

RESEARCH PAPER

Documentation of the factors influencing the quality of coffee at farm level in south Karnataka

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ABSTRACT

Coffee occupies a place of pride among plantation crops grown in India. It is the most important cash crop that is grown in the tropics. Generally coffee is the second largest traded commodity next to petroleum products. Multistage random sampling method was adopted for the study to collect the necessary information from coffee growers and traders. Primarily the information regarding the quality attributes, constraints were collected from farmers. In Hassan district application of, shade regulation inorganic fertilizer and soil are influencing quality of coffee in per harvest practices. Type of coffee harvesting, drying method and after harvest storage are factors in the post-harvest which is influencing quality of coffee. Interrelationship among the factors like bean size, colour and roasting are correlated. Moisture content and storage, hulling and drying are having linkage between quality attributes. The main concern for the planters is labour availability which is also hindering the quality of coffee produced, so government should step forward and try solving this issue. In order to improve the quality of coffee, quality standards should be set not only for export trade and but also at the farm level. Most of the planters are not aware of many factors which influence the quality of coffee; planters should be trained and made knowledgeable by conducting the training program by government organization or by coffee Board.

KEY WORDS : Harvest practises, Documentation, Dendograph, Sorting, Grading

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Coffee occupies a place of pride among plantation crops grown in India. It is the most important cash crop that is grown in the tropics. Generally Coffee is the second largest traded commodity next to

petroleum products. Coffee is grown in the tropical belt of the world where there is good sunshine, heavy rains and rich organic soil. It cannot be grown in places where there is frost or snow. Coffee trees are evergreens and grow to a height of 20 feet. But to simplify harvesting the trees are pruned to around eight feet. The tree takes 4-5 years to produce the first crop. Cultivation of this stimulating beverage crop is mainly confined to the southern states of Karnataka, Kerala, Tamil Nadu and Andhra Pradesh. It is also grown to a small extent in Arunachal Pradesh, Assam, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Sikkim, Tripura and West Bengal forming the non- traditional belt. It is

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also grown in areas which receive predominant north-east monsoon as in Tamil Nadu, Andhra Pradesh and Orissa. Summer showers are important for flowering in coffee and are received during March- April.

India is the fifth largest coffee producer in the world, with 2 per cent of global area under coffee contributing to around 4 per cent of global coffee production. Important varieties of coffee grown in India include Kent (an early variety of Arabica noted for its exceptional cup quality); S.795 (a high yield Arabica noted for its superior cup quality and tolerance to leaf rust); Cauvery (an Arabica descendent incorporating the superior quality of *Caturra* and resistance of *Hybrido-de-Timor* variety); Sln.9 (an award winning Arabica variety that inherits the superior cup quality of Tafarikela); S.274 (an improved variety of Robusta) and CxR (a hybrid of *Congensis* and Robusta). Acclaimed for the unique flavour of its berries and plantation biodiversity; coffee cultivation in India encompassed an area of over 4,09,690 ha and generated a yield of over 3,14,000 MT, in the year 2011-2012. More recent trends, based on the post-blossom estimates released by the Coffee Board, show that India's coffee output is likely to cross 3,25,300 MT in the year 2012-2013. Traditional coffee growing regions in India constitute of the southern states of Karnataka (2,29,658 ha), Kerala (84,948 ha) and Tamil Nadu (31,344 ha). Together they represent over 84.5 per cent of total area under coffee cultivation and produce 97.9 per cent of total coffee in India (*ibid*). Karnataka alone accounts for over 56.1 per cent of total area under coffee cultivation and over 70.4 per cent of total coffee production in India – making it the most significant coffee producing state of the country.

METHODOLOGY

Multistage random sampling method was adopted for the study to collect the necessary information from coffee growers and traders. Primarily the information regarding the quality attributes, constraints were collected from farmers. The study was conducted Hassan, Kodagu and Chickmagalur districts of Karnataka, which are the highest producers of coffee amounting for 2, 21,000 MT (Coffee Board, 2012). Data were collected from Virajpet, Mudigere and Sakaleshpur. The exception of quality was collect from the traders involved in coffee trading. To accomplish the objectives of the research, survey was carried out with a schedule for the various such as coffee

growers, traders and curers. Random sampling was used to select the respondents. Sample size selected for the survey was 60 coffee growers and 15 traders; it is distributed as 20 coffee growers from each district and 5 traders from each district, respectively. The primary information regarding the necessary secondary information regarding area and production of coffee varieties which are suitable for cultivation and best quality was collected from Central Coffee Board Bangalore. The reference year of the study was 2012-13 and the collection of data was carried out during the period March and April 2013. The farmers, traders, coffee curing units formed the focus of this research. Actors involved in coffee quality were also interviewed and interacted. In total, 75 actors were interviewed. To analyze the objective statistical tools like averages, percentages and factor analysis were used.

ANALYSIS AND DISCUSSION

The factors determining quality of coffee at farm level are broadly classified into pre and post-harvest practices and are documented separately based on each district of the study area.

Documentation of pre-harvest practices in Chikmagalur district with weighted scores :

The respondents were asked to rank the variables based on factors contribution to improve the quality of coffee. Firstly the pre harvest practices were listed and based on the importance the planter's ranked factors and the highest rank and highest weighted score of 3.65 was given to soil fertility, because soils of Chikmagalur are rich in iron content and quality in terms of bean weight size and shape will be much better. Application of inorganic fertilizer was listed in the second with a total the weighted score of 3.65 as inorganic fertilizer provide rich source of nutrients and encourage better uniform growth the quality of bean will be better. Shade regulation is ranked in the third position with 3.55 weighted score, as coffee plant is a shade loving plant, shade regulation will affect both quantity and quality of coffee. Application of organic fertilizer and compost had weighted score of 3.53 and 3.48, respectively. Application of organic fertilizer and compost helps to maintain the uniformity in maintaining the yield and quality for a long years. There are many other factors along with the above mentioned that have

an impact on quality which are depicted in the Table 1.

Post-harvest practices in Chikmagalur weighted score :

In post-harvest practices of the Chikmagalur district, weighted scoring method, type of harvesting practices stands in the first rank with a total score of 4.35, followed by drying method with a total score of 3.90, followed by after harvest storage with a total score of 3.65, dry pulping 3.59. Wet pulping had weighted score of 3.56, sorting and grading (3.52) and bagging (3.40) had a lesser importance. When the respondents were asked list the post-harvest practices which contribute to ultimate quality of coffee, the response of the respondents are listed in the Table 2 which describes that type of harvesting practices is the most important attribute that influence the quality of coffee, because as type of harvest practices will decide the damage of coffee bean at the time of harvest, selective hand picking method is the best

as each and every bean is harvested based on the maturity. But the strip method, picking from the ground, using mats to harvest have disadvantage of their own. Drying method of the cherry is ranked in the second position because well dried coffee will not get mould contamination, it can also be roasted easily, the important advantage is moisture content which contributes to cup quality of coffee is maintained by proper drying method. The standard moisture content is 12 per cent at the farm level. After harvest storage is the next important practices that contributes to quality of coffee because the type of gunny bag, place coffee is stored should be air tight and free from pest. If the proper care is not taken quality of coffee will gradually reduce. Dry pulping is in the fourth position as the outer peel is removed using machinery contributing quality of coffee, bean size is one of the important factor as the certification agency and trader will have look at the uniformity of bean, number of A-grade, B-grade, defects, number of blacks. The other

Table 1: Weighted Scores of pre harvest practices of coffee in Chikmagalur district

Sr. No.	Variables	Weighted scores	
		Total score	Rank
1.	Soil fertility	3.65	I
2.	Application of inorganic fertilizer	3.62	II
3.	Shade regulation	3.55	III
4.	Application of organic fertilizer	3.53	IV
5.	Application of compost	3.48	V
6.	Application of micro nutrients	3.42	VI
7.	Disease management	3.35	VII
8.	Trenching	3.34	VIII
9.	Sprinkler irrigation	3.23	IX
10.	Pest management	3.15	X
11.	Digging	3.12	XI
12.	Thinning and pruning	3.08	XII
13.	Weed control	3.06	XIII

Table 2 : Weighted score of post-harvest practices of coffee in Chikmagalur district

Sr. No.	Variables	Weighted scores	
		Total score	Rank
1.	Type of harvesting practices	4.35	I
2.	Drying method (Cherry)	3.90	II
3.	After harvest storage	3.65	III
4.	Dry pulping	3.59	IV
5.	Wet pulping	3.56	V
6.	Sorting and grading	3.52	VI
7.	Bagging	3.40	VII

factors are wet pulping, sorting and grading followed by bagging which contributes to quality of coffee.

Pre-harvest practices of coffee in Kodagu district with weighted scores :

The respondents of Kodagu district were asked to rank pre harvest variables based on their contribution to towards the quality of coffee. The results are presented in the Table 3, which depicts that application of inorganic fertilizer is the most important factor that influence the quality of coffee, because inorganic fertilizers provides the rich sources of nutrients and equal growth to all parts of plant and hence fruit maturity will be at the uniform time. Soil fertility is ranked in second place; soil of Kodagu is dark clayey, brown in colour, which is highly rich in nutrient providing all required nutrients for the plant so that yield and quality will be better. Thinning and pruning will be playing a vital role in quality as cutting the branches will lead to transfer of nutrients in to the

tip, where most of the berries are grown. Shade regulation is ranked in the fourth position with 3.45 weighted score, as coffee plant is a shade loving plant, shade regulation will affect both quantity and quality of coffee. Application of micronutrients plays a vital role as any of the micronutrient deficiency will lead direct impact on quality of the bean. The above mentioned are the top five important factors, the next important factors are listed in Table 3.

Post-harvest practices of coffee in Kodagu with weighted score :

Among post-harvest practices variable type of harvesting practices ranked in the first position with a total score of 4.15, followed by after harvest storage with a total score of 3.70, sorting and grading (3.45), drying method (3.40) and wet pulping (3.43) are given the medium importance. Dry pulping (3.20) and bagging (3.15) are having lesser importance.

Table 3: Weighted scores of pre-harvest practices of coffee in Kodagu district

Sr. No.	Variables	Weighted scores	
		Total score	Rank
1.	Application of inorganic fertilizer	3.65	I
2.	Soil fertility	3.62	II
3.	Thinning and pruning	3.55	III
4.	Shade regulation	3.45	IV
5.	Application of micro nutrients	3.40	V
6.	Sprinkler irrigation method	3.35	VI
7.	Application of compost	3.35	VII
8.	Digging	3.30	VIII
9.	Disease management	3.30	IX
10.	Pest management	3.30	X
11.	Weed control	3.20	XI
12.	Application of organic fertilizer	3.20	XII
13.	Trenching	3.25	XIII

Table 4 : Weighted score of post-harvest practices of coffee in Kodagu district

Sr. No.	Variables	Weighted scores	
		Total score	Rank
1.	Type of harvesting practices	4.15	I
2.	After harvest storage	3.70	II
3.	Sorting and grading	3.45	III
4.	Drying method (Cherry)	3.40	IV
5.	Wet pulping	3.41	V
6.	Dry pulping	3.43	VI
7.	Bagging	3.35	VII

The respondents of Kodagu district were asked to rank post-harvest variables based on their contribution towards the quality of coffee. The results are presented in the Table 4, which presents that type of harvesting practices is the most important attribute that influence the quality of coffee, because as type of harvest practices will decide the damage of coffee bean at the time of harvest, selective hand picking method is the best as each and every bean is harvested based on the maturity. But the strip method, picking from the ground, using mats to harvest have disadvantage of their own.

After harvest storage is the next important factor because the type of gunny bag, place coffee is stored should be air tight and free from pest. If the proper care is not taken quality of coffee will gradually reduce. Sorting and grading is listed third as the bean of grade-A, grade-B, blacks and defects should be separated as cup quality will change if number of blacks and defect are higher. Drying method of the cherry is ranked in the fourth position because well dried coffee will not get mould contamination, it can also be roasted easily, the important advantage is moisture content which contributes to cup quality of coffee is maintained by proper drying method. The standard moisture content is 12 per cent at the farm level. Wet pulping, dry pulping and bagging are also the factors which have a lesser contribution to quality comparatively.

Documentation of pre-harvest practices in coffee in Hassan district with weighted scores :

The respondents of Hassan district ranked shade

regulation as the most important quality attribute because coffee is a shade loving plant and its requires 70 to 75 per cent of shade, direct exposure to sunlight will reduce the yield and quality. Hassan district receive more sun light when compare to Chikmagalur and Kodagu, hence, the responds feels shade regulation one of the key factor for quality improvement of coffee. Application of inorganic fertilizers as the next most important factor in quality of coffee at farm level as inorganic fertilizers provides the rich sources of nutrients and equal growth to all parts of plant and hence fruit maturity will be at the uniform time. Soil is ranked in the third as soil is the medium for growth and soil with good nutrients helps to produce higher yield and quality beans. Thinning and pruning is ranked the next place after soil because training and pruning will be playing a vital role in quality as cutting the branches will lead to transfer of nutrients in to the tip, where most of the berries are grown. Application of micro nutrients are one of the key factors as micronutrient deficiency will lead direct impact on quality of the bean. The above mentioned are the top five important factors, the next important factors are listed in Table 5.

Documentation of post-harvest practices of coffee in Hassan district with weighted scores :

In post-harvest practices variables type of coffee harvesting ranked in the first position with a total score of 4.25, followed by drying method with a total score of 3.70, followed by after harvest storage practices with a total score of 3.55. Bagging (3.43), sorting and grading

Table 5 : Weighted score of pre harvest practices of coffee in Hassan district

Sr. No.	Variables	Weighted scores	
		Total score	Rank
1.	Shade regulation	4.25	I
2.	Application of inorganic fertilizer	4.10	II
3.	Soil fertility	3.55	III
4.	Thinning and pruning	3.45	IV
5.	Application of micro nutrients	3.40	V
6.	Irrigation methods	3.39	VI
7.	Digging	3.37	VII
8.	Application of compost	3.35	VIII
9.	Trenching	3.33	IX
10.	Application of organic fertilizer	3.30	X
11.	Disease management	3.20	XI
12.	Pest management	3.20	XII
13.	Weed control	3.15	XIII

(3.42), wet pulping (3.33) and dry pulping (3.31) were given the lesser importance.

The respondents of Hassan district were asked to rank post-harvest variables based on their contribution to towards the quality of coffee. The results are presented in the Table 6, shows that type of harvesting practices is the most important attribute that influence the quality of coffee, because as type of harvest practices will decide the damage of coffee bean at the time of harvest, selective hand picking method is the best as each and every bean is harvested based on the maturity. But the strip method, picking from the ground, using mats to harvest have disadvantage of their own. Drying method is ranked in the second place, most of the respondents in the Hassan district use cement drying yard for drying as they are cost effective when compare to tiled drying ward. The drying rate is faster in cement drying yard compared to tiled drying yard. After harvest storage is the next important factor because the type of gunny bag,

place coffee is stored should be air tight and free from pest. If the proper care is not taken quality of coffee will gradually reduce. Bagging is important factor as well dried and bagged coffee can be kept for a long period without making much effect of quality. Gunny bag of fertilizer, compost and some other implements should not be used to bag and store coffee.

Interrelationship among importance and ratings on each attribute :

The determinants of coffee quality, importance ratings for each quality attribute have been conducted. Table 7 presents the factor that have a high influence on coffee bean. The factors which are loading the factor more than 0.50 are more important when compare to other factor. The subset indicates that storage is a very important factor because it is having the highest loaded value of 0.736 followed bean size and soil fertility, the second subset indicate that after harvest storage, pest

Table 6 : Weighted score of post-harvest practices of coffee in Hassan district

Sr. No.	Variables	Weighted scores		Rank
		Total score		
1.	Type of coffee harvesting	4.25		I
2.	Drying method (cherry)	3.70		II
3.	After harvest storage practices	3.55		III
4.	Bagging	3.43		IV
5.	Sorting and grading	3.42		V
6.	Wet pulping	3.33		VI
7.	Dry pulping	3.31		VII

Table 7: Rotated component matrix of factor scores

Sr. No	Parameters	Factor interpretation component			
		F ₁	F ₂	F ₃	F ₄
1.	Shade regulation	0.238	-0.088	0.578	0.124
2.	Harvest practices	0.428	0.159	0.437	-0.475
3.	Soil fertility	0.645	0.014	-0.080	-0.418
4.	Wet pulping	0.105	0.049	0.738	0.162
5.	Dry pulping	-0.004	0.062	0.753	-0.050
6.	Drying	0.597	0.292	0.257	0.165
7.	Application of micro nutrients	0.343	-0.430	-0.009	0.665
8.	Storage	0.736	-0.195	0.218	0.102
9.	Bean size	0.686	0.506	0.098	0.011
10.	After harvest storage	-0.032	0.844	-0.040	0.023
11.	Pest management	0.173	0.807	0.070	-0.066
12.	Disease management	-0.063	0.195	0.306	0.719

Note: Values in bold indicate attribute loads on factors (loading > 0.50 criteria)
Rotation method: Varimax with Kaiser normalization.

Extraction method: Principal component analysis

management and bean size are the factor with the higher value. Subset three indicate that drying pulping followed by wet pulping and shade are the highest contributors, subset four presents that diseases management and micro nutrients are high loaded factors. Every subset loaded with the maximum value is highly correlated to each other. First subsets have a correlating with bean size, drying and soil fertility. Subset second has correlation with bean size, pest management and after harvest storage subset third with wet and dry pulping, fourth with application of micro nutrients and diseases management.

Average linkage between qualities and attributes using dendrogram :

A Dendrogram is a form of binary tree that is typically used to visualize hierarchical (importance) relationships in data. Cluster analysis is a way of grouping objects which are similar. In Dendrograms, a node represents a merging of two clusters. Therefore, the node's metric value is typically the Euclidean distance between the two clusters of data. In Dendrograms, the similarity (thus, a node's metric value) is visually reflected by the graphic distance from the node to the root in a vertical or horizontal direction, so that users can focus on graphics. The general objective of data clustering is to minimize within-cluster variation and thus, to maximize the between-cluster variation.

Based on the clustering the factor the average linkage between the factors can be known. The Fig. 1 represents the linkage between qualities and attributes and majorly three clusters are made. The first cluster is linked between moisture content of coffee bean and storage condition because well dried bean with exact standard moisture content can be stored for a long time without any problem, the second cluster is linked between hulling and drying, the third cluster is linked between roasting and wet pulping. All the clusters are linked to each other as quality of coffee ultimately depends on the above mentioned factors. The average linkage between qualities attributes of coffee at farm level, is presented in the Fig. 1 that majorly three clusters having a broad linkage and each with many clusters combination. The first cluster is linked between moisture content of coffee bean and storage condition; these two clusters are closely correlated between each other as there are highly dependent on

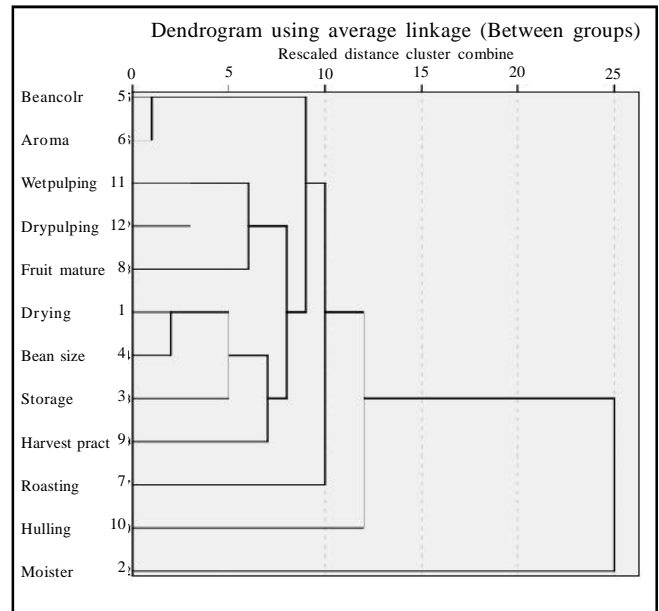


Fig. 1: Dendrogram showing the average linkage between qualities

each other. The second cluster is linked between hulling and drying, the third cluster is linked between roasting and wet pulping. The rescaled distance cluster combination of first cluster is 25 which is the highest and second cluster have rescaled distance cluster combination upto 13 and the third rescaled distance cluster combination is 10.

Conclusion :

The factor influencing the quality attributes varied from district to district in pre-harvest practices but in post-harvest practices type of harvesting was given the top preference. In Chikamagalur district soil application of inorganic fertilizer and shade regulation these factor was given the top priority in pre harvest practices for better quality. Type of harvesting practices, drying method and after harvest storage was given the top importance in quality in post-harvest practices. In Kodagu district application of inorganic fertilizer, soil and thinning and pruning was given the top priority in pre-harvest practices. Type of harvesting practices, after harvest storage and sorting and grading are important key quality contributing factors in post-harvest. In Hassan district application of, shade regulation inorganic fertilizer and soil are influencing quality of coffee in per harvest practices. Type of coffee harvesting, drying method and after harvest storage are factors in the post-harvest which

is influencing quality of coffee. Interrelationship among the factors like bean size, colour and roasting are correlated. Moisture content and storage, hulling and drying are having linkage between quality attributes.

The main concern for the planters is labour availability which is also hindering the quality of coffee produced, so government should step forward and try solving this issue. In order to improve the quality of coffee, quality standards should be set not only for export trade and but also at the farm level. Most of the planters are not aware of many factors which influence the quality of coffee; planters should be trained and made knowledgeable by conducting the training programme by government organization or by coffee Board.

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