricultural Quarantine Act for the Cooperation of Arab Gulf Countries 2001 which guides importation of agricultural products and guards from introduction of dangerous and harmful organisms in to the country; Food and Agricultural Import Regulations which guard against importation of sub-standard goods, the Saudi National Organic Regulation and Standards for organic products. Others include those regulating employment, tax laws, and environment laws, among others.

The government policy to support the agricultural sector and also to have specific packages for coffee, has made coffee farming very attractive to many farmers, including the youth. Farmers who were growing other crops or keeping livestock are converting to coffee. Coffee is now being planted at lower altitudes of below 500m above sea level which may not be suitable for coffee Arabica production. The demand for coffee seedlings will therefore increase while food production may decrease to the detriment of the rural communities.

The coffee varieties being grown by the farmers are mostly indigenous and have over the years evolved and adapted to the local climatic conditions. However, no matter how well they are adapted they may still lack certain traits that do limit their productivity, quality or resilience to climate, diseases and pests. In such situations, it is important to source breeding materials with the required traits to improve the local materials or acquire varieties that have high productivity, good quality and adapt well to the local environment. The breeding materials (germplasm) will be used by research to improve the local varieties. Importation of any plant material for commercial or ornamental purposes has the risk of introducing pests and diseases. These introduced diseases and pests usually create havoc and may lead to serious economic losses like the current olive oil epidemic (Saponari et al., 2019). To safeguard this, plant quarantine is essential. Quarantine is a strategy of control to prevent the spread of pests and diseases and is usually a government responsibility. In the Kingdom of Saudi Arabia, this is undertaken by the Director of Plant and Animal Quarantine under the Ministry of Environment Water and Agriculture and guided by the Food and Agricultural Import Regulation and Standards (FAIRS). The materials will be planted and grown for the purposes of quarantine testing, in an area geographically and ecologically separated from the major coffee growing areas, to prevent the local coffee with any pest(s) or pathogens. Centralized quarantine services will be more efficient because they may have a wider range of expertise in germplasm assessment and better control of the material while under quarantine. The National Agriculture and Animal Resources Research Centre, Riyadh and the Agricultural Research Centre - Makkah –Jeddah are well positioned to carry out this function in the Kingdom for materials coming in through Riyadh and Jeddah ports respectively.

Recommendations

- i. In the short term, MoEWA to provide free coffee seedlings and operational money till the seedlings start producing. To achieve this, the Ministry to establish coffee seedling nurseries in the coffee growing areas.
- ii. To reduce the possibility of bringing in diseases/insect pests and weeds through planting material quarantine services to be set up preferably near the major ports of entry.

- iii. To wean and discourage farmers from growing qat, the government to compensate those farmers who uproot the crop and also provide coffee seedlings for each qat tree uprooted
- iv. Monshaat, to support the establishment of SMEs that will lead to value addition, job creation and improvement of the livelihoods.
- v. Besides these existing laws and policy there are areas that do require legal action like delineation of areas where coffee can be grown, market participation, enforcement of quality standards, certification and geographical indications registration and protection from fake Saudi coffees.
- vi. With the focus on coffee production, the demand for coffee seedlings will increase but food production may decrease to the detriment of the rural communities.

b. Farm labour

The envisaged increase in coffee planting will require more farm labour particularly for harvesting and weeding activities. Labour as a key factor of production is often downplayed with the assumption that there is global unemployment and thus labour will always be available. For many years, the focus on increasing production has often forgotten the worker as a key link in the value chain (Solidaridad, 2016). The effect of labour dynamics, availability and costs on coffee are shown in Figure 17.

The production of quality coffee and labour availability are closely interrelated. Skilled workers are needed for quality coffee production but working in coffee is not seen to be attractive and there is low retention of workers. This if not well managed, labour availability will compromise quality coffee production. In fact, as shown in Figure 17 the overall sustainability of the sector is closely linked to labour availability.

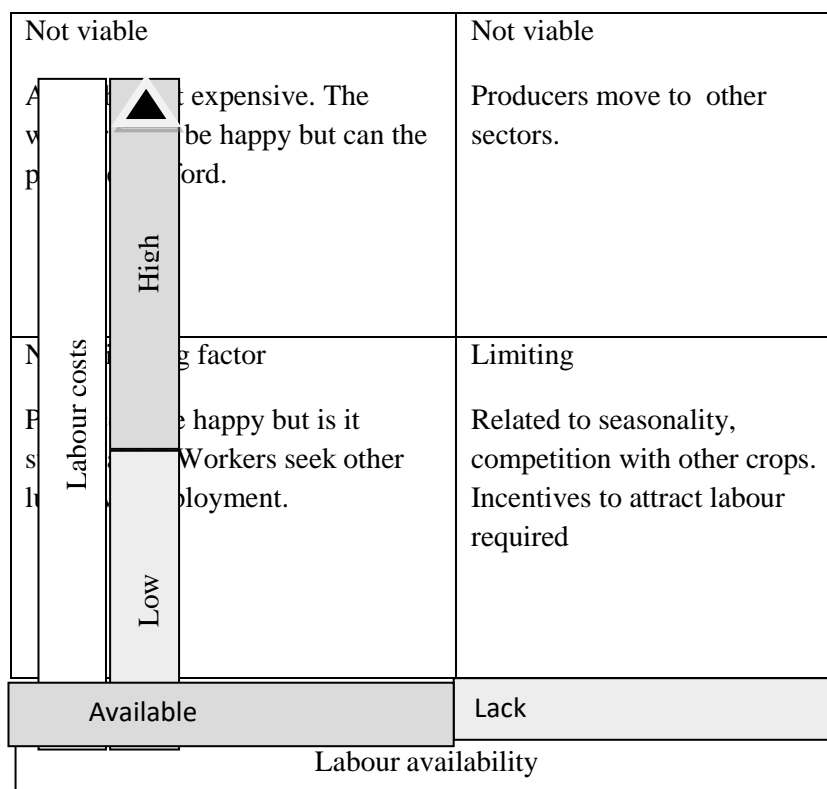


Figure 17: Schematic analysis labour for coffee harvesting

In KSA most of the farm labour has been foreigners from Pakistan, Sudan, and Ethiopia. They are provided with housing and sometimes food just to keep them on the farm. Coffee is grown in the terraces which makes mechanization difficult. Due to the irregular irrigation regimes and erratic rain showers coffee trees flower continuously. This results in a single tree and farm having coffee berries at different stages of growth and ripening. It requires an experienced labourer to identify and manually pick the ripe cherries. This a skill learned over time and necessitates labourers to be retained on the farm for best quality coffee production. Without the presence of these skilled workers many consumers particularly of the Arabic coffee will not enjoy the traditional cups of coffee.

The recent government policy on increasing the cost of iqama renewal, the repatriation of foreigners during the COVID-19 pandemic and the reforms of the “*kafala*” sponsorship system which now allows job mobility and free movement without the employer’s permission, will great reduce labour availability in the farms. The “*kafala*” policy though deemed oppressive was assisting in retaining skilled labour on the farm. The reformed “*kafala*” system may also make farmers wary of training their workers.

Recommendations

- i. Introduction of general wages and productivity-based bonuses,
- ii. Use of hand-operated weeding machines and mechanical harvesters.
- iii. Pooled labour utilization by the farmers
- iv. A labour sourcing and distribution cooperative preferably by the youth to carry out labour needs assessment and avail the labour when and where needed.
- v. At the same time any influx of labourers to the coffee growing areas particularly during peak picking periods will exert pressure on social amenities like toilets, access to drinking water, accommodation and even security. Service providers to be sourced and avail the required services. The respective governorates to address the security issues.

c. Data and information

All matters relating to coffee from production to marketing falls under the control of the Plant Production Unit in MoEWA. A scrutiny of the institutional arrangement shows that there is no specific office dealing with coffee and hence no “one-stop-shop” for coffee data and information. An aggregated database on coffee production is therefore not available and there has been over reliance on data from secondary sources including newspapers and the internet. Where data is availed from regions it is not clear the biggest challenge being expressing yield in cherry form or green beans. The word green has also been confused with green cherry on the tree. This confusion and lack of clarity on data have led to a belief that the Kingdom of Saudi Arabia is a net exporter of coffee whereas it is coffee which is imported by roasted and re-exported to other countries but captured as exports at the port of export. There is more reliability on coffee imports as this is properly captured at the port of entry. However, coffee entering the Kingdom from neighbouring countries via informal routes is sometimes captured as local coffee thus inflating the national production figures.

Recommendations

- i. Collection, generation, storage and accessibility of coffee production, processing and marketing data to be undertaken

d. Women and youth in coffee

In most agricultural countries, women are mostly involved in farm activities but do not have equal access to resources and opportunities required to improve farm activities. The National Transformation Program endeavours to increase women's participation in the labour market through strengthening the culture of women's participation, and providing the possible means that makes the working environment suitable. Women inclusion in the coffee sector is limited. To ensure their incorporation in coffee and harness this massive potential, a gender mainstreaming analysis will be carried out to identify those specific coffee activities that can be undertaken by women.

The Saudi Vision 2030 aspires to harnessing the energy of the youth (men and women) by engaging them in entrepreneurship and enterprise opportunities. The engagement of the youth in coffee and agriculture in general remains low. However, there is a growing number of young and well-educated youth taking up coffee as a business particularly in areas of coffee brewing (baristas) and coffee trade. This is fuelled by the fact that the youth are almost 50 percent of the population offering immense potential in both business and consumption. There is need to find ways to encourage more youth to be involved in coffee by taking cognizance of how to address them.

The rapid changes and penetration of the social network sites commonly referred as social media opens a big opportunity as an avenue for technology transfer targeting the youth. This will also be appealing to the youth and hence provide an opportunity in influencing the youth to the coffee business and consumption.



Recommendations

- i. The youth be supported either as individuals/associations/companies/cooperatives to engage in the coffee industry as baristas, transportation, extension and training services provision, quality analysis, packaging, value addition, trading, consultancy services among other vocations related to coffee.
- ii. A gender mainstreaming analysis to be carried and identify those specific coffee activities that can be undertaken by women and youth.

4.2 Stakeholders

Stakeholder in the coffee sector is defined as any individual, group or organization that can affect, be affected by, or perceive itself to be affected by the activities undertaken to develop the sector. To ensure that their impact and perception is taken into account, a stakeholder mapping and analysis was carried out. (Table 3).

Table 3: Key stakeholders in the coffee sector, KSA

 Level of power	<i>Key and have to be kept satisfied with the implementation</i>	<i>Key primary stakeholders who have to be engaged closely</i>
	<ul style="list-style-type: none"> • MoEWA headquarters • SRADP secretariat 	<ul style="list-style-type: none"> • Coffee farmers • Coffee processors • Coffee/agricultural Cooperatives • Coffee nursery operators • Roasters, packers, retail • Consumers at home and cafes, Arabic and western • MoEWA branches at the coffee growing regions
	<i>To be monitored as their decisions will affect the sector</i>	<i>To be kept informed with a view to influence favourable decisions</i>
	<ul style="list-style-type: none"> • International Coffee Organization (ICO) • International Coffee Exchange (ICE) • General Authority for Meteorology and Environment • Monshaat • Saudi Authority for Intellectual Property (SIPA), • International coffee companies • Coffee certification associations: Rainforest Alliance, Café Practices, 4C, Trair trade 	<ul style="list-style-type: none"> • Relevant government ministries • Local Charities • Input suppliers • Jazan University • KACST • King Saudi University • International and national partners and collaborators • Cooperatives Societies Council • Jazan Mountains Development Authority
	Level of interest 	

The stakeholders were then classified as primary (direct effect) or secondary (indirect effect.) The primary stakeholders include the coffee farmers, processors, traders and roasters while secondary stakeholders include the government, NGOs farm input suppliers and other national and international stakeholders. These stakeholders were further assessed on how their interest and influence impact on the sector and grouped into three categories, those who affect at policy level, production and processing and finally at marketing and consumption (Table 3). The stakeholders were engaged at individual level in one-to-one meetings, key informant meetings and field visits and farmer interviews. The issues raised have been used to improve on the implementation plan of the coffee Arabica production, processing and marketing project. The level of interest and influence is not static and is bound to vary with ongoing activities. All the stakeholders identified and interviewed are shown in Annex I.

Recommendations

- i. Constant review and analysis of the stakeholders to identify new ones or those who cease to be stakeholders.

4.3 Coffee production technologies

a. Coffee varieties

The coffee grown in the kingdom is thought to have originated from Ethiopia and entered Saudi Arabia about 1450 (854 A.H). From here the coffee has spread to all over the world and this region referred to as Yemen (not the country, but the region to the right (*yamin*) of Kaaba) is the centre for diversification (Figure 18).

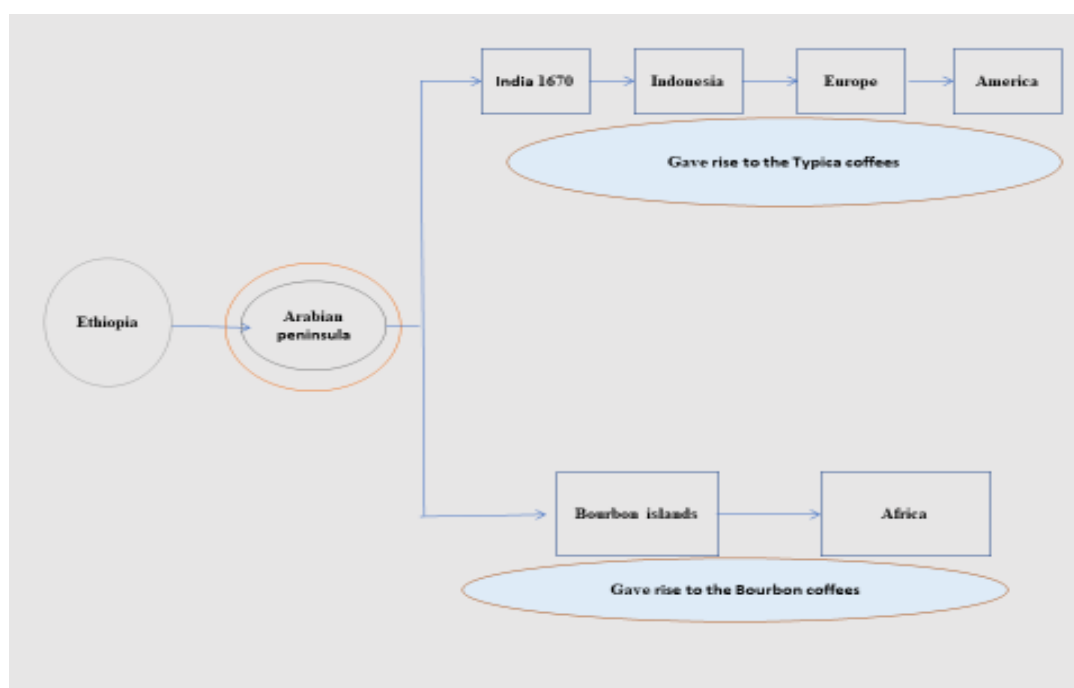


Figure 18: Spread of coffee Arabica from Ethiopia to the rest of the world

These coffee types can be traced to the two main groups of coffee Arabica, the Bourbon and Typica lineages as envisaged by the colour of the young leaves bronze tipped for Typica and green tipped for Bourbon (Figure 19). Both lineages are found in the coffee growing regions of the kingdom indicating the great diversity that exists. This diversity will be key in the development of improved varieties. Coffee germplasm will be collected from all the coffee growing regions based on morphological characteristics (tree canopy structure, shape of the leaves and fruits). Ripe cherries will be collected from these distinct varieties to identify and collect seed from the different and morphologically distinct coffee trees with a view to characterize genetically (including DNA fingerprinting), biochemical composition and the quality profiles and assess suitability for preparing Arabic and the machine-brewed coffees. The genetic characterization of these coffee varieties will also be useful for the purposes of developing and registering Geographical Indications (GI) for coffee.

Preliminary results have indicated that the trees have distinct morphological characteristics and also varying caffeine content (personal communication). This is ongoing work and once completed will shed more light on the genetic diversification of the coffee grown in the Kingdom of Saudi Arabia.

The coffee seed collected will be preserved at the Seed Bank- Riyadh. To fast track, the process of germplasm collection, characterization of the materials and variety improvement partnerships will be developed with local universities and international organizations like the World Coffee Research (WCR).

For the production of coffee seedlings there is only one government sponsored nursery in Jazan region under the Jazan Mountainous Development Authority (JMDA).



Figure 19: Bronze (Typica lineage) and green (Bourbon lineage) tipped coffee leaves, Jazan

It produces seedlings that are planted in Jazan and as far as Al Baha (>500km away). The nursery is not able to meet the demand for seedlings. To supplement in seedling production there are several private nurseries scattered in the growing areas but the price per seedlings is much higher than the price at JMDA nursery (SAR 40 per seedling compared to SAR 10-15.00 at JMDA). As farmers cannot acquire all the seedlings they need, they resort to raising their own nurseries with a very poor germination rate (as low as 8%) or plant volunteer seedlings (these are seedlings that germinate from coffee seeds that drop to the ground) from their coffee fields (Figure 20).

In order to address this perennial shortage of seedlings MoEWA will be putting up at least four (4) coffee nurseries in the coffee growing areas. This will also ease the farmers' burden of sourcing and transporting seedlings over long distances. The new nurseries will also have water harvesting facilities to avail water for the seedlings. Misters will be installed to irrigate the seedlings and bring down the temperatures in the nursery all conducive to better survival of the seedlings. The MoEWA staff in charge and the workers in the nursery will be trained on the best practices for a seedling nursery. The nurseries will be multipurpose, raising other crops grown in association with coffee in a "one stop shop" model.



a.

Figure 20: Traditional coffee seedling production, Jazan and Al Baha

The seedlings are planted during the rains in March –April. With no clear guidance farmers adopt various spacings usually handed down over the generations. The Ministry of Environment, Water and Agriculture recommends to farmers to prepare a planting hole of 60×60 cm at a spacing of 2×2 m. This spacing between plants is too close and branches interlock within the third year creating a bushy canopy structure. This requires continuous pruning by well experienced pruners otherwise yields are reduced. Traditionally farmers did not prune their coffee trees as the bushy canopy helped to preserve moisture. Farmers by then were only focused on producing coffee for domestic consumption and not for marketing.

Recommendations

- a. Although spacing adopted by MoEWA is 2.0×2.0 m this need to be reviewed to a maximum of 3.0×3.0 m and a minimum of 2.5×2.5 m to reduce the creation of busy trees. Bushy canopies create a suitable environment for pests.
- b. Train farmers on how to set up viable coffee nurseries in their farms
- c. Discourage farmers from planting ‘volunteer crops’

b. Field management

Traditionally coffee trees were not supposed to be pruned. As such they grow tall over 7.0 m and bushy requiring ladders to pick (Figure 21). Production from these bushy trees is low as the tree is supporting a lot of unproductive vegetation. A few cherries are found at the top canopy hence the need of a ladder to pick them. This practice though entrenched in tradition is untenable for high production. Farmer training and demonstration on the recommended practices are two approaches that will help to change the attitude and allow for the adoption of practices that lead to high yields.



Figure 21: Tall unpruned coffee trees Shada, Al Baha

Besides the low yields, the excessive vegetative growth takes a lot of water leading to low water use efficiency. The thick bush-like growth also reduces flowering and creates a suitable habitat for insect pests. All these factors contribute to low productivity and training in pruning will have a large impact of coffee productivity in the kingdom. This will require a focussed campaign as the farmers do not prune the coffee trees. A pruning awareness campaign coupled with on-farm demonstrations will assist in building the capacity and changing the farmers' attitude.

Rainfall and water availability play a critical role in the growth, productivity and quality of Arabica coffee. Arabica is mostly grown in countries with adequate rainfall as it requires a well distributed rainfall amounting to a minimum of 1000mm per year. Even with this amount of rainfall, supplementary irrigation may be needed. In KSA Arabica coffee is being grown in a harsher environment with rainfall total not exceeding 450mm per year. For optimal growth and production to occur, supplementary irrigation is needed. Farmers over time have learned how to harvest runoff water during the rains and store it in underground tanks or dig shallow wells. Those with no tanks end up buying water to irrigate their coffee. Under Vision 2030 and the National Transformation Programme the government through MoEWA has supported farmers by constructing concrete water tanks and providing drip irrigation. The drippers on the drip lines are spaced at 2.0 m intervals. However, a mismatch was observed in the field because the spacing between coffee plants is not uniform and varies. The drippers do then not match with the coffee plants and deliver water outside the coffee plant root zone, contributing to low water use efficiency. Training farmers on how to achieve the recommended spacing will go a long way in improving water use efficiency and increase productivity per tree and total production.



Figure 22: Damaged feeder roots while preparing the watering basins, Jazan

Farmers currently using basin irrigation which is wasteful in water use (estimated at 15litres of water per tree). While preparing the water basins, coffee feeder roots are also destroyed (Figure 22) which again reduces the water use efficiency. Farmers irrigate their coffee during the daytime resulting in large amounts of water being lost through evaporation. They also over irrigate the coffee particularly the young recently seedlings leading to waterlogging and sometimes death of the seedlings. Excessive watering coupled with the intense evaporation causes accumulation of salts at the topsoil rendering the soil alkaline and not conducive for high coffee production.



Figure 23: Heavy flowering on a tree after irrigation Faifa, Jazan

The coffee tree requires a minimum stress of one month for flower formation. Once it rains or irrigation is provided, the buds open and flowers blossom (Figure 23). Continues watering reduces stress and reduces

flowering. A delicate balance has therefore to be maintained between watering and stressing the coffee tree. Farmers have no recommended scientific method on when to irrigate and even how much water to apply. They depend on past experiences, neighbours' advice or the farmers "gut feel". There are now modern technologies like the solar operated soil moisture meters that are connected to a computer which are becoming popular with advanced farmers (Figure 24). The system is automatic and is calibrated to open up once the soil moisture deficit falls below a specific level. The system can also be remotely operated using a mobile phone.



Figure 24: A solar powered soil water moisture meter Al Dayer, Jazan

This technology is very useful in increasing water use efficiency, conserving the scarce water resource, enhancing production and improving the coffee bean and cup quality. The application of this technology will greatly increase the value and efficiency of the MoEWA supported programme of equipping the coffee farms with drip irrigation.

The soils under which coffee is grown in KSA are shallow, low in nutrients and water holding capacity. The farmers rarely use inorganic fertilizers for coffee but mainly use own compost or packaged manures. The own compost is usually goat or cattle manure which is not well composted and is applied "fresh" while the purchased compost is low in nutrients particularly nitrogen and heavy in moisture content (Figure 25). The domestic or procured compost may only assist in improving the soil structure but not provide the required nutrients required by the coffee tree for growth and production. This problem is further aggravated by the fact that, farmers who do not apply inorganic fertilizers in an attempt to grow organic coffee are compensated through cash pay-outs by the Ministry. Farmers are therefore not keen to apply fertilizers even though high quality nutrient rich fertilizers are available in the market. Nutrient deficiencies are observed in the farm and in the final bean reducing production and quality. Production of organic coffee leads to lower yields and in some cases serious disease and pest infestation. Organic products fetch higher prices to offset the reduced production but only when there is a demand for the organically grown product. In KSA, this will be a thin line on whether to grow coffee organically but with reduced volumes or grow it conventionally and take advantage of the coffee infrastructure being set up by the government.

Analytical Composition	
Organic Matter	40 - 50%
PH	5.5 - 8.5
Moisture	20 - 25%
Total Nitrogen	0.3 - 0.7%

Figure 25: Nutrient composition on a compost packaging bag Al Dayer, Jazan

In its natural habitat, coffee is an understory plant and thrives well under shade. The original coffee plantings were under shade but in order to maximise on yields, shade trees were gradually removed. Shade trees in coffee, besides providing shade per se also produce mulch through leaf litter fall, fix nitrogen if from the *leguminosae* family, assist in soil and water conservation on the steep slopes where coffee is grown and provide a nectar source for honey bees. Shade trees have been recorded to reduce air temperatures at midday by over 4° C. Coffee grown under shade is known to be of better quality as the sugars mature slowly.

Unfortunately, most of the coffee in the kingdom is in the open sun with no shade. With the many benefits of growing coffee under shade, suitable local shade trees that will not over compete coffee for water, preferably evergreen throughout the year, good litter fall to provide mulch and not harbouring coffee pests will be selected in collaboration with the natural resource management experts and the forest department. Once such trees are identified, they will be raised in the established coffee nurseries and farmers shall acquire the seedlings in a one stop shop. Some of the likely shade trees (already growing in KSA) to be considered include leucaena (*Leucaena leucocephala*), acacia (*Acacia gerrardii*), pigeon pea *Cajanus cajan*, bananas (*Musa spp*) papaws (*Carica papaya*) (would be ideal shade for young seedlings), among others. This will offer initial shade to the young coffee but may be retained to continue providing shade to coffee. The use and benefits of artificial shade and the growing of coffee in green houses are new frontiers that require further investigation.

The climatic environment in the Kingdom of Saudi Arabia is not conducive to fungal growth and minimal coffee diseases have been observed or reported. The major diseases that coffee Arabica in most of the producing countries namely coffee berry disease caused by *Colletrotichum coffeanum* and coffee leaf rust caused by *Heimelea vastratix* are not endemic in the Kingdom but recently a few cases of coffee leaf rust have been sighted in Jazan. Fusarium bark disease caused by a fungus *Fusarium stilboides* that enters the plant through injuries on the stem, is prevalent. The injuries are caused while digging water basins, weeding and removal of branches /suckers by hand. The fungus on entering the plant moves through the stem to the roots and causes root death and finally the plant slowly dries. The fungus then resides the soil and attacks any coffee seedling planted in place of the uprooted diseased plant.

Several pests have been observed on the trees and also on the coffee fruits. A catalogue of the common pests and disease identified in the coffee growing areas has already been developed. It will be regularly updated as pest surveillance surveys are undertaken. With the enhanced coffee planting it will be necessary to monitor for

diseases and pests. Caution must be taken to guard against any introduction of seed, seedlings or coffee destined for consumption. A strong and effective plant quarantine need to be put in place bearing in mind that in some coffee producing countries pests have been introduced through coffee introduction or farmers sowing seed from coffee imported for consumption. MoEWA has to raise a campaign to educate farmers to avoid bringing in seed or seedlings through unofficial methods mostly as exchange or gifts from their farmer friends.

Traditionally, farmers planted coffee in association with bananas and pawpaw (personal communication). This system is known as intercropping and is widely practised in coffee in many producing countries (Njoroge and Kimemia, 1993). Intercropping has the advantage of better land use, food security (coffee per se is not consumed as food), high cash returns, provision of shade to young coffee seedlings, efficient use of water, soil cover, addition of organic matter to the soil and risk management.

Currently, coffee farmers in KSA have been observed to plant a big range of crops in the inter row spaces, like sorghum (*Sorghum bicolor*), millet (*Pennisetum spp*), cowpeas (*Vigna unguiculata*), carrots (*Daucus carota*), coriander (*Coriandrum sativum*), eggplant/brinjal (*Solanum melongena*), green pepper (*Capsicum sp*), chillies (*Capsicum anuum*), maize (*Zea mays*), Irish potatoes (*Solanum tuberosa*), onions (*Allium cepa*) and simsim (*Sesame indica*) among others. The intercrops are sown in the same hole as coffee (Figure 26) or in the inter-row space. For mature coffee mangoes (*Mangifera indica*), Pawpaws (*Carica papaya*), citrus (*Citrus spp*), pomegranate (*Punica granatum*) are all inter planted with coffee (Figure 26).

One of MoEWA's initiatives for the development is to promote intercropping in the coffee farmers with a view to secure food security (MoEWA, 2020). A large number of crops will be assessed for their suitability as intercrops in coffee.



Farmers also keep small livestock mainly sheep and goats for domestic consumption and cash besides manure that is applied to coffee and other crops.

The environment in the coffee growing regions is conducive for livestock, apiculture and aquaculture as a food security strategy and risk management strategy. Farmers despite constraints of their small plots on hilly terrain struggle to keep goats and sheep indicating their relative importance in the coffee-based farming systems (Figure 27).



Figure 27: Sheep and goats in a farm, Al Baha

Recommendations

- i. Maintain the tree height at not more than 2.0m and the trees renewed every 6-8 years by cutting down the old stems and raising new ones. Water holding basins to be dug between two coffee trees leaving a space of not less than 50cm from the base of the plant. This reduces interference and destruction of feeder roots while digging the water holding basins;
- ii. A complete soil analysis in all the coffee growing area be undertaken and the results used to guide the fertilizer/manure program in terms of type, amount and frequency;
- iii. For best soil fertility management, farmers to be trained on composting, compost enrichment, storage and application;
- iv. Suitable shade trees to be introduced to the coffee farms as a way of adapting to climate change. Farmers to be trained on how to avoid damaging coffee tree stems while carrying out field operations. The damaged parts become entry points for the *Fusarium* pathogen leading to many trees becoming infected and subsequent death;
- v. Suitable crops will be grown in the inter spaces as a strategy for food security and crop enterprise diversity;
- vi. Farmers encouraged to keep goats and sheep for the provision of manure, domestic consumption and risk management

c. Farm Mechanization

As more and more coffee is planted through the various government agencies, labour availability will become a key determinant for the success of the coffee sector development. As already mentioned most of the labour is provided by immigrants who also do not regard coffee as a prestigious or lucrative job. The sector does not therefore attract and retain the labour. To overcome this labour shortage, some farm activities have to be mechanized. However, the coffee plot sizes and the terrain do not encourage the use of heavy farm machinery. In such scenario, mechanization will be limited to hand operated machines for a few of the farm operations.

Recommendations

- i. Terrace construction with light duty tractors to excavate and level the terrace. The tractor will also carry stones for the terrace embankment. As individual farmers may not afford to buy a tractor these will belong to MoEWA, a cooperative or private sector and hired on hourly basis. This is an area that MoEWA is already supporting the farmers by constructing the terraces at no cost to the farmer.
- ii. To harvest the rainwater and runoff from the roadside, small community dams are to be constructed. This again will be done using light to heavy machinery belonging to MoEWA or private sector.
- iii. In a seedling nursery, putting soil in the polybags an activity known as potting is the most labour intensive. Automatic machines like those used in packaging are recommended to fill the polybags with the recommended volume of potting mixture.
- iv. Digging of coffee planting holes as recommended (60 × 60cm) is a tedious job particularly in the prevailing hot environment in KSA. It may not attract adequate labour or when available may charge a higher wage. There are hand operated machines that can drill the required planting holes. Such machines are recommended for use and can be owned by the cooperative, a group of farmers and even individual farmers who intend to be large scale coffee growers.
- v. Weeding is a labour intensive and tiring activity. The fact that it has to be done while one is bending makes it a drudgery. Hand operated cultivators will ease the problem by cultivating the middle 1.0m swath (to avoid damaging coffee roots). Weeds around the coffee trees to be pulled by hand or a machete care being taken not to damage the tree bark as this becomes an entry for Fusarium spores.
- vi. Coffee cherry picking is the most labour -activity in coffee all over the world. In a coffee growing area, all the coffee ripens together and if not picked falls to the ground or dries on the tree both reducing yield and quality. Labour for picking is never enough and in most cases the local labour has to be supplemented by sourcing from other regions and sometimes outside the country. Incentives are given to retain the workers. To overcome this problem mechanical harvesters are introduced with Brazil as a leading example. In KSA most of the picking is done by immigrant labour. With increased planting and hence enhanced production, picking labour will be a challenge. Hand operated mechanical harvesters will be encouraged after a thorough assessment and evaluation.

4.4 Coffee processing technologies

The quality of unroasted (green) coffee depends on the variety, climate, soils, farming practices, harvesting and postharvest processing. Climate is a key factor, as temperature and soil water availability have a direct bearing on the coffee growth, flowering, and in particular, the development of the fruit. The altitude in turn has a direct effect on the local climate. Coffees grown on high altitude are known to have good intrinsic quality. Soils

influence the crop by the way it retains and makes water available to the plant and the availability or lack of nutrients. In the coffee growing regions of KSA coffee normally flowers in March to April immediately after the onset of the rains. It takes 32-36 weeks for the fruit (known as cherry) to develop and mature. The cherry ripens and turn from green to red. The growing fruits act as priority sink for assimilates and minerals, and can draw carbohydrates from elsewhere in the tree starting from leaves and then the branches. Under such conditions of low nutrient availability, the branches die starting from the tip and the cherries dry but remain on the branch displaying a “mummified” look. For uniform ripening and high quality of the coffee adequate water is needed at the ripening stage. In all the coffee growing areas of Saudi Arabia coffee is harvested by hand, in a very labour-intensive activity. Farmers usually employ workers for this activity, mostly immigrant labour. The coffee picking season is from October to December. The cherries of the local coffee variety have a rich red colour which indicates good maturation, a critical factor to quality. Green immature fruits when picked give coffee an astringent taste and lowers quality. After picking, the fresh coffee cherries are spread out in the open air, to dry in the sun. This can be directly on the dry ground, on tarpaulins/sack material, roof top or on raised drying beds (Figure 28). The climate conditions in the Kingdom of Saudi Arabia allow for quick drying and it takes 7-10 days to completely dry the coffee cherries.



Figure 28: Drying beds on the house rooftop in Aseer

Farmers who grow coffee at higher altitudes of more than 1 500m above sea level face the challenge of mist and erratic rainfall which interferes with coffee drying. The possibility of using a multi-tier coffee drier (Figure 29), modelled along the Ethiopian sun tunnels will assist the farmers dry the coffee much quicker and safer. The modified driers prevent any rewetting of the drying cherry (even mist/fog can rewet the dry coffee cherry). Any rewetting of the coffee while drying encourages fungal growth. Some of the fungus may be producers of mycotoxin like ochratoxin A that renders the affected coffee not fit for human consumption.

Coffee is recommended to be dried to a moisture content of 10-12%. Traditionally farmers use their teeth to determine whether the cherry is dry or not. If soft, more drying is recommended, if brittle and cracks on biting the coffee is then at the right stage of drying and is ready for marketing.

After drying coffees farmers usually store for a period of 45 days (known technically as conditioning) in a properly ventilated store. This conditions the dry cherries and evens out the moisture content besides gives the dry cherry an appealing black colour. The dry cherry can then be sold as it is or hulled to green beans at local trade centres. However, rarely is the coffee stored for more than three months as there is great demand for the locally produced coffee.



Figure 29: Multi-tier coffee drier Jazan

After drying, the coffee is taken to a hulling machine where the hard, blackened part (the husk, which was once the fleshy pulp of the fruit) is removed mechanically. The hulling machines rub off the husk, and/or parchment, leaving clean, green coffee. This is done at the trading centres within the coffee growing areas and farmers either take the coffee for hulling then sell the green beans or sell the dry cherry to traders who then hull and sell both the coffee and husks. After hulling it is recommended for the coffee to undergo sorting to remove defective beans and foreign materials as a way of increasing quality and making the coffee safe for human consumption. In KSA the hulling machines used are not originally for coffee but for cereals resulting in damaging the beans and lowering the quality. No sorting, grading or quality analysis is done. Sorting, grading and cup quality analysis will allow for marketing the coffee based on quality and fetch higher prices for the farmer.

Recommendations

- i. Farmers are to be encouraged to provide supplementary irrigation when the coffee berries start to ripen. Cherries from well-watered trees are easy to pick and avoids tree damage. Lack of adequate moisture at the ripening stage leads to light wrinkled beans of low cup quality;
- ii. Only the deep red mature cherries are to be picked. Green cherries if picked give the coffee an astringent taste and lowers quality;
- iii. Coffee picked on each day is to dried separately preferable on raised drying beds or in solar driers;

- iv. At no time should dry cherry be allowed to be in contact with water or just moisture.

4.5 Information dissemination mechanisms

In the Kingdom of Saudi Arabia, farmers in the coffee growing areas continue growing coffee as a tradition and passion passed through generations. In these areas it is sometimes the only economic activity to be undertaken regardless of the economic returns. The cropping systems in particular water use, pruning, and processing are inefficient and lead to low productivity and poor quality. The coffee varieties grown by farmers are old and of unknown genetic characteristics. It is only that they have been with the farmers for a long time and have come to adapt to the local climate and soils. The varieties may be drought tolerant, disease resistant (or the weather is too harsh for the disease pathogens) and survive under low management. The soils where coffee is grown are poor (sandy) in nutrients, with low organic matter and water holding capacity.

The farmers carry out post harvesting processing on their farm and after cherry picking mainly drying and storage. The drying and storage process practiced by the farmers, again handed over the years may not be the best for quality coffee production. The farmers' knowledge learned over the years sometimes through bitter experiences will be recorded and will be crucial for developing improvements.

Model demonstration farms will be used to showcase the best production and processing practices along the coffee value chain with a view to increasing production of quality coffee in the Kingdom of Saudi Arabia. The approach will be to integrate modern technologies with indigenous knowledge, collaborate with other stakeholders working in coffee and incorporate the coffee farmers in the learning process. The sites will be selected on a specific criteria based on coffee production processing data. The data collected and this will form the information needed for further enhancement of the coffee production. The lessons learned will be used while setting up the other model farms and developing training programmes for the coffee stakeholders. All the aspects of coffee varieties, soils, farming systems, farmer's indigenous knowledge and technology will be taken into account as the best production and processing practices for the demonstration farmers are being developed. The number of farmers per demonstration farm will depend on the type of demonstration, resources available and the farmer distribution. Best practices recommend 10-30 farmers per demonstration plot (TOPS, 2017) for ease of learning.

Knowledge platforms facilitate joint learning, create linkages and collaborations among the various actors. The coffee value chain has many actors each playing a specific role and controlling a knowledge segment. Unless there is a deliberate effort, there are usually no linkages between the various nor is there any sharing of knowledge. The objective of the knowledge sharing platform would be to bring the value chain stakeholders together deliberating on critical issues and develop a common approach/strategy to address such issues. Such a forum would be used by the actors to effectively influence policy change and promote provision of innovative quality service for male, female and young (small and medium) farmers within the value chain. It would also contribute to setting the national coffee agenda, lobbying on behalf of stakeholders, monitor and tracking progress on national goals and plans. The overall goal of the platform is therefore to increase coffee production and quality by developing an inclusive and participatory knowledge sharing platform that is freely accessible to all the stakeholders.

Recommendations

- i. Model demonstration farms will be used to showcase the best production and processing practices along the coffee value chain;

- ii. Knowledge platforms facilitate joint learning, create linkages and collaborations between the various actors.

4.6 Coffee marketing practices and channels

a. Marketing channels

The marketing of locally produced coffee is not organized and each farmer seeks his own market and sells at his own price. There is no agency that regulates the coffee marketing in the Kingdom. The farmers would benefit more if they are in an association or cooperative and market their coffee together. This would also interest the buyers, to procure the coffee from the coffee growing areas and thus reduce the expenses incurred by the farmer in transporting coffee to the towns.

MoEWA is in the process of setting a coffee hulling factory that will hull the dry cherry and produce green beans. The factory will be set up in one of the coffee growing regions most likely in Jazan being the main coffee growing region. A second factory will also be set up to process the green beans to finished roast and ground coffee. The construction of these two factories will address all the issues identified as contributing to poor coffee quality and launch the Kingdom to be among the quality coffee producing countries of the world.

Currently, the Kingdom was estimated to produce approximately of 300 tonnes of per year. This local coffee is in high demand for the brewing of Arabic coffee making it comparatively more expensive (Table 4). The local price for Saudi coffee (even though the coffee is not sorted or graded) is high as compared to a global average of USD3-5 per kg at the International Coffee Exchange. There is therefore room to fetch even higher prices by sorting and grading the coffee. Farmers need to increase their productivity and benefit from this good price of Saudi coffee.

Table 4: Comparative price differentials for coffee destined for the Arabic coffee segment

Origin	Type	Price SAR/kg	Price USD/kg
Saudi Arabia	Beans	100-150	26-40
Yemen	Beans	35-55	9-15
Ethiopia	Beans	25-35	7-9
Saudi Arabia	Husks	15-20	4-5

With the limited coffee production from the Kingdom, most of the coffee consumed is imported in both green and processed forms (Table 5). Some of this coffee is re-exported mainly to the Gulf Cooperation Council (GCC) countries which is sometimes reported erroneously as exports from Saudi Arabia.

The kingdom under Vision 2030 plans to produce about 7 000 tonnes of coffee for both domestic and export market. For the export market the aim is to create a Geographical Indication and export the coffee to niche markets where it will fetch higher prices. To achieve maximum returns, the farmers have to be in associations/cooperatives, put in place a legal framework for the registration and protection of GI coffee. Because of the price differential even without the GI, it is attractive and profitable to market coffee from other

origins as Saudi coffee. It will be beneficial to benchmark with Hawaii which has put in place systems to protect its GI registered Kona coffee.

Table 5: Coffee and coffee products imports into KSA 2010-2019

Year	Green beans (tons)	Roasted coffee (tons)	Coffee extracts (tons)	Coffee substitutes (tons)	Total Coffee imports (tons)
2010	37 829	927	8 638	4 152	51 546
2011	35 626	1 089	11 828	3 145	51 688
2012	42 178	1 473	13 062	4 308	61 021
2013	38 253	1 639	16 141	4 781	60 184
2014	42 575	1 836	16 097	5 028	65 536
2015	50 464	2 300	20 394	4 091	77 249
2016	44 248	2 010	21 598	3 221	71 077
2017	52 398	3 204	25 476	2 265	83 343
2018	55 176	4 511	26 889	2 769	89 345
2019	48 694	9 982	25 493	12 687	96 856

Source: FAO, 2020

Coffee grading systems are strict and based on the physical appearance of the bean (raw and roasted) and cup quality (assessed by tasting). Most of the coffee producing countries develop their own standards, benchmarked on the internationally accepted standards. In Saudi Arabia, there are currently no quality standards for locally produced coffee.

The coffee plant has more products besides the beverage coffee. In KSA, the husks after hulling the dry cherry are also used to make a beverage. All the other products ranging from flowers, leaves, spent grounds (coffee and husks) are currently unused. An analysis on what can be used, for what purposes will go a long way in giving higher returns to farmers as well as open more agribusiness opportunities.

Recommendations

- i. Coffee Arabica produced from Saudi Arabia fetches very high prices even without sorting and grading. Increasing production, vesting in sorting and grading will earn the farmers more money from their coffee.
- ii. MoEWA to establish coffee quality assessment laboratories and train the required quality analysts.
- iii. MOEWA to set up a factory to process and produce other products from coffee products and by products

b. Food safety considerations

There is a new consumer focus on food safety concerns, a focus on health and diet, and increasingly globalized consumer tastes. The concern is mainly for contaminants and pesticide residues. Contaminants are defined as any substance not intentionally added to food or which are present in such food as a result of the production process, manufacture, processing, preparation, treatment, packaging, and transport or holding of such food, or as a result of environmental contamination. The presence of contaminants in coffee renders it unacceptable to the consumers. In coffee, a major and serious contaminant is Ochratoxin A (OTA), a toxic metabolite produced by fungus growing on rewetted dry coffee (cherry or bean). Ochratoxin A which is not destroyed even by heat while roasting the coffee is known to be cancerous and therefore any OTA contaminated coffee is not fit for human consumption. OTA contamination has been identified in some coffee samples from Saudi Arabia and mould growth dry cherry has been observed in the farms within the coffee growing areas of the Kingdom (Bokhari, 2007). It is therefore important to train farmers on post-harvest technologies that prevent fungal growth and reduce the probability of OTA contamination. At the same time there is need for surveillance on all imported coffee to ensure that they are not OTA-contaminated and that the coffee is safe for human consumption. Patrols to reduce coffee entering from neighbouring countries will also be key in reducing contaminated coffee entering the market. There is need therefore, to identify any critical control points for prevention and reduction of mould on both locally produced and imported coffees.

Pesticides are chemicals or products used to control pests and diseases in both animal and crop production. Pesticides used for agricultural purposes are controlled by the Saudi Food and Drug Authority (SFDA) who have already prepared a list of all permitted pesticides in the Kingdom. Their use may leave residuals on the target crop or animal and also in the soil and surrounding environment. Pesticide Maximum Residue Limit (MRL) is the maximum amount of pesticide residue that is expected to remain on food products when a pesticide is used according to label directions that will not be a concern to human health. Usage of pesticides in coffee is minimal but there is need for awareness creation along the different value chains supported by training on safe use of pesticides in coffee production, processing and storage. In KSA contamination of coffee by pesticides while in storage is a big risk as the dry coffee is stored in old sacks and put in the same store with all other inputs on the farm.

Recommendations

- i. Identify critical control points for the prevention and reduction of mould formation both locally produced and imported coffees;
- ii. Train farmers on post-harvest technologies that do prevent fungal growth and reduce the probability of OTA contamination;
- iii. Border patrols to reduce coffee entering from neighbouring countries which may be contaminated with pesticides and moulds.
- iv. Training for producers on safe use of pesticides in coffee production, processing and storage.

c. Branding and certification:

Coffee consumers have become more inquisitive and are demanding information on how and who produces the coffee they consume. There is also an awakening among consumers with regard to social, economic and environmental standards on coffee production. Consumers would like to know how the price they pay impacts on the welfare of the producer. This has led to the emergence of certification and verification bodies such as

Fair Trade, Utz Certified, Rainforest Alliance, Café Practices, 4C and Organic Coffee among others. Certification is a quality assurance tool intended to determine if an institution's processes, services and products meet specific set standards.

Certification is consumer driven, facilitates preferential market access, may lead to price premiums and facilitates traceability due the meticulous recordings required.

Many buyers and consumers are demanding certification on the coffee offered through accredited certifying bodies. For the Kingdom of Saudi Arabia to penetrate the international market it needs to develop coffee standards to inspire consumer confidence to continually seek coffee from the Kingdom.

The value of the local coffee and its competitiveness in the global market will be greatly enhanced by registering a geographical indication. A geographical indication (GI) is primarily support that a certain product comes or originates from a particular region, is prepared in a certain way and has certain specific characteristic(s) attributable to its geographical location. Considering the rich coffee culture and history of coffee in KSA, GI coffee from the Kingdom would relate well with nature, tradition and culture aspects, giving KSA coffee a natural comparative advantage leading to transformation of traditional knowledge to marketable products. To achieve this, KSA needs to put in place legal instruments to facilitate registration of the GI coffee and other products. It is only after local recognition and legislation can the GI being protected internationally.

Most of the coffee stakeholders in the Kingdom of Saudi Arabia believe that since “no” pesticides are used in the coffee production, the coffee then is organic. Organic coffee sold as certified in the market must be produced under specific standards established by the International Federation of Organic Movement (IFOAM). The government supported Organic Farming Project has established governmental structures and support services to expand organic production and foster the further development of this sector (Hartman et al, 2012). To help meet the high standards for quality, the MoEWA introduced its own Saudi National Organic Regulation and Standards in 2010. The Standards include guidelines for production, processing, trade and the import of organic products. The Department of Organic Agriculture (DOA) is responsible for the implementation, together with the monitoring and surveillance of all organic-sector activities within the Kingdom.

The founding of the Saudi Organic Farming Association in 2007 has paved the way for enhanced private sector in the organic agriculture movement in the Kingdom. In collaboration with DOA the National Regulation for Organic Agriculture 2010, the Saudi National Organic Logos, the Saudi Organic Consumer Logo and the Saudi Organic Input Logo have been developed and launched. This creates a good platform for the production, processing and marketing of organic coffee in KSA.

Recommendations

- i. MoEWA to spearhead legislation to guide certification and registration of Geographical indications

4.7 Coffee consumption trends

The Kingdom of Saudi Arabia is traditional a coffee consuming country. Coffee plays a crucial hospitality etiquette at home, offices and all social events. The coffee is mainly served in the traditional Arabic culture but now western style coffee culture is picking up driven by the youthful population. The Kingdom has a per capita coffee consumption of 2.18kg which compares well within the region but low when compared globally to countries like Finland with a capita consumption of 12kg.

For the Arabic coffee, known as *Qahwah arabiyya* is prepared using a long sprout kettle traditional Arabic coffee maker known as “*dalla*”. It is a legendary and traditional coffee drink made from light roasted coffee and ground to fine powder. The beverage is uniquely brewed with spices such as cardamom, ginger, and cloves garnished with saffron and served in small handle-less cup called “*finjal*”. It is enjoyed either in family gatherings or socially with friends and guests in usually in a *Majlis*, a large, comfortably seated guest outhouse located in the front yard of the home. Young Saudi men prefer to meet in traditionally coffee houses where they can hang out, play cards and games, drink Arabic coffee and smoke *hookah* or *shisha*. Arabic coffee is often served with dates and is enjoyed by both men and women from all segments of the society. The uniqueness of Arabic coffee lies on the fact that the knowledge and traditions are passed on within the family through observation and practice.

Within the Kingdom people in the western and central regions prefer lighter coffee with a golden hue while those the north prefer darker coffee and hence boil their coffee for long period. The coffee is then darker, more bitter and spicier. All the Arabic coffee is garnished with saffron (*Saffron crocus*) which gives it a golden colour. Saffron used in the coffee is the dry stigma (female part of a flower), sourced from Iran, Spain or Morocco. Saffron is one of the most expensive spices in the world.

Unlike other coffee producing countries farmers in Saudi Arabia also roast and prepare a coffee drink from the coffee husks-outer dry cherry cover separated during the hulling process known as *qishr*. This system of coffee processing and consumption can be considered sustainable as both the bean and husks are consumed contributing more returns to the traders. The consumption of the coffee pulp a by-product of wet processing is gaining ground under the name “*cascara*”. For both *qishr* and *cascara* the coffee must be grown without spraying with pesticides to avoid adverse effects of any residual pesticide on the coffee cherry and also proper storage to avoid fungal growth and mycotoxin contamination.

Beside the coffee consumed under the Arabic coffee tradition other western style coffee consumed at home, hotels and cafes. Recently there has been a rise in coffee consumption culture, known as 'specialty coffee' which has spread rapidly in Saudi Arabia, with local cafes popping up on the streets and in shopping malls.

The difference between coffee destined for the Arabic and western style coffee segment is the degree and time of roasting the green beans as shown in Table 6.

Table 6: Green bean processing requirements for Arabic and Western Style coffee

Coffee Beverage	Level of roast	Temperature °C	Roasting time in minutes
Arabic	Light	165	<10
Western style	Dark	210	>15

Coffee substitutes: These are non-coffee products, usually without caffeine, that are used to imitate coffee. There are people who would want to take coffee but fear caffeine addiction or due to healthy reasons/concerns cannot take caffeine. These substitutes which sometimes looks like instant coffee, smells like instant coffee then offer an alternative to coffee. They are gaining popularity in the Kingdom as depicted by the increasing volume of coffee substitutes in the country (Table 5). Between 2010 and 2019, the volume of coffee substitutes imported has increased 303%. Coffee substitutes anchored on healthy living as compared to unhealthy living usually tagged to coffee are a major threat to the coffee sector. Some of the common coffee substitutes are: -

- a. Dandy tea blend: This includes roasted barley, rye, chicory, and dandelion marketed under a common name,
 - b. Chaga mushrooms elixir: Includes chaga mushrooms that grow on birch trees, tastes like coffee, and regular drinkers insist that it has health benefits;
 - c. Teeccino: This includes roasted carob¹ seed, barley, chicory², and organic Ramon seeds³, and have a robust, rich, coffee-like flavour. Enthusiasts indicate that you can prepare it the same way normal coffee grounds are used
 - d. Postum, which is made of wheat bran. It's got a dark, sugar- flavour, and is said to be popular with kids
 - e. Ayurvedic Roast's coffee: Includes barley, rye, chicory and ashwagandha—which is one of those obscure ingredients that has become an inexplicably huge Instagram trend for smoothie bowl-makers.
 - f. Date seed coffee: Date seed coffee has been taken for a long time by the Bedouins and is associated with a multitude of health benefits. It is made from dried and roasted date seeds. Which can be used to make any coffee as with roasted coffee grounds. The challenge is to accumulate enough seed to make the coffee.
-

According to the International Coffee Organization, 2020, Saudi Arabia coffee consumption in the kingdom has been increasing steadily as shown in Table 7. The local coffee production cannot meet the demand and contributes approximately 0.001% of the total consumption.

Table 7: Annual volume of coffee consumed in KSA

Year	Coffee consumption (tonnes)
2016/17	85 800
2017/18	87 540
2018/19	91 670
2019/20*	95 880

* Estimates

Source; ICO, 2020

Recommendations

- i. Producers to be supported to increase coffee production as there exists a strong domestic and regional market.

4.9 Coffee quality standards and protocols

The government is supporting the coffee rural community to increase production and improve quality of the Saudi coffee. In order to improve, control and monitor coffee quality, establishment and operation of coffee quality control centres will be essential. Coffee quality laboratories are equipped to assess the coffee quality from the raw bean, roasted bean and the brewed cup. The analysis follows well laid down procedures developed and accepted internationally. They are manned by qualified staff after intensive training. The use of spices in Arabic coffee makes it very difficult to assess organoleptically the cup coffee quality using the current international protocols. There is need to develop the coffee per se standards and the brewing standards including the mixing ratios of the spices. The functions of the coffee quality control laboratories will be but not limited to: -

- a. To receive and analyse coffee samples from farmers, cooperative, associations and private sector. An advisory report will be generated for each sample indicating the quality profile and defects observed;
- b. To facilitate the quality characterization of coffee from the different regions for purpose of geographical Indication registration and protection of the Saudi coffee;
- c. To offer analyses to traders for coffee marketing purposes;
- d. To develop quality assessments for coffee destined for Arabic coffee segment;
- e. To train coffee quality analysis on regular basis. In this aspect the lead coffee analyst will make efforts to acquire training rights for the internationally recognized coffee quality assessment protocols;
- f. To serve as businesses incubation centres for coffee shops targeting women and youth.

Recommendations

- i. Setting up coffee quality laboratories in each of the coffee growing regions of Jazan, Aseer and Al Baha.

4.10 Agribusiness opportunities

The coffee sector in KSA offers a wide range of business opportunities that can be utilized by entrepreneurs of any age and gender. Some of the opportunities identified during the sector review are but not limited to: -

- a. Processing of coffee dry cherry to clean coffee: There is ripe market condition with a steady demand due to increased coffee planting, quality improvement, market gap and manageable risks.
- b. Processing of dry cherry to finished coffee and coffee products: There is steady demand for local Saudi coffee.
- c. Processing, packaging and utilization of coffee husks; These will be facilitated by centralized coffee processing after the construction of the coffee processing factory facilitating easy access to the husks. At the same time qishr is already popular beverage which traditional is associated with health and wellbeing benefits, a unique culture only available in KSA with a potential market for locals in diaspora. However, it is important to note that beverages made from the coffee cherry husks and pulp are already patented in the USA.
- d. Roasting, grinding and brewing coffee in the growing regions (vertical integration): there will be ripe market condition due increased influx of people as production increases and demand of labour and other services increases. Coffee drinking culture is entrenched in the traditions and coffee houses frequented by all classes of society. Cafes also serve as places where customers drink coffee, talk, catch up with the latest news, and a good distraction from unhealthy habits. Operating the coffee houses is a potential venture by the youth either as individuals or as a cooperative.
- e. Promotion of agritourism and eco-tourism in the coffee growing regions: Coffee is grown in beautiful mountain terrain on terraces creating a unique panoramic view that can be exploited for touristic attraction and outdoor hiking opportunities. It will also offer an opportunity for coffee consumers to experience first-hand coffee farm activities and even procure their coffee from source.
- f. Development, processing and packaging coffee flavoured drinks: With the anticipated increased production, a youthful population, anticipated increase in the tourism industry, a hot weather conducive to the cold beverage industry, assured pilgrimages each year flavoured drinks offer a steady

market opportunity. Some of the flavoured drinks ripe for consideration are yoghurt, laban, honey, dates and fruit juices.

- g. Connecting producers to skilled farm labour: Labour availability will be a key success factor for the coffee sector. A potential opportunity exists in sourcing, compiling and connecting the labour to where it is needed in the coffee value chain. It is a potential agribusiness for the youth.

4.11 Institutional capacity (public and private)

In most coffee producing countries and due to the relative importance of the commodity there are specific institutions mostly government based that are in charge of coffee. For example, National Federation of Coffee Growers (FNC) in Colombia, Coffee Boards in India, Kenya, and Tanzania. In the KSA, the Ministry of Environment, Water and Agriculture (MoEWA) is mandated to coordinate the coffee development. This is done under the Agriculture Department which has four directorates; Plant Production, Plant Health, Local and Migratory Pests and Research and Extension. Each region has MoEWA branch offices ensuring that services are available to the farmers. There are also other ministries, private sector, international and local organizations involved in the coffee sector.

The current agricultural extension officers are not trained on coffee production. As a result, there is a gap in expert knowledge and technical capacity among the staff. Farmers on the other depend on indigenous knowledge passed through generations. They are not trained on best agronomic practices, pests and disease control, harvest and post-harvest management. This scenario is compounded by lack of published technical information. The detailed training of researchers, farmers and extension staff is shown in Annex III.

There is little research on coffee agronomy, variety improvement, product development and value addition in KSA. Currently, there is no institution dedicated to undertake research on coffee. The existing research centres and agricultural universities have not ventured much into research on coffee has not benefited mainly because the crop was not formally recognized as key in the economic development of the kingdom despite being grown for many years. As a result, there is limited expert knowledge on the crop, and coffee production is wholly dependent on indigenous knowledge and technology.

The Kingdom targets to enhance the production of Arabica coffee to over 2 000 tonnes per year by the year 2025. This targeted coffee production will only be achieved by the development of innovations and technologies. An innovation is defined as a new method, idea, product while a technology is the application of scientific knowledge for practical purposes. The responsibility of generating innovations and developing technologies lies within research. An investment in agricultural research is therefore a key to the economic growth of the coffee sector.

The coffee research should also coordinate the importation of any seed or seedlings along the international material transfer and plant quarantine protocols. Besides development of innovations and technologies the research will also offer the other services to the sector mainly training, soil analysis, advisory, data collection collation and storage.

The Kingdom has a limited number of officers from MoEWA who are qualified in coffee production. It is recommended that young graduates be identified for further training in lead universities both locally and internationally. The training will be on split basis where the academic work and report writing will be at the university while the research work has to be done within the country. This training will create a pool of scientists for the sustainability of the industry.

The Coffee Research Centre once established will take over the role of training on coffee matters along the value chain. The coffee quality laboratories will offer specialized training on coffee quality analysis and assurance. The Research centre will liaise and collaborate with other stakeholders to offer well-coordinated and focused training on coffee matters within the Kingdom.

There will also short-term technical trainings targeting both extension staff and farmers. They are best undertaken in producing countries where actual practical training will be undertaken. The trained staff and farmers will become trainer of trainers (TOTs) and in turn train the farmers in the coffee growing areas. Farmers whose farms are used for demonstration will automatically qualify for the training.

Benchmarking trips are to facilitate to learning from the best or successful cases for any particular issue. They help to shorten the learning curve and also how to avoid mistakes done by others in the past. It is recommended that the trips be made senior officials from the ministry accompanied by technical staff it the focus of the visit. During the visits lessons learned include what works or does not work areas of collaboration, exchange of materials and information. Attendance of international coffee meetings and conferences is also crucial for networking and learning purposes.

4.12 Institutional framework

At the National level, the Ministry of Environment, Water and Agriculture provide the overall policy direction and leadership in the development of the coffee industry in collaboration with Regional

Governments, other government ministries and key stakeholders. Other roles include provision of extension services, enforcement of regulations and standards, availing farm inputs; facilitating access to market, provision of infrastructure for agricultural production, marketing, agro-processing and value addition. Specialized Government institutions like ADF, Monshaat, support the industry through their statutory roles as provided in respective statutes. The industry also depends on services provided by other institutions that provide inputs, equipment, research and training services.

There are therefore, many players along the value chain, both public and private with no clear policy guidelines on how each player participates in the process. There is danger of either conflict in operations or some key activities being not undertaken. There is need to develop a well-coordinated approach to ensure that all the efforts are targeted at improving the production and productivity and that there is no duplication of efforts or competition between the various service providers. To coordinate, harmonise and provide data and information, a specific office should be created within MoEWA to deal with all coffee matters led by a Coffee Development Officer. This office will streamline on data and information, coordinate promotion of coffee expansion (there are many players all supporting coffee production), guide and advise on processing, formation of coffee cooperatives and marketing. This will result in a more harmonised development of the sector. The services currently provided by the government and its institutions are shown in Table 8.

Table 8: Services offered by government and its institutions

Service	Service Providers	Remarks
Conducting Agricultural Research to develop appropriate technologies for coffee production and processing	Ministry of Environment, Water and Agriculture	<ul style="list-style-type: none"> Not well established as coffee has not been a priority crop
	Universities	<ul style="list-style-type: none"> Mainly research work by students
Provision of Extension Services	Ministry of Environment, Water and Agriculture	<ul style="list-style-type: none"> No enough extension staff

		<ul style="list-style-type: none"> • Staff not knowledgeable on coffee husbandry • Extension material not adequate • Difficult terrain where coffee is grown
	Public media	<ul style="list-style-type: none"> • Not coordinated and reliability of information
	Farmer-Farmer	<ul style="list-style-type: none"> • Limited in the coffee growing areas • Not based on facts but historical passed on through generations
	Agro input companies and shops	<ul style="list-style-type: none"> • Specific information for their products
Regulatory framework	MoEWA	<ul style="list-style-type: none"> • Mandated to regulate the industry • In liaison with the relevant government ministries and agencies develop policies and laws to regulate the sector and ensure a fair playing ground
Preparing policy and legal framework to Govern Coffee	MoEWA	<ul style="list-style-type: none"> • No specific policies on coffee research, production, marketing and promotion.
Availing seed and seedlings	Farmers own farms	<ul style="list-style-type: none"> • Old varieties • Poor nursery management • Limited number of seedlings
	Jazan Mountainous Development Authority	<ul style="list-style-type: none"> • Organized nursery • Has government support • Provide seedlings free to Jazan farmers and sells to all other farmers • Potential to expand
Supply of farm Inputs	Agro input Companies	<ul style="list-style-type: none"> • Avail fertilizers and other agro inputs to the farmers through their local outlets • Provide guidance on the use of their product • Highlight only the benefits of using their product
Financing the sector	MoEWA	<ul style="list-style-type: none"> • Rehabilitation of coffee terraces • Construction of water harvesting dams

		<ul style="list-style-type: none"> • Construction of concrete water storage tanks • Provision of drip irrigation facilities and equipment • Support conversion from qat growing to coffee by providing seedlings, labour and loss of income • Subsidize organic coffee production
	Agriculture Development Fund	<ul style="list-style-type: none"> • Set up by the government to assist farmers • Provides interest free loans for agricultural activities • Farmers indicate not easy to access • Will be a key player in the coffee enhancement programme
Promotion and marketing	<ul style="list-style-type: none"> • MoEWA • Individual farmers • Private companies 	<ul style="list-style-type: none"> • No government policy/guidelines • Not organized as an association • Individual farmer efforts • Regional promotion like the Jazan Coffee Festival held in February • No international exposure of the Saudi coffees

Major success in coffee farming has been attained through the cooperatives as the case in Brazil, Ethiopia and Kenya among other countries. Cooperatives bring members together to take advantage of economies of scale either for purchasing of inputs, processing and marketing the final products. Coffee cooperatives do provide farming assistance to its members for services like soil analysis, advisory on modern farming techniques, provide the right inputs at the right time and cost, provide farming credit at affordable rates, primary processing, quality assurance and control, access markets, promotion and training of members.

In KSA, there are about three (3) coffee cooperatives namely Khawlan Coffee Cooperatives in Jazan region, Baljurashi Agricultural Cooperative in Al Baha and one at Aseer. These cooperatives also focus on other agricultural products like honey. These societies are registered with the Cooperatives Societies Council the body responsible for regulating the cooperatives. The Khawlan Coffee Cooperatives intends to construct a coffee processing factory with the assistance of MoEWA. The Al Baha and Aseer cooperative societies are collaborating with ARAMCO (The largest oil company in the kingdom in a public-private sector partnership) for provision of coffee seedlings to the farmers. The Baljurashi Agricultural Cooperative in collaboration with

MoEWA is planning to establish a model coffee city in Al Baha, for commercial coffee production seed to cup. The city will serve as an eco-tourism centre.

Recommendations

- i. Formulation of a policy and enact regulations for the development of coffee sector
- ii. Development of viable and beneficial partnerships with leading international and local institutions involved in technology /innovation generation like Jazan University, World Coffee Research, CIRAD, Institute of Agronomic Research of Brazil among others;
- iii. Setting up a coffee research institute in the coffee growing regions preferably Jazan for the development of coffee technologies, innovations and management practices (TIMPS);
- iv. Establishment of coffee cooperatives for the production, processing and marketing of coffee Arabia produced in the coffee growing regions;
- v. Setting up of coffee based agri- and eco-tourism including coffee themed cities.

4.12 Risk management

Risk management is the identification, evaluation, and prioritization of occurrence of events that may have an adverse effect on the implementation of the development of the coffee Arabica production, processing and marketing. After identifying and analysing, suitable mitigation strategies to minimize, monitor, and control the probability and impact of the unfortunate events are put in place. The possible risks (probability and impact) that can affect the development of the coffee sector and the possible mitigation interventions are given in Table 9

Table 9: Risk matrix for the coffee strategy

Activity	Associated risk	Probability	Impact	Mitigation interventions
Development of innovations and technologies	Use of inappropriate technologies to grow coffee	Low	High	Establishment of the coffee research programme
Water scarcity	Lack of water for irrigation	Med.	High	Enhance and diversify water harvesting methods Promote efficient irrigation methods
Farm labour	Lack of adequate skilled labour	High	High	<ul style="list-style-type: none"> • Pooled operations • Attractive policies for emigrant labour

Low literacy levels within the farming communities	Low adoption of technologies and innovations	high	High	Training and capacity building
Lack of youth in coffee	Lack of succession hence coffee production becomes unsustainable	High	High	Youth specific opportunities and support by the government
Cooperative participation	Lack of coffee cooperatives	Low	Low	Cooperatives to be formed
Competition	Competition with other crops like qat and other high value crops	High	High	Government to support coffee producers to make coffee farming profitable
	Inflow of cheap coffees from outside the Kingdom	High	High	Government to set procedures to protect local coffee producers
	Coffee substitutes	High	High	
Environment	Vagaries of global warming and desertification	High	High	Planting of drought tolerant trees Efficient water use both domestic and farm Enhanced water harvesting and storage

5.0 CHALLENGES, SWOT AND GAP ANALYSIS

5.1 Challenges

The broad challenges as identified current situation analysis are low productivity compared to the average global yield; water scarcity, deterioration of terraces and replacement of coffee plantations by other crops; inadequacy of suitable coffee seedlings for the different ecological zones; weak agricultural extension and research services resulting in negative impacts on coffee plantation and development; poor institutionalized finance and credit to small-scale coffee producers and weak physical and institutional infrastructure for coffee post-harvest services. For ease of developing specific interventions, the broad challenges are further assessed on specific areas. These are summarized as follows: -

a. Inadequate access to services, technologies and innovative practices

- i. Poor soil management and low mechanization in coffee farming;
- ii. Inadequate availability and access to high quality planting stock;
- iii. Water scarcity, poor irrigation practices, terraces deterioration, and replacement of old coffee trees;
- iv. Poor management and limited information on coffee pests and diseases;
- v. Absence of coffee research to generate improved technologies and innovations;
- vi. Inadequate institutional financing and credit for the coffee subsector;
- vii. Inadequate extension/advisory services support to promote and develop the coffee subsector;
- viii. Poor presence of active agriculture cooperatives;
- ix. Harsh climatic conditions accompanied by absence of data for coffee production purposes

b. Limited marketing, agribusiness and value addition services

- i. Limited access to markets and low coffee volumes;
- ii. Absence of appropriate coffee quality standards and assessment protocols;
- iii. No branding and commodity protection registration of Saudi coffee;
- iv. No coffee sorting, grading or quality classification;
- v. Limited coffee agribusiness, SMEs and entrepreneurship;
- vi. Lack of, or limited coffee value addition support services;
- vii. Poor coffee harvesting and post handling practices and weak physical and institutions;
- viii. Inadequate coffee development partnerships and limited linkages among actors and stakeholders.

c. Inadequate capacity of the coffee smallholders, public and private value chain actors

- i. Inadequate trained technical coffee development specialists and extension services staff;
- ii. Limited technical/management knowledge among coffee producers;
- iii. Absence of specialized coffee development institutions and organizations;
- iv. Limited/weak capacity of coffee farmer's institutions, associations and cooperatives;
- v. Long and historic knowledge on coffee farming not documented;
- vi. Absence of appropriate coffee production, harvesting, post-harvesting and marketing technical /management guidelines/ manuals;
- vii. Lack of reliable coffee production/ trade data and information;

- viii. Absence of appropriate interactive knowledge sharing platform/services;
- ix. Limited coffee production/development awareness and promotion campaigns.

5.2 SWOT analysis

The analysis of internal environment is undertaken to identify the strengths as well as the weak areas of the sector. It also identified the opportunities and threats. It also identified the opportunities and threats. The aim is to minimize the effect of the identified weaknesses and threats while safeguarding the strengths and exploiting the opportunities. The strengths, weaknesses, opportunities, and threats of the coffee production, processing and marketing in KSA are as follows:

Strengths

- a. Coffee is not a new crop having been cultivated for over 300 years;
- b. Presence of a strong traditional Arabic coffee consumption culture, which has a great social and market significance;
- c. Presence of some well-equipped coffee quality analysis laboratories in the Kingdom;
- d. Well trained coffee cup graders (Q- graders under Coffee Quality Institute (CQI) of America;
- e. Climate that does not favour the occurrence of the major diseases and low incidences of major coffee pests;
- f. Presence of organic farming standards, the Saudi National Organic Regulation and Standards 2010;
- g. Strong presence of both local and international coffee processors;
- h. Political goodwill evidenced by the high priority coffee is given under Vision 2030 and National Transformation Program;
- i. Agriculture Development Fund where coffee farmers can access funds for the coffee farming;
- j. A financially stable economy;
- k. Financial support of the coffee farmers by government and government agencies;
- l. A high proportion of youth that can drive agro business and consumption

Weaknesses

- a. Lack of support institutions for research, extension, marketing and regulation;
- b. Lack of policy guidelines for the coffee industry;
- c. Limited data and information for planning purposes;
- d. Harsh coffee growing environment evidenced by high temperatures and inadequate rainfall to sustain coffee growth and production
- e. Low water harvesting and storage practices;
- f. Lack of improved high yielding, high quality coffee cultivars;
- g. Lack of established coffee seed and seedling production mechanisms;
- h. Old, obsolete and inappropriate coffee processing facilities;
- i. Lack of women and youth in coffee production and processing;
- j. Old and deliberated terraces in the farms.

Opportunities

- a. Presence of a Coffee Festival in Jazan, which can be used to promote coffee production and consumption;
- b. The Kingdom of Saudi Arabia is among the fastest-growing coffee market in the world;

- c. Available market coffee in the Kingdom and within the GCC;
- d. The government's attempts to strengthen non-oil sectors of the economy should benefit areas such as tourism, food and retailing, which would have a positive impact on on-trade sales of coffee;
- e. The registration of Khawlan coffee as a UNESCO heritage will encourage eco-tourism and promote the consumption of Arabic coffee;
- f. Coffee shops offering coffee in towns and major highways;
- g. Emerging Coffee Academies that can carry out training on coffee quality analysis;
- h. A large youth population (about 25 percent of the population) who can be engaged as entrepreneurs along the value chain and are a target for the consumption.

Threats

- a. Competition with qat *Catha edulis*, which has the same biophysical requirements as coffee and a shorter value chain;
- b. Possibility of growing other high value crops like almonds, anona (*Annona squamosa*), jasmine (*Jasminum spp*), roses (*Rosa spp*);
- c. Insecurity in the coffee growing areas;
- d. Competition with cheap imported coffees;
- e. Competition with cheap coffee coming from neighbouring countries through illegal means;
- f. Introduced coffee pests through imported coffee;
- g. Severe shortage of farm labour;
- h. Lack of youth involvement;
- i. Consumption of coffee substitutes (imports increasing), water and soft drinks.

5.3 Gap Analysis

After analyzing the current situation and undertaking both SWOT and PESTEL analysis the following critical success factors (gaps) were identified: -

a. Availability of improved coffee varieties

- i. The coffee varieties/landraces are old having been grown by the farmers for over three centuries. Their characteristics mainly morphological, disease and pest resistance, water use efficiency, yield and quality has not been documented. In order to proceed with development of new varieties, there is need to characterize this variety and identify its strong and weak parameters. This will assist in determining the way forward.
- ii. Breeding the local varieties with external germplasm which has identified and desirable characteristics will lead to improved varieties suited for the country. For this to succeed there will be need to train coffee local breeders but in the short term coffee breeders can be recruited to start the breeding programme.
- iii. The coffee breeding programme could be in one of the universities or a special coffee research centre set up for this purpose.

b. Water Use Efficiency

- i. Water is the most serious challenge facing agriculture in the Kingdom, because there are no perennial rivers or permanent bodies of water. There is also competition for water between agriculture and domestic/industrial activities. The total amount of rainfall and the distribution is not optimal for coffee production and supplementary water through irrigation is critical.
- ii. Farmers harvest runoff water from the mountains and store it in underground tanks or have dug shallow wells. The farmers make a basin of about 1m diameter and 15 cm deep and pour water using hosepipes at least four times a week. This is an expensive and wasteful way of irrigating coffee and there is need to adopt more efficient irrigation practices.

c. Soil Fertility Management

- i. The coffee is grown high on the mountains in man-made terraces. The terraces assist in reducing soil erosion and also conservation of water. In most of the areas the terraces are old and dilapidated and more increased coffee production, will require to be renovated. The government under Vision 2030 has identified this as a key issue and is prioritized in the National Transformation Programme as Initiative no 13 (Rehabilitation of agriculture terraces and application of rainwater collection technologies in the South West area of the kingdom). The soil fertility status determines to a great extent the coffee yield and quality. Besides repairing the terraces, a soil analysis in the coffee growing areas need to undertake.

d. Disease and Pest Management

- i. Coffee is attacked by a wide range of diseases and pests depending on the locality and cropping system. The most common coffee ones Coffee Leaf Rust caused by a fungus *Hemileia vastatrix* and Coffee Berry Disease also caused by a fungus, *Colletotrichum kahawae*. These two diseases cause a lot of damage in the coffee producing countries and their management accounts for about 30% of the production costs;
- ii. Several insect pests attack coffee reducing yield and quality and those already observed are mealybug, berry moth, scales and leaf miner. Some like the berry borers enter the berry at an early stage and feed from inside. The cherry looks health from outside but contains nothing inside;
- iii. Disease and pest survey to be carried out and management strategy for the most prevalent diseases and pests be developed and disseminated.

e. Processing

- i. There are two methods of processing coffee cherries after harvesting: wet method and dry methods. The wet method uses pulping machinery and the process is very rigid while in the dry method (coffee processed this way is known as natural) harvested cherries are dried in the sun. The coffee is then milled to separate the now dry outer cover (husk) and the bean. The husks and the bean are roasted for consumption;

- ii. Due to water scarcity the Saudi coffee is processed through the dry method. However, farmers need to be trained on when to pick and how to dry for retaining the intrinsic quality of the local varieties;
- iii. Equipment used for hulling are not the right ones resulting in damaged beans;
- iv. There is no sorting to remove defects and foreign matter.

f. Marketing

- i. Farmers after processing their coffee on the farm transport and market the coffee as individuals with no bargaining power. The farmers will benefit more if they form cooperatives for purposes of production, processing and marketing. This will be advantageous in terms of economies of scale and also will allow the farmers negotiate for better prices or develop novel.

g. Institutional arrangement

- i. Coffee is a specialized commodity with a long value chain and players both local and overseas. For the smooth running of the industry and also ensuring that all the actors know their respective role and does not infringe on others, a clear industry organizational structure is a key success factor.





6.0 BENCHMARKING WITH THE BEST PRACTICES

Best practices and technologies are those developed and adopted by the high coffee producers that can be borrowed and used to improve productivity and quality without the inventing the wheel. They include all the measures undertaken in coffee farming to ensure its safety to consumers and the producers and include good husbandly practices up to processing. These practices include good growing environment, use of certified and disease-free planting materials, proper establishment, tree training, pruning, nutrition and effective control of weeds, diseases and pests. It also includes measures on safe use of agricultural chemicals to minimize contamination with pesticides, proper harvesting, cherry handling as well as proper documentation and record keeping at farm level. The best practices in coffee have been benchmarked with Arabica coffee producers known for high production or high quality, Brazil, Colombia, Honduras, Ethiopia Vietnam, India and Hawaii (Table 10). Bench marking has also been done with international institutions World Coffee Research (WCR), CIRAD, SCA and ICO (Table 11) for improved high yielding disease and drought tolerance, demonstration plots and training of stakeholders.

Table 10: Benchmarking best practicing countries in coffee production, processing and marketing

Criteria	Brazil	Colombia	Honduras	Ethiopia	Vietnam	India	Hawaii
Presence national coffee policy		✓	✓			✓	
Presence of a national coffee extension programme	✓	✓	✓	✓	✓	✓	
A strong coffee research		✓	✓		✓		
Development of coffee varieties		✓	✓				
Cultivation of coffee on steep slopes			✓				
Presence of a coffee quality assurance program	✓	✓	✓		✓		✓
Presence of improved management practices		✓	✓		✓		
Operational coffee demonstration plots			✓	✓	✓		
Strong cooperatives and farmer associations	✓	✓	✓	✓	✓		✓
Efficiency in water use for irrigation	✓				✓		
Involvement of private sector	✓				✓		
Presence of registered Geographical Indications (GI)		✓	✓		✓	✓	
Effective protection of the GI							✓

Table 11: Benchmarking with key international coffee institutions

	 WORLD COFFEE RESEARCH™	 cirad AGRICULTURAL RESEARCH FOR DEVELOPMENT	 Specialty Coffee Association	 INTERNATIONAL COFFEE ORGANIZATION
Coffee breeding and varietal development	✓	✓		
Modern Research laboratories	✓	✓		
Participatory research	✓	✓		
Capacity Building	✓	✓	✓	
Development of Geographical Indications		✓		
Coffee quality standards	✓		✓	
International coffee agreements and statistics				✓
Tissue culture & biotechnology	✓	✓		
Marketing linkages			✓	✓

7.0 CONCLUSIONS AND WAY FORWARD

Based on the comprehensive assessment, Arabica coffee farming is a viable farming activity in the Kingdom of Saudi Arabia. It can become a source of income and job creation for the rural communities in the south western regions of Jazan, Aseer and Al Baha. Coffee will also assist in disinvesting in qat production.

However, to achieve these goals key issues in innovative technologies, marketing and capacity building will have to be undertaken as per recommendations given as a way forward. From the comprehensive sector review the following interventions for various stages of the value chain are suggested: -

a. Promote technologies and innovative practices among coffee smallholders

- i. Assess coffee Arabica sector and undertake benchmarking activities;
- ii. Promote best ecological practices and pest resistant including high yielding coffee varieties;
- iii. Catalogue coffee diseases, pests, and weeds, and implement an IPM programme for the control measures;
- iv. Pilot and promote farm power and mechanization in coffee production;
- v. Establish coffee seed orchards and modern nurseries to produce and avail healthy coffee seedlings;
- vi. Pilot and promote efficient irrigation technologies/practices for the various coffee farming systems;
- vii. Promote water harvesting practices and technologies;
- viii. Design programme to promote access to institutional and credit financing for the coffee subsector;
- ix. Implement programme to deliver quality extension and advisory services to coffee producers and processors.

b. Develop coffee marketing, agribusinesses and value addition

- i. Assess the coffee small agribusiness, available local skills and its development scope;
- ii. Establish an incubation programme for promotion of small agribusiness entrepreneurship;
- iii. Develop Coffee viable business models for youth and women and a plan for coffee Small and Medium Enterprises (SMEs);
- iv. Design and implement a programme to promote coffee value addition and related services;
- v. Develop coffee sorting, grading and quality classification services within the coffee sector;
- vi. Assess access of Saudi coffee to markets including contract farming and other options;
- vii. Establish geographical indications and develop effective branding strategies for Arabica coffee;
- viii. Connect coffee to e-market platform to enable timely access to transparent market information;
- ix. Review current situation of agricultural/coffee cooperatives in KSA;
- x. Develop and pilot business models for coffee cooperatives;
- xi. Develop a coffee cherry picking regime and disseminate coffee harvesting/processing practices

c. Strengthen the capacity of coffee smallholders and other value chain actors

- i. Design and conduct training for technical coffee development and extension specialists within MoEWA;
- ii. Develop and implement technical/management training for coffee value chain actors;
- iii. Establish a coffee development specialized institutions or units within MoEWA;
- iv. Conduct training to strengthen technical and managerial skills of the cooperative officials and members;
- v. Conduct diagnostic study on rural development, research and extension service structures;
- vi. Develop appropriate structures for coffee research, extension and information services;
- vii. Promote the formation of coffee farmers' cooperatives and build their capacity;
- viii. Implement awareness campaign for small producers and cooperatives members;
- ix. Review coffee cooperatives policies, and regulatory framework.

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ANNEXES

Annex I: List of stakeholders met and interviewed

	Name	Office	Telephone
1.	Fahad Moftah Salem Al Zahranie	DG, MoEWA Al Baha region	0502777707
2.	Naief Saeed Al Abdalie	Agri. GM, MoEWA, Al Baha	0559511099
3.	Mohammad Jafar Al Bahranie	MoEWA Al Baha region	0562200047
4.	Jar Allah Ahmad Al Ali	MoEWA Al Baha region	0556688731
5.	Saleh Awad Al Zahranie	MoEWA Al Baha region	0506773045
6.	Abdullah Mohammad Al Zahranie	MoEWA Al Baha region	0506777996
7.	Eng. Joma'an Mohammad Hamad	MoEWA MekwaH, Al Baha	-
8.	Eng. Muhammad Ali Alateef	DG, MoEWA Jazan region	0500798919
9.	Ibrahim Ja'afari	MoEWA Jazan region	-
10.	Ahmed Ali Zalayi	MoEWA Jazan region	-
11.	Mohamend Arrhem	MoEWA Jazan region	-
12.	Yahya Mashawi	MoEWA Jazan region	-
13.	Salman Hamad Al Malki	MoEWA, Al Dayer Governorate	0533316543
14.	Bandar Jobran Al Sharahelie	MoEWA Aidabie Governorate	0500974404
15.	Mohammed Goghdomi	Manager, MoEWA, Al Aridhah	0500404764
16.	Saad Abdul Aziz	Deputy Director, Jazan Mountains Development Authority	0502775612
17.	Prof. Mohammed H. Aburasain	Vice President for Graduate Studies and Research	173295000 (Ext 2607-2608)
18.	Prof. Zarraq Al Faifi	Director of Centre for Environmental Research and Studies, Jazan University	0505545709

19.	Prof. Habib M. Khemira	Centre for Environmental Research and Studies, Jazan University	0537135188
20.	Ahmad Darraj	Director, Agriculture Development Fund, Jazan Region	-
21.	Fawwaz M Zaaqam	Agriculture Development Fund, Jazan Region	-
22.	Mosa Dallak	Agriculture Development Fund, Jazan Region	-
23.	Ahmad Wali Hakami	Agriculture Development Fund, Jazan Region	-
24.	Alawe Alsafe	Agriculture Development Fund, Jazan Region	0505768804
25.	Dr. Munir Al Ramhie	IFAD Projects Manager	0556958620
26.	Shaiban Arishi	AFAD, Jazan	
27.	Ahmad Mohammad Al Gonfodie	Ministry of Human Resource and Social Welfare, GM	
28.	Hasan Al Ameer	Social Welfare Branch, GM	
29.	Naief Mohammad Hakamie	Social Welfare Branch, Cooperative Unit Officer	0597899951
30.	Abdul Razak Hanash Al Zahranie	Farmer Al Mandaq	0504586781
31.	Ali Algandie	Farmer Shada Mountains	
32.	Yahya Mohammed Yahya	Coffee farmer, Fayfa Governorate	
33.	Mofareh Hassan Al Faifi	Coffee farmer, Fayfa Governorate	0554244192
34.	Jabal Suleiman Hassan	Coffee farmer, Faifa	

		Governorate	
35.	Feisal Hassan Al Malkie	Coffee farmer, Al Dayer Governorate	
36.	Salman Ahmed Al Malkie	Coffee, farmer, Al Dayer Governorate	0582122000
37.	Jabran Mohammed Al Malik	Coffee farmer, Al Dayer Governorate	
38.	Al Salman	Coffee farmer, Al Aridhah Governorate	
39.	Mohammed Yahya	Coffee farmer, Al Aridhah Governorate	

Introduction

All over the world millions of people regardless of race, gender or age start their day the same way. With a cup of steaming coffee prepared to their taste be it an Americano, cappuccino, a mocha, espresso or filter coffee depending on their preferences and local availability. The caffeine in the coffee is a stimulant and a cup in morning wakes up the brain, invigorates the body ready to face another day. In the year 2020/21 a total of 166.63 m bags, 60kg each (9.997m tons) of were consumed despite the COVID 19 pandemic, a slight increase from 2019/20 of 164m bags of 60 kg each (9.84m tons). Consumption is expected to rise to over 166m bags in 2020/21 (9.96m tons).

The Coffee Process Bean to Cup

To get to the cup, the coffee takes a long journey from the producing countries most of them along the tropics to the consuming countries. The coffee is processed to the different forms, blends and brands for consumption in the consumer countries although some of the processes coffee finds its way to the producing country. On average most coffee drinkers take 2-3 cups a day, but consumers in the Norwegian countries consume up to 12.0 kg per year per person. Moderate Coffee consumption is associated with reduced incidence of Type II diabetes, kidney stones, high aptitude for maths and sciences with students and longevity. Coffee consumers are adventures looking out for unique experiences. Kopi luau and black ivory coffee prepared from beans collected from the faeces of the civet cat and elephant in Indonesia and Thailand are among the most expensive coffee in the world. Recently one hotel in Kenya offered coffee laced with gold leaf at USD50 per cup. This brochure is aimed at assisting non coffee drinkers to understand coffee jargon and be able to make informed choices while choosing their coffee in cafes, hotels and restaurants or while buying coffee for home consumption.

i. Green beans

After ripe coffee cherries are harvested and sundried they produce dried cherry coffee. The dried cherry coffee is hulled to separate the cover (husk) from the seed also known as bean due to its shape. This final bean which is ready for roasting is referred to as green or clean coffee. In KSA the coffee cherries after harvesting are dry processed.

ii. Roasted beans

All coffee regardless of the brewing method used is roasted. The roasting is done professionally using specialized roasters. At local level pan frying is practiced a practice prevalent in Ethiopia. The roasting ranges from very light (for Arabic Coffee) to dark (almost burnt). The level of roasting depends on the brewing method anticipated. Most roasting is done in consuming countries. Roasted coffee has to be stored in airtight bags with a one-way valve- allowing carbon dioxide out and not allowing oxygen in. If well stored it can last for 12 months but generally quality deteriorates with time.

iii. Ground coffee

After roasting, the coffee is ground either by hand grinders or machine. The fineness of the grinding depends on the brewing method anticipated. Ground coffee should be kept in airtight containers and can last three months but the quality deteriorates with time.

iv. Soluble

Instant coffee is commercially prepared by either freeze-drying or spray drying; after which it can be rehydrated. Factory processed to make the coffee soluble. This is what is used for instant coffees Instant coffee in a concentrated liquid form is also manufactured.

v. Husks

The fresh pulp after squeezing out the bean under the wet processing is dried and used to make a coffee beverage as it contains some caffeine. The dry pulp is referred to as cascara and is ONLY used where no spraying is done on the coffee. The husks after hulling the dry coffee cherry which is about 50% by weight of the dry cherry is used to make a coffee beverage referred to as qishr in Arabic. For both systems the husks are boiled in a similar manner to the preparation of Indian tea and served with milk and sugar as needed.

v. Decaffeinated

Factory processed to remove caffeine to near zero levels. Decaffeinated coffee is for those people who for different reasons may be affected by caffeine (the active ingredient in coffee). There are also coffee varieties that contain caffeine and this are being developed to produce caffeine free or low caffeine coffee varieties.

c. Coffee beverages

The coffee beans after roasting and grinding are transformed into a wide range of coffee beverages based on the country, region, culture and income levels. An attempt has been made to describe the various coffees and coffee beverages. Coffees with blended with alcohol are not discussed in this review.

i. Arabic Coffee: The Saudi Coffee Culture

Coffee consumed in the Kingdom is traditionally known as Arabic coffee or *Qahwah arabiyya* prepared preferably from locally grown coffee. Saudis, Arabs, and Turkish nationals prefer to drink Arabic coffee.

Saudis drink it by pouring it from an Arabic Coffee pot (*Dalilah*) into a tiny handle less cup called a (*Finjal*). It is enjoyed either in family gatherings or socially with friends and guests in a majlis, a large, comfortably seated guest outhouse located in the front yard of the home.

Young Saudi men prefer to meet in traditionally built and decorated coffee houses where they can hang out, play cards and games, drink Arabic coffee and smoke the increasingly popular water pipe called a hookah or shisha.

Saudi people love to buy two popular brands of coffee beans in the (Attar). The cheapest and most available is from Ethiopia and the most expensive is from Yemen.

People in the Western and Central regions of the kingdom prefer lighter, golden almost transparent brews. People from the north cook their coffee for up to an hour sometimes preferring darker, stronger more bitter, spicier brews.

The local coffee growing communities attribute the coffee growing culture to their ancestor Khawlani bin Amir and hence the coffee they grow is known locally as Khawlani. Ripe coffee cherries are harvested and sundried to produce dried cherry coffee. The dried cherry coffee is hulled to separate the cover (husk) from the beans. The products of hulling are green coffee beans and the coffee husk both of which are consumable in the Saudi culture (beans for Arabic coffee and husk for qishr).

Arabic coffee is made from coffee beans that are lightly roasted to a light golden colour, ground to a fine powder, boiled and served with saffron, cinnamon, cardamom, ginger or cloves depending on preference. The coffee is poured from a special local coffee pot known as dallah into small cups without handles. The server always holds the serving coffee pot with the left hand and serves with the right and guests receive with their right hand consuming it without sugar. A bowl of dates is usually served as accompaniment to the Arabic coffee to mask the bitter taste of the sugarless coffee. It is customary to serve up to three cups of qahwa and a guest should at least accept one cup. Wiggling the empty cup from side to side when finished indicates that the guest has had enough. Arabic coffee is consumed both at home and horeca (Hotels, restaurants and cafes) and drunk by both men and women. Arabic coffee made not be available hotels, restaurants and cafes outside the Gulf Cooperation countries.

ii. Qishr

This is a tea like drink made from coffee husks (dried skin of a dry coffee berry) of Saudi grown coffee. Due to the high cost of Saudi grown coffee, the husks are an affordable alternative to many rural folks. As no pesticides are used in coffee, it is safe to use the husks but there is need to monitor pesticide usage at all times. Not common, but coming up using coffee pulp from coffee grown without use of pesticides. Goes under the name “cascara”. Proper storage is necessary to avoid fungal growth and mycotoxin contamination.

iii. Turkish coffee

This is coffee prepared from dark roasted and fine ground coffee without filtering. It is boiled using a special copper container and over low fire. Available in many cafes in the main towns.

iv. Machine made coffees

These coffee are prepared using special coffee making machines at hotels, restaurants and cafes. Both regular and decaffeinated coffee is used depending on customer needs. The coffee is served hot or cold (iced coffee), with sugar, milk, chocolate or alcohol depending on taste and income. Coffees blended with alcohol are not discussed in this review.

Espresso: To prepare a cup of espresso hot water under pressure is passed through finely-ground coffee. The beans used for espresso are roasted for a longer period and produces dark coloured beans. Espresso is served in tiny cups as a single or double shot, terms borrowed from the liquor industry. The coffee served back and preferably with no sugar although some consumers add sugar or hot water. In most cases espresso coffee is taken after a meal and is thought to help in digestion. It also taken to keep the one awake particularly during long meetings or long drives. One has to get used before appreciating the intrinsic beauty of an espresso cup. Espresso is the base for a number of coffee brews: -

- Cappuccino - cappuccino is an espresso-based coffee drink that originated in Italy, and is traditionally prepared with steamed milk foam. Variations of the drink involve the use of cream instead of milk, using non-dairy milks, and flavouring with cinnamon or chocolate powder. It is usually served in wide brim cups with a nice pattern drawn on top of the foam with black coffee.
- Coffee latte is a coffee drink made with espresso and steamed milk. The word comes from the Italian caffè e latte, which means "coffee and milk".
- Macchiato: Coffee macchiato, sometimes called espresso macchiato, is an espresso coffee drink with a small amount of milk, usually foamed. In Italian, macchiato means "stained" or "spotted" so the literal translation of caffè macchiato is "stained" or “marked coffee
- Mocha: A coffee mocha, is a chocolate/vanilla-flavoured coffee latte. The name is derived from the city of Mocha, Yemen, which was one of the centres of early coffee trade. Commonly served in a glass with a handle.

- **Americano:** Café Americano is prepared by diluting an espresso with hot water, to give it a similar strength to, but different flavour from, traditionally brewed coffee. The strength of an Americano varies with the number of shots of espresso and the amount of water added. It is served black but a sweetener may be added.

v. Filter coffees

Filter coffee brewing involves pouring hot water over coffee grounds. Gravity then pulls the water through the grounds, facilitating extraction, and dispenses it into a mug or carafe placed below. Without pressure to quicken the extraction, it takes more time and water to produce a rich, balanced mug. Filter coffee is made using a standard coffee maker, a chemex brewer, pour over for single cups (coffee grounds are put in an ordinary tea sieve lined with coffee filter and placed on top of a cup or mug). Hot water is poured slowly until the grounds are saturated. The coffee is not stirred and is allowed to brew for about one minute and is ready for drinking. Milk (hot or cold) and a sweetener can be added.

vi. Single Serve coffees

A single-serve coffee is a method for coffee brewing that prepares only enough coffee for a single portion. It is recent innovation, where a measure ground coffee enough for one cup is put into a small container known as pod or capsule or K-cup and vacuum sealed. Single-serve coffee reduces the time needed to brew the coffee and simplify the brewing process by eliminating the need to measure out portions, of both coffee and water. A special machine is used to prepare the coffee. High quality coffees are used and so cost is also high. A new system where the capsules will have bar codes so that the machine can identify what is the type of coffee, the amount of water needed, ideal temperature and centrifugation rate have been developed by already in the market.

vii. Instant /soluble coffees

Instant coffee, also called soluble coffee, coffee crystals, and coffee powder, is a beverage derived from brewed coffee beans that enables to quickly prepare a hot cup of coffee by adding hot water or milk to the powder or crystals and stirring. They are very popular as they are easy to make. The ground coffee is factory processed to make it soluble either by sprain during or freeze drying. The coffee is also mixed with creamer and sugar packed in sachets enough for one cup reducing the need to measure portions of coffee and water. For a long time, instant coffee was produced using Robusta coffee and hence known for low quality. However, with development in coffee technologies instant coffee is now produced from both Robusta and Arabica coffee. Due to its easiness in preparation and availability in single cup sachets it is very friendly to students, workers and even coffee producers. Instant coffees are prevalent in all coffee consuming and producing countries and the market is growing. Instant coffees generally have less caffeine than that brewed coffees.

viii. Ready to drink (RTD) coffees

This can be defined as packaged and constituted coffee beverages that are sold in a prepared form and are ready for consumption. All the machined made coffees can be packaged and availed as RTD. They are available in supermarkets and vending machines. They are mostly served cold but with a possibility of heating in a microwave though the microwave breaks down the intrinsic aromas thus lowering quality.

ix. Whipped Coffee/Algona Coffee

This is a coffee beverage made by whipping equal proportion of instant coffee powder, sugar and hot water until it becomes creamy. This mixture is then added to cold or hot milk and topped with assorted confectionary like biscuits honey. It is also known as Dalgona coffee.

Annex III: the Countries proposed benchmarking and learning points

Country	Key Strategic Actions	Learning Points
Colombia	<ul style="list-style-type: none"> • Creation of the Colombian Coffee Growers Federation (FNC) that brought all the coffee stakeholders together and offers support for the whole value chain, • Creation of the national logo of Juan Valdez, for promotion of Colombian coffee, • Have a Stabilization Fund to support farmers during periods of low prices • FNC has trade representatives in North America and Europe • Have a Coffee Growers Committee, responsible for adopting measures to guarantee export coffee quality, which must be met by the Colombian Coffee Growers Federation (FNC) and private exporters alike. • Established a strong coffee research (Cenicafe). The country strategically invested in developing a coffee leaf rust resistant variety before even the disease was reported in the country. • Cenicafé with support of coffee farmers been the developing appropriate technologies for coffee production in Colombia in terms of economic, environmental and social sustainability. • Have adopted the highest coffee planting spacing of 1 X 1m (10,0000 plants/ha) but with 	<ul style="list-style-type: none"> • Growing of coffee on hilly landscape similar to Jazan • Formation and operation of coffee associations • Coffee promotion and marketing • Branding and certification including Geographical Indications • Research management and financing • Provision of extension farmers

	<p>very high fertilizer applications</p> <ul style="list-style-type: none"> • Coffee beans are selected one by one by picking those with the adequate ripeness level, and they are wet processed • When coffee production stagnated at 12m (60kg) bags for over five years, the government supported a coffee rejuvenation programme 2008-12. • Production dropped to 8m (60kg) bags but has increasing steadily to 15m (60kg) bags and projected to reach 16m (60kg) bags in 2021. • Has a coffee theme park 	
Brazil	<ul style="list-style-type: none"> • Introduced mechanized harvesting to manage coffee operations and reduce labour costs, • Harvested cherry is also sorted by machines to remove unripe cherries and trash as a quality control measure, • Characterized by low production costs of labour, land, and water • Moved coffee northwards though more dry to escape frequent frosts that was destroying coffee, • Invested in development of drought tolerant varieties • Invested in research for efficiency water use in coffee production. • Coffee farmers have been empowered to make informed decisions on production, 	<ul style="list-style-type: none"> • Modern irrigation technologies • Role of cooperatives in coffee production, processing and marketing • Equipment and machinery for coffee processing • Coffee growing under harsh environment-droughts and frost • Demand driven research • Farmer empowerment




	<p>processing and marketing</p> <ul style="list-style-type: none"> • Allowed cooperatives to manage the whole value chain. Boasts of the largest coffee cooperative in the world; Cooxupé with 12,000 member • Cooperatives are the main distribution channel for lime, fertilizers, agrochemicals and seeds. • Have developed machines and equipment to efficiently undertaking post-harvest processing 	
Honduras	<ul style="list-style-type: none"> • In 2000 the government established CONACAFE (National Council of Coffee) to take care of all aspects of coffee production, harvesting and exports, • In 2000 IHCAFE (Honduran Coffee Institute) was established to address technical issues of coffee production, • A national Coffee Policy was developed in 2003 to provide strategic direction for the coffee sector, • The government of Honduras created the Law of Financial Reactivation of the Coffee Production Sector in 2003 in order to support coffee producers, • The National Council of Coffee established National Coffee Fund to support infrastructure mainly roads in the coffee growing areas, • Early Warning System for Coffee Production was 	<ul style="list-style-type: none"> • Role of government in supporting coffee • Formation and operation of cooperatives • Coffee varietal development • Measure to increase national coffee production


	<p>established in 2012 mainly to provide alerts on diseases and pests.</p> <ul style="list-style-type: none"> • IHCAFE’s Research and Development Centre is continuously evaluating the resistance level of leaf rust-resistant coffee varieties and have developed two leaf rust varieties Parainema and IHCAFE 90. • Has a Coffee Quality Control Laboratory and School of Coffee Tasters • IHCAFE has established a cupping School for young Hondurans to learn coffee quality, and also in conjunction with the local university established coffee degree programmes 	
Ethiopia	<ul style="list-style-type: none"> • Coffee is marketed by regional cooperatives (Unions) after they buy the coffee from the primary cooperatives. Farmers are then paid within two weeks after delivering their coffee, • Government supported extension services • In 2008 the government established the Ethiopian Exchange, to eliminate the huge number of middlemen and to enable coffee farmers to benefit from prevailing market prices. • Coffee Unions are allowed to directly export “specialty coffee” • Government trying to lower domestic consumption and increase the exports 	<ul style="list-style-type: none"> • Coffee production by small scale farmers • Drying processing of coffee cherries • Role of cooperatives in marketing coffee • Centralized coffee marketing system • How to apportion coffee for domestic consumption and export markets

Vietnam	<ul style="list-style-type: none"> • Farmers keep on rejuvenating their trees, • The government facilitates the availability of inputs, • Farmers can store their coffee during periods of low prices and sell when prices improve, • There is significant private sector involvement in the coffee production. • Nearly all smallholder farmers construct their own wells and pump water for irrigation • Agro-inputs are accessible and widely utilized • Vietnamese farmers have been very fast adopters • Unique coffee processing and brewing methods 	<ul style="list-style-type: none"> • Rapid expansion of coffee production • Role of private sector • Management of scarce water resources
India	<ul style="list-style-type: none"> • Coffee Board mandated to regulate the industry and also market green beans • Promotion of SMEs to produce coffee processing and brewing equipment • Demand Driven Research as it is financed by the Industry 	<ul style="list-style-type: none"> • Coffee production by small scale farmers • Diversification at the farm • Processing equipment and machinery for small scale farmers • Role of SMEs in fabricating processing and coffee brewing equipment and machinery • Government regulation of the industry
State of Hawaii	<ul style="list-style-type: none"> • Only North American State growing coffee • Grows Arabica coffee, producing unique coffees that are among the most expensive in the world 	<ul style="list-style-type: none"> • Coffee production practices • Protection of national brands

	<ul style="list-style-type: none"> • The special Kona coffee under threat from counterfeits in the market • Strong market cooperation to reduce and control counterfeits 	
Switzerland	<ul style="list-style-type: none"> • Commercial grape growing on man-made terraces around Lake Geneva • Irrigation on the terraces 	<ul style="list-style-type: none"> • Terrace management • Irrigation

Annex IV: Key coffee institutions proposed for bench marking

Institution	Key areas of competence	Strategic issue
<p>World Coffee Research, United States of America</p> 	<ul style="list-style-type: none"> • Coordinate a global strategy to accelerate the creation of new Arabica varieties • Has developed a global catalogue of coffee varieties with their characteristics • Development of heat tolerant varieties (TMax32⁰C) • A tool for understanding and measuring coffee's flavours and Aromas-Sensory Lexicon. • Develops partnerships with producing countries 	<ul style="list-style-type: none"> • Coffee breeding • Access to improved varieties and germplasm
<p>French Agricultural Research Centre for International Development</p> 	<ul style="list-style-type: none"> • CIRAD's operations encompass the life sciences, social sciences and engineering sciences, applied to agriculture, food and rural territories. • From the field to the laboratory, CIRAD works in response to the needs expressed by socio-economic players in developing countries. • Develops its research projects in association with its partners. • Develops platforms in partnership for research and training worldwide 	<ul style="list-style-type: none"> • Research development • Coffee breeding • Training and capacity building
<p>Specialty Coffee Association (SCA), United States of America.</p> 	<ul style="list-style-type: none"> • SCA acts as a unifying force within the specialty coffee industry; • Works to make coffee better by raising standards worldwide through a collaborative and progressive approach; • Dedicated to building an industry 	<ul style="list-style-type: none"> • Marketing of specialty coffee • Development of internationally accepted coffee standards • Training and

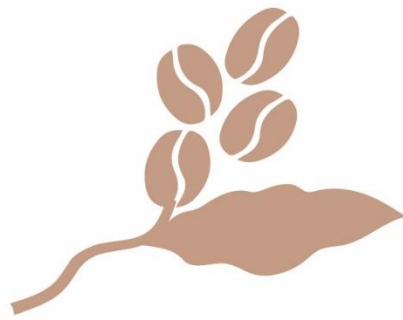
	that is fair, sustainable, and nurturing for all.	capacity building in coffee quality analysis
<p>International Coffee Organization (ICO), United Kingdom</p> 	<ul style="list-style-type: none"> • Intergovernmental organization composed of coffee producing and consuming countries • It administers the International Coffee Agreement, an important instrument for development cooperation within the coffee sector 	<ul style="list-style-type: none"> • International coffee agreements and trade
<p>Instituto Agronômico de Campinas (IAC)</p> <p>Brazil</p>	<ul style="list-style-type: none"> • Undertakes research on coffee and other crops • Instrumental in the cultivation of coffee in Brazil, by increasing productive yield, resistance to diseases, adaptation to different soils and climates; • A pioneer in the use of satellite-based remote sensing and its applications to agriculture 	<ul style="list-style-type: none"> • Coffee research structure • Access to germplasm • Irrigation and water use
<p>National Coffee Research Center, Cenicafé</p> <p>Colombia</p>	<ul style="list-style-type: none"> • Provision of support to coffee-growing families through scientific research, • Development of new varieties • Production of seeds of improved varieties of coffee, technologies coffee harvesting, • Coffee post-harvesting technologies 	<ul style="list-style-type: none"> • Modern approaches to coffee research • Involvement of farmers in research
<p>Alamcafe</p> <p>Colombia</p>	<ul style="list-style-type: none"> • General warehouses of coffee deposit and logistic arm of the FNC. • Services it offers: Milling, roasting, grinding, packing and transport to port, as well as reception, storage, import-export procedures and customs agency. 	<ul style="list-style-type: none"> • Coffee processing and marketing • Value addition

	<ul style="list-style-type: none"> • The company is dedicated to transforming coffee into a marketable product with the highest quality standards. 	
<p>Central Coffee Research Institute, India</p>	<ul style="list-style-type: none"> • Coffee breeding programme to produce new varieties • Plant Tissue Culture & Biotechnology for rapid research and production of planting materials • Quality Control Division recognized for upgrading the quality of coffee in India. • Crop diversification with crops such as pepper for risk management 	<ul style="list-style-type: none"> • Application of tissue culture & biotechnology methods in seedling production • Crop diversification

Annex V: MoEWA Coffee Sector Themes, Challenges and Initiatives

Theme	Challenge	Initiatives
Coffee Sourcing	i. Absence of a nursery specialized in production of high quality seedlings	i. Establish a coffee nursery for the production of high performing plants using selective
Coffee Tree Planting and Cultivation	ii. Suboptimal planting and cultivation practices	ii. Establish a local research and training Institute
		iii. Develop and publish an ROI (Return on Investment) calculator to promote intercrop plantations
		iv. Set up plant clinics to support disease control & extension services
		v. Offer training and awareness programs to upskill farmers
		vi. Set up demonstration farms to showcase best farming practices
		vii. Rehabilitate agricultural terraces
	iii. Degradation of agricultural terraces	vii. Rehabilitate agricultural terraces
	iv. Limited water availability and poor irrigation management	viii. Set up rainwater harvesting and drip irrigation solutions
Bean Extraction and Treatment	v. Suboptimal bean drying practices a.	ix. Promote simple but effective drying methods
	vi. Limited labour availability during harvesting seasons	x. Develop a database to optimize the rotation of labour across farms
Bean Processing	vii. Suboptimal processing of beans to ground	xi. Establish modern processing facility

	coffee	
	viii. Limited utilization of coffee by-products	xii. Establish facilities for the production of coffee secondary products
Packaging, Sales and Distribution	ix. Lack of effective sales and marketing channels for small farmers	xiii. Empower cooperatives to sell coffee under a common brand
	x. Low income of small scale farmers	xiv. Establish a “made in Jazan” certification
		xv. Adopt coffee quality grading standards that tie to pricing
		xvi. Offer direct subsidies to small scale farmers



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