OPPORTUNITIES IN SUSTAINABLE IMPROVED COFFEE TRADE

Presenting water challenges in production and role the Dutch Importer plays.

Presented by

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Sarette Joylin Dsouza

Abstract

India has risen as the seventh biggest coffee producer internationally. This study investigates the sustainability challenges of using water efficiently during coffee production in India. The production of coffee uses considerable quantities of water and can adversely affect areas where water is scarce. A challenge facing the community in developing countries is the inevitable increase in urbanization and population growth and the increase in the water needed to sustain the population. The present research explores the possibility of the role the Dutch importers, Government and NGO's play in influencing a more sustainable and improved coffee trade and the role they can play for an Indian farmer to reduce water use. In this thesis, we analyse current practices and address the challenges faced with respect to the water footprint of coffee. We also examine socio-economic issues, like availability of water in India and its use in the production of coffee.

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List of Abbreviations

VSS – Voluntary sustainable standards

MSP – Minimum support price

WFN - Water Footprint Network

LESA - Low Elevation Sprinkler Application

LEPA - Low Energy Precision Agriculture

MESA - Mid Elevation Sprinkler Application

1. INTRODUCTION

Coffee is a sensational and emotional pleasure and a good cup of joe is enjoyed every day by billions of people around the world. Due to its taste and physiological benefits in this fast-paced life, it has become the most consumed beverage in the world. The demand for coffee can only be expected to grow as time progress. To quote the International Coffee Organization, 'Global consumption in year 2018/19 grew by an estimated 2.1% to 164.84 million bags' ("International Coffee Organization - What's New", 2019). Growing and processing the coffee beans requires about 140 liters of water to create a cup of coffee. Hence, it is essential that necessary measures derived from extensive scientific research be taken for the sustainable production of coffee. This thesis is one small step toward this goal. The production of coffee beans in India is chosen as a test case, as it is a developing economy and sustainable measures in coffee plantation and trade can be replicated in other developing economies like Vietnam, Colombia etc. Coffee plantations in specific regions of India are discussed in greater details, which include the history of the plantation there, impact of climate change and yield so as to understand socio-economic impacts.

Coffee has grown exponentially in the last decade and is one of the most commercially traded crops in the world (Pierrot, Giovannucci, Kasterine, 2010). But not all coffee is consumed by the masses. Among some 100 species of the genus 'Coffea' (Davies et al., 2006), only C. arabica L. (arabica coffee) and C. canephora Pierre ex A. Froehner (robusta coffee) are economically important worldwide, with these species being responsible for about 99% of world bean production (DaMatta, Ronchi, Maestri, Barros, 2007). 64% of the coffee produced is arabica coffee, and the rest is robusta (Fassio and Silva, 2007). Caffeine content of arabica coffee is about 1.2%, and robusta coffee is 2.3% (CBI Ministry of Foreign Affairs, 2019). Apart from the general information about the two coffee species, one quintessential information in the scope of this thesis is the rainfall requirement for the growth which depends on the retention properties of the soil, atmospheric humidity, cloud cover, as well as cultivation practices. The optimum annual rainfall range is 1200-1800 mm for arabica coffee (Alègre, 1959). A similar range seems to be required for robusta, although it adapts better than arabica to intensive rainfall exceeding 2000 mm (Coste, 1992). Another key information one must look for is the water footprint of coffee beans and estimate the water used for the same and draw parallelism with the water bodies of the country one is residing in (here Netherlands).

The average water consumed in one cup of standard coffee is about 140 litres (global average) of water per cup of coffee and the coffee plant growing on its own has the highest water consumption (Chapagain and Hoekstra, 2007). Since 125 ml is regular for coffee, it takes almost 1100 drops of water to produce a single cup (Chapagain and Hoekstra, 2007) (Aprile et al., 2019). The Netherlands consumes about 90 thousand tonnes of coffee annually – 1.5 million 60kg bags, which is an estimated 4% of the total EU consumption of coffee in 2015 (CBI Ministry of Foreign Affairs, 2019). The total annual coffee use in the Netherlands requires 2.6 billion cubic meters of water, which is about 36% of the annual Meuse river flow. 2.4% of the world's coffee consumption is by the Dutch (Chapagain and Hoekstra, 2003). The Netherlands, having 26% of its land below sea level, imports its coffee which estimates to an overall value of $1.07 (€0.97) billion (The Netherlands's Top Commodity Imports Exports, 2019).

This imported coffee is mainly produced by developing countries like Brazil, Vietnam, India and is of great economic importance, as is the social importance to the consuming countries (International Coffee Organization, 2018). In order to understand sustainable use of water in coffee production, one needs to take a closer look at a particular region in developing country where coffee is the major crop. The southern part of India fits the bill, where Karnataka with 71%, Kerala with 21% and Tamil Nadu dominate the coffee production. This coffee is grown in the shade under indirect sunlight on the slopes of hills and is considered one of the finest coffees (Coffee Board of India, 2019). 80% of Indian coffee is exported, where 70% ships to Germany, Netherlands, Russia, Spain, Belgium, Slovenia, United states, Japan, Greece and France, 29% to Italy, altogether comprising of 4.5% of the global production (Illy and Viani, 2005). Hence, one can also discuss trade policies, since India being a developing country and having an export-based economy, with its coffee board and research units, trying to maximize output to improve its economic situation. But first and foremost, we shall see the impact of climate change on coffee production and inspect its resilience by presenting a case study.

India is an agricultural economy with 70% of its rural households still depend primarily on agriculture for their livelihood, with 82% of farmers being small and marginal ("India at a glance | FAO in India | Food and Agriculture Organization of the United Nations", 2019). Because of this and its high dependence on climate, agriculture has received a great deal of attention promoting studies and debates over how developing countries of developing economies might adapt to the impact of climate change. The subject becomes exceedingly complex for coffee plantation as climate change, fluctuating rainfall patterns and a high- water footprint make the future of coffee market in India more precarious.

To explain it even further, for both species, a short dry spell, lasting two to four months, corresponding to the quiescent growth phase, is important to stimulate flowering (Haarer, 1958). Lack of a dry period can limit coffee cultivation in lowland tropical regions. Furthermore, abundant or less rainfall is often liable for scattered harvests and low returns throughout the year (Maestri and Barros., 1977) not only from an agricultural view, but also because of its consequences for worldwide agricultural and trade policies that affect agricultural production and food security. While climate change is just one of many other factors that may affect global coffee production, it is nevertheless likely to be one of the most important ones. It is true that there is still a good deal of uncertainty about how individual producing areas will be influenced and how global coffee production will be influenced by climate change. However, experts in this matter expect some changes to occur, and this could be significant in some regions. To elucidate matters further, the potential impact will not only vary between coffee producing countries but also within coffee producing areas in individual countries, for example due to different altitudes. Global initiatives to reduce the emission of Greenhouse Gases (GHG) will play an important role in the mitigation of Climate change in the long run but this apart, better farming methods and scientific practices are adopted to undergo a series of change in the coffee production (Climate change and the coffee industry, 2010). To explore the issue of climate change and rainfall and its impact on coffee plantation, a case study in the region of Kodagu and Chickamagalur is presented. But in order to prepare for it, a brief history of plantation of coffee in India and its corresponding yield is presented below.

1.1 History of Coffee in Major Growing Districts of Karnataka and the Neighbouring States

The year 1834 marked the invasion of the British imperialist forces on the political, economic, social and ideological aspects on the people of Karnataka. Due to plantation culture in western Ghats especially in Coorg (now known as Kodagu) Chickamagalur, during this period lost its isolation and began to make progress towards a different socio-economic setup hitherto unknown to its people. The emergence of plantations on a large scale with a huge capital and labour force is what we find during the British rule *(Introduction of coffee,* n.d*)*. With the support of the colonial regime the pioneering European capitalists, most of whom came from Ceylon, had to quit due to their miserable failure in coffee cultivation. These Europeans opened up virgin forest lands and converted them into coffee estates. The example of Europeans was initiated by the local people of Coorg and Chickamagalur who with the intention of supplementing their meagre share of income derived from

paddy, cardamom, orange and plantain switched over to coffee and transformed their 'Bane lands' hitherto not used for plantations into coffee estates. They also took lot of suggestions from the experts and tried all way and means to implement these suggestions applicable for the cultivation of coffee (*Coffee belt of Karnataka and the coffee board*, n.d.).

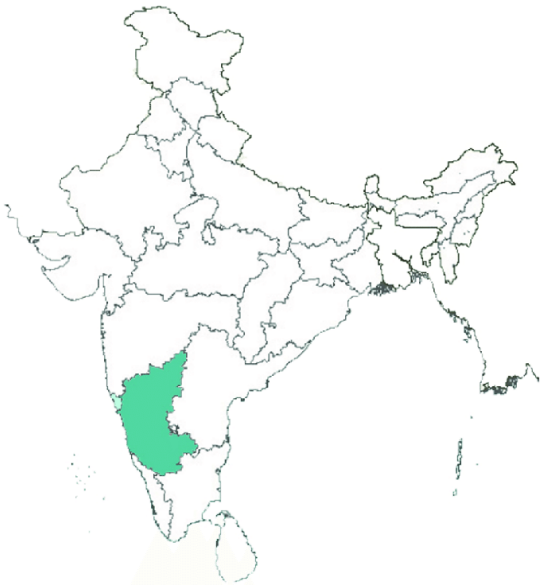
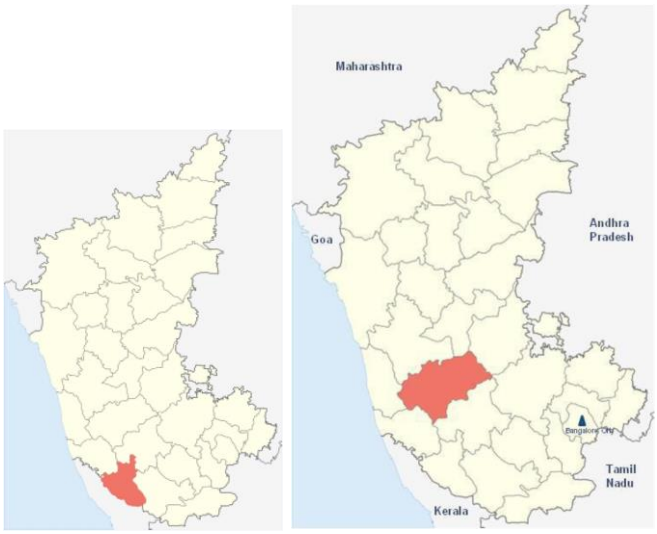


Figure 1: Karnataka State (Highlight) [source: Kaup et al, 2017]

The charming story surrounding coffee arrival in India is shrouded in the mists of the Chandragiri hills of Chickamagalur District. The legend of coffee begins with the story of a pilgrim, 'Baba Budan' to the holy places of Islam in the 17th century. Having brought back with him seven seeds of coffee from Yemen, he planted them near Chickamagalur in his hermitage at the 'Bababudan Giri'. Gradually people from the surrounding villages began growing coffee in their kitchen gardens. From here this cultivation spread to Nalknad area of Kodagu District. From this very place the coffee seeding spread to other parts of South India (*Coffee belt of Karnataka and the coffee board*, n.d.).



Kodagu District (b) Chikmagalur District

Figure 2: Regions of Coffee Plantation in Karnataka (Source: *Introduction of coffee*. [Ebook]).

During the king's time there were coffee plants in Kodagu in some places around the palace at Nalknad. Capt. Lehardy, the first Superintendent of Kodagu did much to extend the coffee cultivation in the State. In 1854, the attention of the European planters turned towards this industry when it was found lucrative. Since growing crops for subsistence was the tradition of peasant cultivators, the concept of producing a crop for distant markets eluded them. Therefore, the jungles were cleared all over the district and coffee plantation was started in almost all the lands of Kodagu. The first estate was opened in Madikeri in 1854 by Fowler, the first European planter in the state ("Kodagu: Land of Coffee", 2019). Next was Mann to open his estate in the Madikeri in 1855 and Maxwell in 1856. In addition to private individuals, companies also began cultivating coffee. Perhaps the Karnataka Coffee Company (1870) was the first institution to start coffee cultivation with 3000 acres. In the Brahmagiri range also many coffee estates came up.

G.K. Martin's Abbiyal estate was one of the oldest of the coffee estates in South India. Cannancadoo, Jumboor, Glenlore, Chappekad, Wooliguly, Peram- boocolly, Chennankote, Fairwell, Dubbare, Palpare, Siddapur estate and numerous other estates around Pollibetta and Siddapur were some of the old estates noted for their rich yield. Robert H. Elliot records, in his book 'Gold, Sport and Coffee Planting in Mysore' 2018

that, by 1890-91, there were 6,207 native estates with an area of 70,669 acres, and 130 European estates with a total area of 32,323 acres which illustrates the rapid expansion of the coffee industry in Kodagu during those early days. The question was taken up very seriously when the soil, climate and rainfall condition in the country favoured the crop. The Kodagu coffee which was then known as Macpherson coffee was found to be the best in the world ("Kodagu: Land of Coffee", 2019).

The early development began with the opening up of small individual units in promising areas. The next phase was the gradual consolidation of several such holdings in close proximity. The usual process was the buying up by a successful neighbour or their inclusion in a partnership. The enactment of the law to permit the incorporation of companies with limited liability encouraged many planters to take advantage of turning their properties into corporate ownership. The size of units began to grow as more capital for expansion became available. Thus, many planting companies were registered in the U.K., though partnerships and family holdings continued to dominate in Indian Coffee. The Plantation Inquery Commission of 1953-56 refers to several non-Indian (Sterling Companies) properties in old Mysore and Coorg. As the commercial exploitation of coffee by the British in this country spread, scores of small coffee plantations merged to become larger, more viable entities. One such was Consolidated Coffee Estates Limited, created from the merger of two of the larger British-owned estates, Pollibetta Coffee Estates Limited and Coorg Coffee Estates Company Limited in the year 1922 both managed by Matheson Co. In 1943 this company was converted into an Indian company with its head office at Pollibetta in Kodagu District ("Kodagu: Land of Coffee", 2019). Late Ivor Bull was the Managing Director of the company for over a period of fifteen years and he had rendered yeoman service for the progress of the company and coffee industry. In 1991 Tata Tea Limited acquired a majority stake in Tata Coffee Limited following which Tata Coffee limited became a subsidiary of Tata tea Limited. The name of the Company was changed to Tata Coffee Limited in 2000. Tata Coffee Limited is the largest Coffee Plantation Company in Asia with estates located in Coorg, Hassan and Chickamagalur districts of Karnataka, which are amongst the best coffee growing regions in the country. The Company along with coffee also cultivates pepper and cardamom in its coffee estates. The present coffee region is approximately 8000 hectares annually generating over 9000 metric tons of coffee. Both the Robusta and Arabica varieties of coffee are grown in the estates. Tata Coffee Limited has had a track record of higher productivity vis-a-vis the local yields and all-India averages. This was on account of emphasis on better irrigation systems, active research and balanced use of fertilizers ("Kodagu: Land of Coffee", 2019). Due to the presence of this decentralized network of rainfall measuring stations, it is easier to obtain a clear picture of the precipitation

trends for Kodagu Chickamagalur, earlier known as one of the better places in Karnataka for its chilled climate, than in other parts of India. The average annual rainfall varies from more than 5,000 mm in the western edge of the district to 1,200 mm in the east as seen in figure 4. The data were collected and analysed as part of the baseline survey by an international collaborative project to study the unique coffee agroforestry system of Kodagu Chickamagalur districts. The College of Forestry at Ponnampet in Kodagu, as a participant in the Coffee Agro-forestry Network project, or CAFNET, has analysed the rainfall data of over 60 years from 116 coffee farms (Kushalappa, Vaast, Yenagulla, Garcia & Sinclair, n.d.). "Keeping meticulous rainfall data is part of the culture we inherited from the British," said C.G. Kushalappa, University Head for Forestry and Environment Sciences at the College of Forestry. The CAFNET study observed that over the previous 35 years, the rainy season's duration had reduced by 14 days. It also noticed a strong fluctuation in annual rainfall with an apparent cycle of 12 to 14 years. Due to the negative impact of this seasonal variations in rainfall water shortage for agriculture has been noticed which can also have an impact on overall coffee production of Karnataka state (Gayathri, 2017).

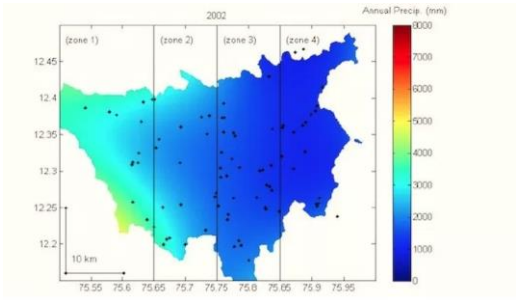
Impact of low rainfall in coffee land in Kodagu & Chickamagalur:

Regardless of whether it is expected to being the absolute bottom in this cycle or an El Nino changing precipitation designs, 2015 and 2016 have been long stretches of low precipitation in Kodagu and Chickamagalur districts (Gayathri, 2017). This is the second year of deficit rainfall in both districts. During 2015, it was deficient by 19%. As a result, the storage in the Krishna Raja Sagara dam reservoir, built across the Kaveri River immediately downstream of Kodagu district, has a 31% deficit this year.

Figure 3: Average rainfall in Kodagu

[Source: https://www.ksndmc.org/GraphicalRainAnalysis.aspx]

S.No.	Year	Rainfall (in mms)
1	2003	2090
2	2004	2678
3	2005	3509
4	2006	3374
5	2007	3448
6	2008	2413
7	2009	2912
8	2010	2647
9	2011	3077
10	2012	2001
11	2013	3229
12	2014	3016
13	2015	2500



Geographical location of coffee farms where rainfall data has been collected for 70 years and a map of rainfall distribution generated with these data points as an exmple for the year 2002. (Image by College of Forestry, Ponnampet)

Figure 4: Average rainfall in Kodagu in year 2002 [Image by College of Forestry, Ponnampet]

On the ground measurements by coffee grower in a village near Ponnampet in Kodagu (Coorg) confirmed that average rainfall of ninety to one hundred inches per annum has also not reached this will witness water shortage. Similarly, large growers of coffee of Mudigere other neighbouring places in Chickamagalur district are of the opinion that there are changes observed in the pattern of rainfall year on year which will negatively influence the production of coffee. Mainly those large agriculturists with their landholdings in agriculture of fifty acres above will go for cultivation of other crops along with the coffee as guess crops are more resilient and requires less water. Hence, they are not totally dependent on coffee crops alone. Agriculturists with the landholdings from the range of twenty-five to fifty acres depend less on substitute crops remain satisfied most of the times with coffee production alone. Lastly, there are small agriculturists who have less than twenty-five acres of land. These growers find very difficult to manage the same because on one hand they are dependent on rainfall as a consistent source of water required for the growth of coffee on the other hand costs of maintenance have gone up very high compared to a decade of years or two (Warrier, 2019). Lastly for completion, its worth mentioning the area production and yield of coffee in the state of Karnataka and Kerala and simultaneously comparison is drawn wherever necessary to bring a wholesome picture.

1.2 Area Production and Yield of coffee

It is no surprise that agriculturists in Karnataka grow two varieties of coffee mentioned in the beginning of the introduction, namely Arabica and Robusta. The bulk of the area and production is that of Arabica in North Kodagu, whereas, it is Robusta in the

case of South Kodagu, Chickamagalur Sakaleshpur in Hassan taluk grows more Arabica coffee (*Coffee - study area*, n.d.). Karnataka holds the key to coffee production in India. Although India accounts for only about 4% of world production, Karnataka contributes about 70% of India's production. The present area under Coffee is more than double of what existed during 1946-47: 35,433 hectares. According to the 1972-75 census of the coffee orchards in India, Kodagu District had the largest number of coffee orchards producing l/3rd of the country's production. In 1972-75, the area under coffee in Kodagu District was 42,320 hectares. The area under coffee increased to 60,289 hectares in 1980-81 and further to 75,098 hectares in 1992-93; which formed 27% of the total planted area under coffee in India. The production has shot up from 41,085 tonnes (1985- 86) to 64,000 tonnes (1992-93) or 40%to the India's total production of 1,61,500 tonnes. In this context a study of the growth rates in area, production and productivity assumes importance. It is gratifying to note that the area under coffee and its production have been increasing over the past thirty years. There are approximately 1.78 lakh (1 lakh=100,000) coffee holdings in India, of which 98% come under small holder category (10 hectares and less) (*Coffee - study area*, n.d.). These small holdings occupy 65% of the total area under coffee and contribute around 60% of the country's production. The remaining 2% of the holdings come under large grower sector (above 10 hectares) and occupy 35% of the area and contribute 40% to the total production. Kodagu can be compared to some other coffee-growing areas. While in Kerala small plantations are very dominant, in Chickamagalur, second highest coffee growing district of Karnataka, the number of very large estates is higher than in Kodagu. The percentage of small plantations (10 hectares) to the total area under coffee in Kodagu, Wyanad (largest coffee growing district of Kerala) and Chickamagalur is 62%, 85% and 30% respectively. Besides, the tree cover in Kodagu plantations shows a much higher diversity than in those of Chickamagalur where silver oak and dadap are the only shade trees in most plantations. The distribution of coffee area among small, medium and large holdings, to a large extent, achieves a more equitable sharing of income. Coffee industry in Kodagu District registered a remarkable progress during the last century. During the period from 1956-57 to 2013-14, the area under coffee increased steadily by three-fold from 24,321 hectares to 82,554 hectares. The productivity has also doubled from 659 kg/ hectares to 1125 kg/ hectares during the same period. India stands in third position in terms of productivity next only to Vietnam (2000 kg/ hectares) and Costa Rica (1500 kg/ hectares). Productivity is far ahead of major coffee producers viz. Brazil (73 kg/ hectares) Colombia (810 kg/ hectares) and Indonesia (539 kg/ hectares). As a result, coffee production has reached the level of 1,00,000 tonnes from a small 16,037 tonnes some fifty years ago with a remarkable increase of six folds. To make the production analysis more incisive and

to apportion the effects of area and productivity (yield/hectare) on production, growth rates for area, production and productivity were worked put separately. It could be noted from the facts and figures that the compound growth rate for area, yield and production of coffee for the period 1956-57 to 2013-14 was worked out as 2.89%, 1.17% and 4.2% respectively, per annum indicating that both the expansion of area and improvement in yield have contributed to the growth in production. Although, more recently growers of this geography are very much satisfied with the crop but not with the production of the same. Production rate of coffee had come down mainly due to inclement weather conditions which had drastic impact on climatic change. The change in climatic conditions negatively influenced the source of water mainly due to disrupted rain schedules. This leads us to describe the problem statement of our thesis.

1.3 Problem Statement

The logical Indian reported on 13 June 2019, "1900 Villages in Karnataka Facing Drought; Water scarcity is slowly crippling the state". Additionally, Department of Rural Development and Panchayat Raj suggested from the data obtained that 138/176 taluks (districts) have very low ground water levels. Hence, water scarcity is an existing problem in the state. Now, bringing into this picture coffee production, leads to use of substantial amount of water as explained in the beginning through its water footprint. Even though a major part of water used during production comes from rainwater it also uses blue water (obtained from the surface and ground water). Also, even rainwater fluctuations due to climate change pose a big problem. Simultaneously, the demand for coffee is increasing, especially in developed countries, and India being an export derived economy would respond to it. Hence the situation at hand calls for sustainable opportunities. During the wet production process of coffee, the wastewater generated is generally massively polluted. Hence it is important to reduce the water footprint of coffee not only in areas where water is scarce, but also in parts where it has not been the problem so far. For India which is the seventh largest coffee exporter in the world, it is paramount in understanding how the situation would affect in the near future with climate change and rise in global temperature. The main goal, along with a sense of consumer responsibilities and resources, is to also approach coffee importers, and understand the existing situation – are they aware of the water footprint for coffee? Are they trying to improve the current situation? These issues are mainly addressed to the developed countries which in our case would be The Netherlands. Lastly, exporters and on grass-root level, coffee farmers – how are they managing the water related issues and governments – what steps can be taken to improve the current situation - are relevant.

1.4. Research Objectives

The objective of this research is to analyse the interrelations between different actors understanding the role of European and especially Dutch coffee importers, NGO's and governments – a developed country and their influence on the water consumption in the production of coffee in a developing country such as India, in order to give recommendation to the related parties to avoid the forceable water issues.

2. LITERATURE REVIEW

The chapter is essentially divided into three sections. Firstly,' water and coffee' after introducing the concept of water footprint, describes the same with support of several literature review in the context of coffee. In the end biodiversity dependence on coffee plantation is explored. This chapter is essential in understanding severity of water situation in coffee industry. Section 2.2 describes the socioeconomic aspect of coffee industry in India which touch upon the role of government, market and farmers on coffee industry. Lastly, section 2.3 briefly looks at the literature which analyzed the value chain of coffee in India and maps it to the Netherlands.

2.1 Water and Coffee

2.1.1 The Concept of Water Footprint

In line with the concept of virtual water, the concept of the water footprint was introduced to form a consumption-based indicator of water use (Hoekstra and Hung., 2005; Hoekstra and Chapagain., 2007). This is in distinction to the standard production sector-based indicators of water use, which normally are helpful in water management however do not indicate the water that is really required by the inhabitants of a country in respect to their consumption pattern. The water footprint can be defined as the volume of water required for the production of the goods and services consumed by the inhabitants of a country. This concept is developed analogous to the concept of the ecological footprint (Wackernagel and Rees., 1998).

The water footprint can be divided into a blue, a green and a grey water footprint. The blue component covers the use of groundwater and surface water during the production of a commodity, the green component covers the use of rain water for crop growth, and the grey component covers the water required to dilute the water that is polluted during the production of the commodity. The distinction between green and blue water has been introduced by (Falkenmark Rockström, 1993). The grey component has been introduced by (Chapagain et al., 2006).

2.1.2 Water Resources in Coffee

The lifetime of coffee crops begins with the cultivation of beans in nurseries where they eventually grow into small trees. Initially, within few months of planting,

sprouts emerge, and the plant starts to grow up with the coffee bean on top. After some months, the coffee plants can be put out on the field where they proceed to grow (Martinez-Torres, 2006). Once the plants are 3 to 4 years of age, they bloom whereat the flowers transform into coffee cherries. The cherries are then harvested after about 40 weeks (Mr. Sandesh Roche[1]). The coffee cherries have many layers shown in figure 5 that ought to be removed so as to create a coffee that is able to be shipped off for additional processing and roasting. Processing of coffee is accomplished via two methods, dry processing and wet processing. Dry processing is the age-old method of drying in the sun which is favored for its flavor generating characteristics. In the wet processing method, coffee beans are fermented and washed, which is the preferred method for improved yields.

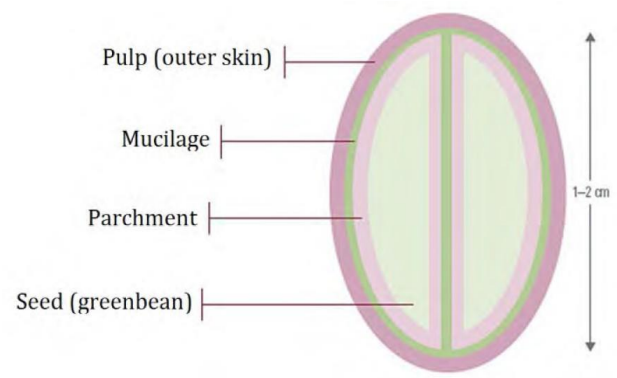


Figure 5: The anatomy of the coffee fruit with the different layers of the cherry. [Modification by Moberg (2016) from illustrations in Chapagain and Hoekstra (2003) and Greenbean (n.d.)] (Source: Emma 2016)

The coffee crop water demand in India is majorly satisfied by rainfall and a very small percentage is subjected to irrigation. Regarding the processing, i.e. the pulping, fermentation and washing, the water originates from soil and groundwater. Hence, the processing is the water intensive step and leads to the wastewater.

Coffee Milling: In a wet-milling process initially pulp is removed from freshly harvested coffee cherry. After that cherry is poured into a funnel leading to a depulper, where it is caught between depulper's outer sash and cylindrical grate, resulting in removal of outer skin or pulp. This leaves the seeds, or coffee beans, coated in a sticky, thick mucilage. Removal of this thick mucilage is accomplished

[1] "How coffee is grown?" this general question was answered by Mr. Roche (coffee farmer and trader) with specificities about his region – Chikmagalur. Minutes of this meeting check Annexure 1.

through fermentation which last anywhere between twelve to thirty six hours or more, depending upon local conditions and practices. Where does the water used come in? A common method of depulping involves running a continuous stream of water for hours through the depulper as it is operating. Following fermentation, the coffee is washed to get rid of the mucilage, a water intensive process which need enormous volumes of water. For each hundred-weight bag of coffee cherry, wet milling processes uses up to 1200 litres of water and sometimes even more, which can turn out to be as little as 16 pounds of export ready green coffee. In numbers, 250,000 litres of water is used in for only a single container of coffee.

Harmful Effects of the Coffee Wastewater: Effluent water from the processing of coffee has a high viscosity because of its content of organic matter like proteins, cellulose and sugar from the pulp and therefor the mucilage. This viscosity of the water has led to it being referred to as honey water. Once the mucilage starts to dissolve throughout the fermentation process, the sugars are converted into organic and acetic acids which alters the acidity of the wastewater, eventually lowering the pH-values to around 3.5 to 4.5 (Adams and Ghaly, 2006; Padmapriya, Tharian and Thirunalasundari, 2013). If the effluents are discharged directly into rivers and streams without any treatment, there is a risk that the pH values within the receiving water bodies will be affected to substantially lower levels than the natural values of about 6.5 to 7.5 (Beyene et al., 2012; Lampert and Sommer, 2007). If the pH would be reduced to below five for an extended time, the lives of most aquatic animals are subjected to high risk (Lampert and Sommer, 2007).

When microorganisms within the receiving bodies of water are supplied with the organic matter present in the effluents, they will start decomposing it. Decomposition of such effluents will release ammonium that later transform into nitrate by the microorganisms, in a process referred to as nitrification process. This transformation solely occurs in aerobic conditions, that is in presence of oxygen where the nitrate works as nutrition source for the organisms. A parameter which indicates the capacity of microorganisms to decompose organic matter is the chemical oxygen demand (COD). This parameter indicates the amount of oxygen required in the oxidation of organic matter. Concerning coffee effluents, the COD may be significantly higher than the natural levels of the water bodies which can lead to depletion of the oxygen levels in the water. This could cause anoxic conditions during which the bacterium, in absence of oxygen, begin to oxidize the organic compounds, using nitrate as electron acceptor within the oxidation process known as denitrification. Furthermore, ammonium or nitrate will be released depending on the working microorganism. The process where ammonium is released is called ammonification whereas the discharge of nitrate is named as nitrification (Lampert and Sommer,

2007). Bacteria living in anoxic environments might begin reducing sulfate in the leading decomposition which will turn into hydrogen sulfide (H2S). Hydrogen sulfide is deadly to the biota and may also cause a foul and rotten smell (Bydén, Larsson and Olsson, 2003).

Referring to a study by Haddis and Devi (2008) concerning coffee wastewater problems, the anoxic conditions in the waters may cause health issues for humans in the vicinity of the processing plants who use the water for daily purposes. Haddis and Devi mention the sixteen increased ammonium concentrations in the waters which contribute to eye and skin irritation, stomach problems and respiratory issues.

Another issue attached to the wastewater being channelled into the waterways is the increase in turbidity of the water. Water also takes a darker color because of high amount of suspended and non-dissolved solids and also red color of flavonoids coming from the coffee cherry. Apart from organic matter, the suspended particles may consist of the increased number microorganisms (Adams and Ghaly, 2006; Padmapriya, Tharian and Thirunalasundari, 2013). Because of suspended particles and higher turbidity, more heat will be absorbed from sunlight, thus heating the water. This may lead to decrease in the levels of oxygen even more, as oxygen dissolves better in colder water. Consequently, the photosynthetic activity will be reduced as suspended particles will scatter the sunlight. Due to decrease in the photosynthetic rates, even less oxygen levels will be available and aquatic life will be subjected to danger (Lampert and Sommer, 2007).

2.1.3 Water Footprint Studies on Coffee

Coltro et al., 2006 presented that the production of 1000kg of green coffee in Brazil needs approximately 11,400 kg of water, 94 kg of diesel, 270 kg of fertilizers as NPK, 900 kg of total fertilizers, 620 kg of correctives, 10 kg of pesticides and 0.05 hectare of annual land use. Outputs associated with these functional units are approx. 3,000 kg of wastewater from coffee washing, 8,500 kg of wastewater from the wet method and 750 kg of organic residue that is reincorporated to the tillage as fertiliser.

Humbert et al., 2009 found the water footprint both for irrigated and non-irrigated coffee. If the coffee plantation is irrigated, the amount of non-turbined water used can be up to 40 l per cup of coffee. For the non-irrigated coffee, the total use of non-turbined water amounts to between 2.5 and 4 l per cup.

Mekonnen and Hoekstra (2011) state that the world average water footprint of coffee amounts to 15 774 m^3/ton of processed coffee that has been rain-fed during cultivation. This total footprint consists of the green water component of 15 251 m^3/ton and the grey water component of 523 m^3/ton while the blue water footprint equals zero.

Chapagain and Hoekstra (2003; 2007) have performed studies on the virtual water content within a regular cup of coffee in the Netherlands. However, there are no findings of more local studies using the complete methodology of the Water Footprint Network i.e. separating the green, blue and grey water footprints.

2.1.4 Coffee and Biodiversity

Rural landscapes are often dominated wherever coffee is grown. Coffee plantation has the ability to shape the ecology of the entire region. Flora, watercourse and even infrastructure are influenced by coffee production practices. In terms of land use choices, coffee agroforestry systems are arguably the most effective agriculture system for watershed health, other than that natural forests are more effective at circulating the water cycle. However, there exist a broad spectrum on how coffee is grown and managed. There stay major implications for water resources depending upon the kind of practices employed during coffee production and processing.

Shade Grown Coffee: Significant water resource benefits such as regulation of water cycle, protection of surface water in the form of streams, rivers and lakes on which downstream water rely and increased recharge rates of underground aquifers can be realised when coffee is grown within the shade of forest canopy as they mimic natural forests. Simultaneously, coffee grown in such manner increases the ability of watersheds to absorb water and effectively minimizing soil erosion as well. Overall, these benefits improve the watershed health. This also leads to constant ground cover in coffee farms which not only increases soil structure but also maintains soil moisture and adds organic material.

Non-Shade Coffee: A great deal of advantages of shade grown coffee systems are gone when coffee is grown under the full exposure to the sun. Soil degradation, erosion acceleration, runoff, flooding and sedimentation of water resources are consequences of poor soil management practices originating from full sun farming. This leads to reduction of rates at which aquifers are recharged. To even worsen the situation, when agrochemicals are used frequently on these farms, they contaminate water resources on which low lying communities depend.

Indian coffee is said to be the finest coffee grown in the shade rather than direct sunlight anywhere in the world (Coffee Board of India,2017). Below is mentioned a case study about the biodiversity in Karnataka coffee plantation region

Biodiversity in Karnataka Coffee Plants: This study was conducted in the Kodagu district of Karnataka state in the Western Ghats of the Southern Indian peninsula. Where both Coffea arabica (Arabica coffee) and Coffea canephora (Robusta coffee) are grown, it is one of the major coffee growing regions in India. It was observed that, large areas of forests have been converted to shade grown coffee cultivation in the last century in Kodagu (Ambinakudige2006; Menon and Bawa1998; Lele2001).

Higher prices of coffee were observed by growers with the opening of an open market in early 1990s by Coffee Board. This encouraged coffee growers to allot higher percentage of land under coffee. This introduced more severe transformations of the landscape (Elouard2000; Bhagwat2002). It was reported by French Institute of Pondicherry that net loss of forest habitat was observed during the period of 1977 to 1997 due to increase in the area of coffee cultivation. Although shaded coffee plantations resemble the original forest, they have a relatively high biodiversity (Moguel and Toledo1999; Perfecto et al.1996), only 36 percent of forest cover remained in Kodagu which is a drastic change from 88 percent in 1920. Around 71% of this forest loss is due to coffee cultivation (Menon andBawa1998). Nevertheless, due to shade trees inter spread within the coffee, there still exist a substantial amount of tree cover.

S. Ambinakudigen et, al, (2007) describes in the discussion of his paper that introduction of coffee in Kodagu reorganized the patterns of tree diversity. The main way in which patterns of tree diversity and composition have changed has been due to the introduction and encouragement of non-indigenous tree species. Another disadvantage of coffee cultivation is that it discourages the regeneration of tree species because the under storey is dominated by coffee plants. In this situation, it may be wiser to encourage shade grown coffee than sun grown coffee as shade coffee retains some amount of biodiversity. However, in the regions like Western Ghats where the biodiversity is threatened by human activity, no more new coffee plantations should be encouraged. Even though coffee retains some biodiversity, it cannot substitute for natural forest. Existing coffee plantations should be encouraged to preserve endemic species. The encouragement may be in the form of niche market for the shade grown coffee where growers receive premium prices for shade grown coffee. Some conservationists such as Conservation International and National Audubon Society (Conservation International2001; National Audubon Society2000; Philpott and Dietsch ,2003) already advocating for premium price for shade grown

coffee. Shade coffee can conserve tree biodiversity and could help improve the livelihoods of the local people if conservation practices and coffee markets are linked.

2.1.5 What still needs to be known?

While the general relationship between the coffee process, water availability and quality may be understood, in literature they haven't necessarily been quantified at a systemic level. Mapping the relationships between the coffee process, water availability in coffee communities, and downstream water quality would be a major contribution to the state of knowledge around coffee and water at origin.

One can find substantial amount of studies on water footprint of coffee as mentioned above. However, there have been no findings of more local studies using the complete methodology of the Water Footprint Network i.e. separating the green, blue and grey water footprints. Lastly, the basic assumption in specialty coffee is that the washed process (depulped, fermented, washed, dried) produces a superior cup. But there's been very little experimentation to prove that this is so. Hence, relationship between the various processes involving different level of water consumption and the quality was not established in literature on quantitative level.

2.2 Socioeconomics of Coffee in India

2.2.1 Government Role

Time and money are required to cultivate commercial crops like coffee. In the present market economy, cultivator of coffee comes across two major concerns firstly the cost of production of the crop & secondly the returns available from coffee yield. Therefore, as an agriculturist, along with the passion of cultivating coffee crop he must come out with two major solutions firstly he must recover all the costs associated with coffee production & secondly he must make profit by selling the yield of coffee at substantial price in the well regulated market. To make this possible, several steps are taken by the Government of India for instance, governments often intervene in agricultural markets as price regulator and fix up a minimum support price for coffee in the market. Intervention is justified due to several reasons, initially there is a time lag between production and harvesting and there is uncertainty regarding realization of agricultural output. A complete set of future markets that can provide insurance against all possible outcomes do not exist. Second, the income distribution resulting from weather fluctuations and market forces may not be

satisfactory. Thirdly, yield security is believed to be important to the growers of coffee crop and cannot be left to the market. Fourthly non price factors such as research and development and technological improvement are important for agricultural output growth. These areas are very important and requires very active role, presently it is felt that more ignorance has resulted in less optimal output of coffee. Another initiative by the government is the formation of Coffee Board (CB).

Following the Coffee Board Report (2016-17) the main functions assigned to the board are: Firstly, promotion of agricultural and technological research in the interest of the Coffee Industry. Secondly, assistance to Coffee Estate for their development. Lastly, promotion of the sale and consumption in India and elsewhere of the coffee produced in India. Also, on behalf of central government, Coffee Board (CB) along with state governments and their agencies procure a sizable quantity of the total grain yielded in a season. Since production is concentrated in a few states in India there is a large regional mismatch between demand and supply of coffee which is relieved by the transfer of grains from surplus to deficit states. Additionally, it is also responsible for bringing price supportive measures by minimum price fixation or a supporting price which can improve production rate of crops.

2.2.2 An Insight on Indian Agriculture

Scholars have come across with a lot of insights on Indian agriculture. These throw light on mode or modes of production of Indian agriculture. Due to heterogeneity of the socio-economic structure and the variety of social conflict in developing countries like India and the inability of the government to control the situations due to its own limitations. Presently Indian agricultural commodities are dominated by capitalists and not with the socialists and small farmers. Small farmers encounter difficulties and are frequently opposed by one or the other forces and are often victims to natural calamities. Advancement in agriculture has taken placed in developed economics were there are no specific classes and social division is extremely complex. Their focus is on improvement of agricultural crops and to see the prices remain consistent for their agricultural crops. What is needed today is deeper investigation to know the stronger reasons behind failure of agricultural crops and also failure in providing minimum support prices. In other words, one would reduce the concept of reality to reality itself. In actual terms reality concerning Indian agriculture is failure of Indian agricultural crops, this has created severe distress among Indian farmers and Indian agriculturists. Agriculturists obtain price levels below the minimum support levels. Speculative prices disturb cultivation of agricultural crops and even it may stop further cultivation. Development of productivity in agriculture can come out when

bottom level problems are identified, solved and the actual reality is accepted in earlier stages based on past experience of failures.

2.2.3 A look at the industry itself

One can characterize Indian coffee industry by describing four different kinds of farmer based on their land holdings. Marginal (<2 hectares), Small (2 – 10 hectares), Medium (10-25 hectares) and large (>25 hectares). The industry is dominated by marginal and small farmers who constitute 98.5 percent of 180,000 coffee holdings whereas less than one percent goes under large farmers. 72% of the planted area is under marginal and small holdings who contribute to 60% of total coffee production. Remaining 40% of the total production belongs to 28% of land area owned by medium and large farmers.

India produces 40% of Arabica coffee and 60% of Robusta coffee which is processed either by dry or wet method. Almost 80% of Arabica processing involves wet method while in case of Robusta it amounts to only 20%. After harvesting, especially marginal and small farmers sell their parchment coffee or cherry coffee at farm gate prices while the medium and large farmers have their own storage and processing facilities. They send it to curers afterwards for secondary processing. Due to lack of any active growers' co-operatives, despite the predominance of marginal and small growers. Exporters have to depend upon middleman/ agents for procurement of coffee for their operations. Lastly, there exist 75 curing factories spread evenly all over the coffee growing regions. They provide warehousing and curing services to coffee growers on payment basis. Some of them purchase coffee directly from growers and either export it themselves or sell it to other exporters. An interesting fact borne out is that out of 100 registered coffee exporters, 20 of them accounts for more than 80% of coffee exported.

The coffee supply chain in India would basically generate a pyramid where growers sit at the base and exporters placed at the top. Coffee is then processed either by wet method or dry method to get parchment or cherry coffee as an end product. Before storing them on the estate for further sale the coffee parchment or cherry is dried. Like mentioned before, local agents now procure the coffee from growers, especially small and marginal growers. Coffee then later finds its way to curing works. Depending upon the existing quality standards set by curing works or exporters necessary deduction are made. The cured coffee is than sold in domestic market or exported. Medium and large farmer also participate in domestic auction or sell it directly to exporters.

2.2.4 Socioeconomics of coffee in India

In the free market economy, we observe that coffee prices start to fluctuate and these fluctuating prices are higher than the minimum support prices fixed by the government. But if access to the market is made difficult by the middlemen & other channels directly or indirectly associated and if the agriculturists are stopped from entering markets and get access to the transparent prices on one side & on the other hand if crop failures are witnessed due to natural calamities like flood and draught this will bring down confidence level of agriculturists which will result in bringing down the level of coffee production in the country. Fluctuations in agricultural crops particularly coffee production has hampered economic development. Hence stronger emphasis on policy and programs of agriculture aiming at rapid growth in coffee production has to be undertaken. Modernization in our agriculture must result in providing more employment opportunities to the skilled hands and this will directly result in improved productivity within the basic tenets of planning namely growth, modernization, self-reliance and social justice.

Natural calamities have resulted in climatic changes, these climatic changes have resulted in loss of coffee crops for a time being which has brought backdrop in security amongst our society of agriculturists and price fluctuations in our coffee markets too. Due to this in our agricultural policy there has been due emphasis on ensuring reasonable prices to the producers produce and to make available agricultural commodities like coffee at affordable prices in the market. Coffee outputs are supplied through the growers & it has an arrival in the market. This is later purchased by the traders by paying reasonable price. At present the actual need of the hour is to focus on improvements in coffee production and new innovative technologies have been planned to increase the yield by providing a price support mechanism. Agriculturists can have the following areas to focus upon, price fluctuations of coffee commodities due to international price variations, incentive structure to allocate funds on coffee crops, present agriculturists' suicide due to crop failure and irregular monsoon, value additions to cultivators as well as consumers, hence it acts as dual instrument focusing the needs of both producer and consumers.

Coffee board procures coffee at MSP (Minimum support price). Initially their operation was carried out in a state where there was surplus production of coffee, but at present with the view to protect our agriculturists and improve the production of coffee this practice is continued even in those areas which had deficit in coffee production. Agriculturists in these states (Tamilnadu) do not have much awareness on benefits of MSP. Thus, there is a need to have effective procurement operations to

ensure MSP to the agriculturists. The advantage of this is that transport cost of operating the commodity would be reduced to a considerable extent.

A system of purchases and distribution of major coffee was introduced in India earlier itself and statutory minimum prices were set, through it was not strictly implemented in many states. Indian agricultural policy mainly includes three main types of administered prices, these are support, procurement and issue price. These prices make sure to the agriculturists that, in the event of excess production in the market leading to oversupply of commodities, prices of his produce will not fall below the support price. In general support prices may affect agriculturist's decisions indirectly, regarding land allocation to crops. Cultivated areas for specific coffee crops however depend upon the actual price agriculturists realize for their earlier crops and their expectations of prices for the coming seasons. The quantity of coffee to be procured is determined by the need of the market at present. In the recent years, however the actual quantities procured have depended upon coffee outputs offered for sale by the agriculturists at a price fixed by the government. These prices generally are higher than the support prices but lower than free market prices in the recent years. In a year with best crop yield in surplus producing states, free market prices for the coffee would have been lower, but for government purchases after the surplus is taken off, market prices tend to climb higher than procurement prices. Major objective behind fixing a supportive price is to evolve a balancing and stable price structure to meet the overall needs of economy and also producers and consumer's needs in particular.

2.2.5 Coffee and Farmer/Labor

With coffee product prices being low, and simultaneously global competition becoming intense, producers face constant pressure to cut costs, including those relating to labour. The review of farm profitability in four major coffee producing countries in 2016 by the ICO confirms that coffee farmers have often been subjected to loss between 2006 and 2016, and that coffee does not provide a viable livelihood (ICO,2016). This generates to a negative spiral as subsequently there is little to no funding for investment in better agricultural practices and farm sustainability, resulting in decreasing yields and quality, meaning lower income and the cycle continues. Therefore, there is a tendency among producers to stop growing coffee because of decreased income per smallholder farm unit, due to a combination of low market prices, lower productivity, higher labour costs and pests and diseases (Coffee Barometer,2018).

2.3 Certification in Coffee

Coffee Board in their annual report 2011 mentioned Indian coffee as world's best shade grown mild coffee since majority of coffee cultivation is beneath the shade. Unlike Uganda, Brazil, Mexico where coffee is grown in open conditions referred to as 'Sun Coffee' (Damodaran, 2002). Coffee grown in India is usually mild and is not too acidic and possessing an exotic flavour with a gentle aroma. Specialty coffees are also experiencing rapid growth in the market. With growth rate of approx. 10% per year, specialty coffee shares 15-20% of coffee market in United States (USAID,2010). Certified coffee (e.g. Utz, Faitrade etc.) have reached over 10% in Scandinavian countries. This percentage is as high as 40% in countries like Netherlands. Certified coffee witnessed growth rates of around 20-25% per year whereas conventional coffee rests at only 2% (Pierrot, Giovannucci and Kasterine, 2011). Although, organic coffee market is small amounting to only 3% of the total market but showed tremendous growth rate of 29% for almost 8 years (2000-2008) before the financial crisis in United States (Pay,2009). These trends in coffee opens up whole new world of opportunities for Indian coffee as it fulfils both the quality as well as attribute profile of customers. A potential niche for Indian coffee is within the development of environment friendly products, by taking advantage of biodiversity and natural environment available in many districts. This also gives coffee growers an opportunity to incorporate sustainable measures to produce more of the certified coffee.

2.3.1 Coffee in The Netherlands

The Netherlands has a special place in coffee imports as it was the first country to incorporate 'Fair' coffee for the first time on a broader scale (Gielissen, Graafland,2009). 4C, the Common Code of Coffee Community in 2007 became a benchmark in embedding sustainable practices in the coffee industry. Its recognition increased with time in coffee sector especially in various companies so as to reinforce their market standing. According to a 2010 Oxfam Novib study, a remarkable 45% of total consumption of coffee in The Netherlands was found to be certified (Oxfam Novib 2010). A memorandum of understanding was announced on Nov 2010 (Signed by Dutch coffee and tea branch) expressing the intend of touching 75% mark by 2015 in consumption of certified coffee and tea. Dutch Ministry of Economic affairs, agriculture and innovation, supermarkets as well as NGOs all came on to support the referendum (Ingenbleek, Reinders 2013).

Consumer land certification policies as signified by 4C in the Indian coffee Industry can be perceived as some sort of economic and political imperialism in which non-

western manufacturers downgrade the standards of sustainability to those that fit under western corporate model. The irony of the matter is that conservation and maintenance of biodiversity rich forests in Western Ghats is extraordinarily dependent upon the current coffee production technologies being able to provide outputs for worldwide markets, which in the shadow of 4C, may become dependent on producers ability to satisfy the regime's certification requirements. At best, 4C might be regarded as a minimum set of norms meant in generating areas to avoid blatant labour and environment abuse. The outcome of political and economic value chain struggles among producers and consumer groups, it will decide the future opportunities for 4C tremendously (Neilson, Pritchard 2007).

2.3.2 Sustainability in Value Chain

The Food and Agriculture Organization of the United Nations (Neven, 2014) planned a guiding approach to include and analyse sustainability in food supply chains and develop methods to improve sustainability across value chain activities. The approach is analogous to the principle of the Shared Value concept (Porter and Kramer,2011), combining an analysis of the actor's requirements and expectations to realize greater sustainable outcomes.

As a consequence of numerous economic reforms, liberalization and cost pressure among others that have infested the coffee sector, a variety of private and multi-stakeholder initiatives are launched to market socially responsible and environment friendly measures in coffee production (Petkova, 2006). Such initiative brought the development of sustainability standards which are now increasingly being adopted for example 4C, Utz, Rainforest Alliance and Fairtrade besides others. These initiatives would promote a mode of governance that is closer to producer driven chain structure as it could improve growers' position vis-à-vis traders/roasters (Muradian and Pelupessy, 2005). As such, Voluntary Sustainability Standards (VSS) adoption by coffee farms is rapidly becoming a sine qua non for access to specialty coffee markets.

2.3.3 Implication of Sustainability in Value Chain

Regulation of externally authored ethical and environmental standards were found to have many implications for value chain structures and institutions within the small-holder coffee systems of Indonesia. Neilson (2008) ascertained that the sustainable coffee agenda has resulted in structural changes in modes of producer organization, trader –producer relationships, enhanced product traceability and increased the

presence of multinational trading firms. Based on a matched panel analysis of 218 coffee growing farm households belonging to three cooperatives in Central Kenya, Van Rijsbergen et al (2016) confirmed that Utz and Fairtrade-certified coffee production improved coffee returns. However, Fairtrade was more beneficial in coffee processing, whereas Utz effectiveness was seen in productivity. Under stagnating coffee prices, Fairtrade producers increased their coffee specialization, whereas Utz producers reduced coffee areas but increased yield. Further, Bolwig et al (2013) used a Heckman[2] selection model to spot the revenue effect stemming from certification and concluded that the largest effects were due to involvement in coffee processing. On the other hand, Mendez et al (2010) demonstrated that Fairtrade-certified growers receive better prices and higher coffee revenues, but sales to certified markets were far too scare for reaching sustainable livelihood effects. In Peru, Ruben and Fort, 2012 found modest direct income and production effects, but vital changes were seen in organization, input use, assets and wealth, and risk attitudes among small coffee producers.

2.3.4 What still needs to be known?

Although, several success stories can be seen from the literature but still one needs to figure out how value added is distributed among different actors at domestic level. Eventually, increasing the livelihood of the farmers. But more specifically, encouraging the farmers to adopt sustainable water practices. This can be achieved by water related certification highlighting the amount of water polluted to obtain a cup of coffee, which still need to be researched upon

[2] Heckman fits regression models with selection by using either Heckman's two-step consistent estimator or full maximum likelihood.

3. RESEARCH METHODOLOGY

Research design of a project stands for a comprehensive reasonable strategy composed to answer the research questions and lays the groundwork to the research methodology and its structure (Verschuren, Doorewaard, Poper & Mellion, 2010). This chapter will review the steps undertaken to find answers to the research questions and thus draft the recommendations for the Dutch coffee importers, NGO's and governments on sustainable use of water in the production of coffee.

3.1. Research Framework

The fundamental component of any research design, the research framework, is a schematic representation of the research objective. It consists of a 7-step approach to achieve the research objective (Verschuren, Doorewaard, Poper & Mellion, 2010).

i. Step 1: Brief characterization of the objective of the research project
The aim of this research is to form a recommendation to the Dutch coffee importers; NGO's and government for the improvement of coffee trade and water usage towards a more sustainable and effective approach.

ii. Step 2: Declaration of the research object
The research object in this research is the improvement in current amount of water used in growing coffee in India by raising the involvement of coffee importing countries and coffee importers, the Netherlands as example.

iii. Step 3: Explanation of the nature of research perspective
The conducted research suggests the concept of sustainable water usage as a long-term solution to address water scarcity in coffee production technique in India. It will observe all the relevant actors influencing the coffee Import sector with the environmental, social, and economic aspects focal to the study. Opportunity for a sustainable and improved coffee trade will be investigated from the perspective of a suitable and feasible method to import coffee for the Dutch coffee importers to consider making it a practice-oriented qualitative research project.

iv. Step 4: Description of the sources of the research perspective
The research is conducted in 2 complimentary stages, firstly including a descriptive research goal in the pursuit of understanding the water footprint of coffee in terms of irrigation, farming technique, process method along with stake holder and supply chain analysis for the import of coffee into The Netherlands.
Secondly, a more analytical stage by interviews to understand the situation of an Indian farmer and Dutch importers to understand international trade play in reducing the water use.

v. Step 5: Formulation of a schematic interpretation of the research framework
The research framework is depicted in the following schematic diagram.

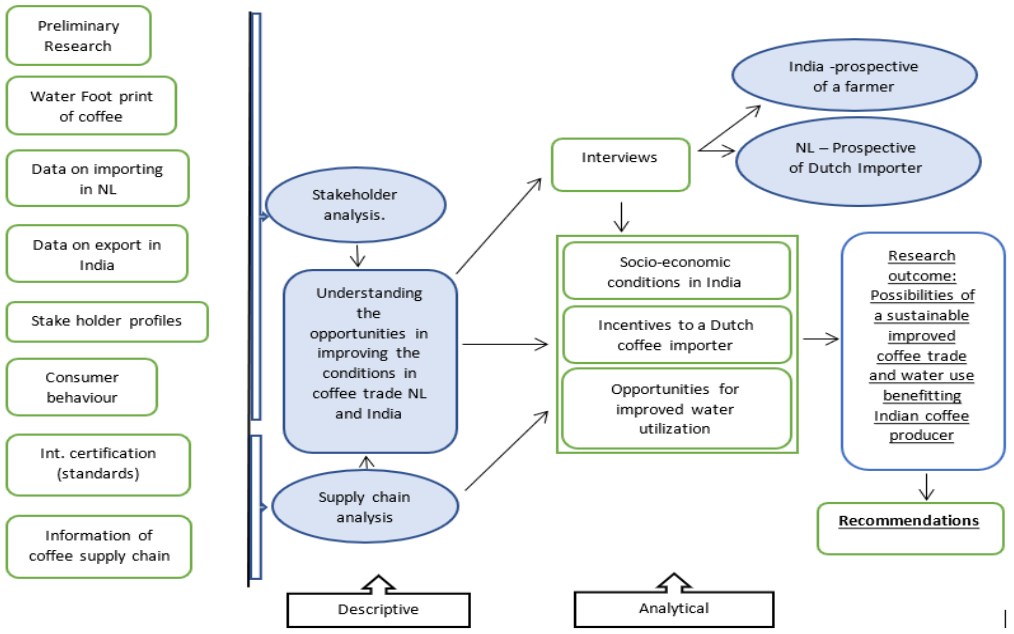


Fig.6 The Schematic Representation of the Research Framework

vi. Step 6: Segmentation of the research framework
The four stages of the research framework shown in figure are mentioned below.
(a) Analysis of the theories and information with explored water footprint for coffee, stake holder information on the interrelations between actors, consumer behaviour – international community and its standards and coffee trade supply chain.
(b) The means of identification of the research object (improvement on the water consumption), through assessment of the current practices in India and the international trade with The Netherlands.

(c) Tackling the results of conducted analysis as a basis for the proposed recommendations.
(d) Proposed recommendations for improving sustainability in import of coffee from India.

vii. Step 7: Review of the model for any possible amendments

3.2. Research Questions

With changing climate and rainfall pattern, the production of coffee will suffer, and it will find its dependence on other water resources for irrigation. Simultaneously, present cases of water scarcity around the regions of coffee plantation will only increase water stress level. Hence, through this thesis a sustainable and resilient approach for water in coffee industry is sought.

Below are the subset of queries which will help justify the overall aim of the thesis.

(a) What does coffee footprint look like in coffee holdings?
(b) What is the situation among Indian coffee farmers with regard to coffee production, socio-economics issues, water availability and water use?
(c) Is initiative towards more efficient water felt by Government, NGO's in India and what are the steps taken in this regard?
(d) Who are the main influencers of coffee value chain in India?
(e) How can The Netherlands, the international trade help the Indian farmers to take sustainable measures especially with respect to water use?

3.3. Research Strategy

A research strategy is the approach used by the researcher to collect and analyse material to obtain conclusive answers to all of the research questions. This research uses a dual approach descriptive and analytical which will be analysed in depth incorporating the general research strategy. It incorporates a desk research approach to identify applicable sources of information and data collected from interviews and the desk research to assist the study.

3.3.1. Research Unit

The research unit for this research is the water footprint for coffee, with the observation unit being the framework for supply chain with stakeholder analysis for the Dutch coffee importers.

3.4 Research Material

Regarding this research, primary data will be collected through interviews to understand the current situation of Indian farmers, the role of international community, international trade and measures to reduce water use. Secondary data is to be obtained from reputable sources, researchers who have been carrying out research related to the water footprint of coffee, stake-holder analysis and supply chain analysis. Various academic literature available online will be used along with the annual reports published by the concerning department as a part of research conducted to further justify analysis of the collected data.

3.5. Data Analysis

Data analysis in this thesis involves both qualitative and quantitative approach. Initially, information regarding water footprint analysis were explored with a qualitative approach. The findings of initial stage provided a base for the analysis and research questions were formulated. In the second phase, survey and interviews were taken to obtain data. In the final phase, discussion is presented using the data obtained and the literature review. Below the Table 1 outlines the approach used in each research query.

The sample structure for the conducted survey and interviews is as follows (see appendix 1):

In Chickmagalur district, mainly Mudigere taluk was selected. 20 farmers were randomly chosen in different villages in the Mudigere taluk. Also, 6 traders/middleman were chosen making sure that they have diverse background and different length of experience. The sample constituted several group of respondents as mentioned above. The data collection was carried during the period of June to August 2019.

Table 1: Method of Data Analysis

Research Query	Method	Analysis
(a)	Approximation via literature review	Qualitative
(b)	Survey 1 Research Papers Annual Reports	Quantitative and Quantitative
(c)	Annual Reports Interviews	Qualitative
(d)	Survey 1 Interviews Literature review	Quantitative and Quantitative
(e)	Survey 2 Interviews Literature review	Quantitative and Quantitative

With respect to coffee growers, the primary information was collected from the adult member based on the farm records (see image 1 in appendix) and memory of the respondents. A separate semi structured questionnaire with both open and close ended questions related to the study objectives was used to collect relevant information. The questionnaires were used to interview the famers while the other intermediaries were allowed to speak openly and share their experiences. The required information was extracted from the interaction with them. The questionnaire which were derived from the literature review was pretested and appropriate changes were made to get relevant information. The questions were administered in local language Kannada. Interviews have been carried out for a total number of 20 coffee growers. The coffee growers selected were different scale producers relevant to the research question. Care was taken to explain the objectives of the study to the respondents and to avoid unwanted information and redundancy.

Finally, expert interviews were carried with officials of Coffee Board (India), Non-Governmental Organisations (NGOs), coffee exporters and coffee importers in The Netherlands. Apart from this, consumer awareness survey (Survey 2) was also

conducted in The Netherlands so as to cover both ends of the spectrum of supply chain.

3.6. Research Constraints

The study is mainly qualitative based. However, simple quantitative methods are used. The sample size of the respondents was limited to 20 farmers, 20 traders and few intermediaries. Complex Quantitative tools like Water Footprint Network (WFN) and Life Cycle Assessment (LCA) framework to calculate water footprint are not applied in the study as it demands a larger sample size and more time and effort in collecting the data. As time was the foremost constraint during the period of this study. Another factor of constraint is the availability of respondents since the coffee growing households are scattered and isolated, it was time consuming to move around and meet the respondents. Further, the information obtained from the curers and other intermediaries may be biased since the answers given by them were mostly based on approximations. The research was therefore unable to capture the value-added situation to its 100%.

3.7. Research Ethics

Considering all the ethical issues within a study it is essential to ensure the research done upholds to all ethical principles. Since the research deals with the data collected from a group of individuals, the data shall be used only upon the consent of the participant. Since the study aims to contribute to sustainable development in the coffee importing sector, the principles of ethical research are respected and obeyed throughout every aspect of research including data gathering, analysis, and reporting.

4. FINDINGS AND DISCUSSION

This chapter aims at finding an answer to all the research queries presented in chapter 3 which were an extension to our problem statement. Both, qualitative and quantitative approach is employed while looking for an answer to a particular research problem.

Research Query a): What does coffee footprint look like in coffee holdings?

The approach used to answer this question was to form an estimate of water footprints through qualitative research that is collecting the information about the same through various literature. Consequently, translating that information to understand the water footprint of Chickmagalur district.

4.1Water Footprint Study Results

Mekonnen and Hoekstra (2011) mentions the overall water footprint of coffee as 15774 m3/ton as a global average disregarding the location. The global averages mentioned in the study can be misleading to an extend as they employed CROPWAT[3] model in which the green water component relies on the climatic condition of a specific location. In the study by Chapagain and Hoekstra (2003), they did not separate green and blue water components and hence, it will not be possible to deduce whether the crops were regarded as rain-fed or irrigated and a further comparison is not possible to carry out. Humbert et al. (2009) under the LCA framework, considered rainwater as having no impact on water resources and thus excluded this factor from their calculations, making difficult to draw parallelism to this thesis.

Although, above mentioned studies come up with remarkable results, but they proved to be insufficient in providing even an approximate picture of water footprint specific to a location. Also, specific data regarding green, blue and grey water footprint was not obtained. However, in this thesis evaluation of grey water footprint has higher priority as these numbers could help us estimating the extend of pollution in water. Grey water footprint is mentioned in several studies, but it comes with some limitation. For instance, Humbert et al. (2009) under LCA methodology, though stating that a substantial volume of water gets polluted in coffee processing, did not account for a grey water footprint. Instead, the studies used other impact categories such as water eutrophication (due to application of fertilizers) or eco toxicity (due to

[3] The CROPWAT model has been developed by the Food and Agriculture Organization of the United Nations (FAO) and is based on the Penman-Monteith equation (FAO, 2010).

application of pesticides). With respect to the accounting for the grey water footprint, Mekonnen and Hoekstra (2011) excluded the application rates of pesticides. The only factor which was taken into consideration in the accounting for the grey water footprint was the application of nitrogen.

In order to get a better comparison of the magnitude of the findings of the grey water footprint in our study, another method was applied by using studies on the water footprint of other crops where accountings have been made with respect to both pesticides and fertilizers. For example, Chapagain et al. (2006) estimated the water footprint of cotton production worldwide. Their findings showed a grey water footprint of 2.1 billion m3 per year as an average for all the producing countries. Another study by Chapagain and Hoekstra (2011) calculated the water footprint of the production of rice which showed an average grey water footprint of 4.5 billion m3. The grey water footprint can thus be reduced by applying less nutrients or pesticides, by applying chemicals that can be easier assimilated (require less water to get assimilated), by lowering the fractions of applied chemicals that reach ground- or surface water by leaching or runoff, or by increasing the yield.

Above mentioned studies in the direction of grey water footprint helped us identifying the sources of grey water. During production of a coffee it is accounted to fertilizers and pesticide and during processing of coffee, it can originate from both point and diffuse sources of pollution. The contribution to the grey water footprint from point source pollutions includes the honey water which is released from the processing plants directly into the waterways. Regarding the diffuse source of pollution, its origin from the effluent water which is led from the processing plants into evaporation/percolation basins.

Grey Water during production:

Major source of grey water during production can be attributed to the use of fertilizers and pesticides which can finds its way to water basins, hence polluting them. During the survey conducted, 100 percent whether big or small, all admitted using fertilizers. Nitrogen, Phosphorus and Potassium, DAP mixture, Urea mixture, 19-19-19 or 16-16-16 NPK balanced, composite Vermi fertilizer were some of the fertilizer mentioned by respondents of our survey in Chickmagalur.

The use of pesticides has customarily been excluded from the agricultural practices in Chickmagalur district. However, when the cultivations were affected by the fungal parasite, many of the producers saw themselves forced to abandon the organic techniques. Bavistin fungicide and Ekalux pesticide were two names of pesticides which came up during discussion. However, it was emphasised that its use is very less.

Farmers rather use traps to catch and kill the pests. To account for the contribution to the grey water footprint from the fertilizers and pesticides, it was necessary to know the concentrations of the selected parameters such as Nitrogen, Phosphorus, COD etc. in the effluent water at several location in the district. But no such data was obtained during the tenure of this thesis.

Grey Water during processing:

Processing of coffee can be done at hullers, at coffee estate establishments or at curers. The primary processing is normally done by coffee estate holes at their own storage facilities which later is sent to curers to perform the secondary processing. The role of hullers basically is to process cherry coffee from dried cherries to parchment coffee. They are located all over the growing regions. However, hulling results in a low-quality coffee since it results in higher number of damaged beans as the machines used by them are very simple. Hence, it is not preferred overall.

Almost all the coffee estate holders in Chickmagalur have their own pulping machine setup for the primary processing. These coffee pulping machines utilise about 1500 l per ton and also discharge polluted water with wastage pulp. A 20ft by 20ft by 15ft hole is dig where the wastage pulp, cow dung and chemicals are added to treat them. Later this is used back as a fertilizer. Having this polluted water treatment is a must for all coffee estate holders as Karnataka State Pollution Control Board keeps an eye on them especially in the coffee growing period (November-April). Since, this process is considered costly among the coffee growers, there is a slight chance that the polluted water can be discharged in the river basis. But, the possibility of this happening is as low as 10 percent (although substantial) because others witnessing this happen can complain to pollution control board.

Curing works play an important role in the Indian coffee chain. They are usually located in precise towns of every coffee-growing region and are normally owned by exporters. The Curers carry out secondary processing, both dry and wet processing and allow good storage conditions. Coffee curing works in Chickmagulur were interviewed to understand their water management. Arun Saldanha who owns the curing work expressed that 'Water is used for preparing washed coffee, i. e., parchments. Here the quantity of water used, is now reduced to a large extent due to modern and efficient machinery which use very small quantities of water and also adapts recycling of water.' This view about water usage was common among other coffee curers. However, during the research no quantitative data was obtained about the grey water footprint of the coffee processing. Now that one has a pretty good idea about how water footprint of coffee may look like. One can move on to next research

query which reveals a picture of water availability and water usage through the eyes of farmers.

Research Query b): What is the situation among Indian coffee farmers with regard to coffee production, socio-economics issues, water availability and water use?

This research problem used both qualitative and quantitative findings. Initially, socioeconomics of farmers was obtained via survey. Later, both literature findings and survey results were used to highlight the water availability and water use in Chickmagalur district.

4.2 Socioeconomics of coffee growers

The objective of the socio-economic survey is to assess the impact of social, economic and cultural factors of the coffee growers on adoption of recommendations practices at the estate level.Coffee estates in India can be classified into marginal (< 2 hectares), small (2 -10 hectares), medium (10-25 hectares) and large holdings (>25 hectares). A total of 20 coffee growers were surveyed and following Table 1 shows the breakup of the sample surveyed:

Table 2: Sample Distribution in the study region

District	Marginal	Small	Medium	Large	Total
Chickmagalur	2	10	7	3	22

The socio-economic features of the coffee growers notably, experience of growing coffee and land holdings, presented in Table 2, which can be regarded as an important factor on the production practices of the coffee growers. The average land holding size in respect of marginal, small, medium and large growers was about 1.23 hectares, 6.5 hectares, 19.7 hectares and 69.3 hectares respectively across all the regions. The marginal and small category farmers had less years of experience in coffee cultivation (23-25 years) as compared to the medium and large growers (36 years).

Table 3: Socio-economic data of coffee growers

District	Variable Name	Marginal	Small	Medium	Large
Chikmagalur	Land Holding	1.35	6.05	15.21	63.3
	Age	42.5	41.3	52.71	57.66
	Experience	24.5	23.3	34.71	37.33

The details of the educational qualifications of the respondents are presented in Table 3.

Table 4: Educational qualification of coffee growers

Educational Qualification	Marginal	Small	Medium	Large
Graduate	0	0	3	3
High School	0	7	4	0
5th Standard	1	3	0	0
Illiterate	1	0	0	0

From the table 4 above it is apparent that a large percent of the marginal and small coffee growers are least educated whereas most of the large farmers are graduates and a majority of the medium farmers have educational qualifications in excess of High school. This aspect needs to be borne in mind while catering to the training needs of these categories of growers.

4.3 Water availability and Water Use

In this part water availability of Chikmagalur especially of Mudigere Taluk is presented in terms of drainage, groundwater and rainfall. Both qualitative and quantitative approaches were used to understand the water availability and water use. Later in the section, the concept of water use in context of coffee production is presented by irrigation techniques and strategies.

Drainage: Chikmagalur district falls in Krishna basin. The district is the birthplace of six rivers. They are Thunga, Bhadra, Hemavathi, Vedavathi, Yagachi and Netravathi.

Groundwater: Ground water in the district occurs under water table and semiconfined conditions. Weathered, fractured and jointed gneiss and schist serve as potential aquifers in the district. Ground water development in the area is through dug wells and bore wells.

Mudigere: Nearly 60 percent of the area in Mudigere talk is covered by gneiss and rest of the area is occupied by schist formation. Weathered fractured and jointed gneiss and schist serves as potential aquifers in the area. Based on water level data of the National hydrograph stations located in the taluk (long term water level trend 2001 to 2010), it is observed that all hydrographs of Mudigere taluk show rising trend during pre–monsoon as well as post-monsoon.

Rainwater: The average annual rainfall of the district is 1904 mm. Kadur taluk receives the lowest rainfall of 646 mm, whereas Sringeri taluk receives the highest

rainfall in the district amounting to 3850 mm. Seasonal and Annual Normal Rainfall for the period 2001 –2010, of Chikmagalur district is illustrated in the table below. One can notice that annual rainfall in Mudigere taluk is 2756mm.

Table 5: Seasonal and Annual Normal Rainfall for the period 2001 –2010, of Chikmagalur district

Station	Pre- - Monsoon	SW Monsoon	NE Monsoon	Annual
	Rainfall (mm)			
Chikmagalur	212	470	229	911
Kadur	164	302	180	646
Koppa	166	2322	216	2703
Mudigere	300	2132	324	2756
Narasimharajapura	150	1173	183	1506
Sringeri	232	3332	286	3850
Tarikere	146	639	212	997

Coffee is a water-sensitive crop and the required quantity of water is necessary for getting the expected quantities of yield. Blossom showers are vital for a coffee plant's prompt flowering. Blossom showers are required at least thrice a year. The first doses of the shower are essential during February or early March. Then, for the plant's complete flowering, at least three or four more showers are needed within a month. The total dependence on rainfall makes coffee cultivation a gambling with nature and farmers get good crop only if blossom showers are revealed in time and in adequate quantity. If the rain is received late, it will adversely affect manufacturing and productivity rates. Table 5 represents coffee grower's opinion about the adequate rainfall received during the years from 2010 to 2018. It is seen that in 5 of the 9 years, rainfall was scanty or inadequate.

Table 6: Coffee grower's opinion about the adequacy rainfall

Year	Rainfall
2010	Adequate
2011	Adequate
2012	Inadequate
2013	Inadequate
2014	Inadequate
2015	Inadequate
2016	Scanty
2017	Adequate
2018	Excessive

Therefore, the significance of implementing coffee irrigation equipment is evident. Hence, following irrigation technology and strategy is described in detail.

4.3.1 Irrigation technology and strategy

Sprinkler, drip and subsurface drip irrigation technologies are some of the irrigation technologies which have a major effect on consumptive water footprint. Some studies even highlight their dependence on the yield of the crop. Sprinkler irrigation is a method of applying irrigation water that is similar to natural rainfall. Water is generally pumped through a system of tubes. It is then sprayed into the air through sprinklers so that it breaks up into small water drops that fall to the ground (Brouwer & Heibloem, 1986). LESA (low elevation spray application) and MESA (mid-elevation spray application) are sprinkler system technologies with the potential to reduce water losses. Drip irrigation systems use commonly tubes that are placed on the soil surface next to the crop to apply irrigation water with high precision. Similarly, the emitters of low energy precision application (LEPA) systems are also in contact with the soil surface. LEPA systems are often used in conjunction with furrow dikes. Subsurface drip is a low-pressure, high efficiency irrigation system that uses buried drip tubes or drip tape to meet crop water needs (*Deficit irrigation practices*, 2002).

The conclusion drawn from various experimental and simulation studies is that drip and in particular subsurface drip irrigation can lead to an increase in yield and a reduction of the consumptive water footprint of coffee production when compared with sprinkler or surface irrigation. Yet, while drip irrigation may not increase yield relative to well managed surface irrigation (Howell et al. (1987) show an example for furrow versus drip irrigation), the practice of sprinkler and surface irrigation may result in non-beneficial water use, as the irrigation water evaporates, rather than to contribute to crop growth through transpiration.

Apart from the novel irrigation methods mentioned so far, precision irrigation is a method which is highly overlooked. Precision irrigation has the potential to increase water use efficiency by optimally matching irrigation inputs to crop water needs. The consumptive water footprint (WF) can generally be reduced through (i) optimized irrigation scheduling (in time) and (ii) variable rate irrigation (VRI) (in space). Optimizing irrigation scheduling can have substantial influence on achieving the goal to reduce water consumption without sacrificing yield.

With above information in mind, irrigation practices of farmers were questioned which resulted in response presented in Table 7.

Table 7: Irrigation Practices used by coffee growers

Irrigation Method	Marginal	Small	Medium	Large
Sprinkler	None	5	All	All
Drip	None	None	4	All
Canal/Pipe/Hoses	2	5	Had access	Had access
Precision Irrigation	-	-	Aware Not Used	Aware Not Used

As seen from the Table 7 above, among the marginal and small farmers of Chickmagalur, none had used the drip irrigation method. However, 50% of the small farmers are utilizing the benefit of sprinkler irrigation. 100% of medium and large farmers are using sprinkler irrigation to a large extend but also had access to rough pipes and hoses which they rarely put into use. Only few medium and all large farmers employed the drip irrigation technique. A striking data was obtained for precision irrigation as it was not put into practice by any farmer although, medium and large farmers were aware of this method of irrigation.

The difference in practices adopted by smaller and larger farmers for irrigating their fields can be attributed to their socio-economic status. Firstly, there is a difference of educational background which favours larger farmers to access information about these new or tried and tested technology and later translate them into reality. Secondly, cultural reasons played a slight role as well where small farmers treated rainfall as God and hoped for timely rainfall driven by their prayers. Lastly, even when small and marginal farmers convinced about the benefits of new irrigation methods, the cost of implementation of such practices holds them back.
Discussion about water availability and its usage is incomplete without finding out the measures which are taken to make it more resilient. Next research query sheds some light into it.

Research Query c): Are initiative towards more efficient water felt by Government, NGO's in India and what are the steps taken in this regard?

4.4 Role of local bodies

The findings of this research question were purely qualitative in nature. Ground Water Information Booklet via Ministry of Water Resources were used to obtain measures taken on groundwater. Coffee Board annual reports and interviews with farmers helped in understanding initiative taken towards irrigation and reduction of grey water. Finally, interview with an official of M. S. Swaminathan Research Foundation (NGO) was conducted.

Towards Groundwater: Central Ground Water Board under the Ministry of Water Resources has carried out ground water development on large scale in eastern part of Chickmagalur, Kadur and Tarikere taluks through structures like dug wells and bore wells. An important initiative taken by the board to combat the water scarcity comes under Water Conservation and Artificial Recharge whereby constructing suitable structures the contact time of this flowing water with the land is increased or the flow is arrested for some time.

Chikmagalur and several other coffee growing regions have one thing in common. Their unique landscape forms valleys and wetlands. Therefore, the water which flows from higher altitudes to lower altitudes helps in formation of wetlands, marshlands, ponds, lakes and replenishing of water streams.Therefore, distinct kinds of artificial structures are suggested by studying the nature of geological formations, soil slope, weathering depth, depth to water level and accessibility of land and water source for artificial recharge systems. Check dams, Nalabunds, Sub-surface dykes, Percolation tanks, and point recharge structures like recharging through existing borewells/ dugwells and recharge pits can be done in plain lands of eastern part of district of Chickmagalur.

For Irrigation: Coffee board of India since 2015 is organising awareness campaigns regarding smart irrigation method where they popularize sprinkler irrigation. Due to which, almost 50 percent of farmers are taking benefits from these technologies. Furthermore, Coffee Board has recognized the potential of drip irrigation in decreasing the usage of water substantially. Hence, they are now providing subsidies for farmers using drip irrigation method. It seems that Coffee Board is on a mission to slowly change the old methods like furrow irrigation via new irrigation technology. However, Coffee Board is overlooking small and marginal farmers due to their educational background and financial constraints not been able to take advantage of these new methodology in irrigation.

Grey Water Reduction: Karnataka Pollution Control Board made sure by keeping a continuous watch on coffee estates who own pulping machines for the first processing in their storage facility, are recycling the grey water to be reused in the farms again. Farmers during the survey expressed the fact that the board was highly effective in catching the farmers who were discharging the polluted water into baseline streams. Due to this effectiveness, the practice of discharging the polluted water into river basins has come down to 0%.

To ensure water sustainability Coffee Board every year publishes recommended use of fertilizer in coffee crops. Officials are appointed to spread this information verbally for illiterate farmers such that they don't use excess or deficient amounts of it,

eventually leading to either increase in level of water stress or decrease in yield of production.

Apart from government, NGOs although very less in numbers also takes necessary steps towards sustainable water use. On their priority list come small and marginal farmers. Awareness campaigns, introducing effective and cheap mulching techniques and connecting farmers to liberal financing by various banks for agricultural development for installation of irrigation technology were some of the measures taken by M. S. Swaminathan Research Foundation (NGO) based in Waynad, Kerela.

4.4.1 Towards Sustainability

Finally, Goal 6 under UN Sustainability goals was tried to realize on a localized level of Chickmagalur. Government of Karnataka doesn't seem to publish any such sustainable reports where specific targets and indicators are mentioned which should be realized under the time constraints. But neighbouring state Kerela, where Waynad is coffee growing district whose topology of terrain is almost similar to Chikmagalur, published their report about sustainable goal where focus on water use can been seen. Hence, some coffee growing regions are far ahead in realizing water sustainability on a more quantitative scale, other districts like Chikmagalur has some catching up to do.

Responsibility of realizing water sustainability or resilience is not only limited to farmers, government and NGO. There are other factors which can also play a substantial role in making it a reality. However, first and foremost one needs to know all the major players who can contribute to it. Therefore, next query seeks for that information only.

Research Query d): Who are the main influencers of coffee value chain in India?

4.5. Main influencers

This section takes a dig at the existing value chain of coffee in India. This information is essential in the context of this thesis so as to identify links among various role players. Also, to get an idea as to who is at disadvantage and who are neglecting their responsibilities in the value chain. Below the description starts with middleman who is at times for majority of farmers first point of contact. From there we follow the thread and present a pictorial representation of supply chain observed in the context of this thesis.

4.5.1 Agents/Middleman/traders

One can acknowledge the presence of agent since liberalization. It was observed from the study that agents are powerful local actors. Collection of the coffee from planters, transportation to the curing works, storage facilities are some of the support services provided by the agents. Additionally, they are also associated with providing financing facilities and information collection. In these operations they have created enormous control, which has enhanced their position as key intermediaries between curers and planters. Furthermore, this control expands their network that provides them with good information concerning the plantations, their practices as well as prices.

For the survey in Chickmagalur region it was found that out of 22 coffee growers, 55 percent of farmers were selling their produce to the agents at farm gate prices which mostly include small and marginal farmers. While, rest 45 percent of them sell their produce directly to the curing works.

Here is important to notice that small growers are largely taken aside of the marketing channels of their coffee. Although, most of the small and marginal farmers contribute to majority of production, they sell their coffee at the farm gate to purchasing agents. Hence, they do not participate in the marketing of their coffee and do not benefit from the information related to the valuable attributes of their product. This is because when the small farmers sell their coffee in bigger towns or to curing works directly often loose money because of higher transportation costs. The price they get may be higher, but deduction of transportation costs might then make a lower price than agents' ones. Hence, they prefer to sell their produce to the agents rather taking the burden of transportation costs. Furthermore, Agents also lend loans to the growers and then secure their supply. Although taking interest is not their priority, they tend to secure their supply by giving the loans and increase their bargaining power. Their intension is by lending money, they can afford paying less than the market price for the coffee they purchase from the grower.

Curing Works: In recent times, the importance of curing works has increased fourfold. This can be attributed to their storage facilities that often lacks in the farm. This gives them flexibility in the time when they sell their coffee, and thus making profits by speculating on the price movements. Although, Small growers can store their coffee at their farm but the poor storage conditions at the farm level can lead to a deterioration of the coffee quality.

Out of 22 coffee farmers, marginal and small farmers store their coffee at the agent's storage facility and others directly at the curing companies. Large coffee estate holders have their own private storage facilities.

Chikmagalur Coffee Curing Works Pvt Ltd, Sargod Coffee Cuing Works are some of the curing works in the district of Chikmagalur. Interviews of the traders and

middlemen pointed out that some curing works are owned by big companies who also own large corporate plantations for instance Coffee Day Global. Other curing works like J. Rodrigues Coffee Pvt. Ltd, I.J.J Rebello, Estate Coffee Processing Unit etc. are owned by exporters. While, very few of them work independently. Some of them also have the grading facilities in their curing works. After grading they further sell it to the exporters. Curing works without the grading facilities hand over their produce to the Big Curing Works for further grading and export purposes.

4.5.2 Exporters

Clean coffee, after secondary processing is done at the curing works can go through three main channels. This includes exporting it, selling it in domestic rosters or selling it through Indian Coffee Traders Association (ICTA) in Bangalore. ICTA auction is held once a week in Bangalore. Very small quantities are sold through this auction where purchasing is done mainly by small or medium domestic roasters. Nearly 70 percent of coffee produced is being exported. Indeed, exporters play a very important role in the Indian Coffee Industry having a huge control in the supply chain and trade channel.
Three major coffee exporters viz., Arun Saldanha, Saldana Internationals (A), M/s. Amalgamated Bean Coffee Trading Co.Ltd.(B) (now called Coffee Day Global) and M/s. Ramesh Exports(C), who have sizable export and domestic market presence, were identified for the survey. The profile of selected exporters is furnished in Table 8 below.

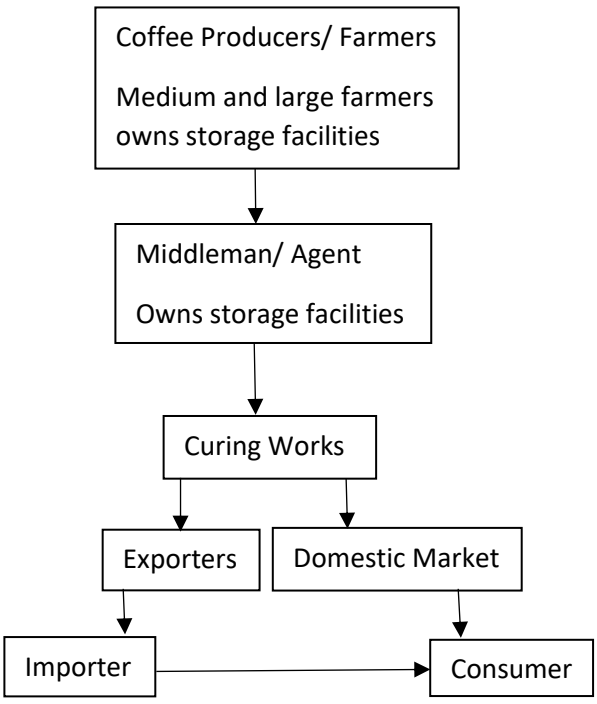
Table 8: Information with regard to exporters

Information	Exporter A	Exporter B	Exporter C
Mode of sales of coffee	Exports	Exports	Exports
Major Export destination	-	Belgium, Germany, Italy	Germany, Italy, Japan
Major region of operation	Chickmagalur, Hassan	Chickmagalur, Hassan	Chickmagalur, Coorg
Mode of coffee collection	Agents, Curing works	Company depots, Agents	Agents, Curing works
Own Curing Works	Yes	Yes	Yes
How is information regarding price and quality conducted along the chain	Through Suppliers	Through Suppliers	Through Suppliers

It was noted during the coffee growers survey that big companies such as Coffee Day Global and few others provide subsidies (almost 50%) on the packaging bags for those who practice sustainable ways of farming.
Goods and Service Tax Registration, ICO (International Coffee Organisation) Registration from Coffee Board, Import Export Certificate, AD (Authorised Dealer) Code are some of the minimum certification acquired by above mentioned exporters. Concerning the Fair-Trade Policy, a common thought among the exporters is expressed by Mr. Saldana who says "Although we have not directly benefited from fair trade, there are lots of indirect benefits. We supply lots of coffee to NESTLE India, which is 4C certified. Nestle gives incentives to growers who supply coffee to Nestle through us and are 4C certified". Finally, all the exporters mentioned that they do not receive any incentives from the importers for sustainable farming.

To conclude this section, taking the bottom up approach, coffee supply chain starts with farmer at the bottommost thread. It was found that medium and large farmers have their own storage facilities while small and marginal farmers sell their cherries to middleman or the agents who are the second link in this value chain. Big farmers and agents send the cherries for the secondary processing to curing works which can either be exported or sold in the domestic market to consumers. In Chickmagalur 70% of the coffee produced is exported. Below one can see the pictorial version of the value chain encountered in this thesis.
It is important to notice that Importer and consumers in coffee supply chain have not been visited yet, which is due in next research problem. Also, there could be presence of other role players in a coffee chain apart from the mentioned. But we recognized these to be the essential one in order to obtain sustainable water use.

Figure 5: Value chain of coffee in India.



Research Problem e): How can The Netherlands, the international trade helps the Indian farmers to take sustainable measures especially with respect to water use?

In the research problem c) we encountered Government and NGOs initiative towards water sustainability. Furthermore, one would like to know how the importers of commodity (here coffee) and consumers in the importer country can help realise this goal. This section is divided into two parts, first we present the viewpoint of the importer which was obtained through phone interviews and second, viewpoint of consumers was surveyed about sustainable coffee.

4.5.3 Importers

The Netherlands is a medium-sized coffee market in Europe, and it stands out from other countries in a manner that, production sustainability and trade sustainability plays an important role in gaining access to the Dutch market. Thus, it is an ideal country to choose importers and learn about their practices. Hence, three people with various designation in the coffee importing industry were chosen and were questioned about water sustainability in coffee and do they account for it.

A common consensus among all importer was that, they only import certified coffee according to EU guidelines. They all mentioned that the coffee world is divided in two parts, one which deals with speciality coffee and the other is commercial coffee. High prices are awarded by the importers to speciality coffee. Other than that, the pricing depends on the cupping score and the certifications. The coffee quest where they control the supply chain make sure by themselves that grey water footprint in coffee processing is kept as low as possible. Else, the criteria of sustainable using water in coffee production is something which is overlooked via the importers. Importers also mentioned that the industry is consumer driven, if the consumer demands for coffee which sustainably produced taking water into consideration then they will be sought for it. Hence, the study then took its routs to consumer and carried out a survey.

4.5.4 Consumers

This study was conducted in Leeuwarden in order to understand the general awareness in people about the water footprint of coffee. You can summarize the findings of this study as follows:

- It was seen that more than 50% of the respondents drink at least 3 cups of coffee a day with 70% unaware that coffee is a water intensive crop.
- General awareness of Fair trade exists among the Dutch with more reference to the fair-trade chocolate available in the supermarkets in Netherlands.

- It was observed that the regular coffee drinkers are willing to pay slightly higher for sustainable coffee along with signing a petition to improve the current scenario for sustainable coffee.
- Mainly, it can be comprehended that even though people care about sustainability, if the price of coffee shoots up drastically then they would revert back to regular coffee.

Hence, it is clear that not only consumer influences the sustainable products in the market but also the coffee companies and importers. They should also take up the responsibility to spread the word, establish the need and then escalate the inflow of sustainable coffee. For instance, importers should include the true cost of coffee which the costs of environmental and social externalities in production of coffee.

True pricing incorporates burdens to society, such as soil and water pollution, farmers and workers social security and a decent wage level, in the total costs of coffee. This methodology is based on an approach driven by a cost-benefit equation, rather than on compliance. This should in turn improve the effectiveness of investments in sustainability. An example from research in Mexico estimates the true price of conventional coffee at $11.10, while the market price is only $3.30. If we compare this to climate-smart coffee (CSA), its true price is estimated around $3.90, while the market price of this CSA-coffee is around $2.90. This research concludes that investments in climate-smart coffee have a higher return on investment. Thanks to yield increases, but also to environmental gains in natural capital and higher carbon sequestration. This is both cost-effective and profitable, although support to farmers to make this transition is required. Incorporation of external costs and benefits allows for benchmarking different production systems, and it lowers the bar to decide to investment in coffee produced with lower external costs (Adelhart Toorop de, R. et al, 2017).

After taking a deep dive into research questions, a final conclusion will be presented in the next chapter and recommendation will be provided wherever necessary.

5. CONCLUSION AND RECOMMENDATIONS

Conclusion

This thesis, since the beginning sought for sustainable water use in coffee industry. This becomes particularly important for coffee growing regions which are facing water scarcity or may face it in near future. Hence, to avoid major production and economic losses, this issue calls for an immediate action. But, what action, by whom, where, on what level are obvious queries whose solutions must be searched actively. To make this possible, in this thesis the problem statement was further sub-divided into five essential queries and a methodology was framed to tackle those queries. Through surveys, interviews, annual reports and literature reviews, these queries were discussed in detail in Chapter 4.

Research query (a) aim towards getting a picture of water footprint in coffee chains which can be translated to specific regions. Although a lot of studies came up with fantastic number but no study (what so far was encountered) was able to clearly describe all (green, blue, grey) footprints which can be used to approximate the water footprint of region under study. Hence, a further study on quantitative water footprint with regard to a location, clearly mentioning the contribution of green, blue and grey water footprint would be beneficial for future researches. Nevertheless, the first research question helped us paved the pathway to our next research query.

In **research query (b)** water use and its availability was seen through the lens of farmers. A socio-economic survey helped in realizing the demographics of farmers. It was quite evident that small and marginal farmers were at a disadvantageous position especially, when it comes to access to modern irrigation techniques and strategy. Drip and precision irrigation still needs to finds its place in coffee holdings. In terms of water availability, the district has ample of water which now should be managed properly to avoid incidence of floods and droughts in future.

Water management in coffee plantation is of highest priority to Ministry of Water Resources in India. Their reports help us find the answer to **research query (c)** by mentioning the measures taken in the direction of water management. Equivalent efforts were observed by Pollution Board and Coffee Board to make sustainable use of water a reality. Hence, one can say that the efforts done by government and NGOs are sufficient and necessary. However, small farmers again here not able to take the advantages of new policies. This can be attributed to lack of planning in policy making where emphasis should be given to small and marginal farmers. Also, a more

quantitative approach for sustainable goal number 6 with proper targets and indicators must be worked upon, which cease to exist at this stage.

From the first three research question a strong background on water footprint, water use and measures to improve current practices, was developed. Now, one would like to know what happens to coffee once it is harvested. Through which channel it goes through and who are the important role players in this channel. **Research query (d)** found that higher number of farmers sell their coffee to middleman and others have their own storage facility for primary processing. For secondary processing, it is sent to the curers who are also (most of the time) exporters of the coffee as well. Through them it is sent to international market where it finds access to importers and later consumers. Middleman and importers, two very important role players who by obtaining good practices can help move the process of water sustainability faster.

Furthermore, to understand how international trade can escalate the better practices on water use in coffee growing countries, **research query (e)** was dealt where it was found that several measure like paying higher prices for specialty coffee, certifications, Fairtrade helped importers to obtain a sustainable coffee. However, no indicator of water was available which monitors usage of coffee during production or processing, the grey water percentage, water stress level of coffee from where it is obtained of which could influence the decision making of importers. Nevertheless, consumers expressed the fact that they are willing to pay for the water prices which goes into making of coffee.
Since India is a hub of speciality, organic and sustainable coffee, a huge market of certified coffee for The Netherlands lies in this country. The Netherlands still have to achieve their mark of 75% in consumption of certified coffee which was due 2015, the world still needs an example of how sustainable coffee can become a norm in daily life of people so that it can be translated into other commodities. Through this thesis we understood how the different role players such as importer in The Netherlands, Government in India, nearby NGOs can help farmers/producers to obtain sustainable coffee. The emphasis was on water use as this factor can decide the production level of coffee (a water intensive crop) in future. We found that the importers sitting on the top of the chain can have huge influence on water use practices by farmers in India as they require certified coffee and having strict guideline of sustainable water use in those certifications can make it happen. Once such emphasis is present, companies and importers will take necessary steps at grassroots levels to make sure the continuous supply of certified coffee does not stop.

Although, to make sure that sustainable coffee is just not a market gimmick by industry and importers to show their market standing to their customers and sell normal product at higher prices with no improvement in the lives of coffee producers, care has to be taken by analysing the reports, data and situations presented by the

government and NGOs in the coffee host country. Water use, here, can serve as a huge indicator. To make sustainable water use in coffee a reality, transparency in coffee chain is required. This is where the Government and NGOs will come in play, to make sure that the small and marginal farmers to whom 98.5% of coffee holdings belong, are not at disadvantage. Also, making sure that the middleman is not using unfair means in business. Making them aware of modern irrigation technology, and with the help of importers providing higher subsidies to make it a common practice not just restricted to medium and large farmers. Helping them realize that every good water use practice would be rewarded by the importers and the government as well. Although, we saw in Chapter 4 that several measures are taken but they are not reaching to the very end to marginal farmers. Hence, these main role players like The Netherlands, Governments and NGOs have to work in unison to make coffee the most sustainable traded product in the market. Below the thesis present some recommendation, here practices on how to conserve water for groundwater or measure during heavy rainfall are avoided as they are subject of whole another but similar topic.

Recommendations

Future Research Scope: As one has encountered in research query (a), how lack of concrete data hindered the visualization of water situation at a location, especially in the context of grey water footprint. Hence, this thesis proposes a study which should carry out a quantitative water footprint analysis for coffee regions, starting with those where water stress level is high. This can be achieved by the education departments of states in India where coursework should be designed in such a manner that students and researcher carry out such studies. Furthermore, incentive should be provided to increase the pace of the work as this is high time because several states are already seen cases of droughts and floods in their regions.
Later it can be extended to different crops as well. This procedure will help in obtaining concrete numbers which can be used in defining targets and indicators of Sustainable Water Use in future to come.

A Top Down Approach: It is quite obvious that sustainability reporting in this scenario has room for lots of improvements, especially when it comes to reflecting the views and priority of coffee farmers who resides at one end of the spectrum of supply chain. Looking from farmers perspective, sustainability conditions imposed on supply chain actors would result in less gaps and disparities. Hence, the need of the hour is regular reporting or sustainability assessment by big coffee companies and importers. This will help them recognize the priority topics such as water scarcity in coffee growing region, decreasing population of coffee farmers that the coffee industry needs

to concentrate on for its long-term viability. These top-down experiences can be put to use for bottom-up efforts in an effort to engage coffee growing organizations to arrive at more meaningful sustainability initiatives that provide more benefits to farmers. Sustainability reporting will not only provide a narrative to stakeholders but also build direct trade and build relationship coffee trends that focus on individual farmer or community stories as a way to bring more authenticity. Eventually making farmers more resilient as they would be more encouraged to implement sustainable practices.

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ANNEXURE

Annexure 1: Minutes of meetings – Stakeholder Interviews and surveys.

1.1 Interview with an Indian Coffee trader.

Interviewee Name: Sandesh Roche

Designation: Coffee trader (Green valley estates, Mudigere)

Interviewer Name: Sarette Joylin Dsouza

Date: 26/07/2019 Time: 10:00 – 11:00 hr

Languages spoken – Konkanni and English.

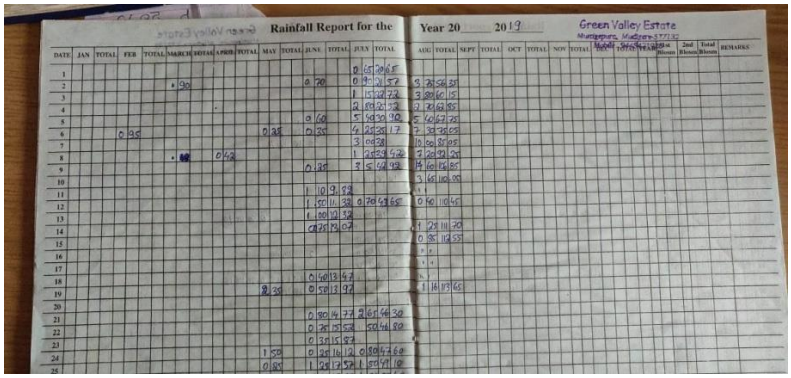
An interview was conducted with a local coffee trader in India to explore the ground reality for the current water footprint of the coffee production process and the implications climate change can have on water availability. The discussions were held in respect of three aspects namely local trading, irrigation methods and rainfall data. Before conducting the interview, an extensive desk research was carried out and a checklist of questions was prepared for discussion. The observations of the interview are given below.

The main question to be answered is understanding this process of coffee production and the local adapted practices to help in the process. How is coffee grown in your region? Was how the conversation started with Mr. Roche explaining the details of his livelihood.

Discussion about adequate rainfall through the years – Being a midsized farmer growing 90% Robusta and 10% of Arabica coffee in his 12 hectare estate provided details with the coffee production and rainfall pattern according to his logs, Robusta coffee needs minimum of 2032mm and maximum of 3048 - 3302 rainfall per year for a good harvest. In the year 2015 and 2016 they experienced bad draught which resulted in only 1993.9mm and 2413mm of rainfall proving to be a very bad span of 2 years. This year 2019 so far, the district has already received 3048mm of rainfall and with 4 months in hand no preventive measures have been taken to keep the farmers from facing the damages. Irrigation methods – Still using sprinkler technique due to time, money and labour constraints. Gave a detailed view of how the water dispensing works in estates like his and how the farmers manage with limited water during summers like showering the coffee plants with just 2 showers instead of 3.

Mr. Roche trades his coffee locally to a company named coffee day global which eventually is traded internationally but to avoid all the hassles with licensing and financial reasons sell it to the middleman. He explains the levels involved in trading and number of people (stakeholders involved). The total yield in his estate in 2018 is 32000kgs of which arabica sold for 4500Rs (57euros) per 50kg bag and robusta at 3150Rs (40 euros) per 50kg bag as against the prices for this year which is arabica 3500Rs (44euros) per 50 kg bag while price for robusta remains same.

Image 1: Records maintained by Mr Roche



1.2 Survey 1 with Indian Coffee farmers.

A survey was conducted among the coffee farmers in the district of Chikamagalur in order to understand the current trend among farmers - processes they use in their respective estates, to get a better understanding of the local region for putting forth recommendations that can make a difference not only in that region but collectively in all coffee producing regions. Due to time constraints 20 of the coffee farmers spread across different regions in the district participated in this survey. Language used for the survey was the regional language Kannada given the differential educational background.

Survey questions for the Coffee farmers:

Name (ಹೆಸರು):

Age (ವಯಸ್ಸು):

Educational qualification (ಶೈಕ್ಷಣಿಕ ಅರ್ಹತೆ):

Land holding (ಭೂ ಹಿಡುವಳಿ):

(1) What is your opinion about rainfall in the post year (ನಂತರದ ವರ್ಷದಲ್ಲಿ ಮಳೆಯ ಬಗ್ಗೆ ನಿಮ್ಮ ಅಭಿಪ್ರಾಯವೇನು)?

- Adequate (ಸಾಕಷ್ಟು)
- Inadequate (ಅಸಮರ್ಪಕ)
- Scanty (ಕಡಿಮೆ)
- No opinion (ಯಾವುದೇ ಅಭಿಪ್ರಾಯವಿಲ್ಲ)

(2) Which of the following irrigation technology is used (ಈ ಕೆಳಗಿನ ಯಾವ ನೀರಾವರಿ ತಂತ್ರಜ್ಞಾನವನ್ನು ಬಳಸಲಾಗುತ್ತದೆ)?

- drip (ಹನಿ)
- sprinkler (ಸ್ಪಿಂಕ್ಲರ್)
- canal, pipe, hose (ಕಾಲುವೆ, ಪೈಪ್, ಮೆದುಗೊಳವೆ)
- precision (ನಿಖರತೆ)

(3) Does awareness campaign happen in your region regarding irrigation (ನೀರಾವರಿ ಬಗ್ಗೆ ನಿಮ್ಮ ಪ್ರದೇಶದಲ್ಲಿ ಜಾಗೃತಿ ಅಭಿಯಾನ ನಡೆಯುತ್ತದೆಯೇ)?

- Yes (ಹೌದು)
- No (ಅಲ್ಲ)

(4) Does government provide subsidy for new technology (ಹೊಸ ತಂತ್ರಜ್ಞಾನಕ್ಕೆ ಸರ್ಕಾರ ಸಬ್ಸಿಡಿ ನೀಡುತ್ತದೆಯೇ)?

- Yes (ಹೌದು)
- No (ಅಲ್ಲ)

(5) What do you do with coffee cherries after harvesting (ಕೊಯ್ಲು ಮಾಡಿದ ನಂತರ ನೀವು ಕಾಫಿ ಚೆರ್ರಿಗಳೊಂದಿಗೆ ಏನು ಮಾಡುತ್ತೀರಿ)?

- Sell it to agents (ಅದನ್ನು ಏಜೆಂಟರಿಗೆ ಮಾರಾಟ)
- Sell it to coffee curers (ಇದನ್ನು ಕಾಫಿ ಗುಣಪಡಿಸುವವರಿಗೆ ಮಾರಾಟ ಮಾಡಿ)
- Store it for preliminary processing (ಪ್ರಾಥಮಿಕ ಪ್ರಕ್ರಿಯೆಗಾಗಿ ಅದನ್ನು ಸಂಗ್ರಹಿಸಿ)
- Others (ಇತರರು)

(6) Are you considering switching to another crop production (ಮತ್ತೊಂದು ಬೆಳೆ ಉತ್ಪಾದನೆಗೆ ಬದಲಾಯಿಸಲು ನೀವು ಯೋಚಿಸುತ್ತಿದ್ದೀರಾ)?

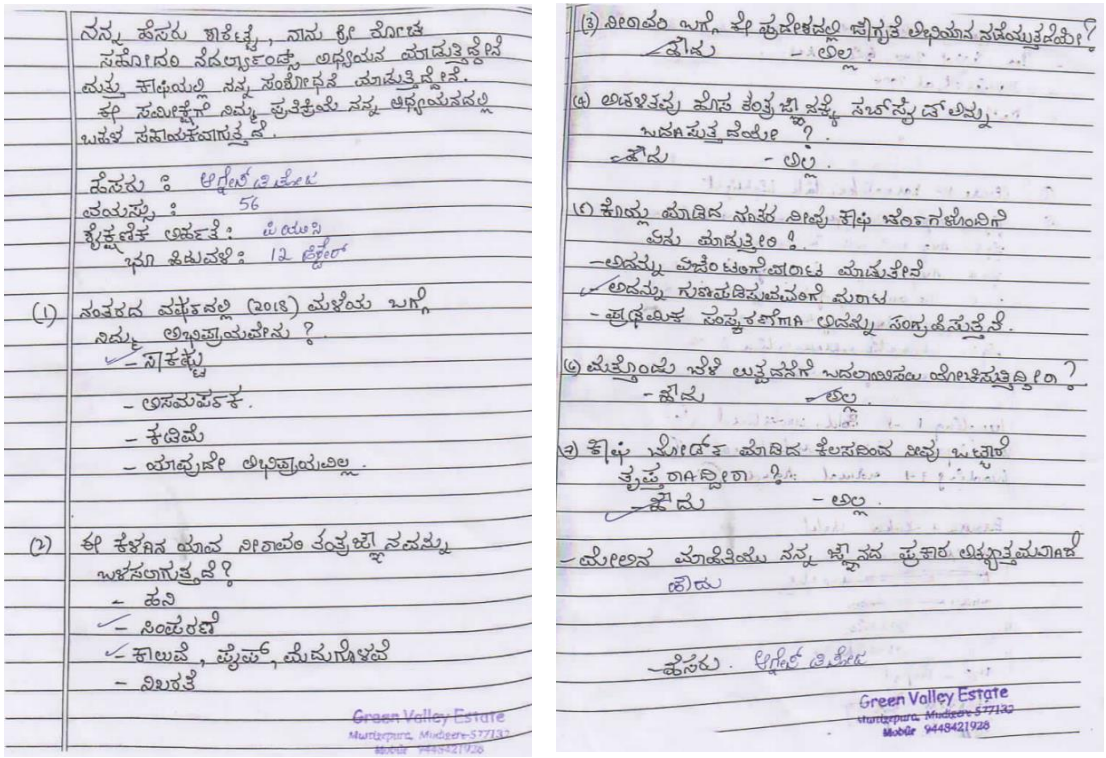
- Yes (ಹೌದು)
- No (ಅಲ್ಲ)

(7) Are you overall satisfied by the work done by Coffee Board (ಕಾಫಿ ಬೋರ್ಡ್ ಮಾಡಿದ ಕೆಲಸದಿಂದ ನೀವು ಒಟ್ಟಾರೆ ತೃಪ್ತರಾಗಿದ್ದೀರಾ)?

- Yes (ಹೌದು)
- No (ಅಲ್ಲ)

Attaching images of sample survey result. The survey was conducted manually by sister Mrs. Shalet Dsouza in India, due to technical constraints.

Image 2: Sample survey result of Mrs. Agnes Dsouza



1.3 Interview with an Indian Coffee Exporter.

Interviewee Name: Arun Saldanha

Designation: Coffee Exporter (Saldy Exports, Mudigere)

Interviewer Name: Sarette Joylin Dsouza

Date: 24/08/2019 Time: 10:00 – 11:00 hr

Languages spoken – Konkanni

An interview was conducted with a local coffee exporter from India to interpret the standards and quality requires for a small and midsize farmer to export his coffee internationally and explore the possible hidden opportunities in this for other coffee producers to get on the same level in terms of quality. The discussion was held in terms of understanding more about quality maintained and achieved to export, help from government – financial or otherwise also. Before conducting the interview, an extensive desk research was carried out and a checklist of questions was prepared for discussion. The observations of the interview are given below.

-The coffee from 'Saldy exports' has an export name of "Caffe Indiano". The company has exported almost 2500 tonnes of green coffee bean exports from January 2019 until date. they produce about 100 metric tonnes of coffee from their own plantations. The remaining coffee for exports is procured from coffee planters in and around Mudigere Taluk of Chickmagalur district.
Minimum Certifications followed by the company:
a) Goods and Service Tax Registration.
b) ICO (International Coffee Organisation) Registration from Coffee Board.
c) Import Export Certificate
d) AD (Authorised Dealer) Code

They even follow the set quality standards by the "Coffee Board of India" for exports of green coffee beans.
a) Appearance of Beans (good appearance and beans without defects).
b) Size of beans (as per screen size).
c) Moisture content of beans (within 12.5%)
d) Coffee cupping (cup taste analysis)
e) Packing as specified by the buyer.

-Water Usage:
Indian coffee is shade grown. It needs lots of water for irrigation during blossom period (flowering period). Their main source of water is: borewells, open wells and water tanks (lakes). They also do recharging of all these water sources during monsoon.
Water is also used for preparing washed coffee, i.e., parchments. Here the quantity of water used, is now reduced to a large extent due to modern and efficient machinery which use very small quantities of water and also adapts recycling of water – Saldy exports uses new and improved pulping and pulp washing machines to improve on the water footprint. 'Saldy exports' export only commercial grade coffee. There are exporters who export speciality and certified coffee.
-Fair Trade:
Although they have not directly benefited from fair trade, there are lots of indirect benefits. Mr Saldana says since they supply lots of coffee to NESTLE India, which is 4C certified. Nestle gives incentives to growers who supply coffee to Nestle through them and are 4C certified.
-Incentives / Subsidies:
MEIS: Merchandise Exports from India Scheme: 5% incentive on FOB (Free On Board) Value.

This incentive is for general exports including coffee exports. We have no subsidies as such for sustainable farming.

1.4 Interview with an Indian NGO representative.

Interviewee Name: N. Gopalakrishnan

Designation: Farm Manager of M.S. Swaminathan Research Foundation (NGO)

Interviewer Name: Sarette Joylin Dsouza

Date: 21/07/2019 Time: 12:00 – 1:00 hr

An interview was conducted with Mr. Gopal who represents the NGO M.S. Swaminathan Research Foundation which seeks at speeding up the use of modern science and technology for agricultural and rural development in order to enhance the communities' lifestyle. The discussions were held in respect of three aspects namely water, irrigation methods and sustainability. This interview helped in understanding the influential role an NGO plays in order to get best practice acceptance at the bottom of the pyramid. Before conducting the interview, an extensive desk research was carried out and a checklist of questions was prepared for discussion. The observations of the interview are given below.

Questionnaire for the NGO representative:

- In what way is an NGO different from a government body (difference in role of an NGO and Coffee Board – govt body)
- What sectors do you normally work in?
- Do you think small and marginal farmers are at a disadvantage?
- Are the small and marginal farmers overlooked by the authorities?
- Can you explain the current method you help the farmers within the context of water use in coffee production?
- Generally practised methods of irrigation and why?
- Awareness of sustainability in the ground level and measures taken to change current trend into sustainable options for the production.

1.5 Interviews with Dutch coffee Importers.

Interviews were conducted with 3 Dutch coffee importers to understand the the minimum requirements to import coffee along the demand for sustainable coffee in the Netherlands. The discussions were held in respect of three aspects namely Fair trade, understanding if any measures taken to source from sustainably farmed produce and certifications and standards. Before conducting the interview, an extensive desk research was carried out and a checklist of questions was prepared for discussion. The observations of the interview are given below.

Interviewee Name: Friso spoor and Michiel Lampers

Designation: Co-founder and Import-Export manager

Coffee Importers (The Coffee Quest)

Interviewer Name: Sarette Joylin Dsouza

Date: 20/08/2019 Time: 10:00 – 10.40 hr

After sharing a couple of email back and forth a telephonic interview was conducted with Mr. Friso to understand his motivation in getting into the importing of coffee. The main agenda of the call was to understand the importance given to fair trade and sustainable farming. The same set of questions were asked to 3 different importers to understand a different viewpoint to understand the influencing factor in the import business.

Interviewee Name: Leon Zaal

Designation: Managing director, Greencof (Dutch green coffee importing company)

Interviewer Name: Sarette Joylin Dsouza

Date: 23/08/2019 Time: 12:00 – 12.45 hr

Questionnaire for the Importers:

- How important is fair trade in your business and how does an importer in Netherlands make sure it is achieved in the producing countries?
- Where do you source your coffee from? – size level of farmers, techniques used.
- Your opinion of the water price being added to the final pricing of coffee (should the water component used in production reflect in the price of coffee since water now is a paid commodity).
- The policies and minimum standards the importers expect the farmers to possess to do business with him.
- Has achieving shorter coffee supply chain made a difference for small and mid-level farmers.
- Financial support or subsidies for implementation of new technologies – How can an importer help bridge the gap.
- How the developed countries can help the developing countries.
- Pain point – Quality? Price? Availability?

1.6 Survey 2 with Dutch coffee Consumers.

The Dutch generally are people who appreciate good coffee. This survey was done in Leeuwarden throughout the month of August at NHL Stenden, ABN Amro bank, Rabo Bank, Deloitte and DE (Douwe Egberts) and Leeuwarden city centre. It was mainly to understand if the people acknowledge sustainable coffee or not. Since the consumers and the last piece in the value chain the magnitude of success in the projects depend on their acceptance of high price but better quality and fair-trade coffee.

Questionnaire for the Consumer survey:

- How many cups of coffee do you have in a day?
- Are you aware of the amount of water used to achieve 1 cup of coffee?
- Are you aware of fair trade?
- Do you know where does your coffee come from?
- Would you pay more and buy sustainable coffee or go with regular coffee given a choice.
- Would you be willing to sign a petition demanding sustainable coffee?
- How much extra are you willing to pay for sustainable coffee?
- Can you make out the difference in expensive and cheap coffee?

Annexure2: Consent Form for Individual Participants in Interviews.

Informed consent form for individual interviews for thesis studies in MSc MEEM

Title research or acronym: *OPPORTUNITIES IN SUSTAINABLE IMPROVED COFFEE TRADE*

I declare to be informed about the nature, method and purpose of the investigation. I voluntarily agree to take part in this study. I keep the right to terminate my participation in this study without giving a reason at any time.

My responses may be used solely for the purposes of this study. In its publications, they may *(please tick one of the options):*

O be cited with my name or function revealed
O be cited anonymously, thus without identifying context
O only used as information source

During the course of the interview I keep the right to restrict the use of (some of) my answers further than indicated above.

Name participant: ……..

Date: …….. Signature participant: ……

I declare to fully adhere to the above.

Name researcher: Sarette Joylin Dsouza

Date: -/-/2019 Signature researcher: 

Annexure 3: Data received region specific for coffee estates in Chikmagalur – Coffee board.

Coffee Out-turn (with Present standards followed by Curing works)

From Fruit to cherry as well as from Fruit to Parchment

note : all Measurements are in Kilograms

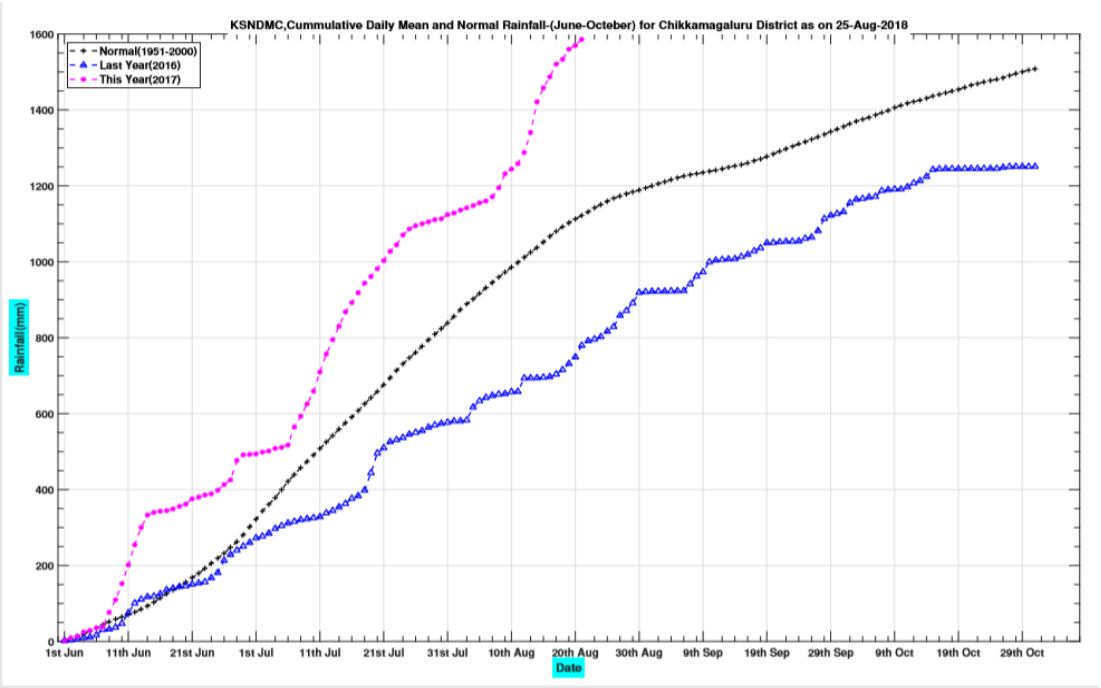
Chart Prepared By : **Vishwanath K K**

Mobile : +91 94480 45517 E-Mail : vishwanath_kk@yahoo.co.in

27.10.2017

Robusta Cherry 27 kg/50 kg 37.03 bags ton		**Robusta Parchment** 43kg/50 kg 23.25 bags/ton		**Arabica Cherry** 28 kg/50 kg 35.71 bags/ton		**Arabica Parchment** 41.5kg/ 50 kg 24.09 bags/ton	
Fruit required to get one bag of Cherry	required Fruit to get 1 ton of clean Coffee	Fruit Required to Get One Bag of Parchment	required Fruit to get 1 ton of clean Coffee	Fruit required to get one bag of Cherry	Fruit required to get 1 ton of clean Coffee	Fruit Required to Get One Bag of Parchment	required Fruit to get 1 ton of clean Coffee
105	3888	185	4301	140	4999	220	5300
106	3925	186	4325	141	5035	221	5324
107	3962	187	4348	142	5071	222	5348
108	3999	188	4371	143	5107	223	5372
109	4036	189	4394	144	5142	224	5396
110	4073	190	4418	145	5178	225	5420
111	4110	191	4441	146	5214	226	5444
112	4147	192	4464	147	5249	227	5468
113	4184	193	4487	148	5285	228	5493

Coffee outturn is a value that determines the quality of coffee produced from a particular estate and the price for coffee is estimated on the basis of it.



Rainfall comparison for 3 consecutive years.

2.3 No. of Holdings - 2015-16, 2016-17 & 2017-18

Name of the Region	2015-16			2016-17			2017-18		
	<10	>10	Total	<10	>10	Total	<10	>10	Total
Chikmagalur	14853	1166	16019	20513	1338	21851	20513	1338	**21851**
Hassan	12120	387	12507	13751	387	14138	13763	387	**14150**
Madikeri	21153	237	21390	21492	245	21737	21492	245	**21737**
Virajpet	21251	229	21480	21204	231	21435	21203	242	**21445**
Total for Karnataka	**69377**	**2019**	**71396**	**76960**	**2201**	**79161**	**76971**	**2212**	**79183**
Kerala	77200	275	**77475**	77370	275	**77645**	77584	277	**77861**
Tamil Nadu	16831	345	**17176**	17656	350	**18006**	17656	350	**18006**
Total for Traditional Areas	**163408**	**2639**	**166047**	**171936**	**2826**	**174762**	**172211**	**2839**	**175050**
Non Traditional Areas	157784	26	**157810**	167370	26	**167396**	178689	26	**178715**
NER Region	9661	9	**9670**	10477	9	**10486**	12466	11	**12477**
Grand Total	**330853**	**2674**	**333527**	**349783**	**2861**	**352644**	**363366**	**2876**	**366242**

Average land holdings year and region wise.

Annexure 4: Definitions

1.) Life-cycle assessment (LCA, also known as life-cycle analysis, Eco balance, and cradle-to-grave analysis) is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. Designers use this process to help critique their products. LCAs can help avoid a narrow outlook on environmental concerns by:

- Compiling an inventory of relevant energy and material inputs and environmental releases;
- Evaluating the potential impacts associated with identified inputs and releases;
- Interpreting the results to help make a more informed decision.

(Definition taken from Wikipedia, accessed 15.08.2019)

2.) CROPWAT for Windows is a computer program for the calculation of crop water requirements and irrigation requirements based on soil, climate and crop data. In addition, the program allows the development of irrigation schedules for different management conditions and the calculation of scheme water supply for varying crop patterns. CROPWAT 8.0 can also be used to evaluate farmers' irrigation practices and to estimate crop performance under both rainfed and irrigated conditions.

(Definition taken from wikidot, accessed 15.08.2019)

3.) Principle behind shared value concept: "Shared value is not social responsibility, philanthropy, or sustainability, but a new way for companies to achieve economic success." *Michael E. Doorman and Mark Kramer, "Creating Shared Value,"* Harvard Business Review.

Mutual worth is an administration system where organizations discover business openings in social issues. While altruism and CSR center endeavors center around "giving back" or limiting the mischief business has on society, shared worth spotlights organization pioneers on augmenting the focused benefit of taking care of social issues in new clients and markets, cost investment funds, ability maintenance, and then some.