CHAPTER - 2
REVIEW OF LITERATURE

2.1 INTRODUCTION

This second Chapter of the Thesis presents a review of select literature about the coffee industry. The first part presents review of certain articles about coffee’s agricultural chemistry, the second part emphasizes on coffee’s agricultural economy, while the third part takes a review of the general press relating to coffee.

(I) AGRICULTURAL CHEMISTRY

2.2 SOILS

2.2.1 Studies on Coffee Soils

An attempt was made during 1962 to study the soil conditions of the problem blocks and compare them with virgin jungle soil. Three profiles of problems blocks and one profile from jungle were examined. The soils are red and they have been formed in situ. They are deep, heavy and poor in drainage. The specific gravity of the soils is due to the formation and accumulation of iron concentrations. The correlationship of clay and organic matter with water holding capacity is positive but not significant. The percentage of active water stable aggregates in general is poor, and in particular compared with jungle and reduces down the profile. The soils are acidic. Low acid insoluble and sequeioxide content indicate the advancement of laterization. The soils are poor in calcium and phosphorus. Building up of soil fertility by fertilizer application without stabilizing the soil structure and drainage may not make the soil productive.1

2.2.2 Nutrient status of coffee soils in South India and its influence on crop yields

The level of nutrients varied from zone to zone and from location to location within each zone. The highest level of available nutrients and lowest acidity were seen in Coorg zone while poorest soils with respect to its nutrient status and the maximum acidity were met within Kalpetta zone. Since 1961, the nutrient status of soils had increased considerably the maximum shift being in phosphoric acid status and soil reaction. High yield was generally associated with higher nutrient status, particularly high level of phosphoric acid. Adoption of recommendation prescribed on the relevant factors, including the nutrient status as revealed by soil tests, enhanced the yield in many of the estates studied.2

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2.2.3 Distribution of forms of soil Sulphur and its retention on clay of some coffee estate soils in Karnataka

Typical surface soil samples of coffee estates were characterized for different forms of soil Sulphur along with other associated soil parameters. Of these forms, organic, ignition and alkali-soluble Sulphur formed the bulk portion of total Sulphur, while heat soluble Sulphur were found in readily available form. Correlations of different forms of Sulphur with the total Sulphur were worked out. Retention curves of Sulphur on the clay of these soils by incremental additions of Sulphur revealed remarkable absorption capacities of these soils.3

2.2.4 Fertility Status of Andhra Pradesh soils

The data indicated that in general, the soils were neutral in soil reaction, normal in electrical conductivity, medium to high in organic carbon and available phosphors and high in available potassium.4

2.2.5 Coffee soils in Chikmaglur

It was found that around 50% on an average of the soils are acidic in nature, requiring the application of lime, based on exchangeable Aluminium. Most of these soils are low in base saturation and, therefore, poor in Calcium and Magnesium. The soils rich in organic matter except 10-12%, poor in available Phosphorus and medium to high in available Potassium. Since the entire district is highly rainfed, the soluble salt content is low in these soils, signalling the use of Sulphur, Magnesium and Zinc. It was observed that high yields are registered wherein the soil pH is normal.5

2.2.6 Physical and Chemical Properties of soils cropped to coffee

Particle size distribution and chemical properties of soils from Kerala, Tamil Nadu and Karnataka are presented. Chemical properties indicated that 68% of the soils were acidic in reaction, rich in organic matter, low to medium in available phosphorus and medium to high to exchangeable potassium with optimal levels of available sulphur. The carbon exchange capacity ranged between 6 and 25 cmol kg-1. The soils were sandy clay loams with 25 to 42 percent clay.6

2.2.7 Soils and weather profiles

Soils and weather profiles of Indian coffee tracts are described. Their effects in general and agriculture management in particular for increasing the productivity are discussed.7

2.3 Analysis

2.3.1 Leaf analysis

Correlation studies: results obtained correlate yield with Nitrogen applied in graded doses to the soil and leaf Nitrogen content revealed that

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Nitrogen applied to the soil had significant effect on Nitrogen content of leaves during March and September in 2 out of 3 years, while the difference in Nitrogen content of leaves in June were significant only during 1970. The correlation studies also show consistently that the Nitrogen content of leaves during May-June and September were highly correlated with the level of Nitrogen applied to the soil, indicating that the Nitrogen content of leaves during these months is a good index of soil available Nitrogen. Leaf analysis thus can be used only to determine the current nutrient status of the coffee plant which indicates deficiency and sufficiency of nutrients since the correlation between leaf Nitrogen content during different months and yield were poor. Leaf analysis values can, however, be used to adjust the level of fertilizer application. Leaf analysis does not quantitatively indicate the amount of fertilizer to be applied.\(^8\)

### 2.3.2 Leaf Analysis techniques in coffee research

Investigations were carried out to evaluate the leaf analysis technique as a guide to fertilizer practices in coffee. Leaf samples collected from a trial laid out for the purpose in different locations were analyzed for total Nitrogen. Yields obtained were correlated with Nitrogen applied in graded dozes and the leaf Nitrogen content. Leaf Nitrogen was also correlated with applied Nitrogen. The difference in yield due to treatments was not significant. Applied Nitrogen had a significant effect on leaf Nitrogen only certain months.\(^9\)

### 2.3.3 Calibration of soil test values

The soil test data and yield figures obtained in the course of soil testing in various coffee zones were utilized to fix the critical levels of pH, available Phosphorus and Potassium. Application of Cate and Nelson Procedure of non-parametric test of association indicted that the critical soil pH for coffee under South Indian conditions was 5.8-5.9. For available Phosphorus and Potassium, the critical values were found to be 7 and 60-80 ppm, respectively. No appreciable differences were noticed in the critical soil test values between Arabica and Robusta.\(^10\)

### 2.4 Liming

#### 2.4.1 Lime requirement of coffee soils

The lime requirement of 33 high-level lateritic soils of West Coast where coffee is being grown was investigated. The lime requirement of these soils varied from 0.5 to as high as 5.4 tons/acre as Calcium carbonate depending upon the soil acidity, exchangeable bases and exchangeable Hydrogen and Aluminium contents. A prediction equation has been established between pH and like requirement to calculate the quantity of lime to be applied to similar acidic soils.\(^11\)

#### 2.4.2 New method to determine lime requirement

Six different methods, viz., Shoemaker’s, Calcium hydroxide incubation, Woodruff’s, Adam’s and Evans’ and Barium chloride (TEA)
were evaluated in a laboratory incubation study to determine the lime requirement of oxisols cropped to coffee. The soils were sandy clay loam with OC content of about 2.5% and CEC of about 10 me/100g. It was found that liming the soil of 4.2 pH according to Shoemaker’s method and liming @ 40% of the L.R. values determined Barium chloride - TEA method brought the pH to the desired value of around 6.5 or the soil of pH 5.0, liming @ half the L.R. value of Shoemaker’s method would shift the pH to desired level while other methods indicated that either too much or too little lime requirements. For the soil of pH 5.6, all the methods tried excepting Adams & Evans, proved efficient to change the initial soil pH to around 6.5. Liming at only 1/3 or 1/2 the L.R. value was found sufficient to shift the pH of the soil from 5.6 to 6.5, suggesting that only smaller quantities of lime were required if the initial pH is near neutral. This study also indicated that the reaction between the liming material and the soil matrix could be completed in a month’s time, provided the material is of very fine texture and thoroughly mixed with soil and adequate moisture is maintained.

2.4.3 Studies on liming Oxisols cropped to coffee. II. Effect of liming to varying pH levels on the chemical characteristics of soil.

Soils of pH 4.2 and 5.6 were treated with calcium carbonate ranging from 0.3 to 10 t/acre, to result in varying pH levels and incubated for 3 months with moisture at field capacity. Analysis of the soil samples for different chemical constituents after the incubation period indicated that the varying amounts of calcium carbonate had practically no effect on the organic carbon content, cation exchange capacity and available Potassium in the soils studied. Total exchangeable bases and exchangeable Ca + Mg was found to increase with increasing amounts of added lime. In the soil of pH 4.2, an initial increase in the available Phosphorus (Bray 1) was observed but further addition of CaCO$_3$ resulted in significant reduction in available Phosphorus. In the soil of pH 5.6 also, liming caused lowering of Phosphorus available. This study suggested that when the available P level is in the high range, beneficial effects could be expected by liming with regard to Phosphorus availability.

2.4.4 Effect of liming on growth and chemical compositions.

The effect of 5 different liming rates on growth and chemical composition of seedlings of 4 cultivars of Arabica grown in polybags filled with jungle soil of normal reaction (pH - 7.0), compost and sand in the ratio of 6:1:1 was studied under nursery conditions. The pH of the soil increased from 7 to 7.2, 7.6, 7.7, 8.0 and 8.3 with increased liming rates at the end of 15 months. Heavier application of lime adversely affected the height, number of primaries and leaves. The available Phosphorus status of the soil decreased with increasing rates of lime, while the available Potassium level remained unaffected. Leaf Phosphorus, Potassium, Magnesium and Iron levels were not influenced. Leaf Calcium content increased with some increase in the level of lime applied while leaf Manganese content decreased with increase in lime application. This Shivaji University, Kolhapur.
A study has shown that lime need not be used with jungle soil of normal reaction for raising seedling in nursery.  

2.4.5 **Liming of soils cropped to coffee**  

Some of the results reported on the method to determine the lime requirements of coffee soils, the quantity of lime to be applied, efficacy of a few liming materials in this paper, have been discussed. Liming had practically no effect on organic matter status, CEC and available K.  

2.4.6 **Lime-Zinc Interactions**  

In a laboratory trial addition of Calcium carbonate @ 2.5-20.0 t/ha significantly raised the soil pH with simultaneous decrease in DEPA extractable Zinc. Increases in exchangeable Calcium, consequent to liming resulted in higher leaf calcium, in *C. arabica* seedlings grown in differentially limed soils. Application of lime, boosted the growth of seedlings inspite of decreasing extractable Zinc, possibly due to the nutritional effect of Calcium in promoting abundant root growth. Leaf Zinc was not altered appreciably by liming.  

2.4.7 **Evaluation of liming materials and Rock phosphate of different particle size at varying soil moisture regimes.**  

A laboratory incubation study was conducted for a period of 6 months to find out the efficacy of few liming materials and Rock phosphate of different particle size at varying soil moisture levels to raise the pH of soil grown to coffee to 6.5. The study indicated that soil moisture played a dominant role in raising the pH, the moisture level of 60% water-holding capacity being necessary for complete reaction. Particles, which passed through 80 mesh, were found more effective than the coarser ones even at lower moisture levels. It was further observed that most of the lime-soil reaction resulting in the pH change occurred in a week’s time. Finely ground Rock phosphate also effected a pH change and was found on par with basic slag. The efficacy of liming materials tested was in order of burnt lime > lime stone > dolomite > basic slag.  

2.5 **MANURING**  

2.5.1 **Coffee Manuring**  

For an average crop of 600 lbs. of clean coffee/acre, a balanced manure mixture containing 30 lb. of N, 45 lbs. of H₃PO₄, and 60 lbs. of K₂O/acre was suggested. As many Indian planters were not willing to spend more than Rs.30/acre for manuring, the quantity of manure in actual practice could not provide more than 20 lbs. of N, 30 lbs. of H₃PO₄, and 40 lbs. of K₂O/acre. A comparison of the 2 years of yield figures shows clearly gradual lowering yield due to neglect of manuring. Curing returns for a number of years also showed the effects of manuring on the out-turn and quality of crop. Bordeaux appears to have a tonic effect on coffee but if spraying is done, it must be followed by manuring or the result is disastrous.  

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2.5.2 The manuring of coffee in South India - Review

The NPK should be applied half before monsoon and half after monsoon. The first experiment at Balehonnur on 25:37.5:50 failed to show significant differences in yield among various treatments but improved the appearance of coffee bushes in the treated plots. The second series on 20:30:60 formula though not capable of strict statistical interpretation nevertheless showed 54.8% increase on NPK and 40% increase on N+P. The PMT started in 1937 at Balehonnur showed that only in 3 out of the first 9 years were the results were significant, but the mean of the 9 years produced 54.8% increase in favour of NPK which is significant. The experiments are valuable to the extent that they show that when such disturbing factors as root competition from shade trees and the diversity of experimental plants are eliminated, there is a significant response to a complete manure and a well-defined trend in favour of Nitrogen alone or in combination with other plant foods. But in the case of experiments conducted under natural conditions of an average coffee plantation, these trends are absent. Workers in Kenya have found that the mulching of coffee with Napier grass has given substantial increase in the yield. This mulch contributes on decay 88-220 lb. N and 60-150 lb. P2O5. Using banana trash as mulch, increases in exchangeable Calcium and Potassium, the Potassium increased by about 100% by 13 years of mulching.19

2.5.3 Some reminiscences

A application of only 20 lb. of Nitrogen/acre with requisite amounts of Phosphorus and Potassium has been found quite adequate to get an average yield of 4-5 cwt. of clean coffee/acre. If it is desired to get bigger crops, heavier manuring should certainly be done. The size of the crop depends not only on the amount of manure used but also upon soil, climate, cultural operations, shade conditions and capacity of the plant to produce the crop. Under normal conditions, an application of 50 lb. Nitrogen/acre with corresponding amount of Phosphorus Potassium to maintain a ratio of 2:3:4 seems to be quite adequate to produce an average crop of 7 cwt./acre. As a standard practice or all plants in good shape and bearing condition, a dose of 20-50 lb. Nitrogen/acre with 30-75 Phosphorus and 40-100 Potassium according to the capacity of the planter to spend money on manures and variation of the same for comparison is suggested.20

2.5.4 Balanced fertilizer for coffee - I. Preliminary report on simple manurial trials conducted in various liaison zones of coffee growing areas of South India.

Results of simple manurial trials conducted for three years in 46 estates located in various agro-climatic regions growing coffee under mixed shade are reported. The trends were in favour of application of balanced fertilizer, i.e. N+P+K when applied at 60:30:40 kg/acre or 67:37:45 kg/ha., respectively, rather than Nitrogen alone or in

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2.5.5 **Some trends in manurial experiments in coffee.**

The results of two sets of experiments by Coffee Board Research Department are reported. The first set relates to varying levels and combinations of NPK and the second to different sources of Nitrogen. The results of first set indicate that under the conditions of experiments, 100 lbs. of Nitrogen/acre is beneficial to young and old coffee alike whether the $P_{30}K_{40}$ or $P_{45}K_{60}$. Nitrogen, Ammonium sulphate and Urea appeared to be good for both young and old coffee.  

2.5.6 **Some fertilizer experiments on coffee.**

From the results of the Permanent Manurial Trial outlined, the need for balanced application of NPK is clearly evident. Other trials show that application of NPK at 100:30:40 is optional for bearing coffee. As regards the maximum dosage for old coffee, 100:45:60 appears to be beneficial. For young S.795 selection, application of 160:120:160 NPK so far has been found to be useful.

2.5.7 **A note on cationic imbalance in Arabica coffee.**

This study reveals that a Leaf Magnesium of 0.02% and Leaf Calcium of 0.6% for S.795 may indicate the level of inadequacy. The high level of Potassium in leaves of affected plants suggests antagonism between Potassium and Manganese and to a slight extent, between Potassium and Calcium. In S.795, upto a total cation content of about 3.5%, the antagonism between Potassium and Calcium and Potassium and Magnesium seem to be present. This deficiency of Magnesium and to a lesser degree of Calcium in S.795 Arabica coffee seems to be due to the cationic imbalance in the plant as also pH <6.0.

2.5.8 **Factors in evaluation of fertilizer requirement of coffee**

Factors such as (1) Plant material - its inherent qualities, (2) Size of harvested crop, (3) Quantum and nature of bearing wood, (4) Light intensity along with elevation and aspect of estate, (5) Data on soil and leaf analysis to determine the availability and nutrient status of major and minor nutrients, (6) Structure and texture of soil-drainage moisture holding capacity, (7) Organic matter status of the soil and the nature of rhizospheric microflora, (8) Residual and cumulative effects of previous inputs of soil amendments, fertilizers and manures presented.

2.5.9 **Fertilizer needs of coffee in India.**

In India, manurial trials were initiated and systematic experiments were laid out on the varying dosages/forms of nutrients. Based on these trials, the ratio of nutrients and the basic dosage were fixed as 2:3:4 NPK and 25 lb. N, $P_2O_5$ and 40 lb of $K_2O$ per acre per annum, respectively. Results of trials carried out or 12 years indicated that (1) application of

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complete fertilizers was better than no manure, (2) application of nitrogen levels greater than 40 lb. increased the crop, (3) Phosphorus and Potassium have good responses only in the presence of increasing Nitrogen, and (4) application of bulk manures at comparative levels was not economical.

2.5.10 Influence of continuous use of inorganic fertilizers on the nutrient status of oxisol cropped to coffee (*Coffea arabica*)

Surface soil samples collected from a manurial experiment on *Coffea arabica* were analyzed to find out the nutrient status of the soil as a result of continuous application inorganic fertilizers for a number of years. It revealed that long term manuring had practically no effect on Nitrogen, Organic Carbon, humus and CEC of soil. But it improved the soil fertility with respect to Phosphorus and Potassium. Total exchangeable and available Potassium and total and available Phosphorus increased with increasing amounts of applied fertilizers. The pH and exchangeable Calcium and Magnesium showed a significant decrease with simultaneous increase in exchangeable Aluminium.

2.5.11 Fertilizer Practices in Wayanad

A preliminary investigation on the poor performance of Robusta in small holdings of Wayanad indicated the inadequate fertilizing practice was a major factor. Addition of fertilizer was observed to result in better yields and it was a significant positive correlation between nutrient input and yield. While positive correlation was seen between soil Potassium and yield fertilizer Potassium no correlation was noticed between soil Phosphorus and yield fertilizer Phosphorus. Soil reaction could not be correlated with any of the observed parameters. The average yields of these small holdings are very low. The agro-climatic conditions in Wayanad are more conducive for cultivation of Robusta and the rust problem is not a major handicap.

2.5.12 Evaluation of economic optimal level of fertilizers

Input-output relationship in Arabica was studied using experimental data of different doses of fertilizers and their corresponding yield levels with an objective of estimating the economic optimal level of fertilizer to coffee. It was found out that 154:116:154 kg/ha of N, P$_2$O$_5$, K$_2$O, respectively to be on the economic optimal level at the existing prices of inputs and clean coffee.

2.5.13 Nutrients extracted by crop - A basis for fertilizer recommendation.

Based on the fertilizer use efficiency, crop removal of nutrients and biomass production nutrient requirement was computed for an anticipated crop of 1000 kg. of clean coffee.

2.5.14 Soil tests, fertilizer recommendation - Response in terms of soil fertility and crop improvement. 

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Large scale analysis of soils has indicated that prior to 1960s, 91% of the samples analyzed was low to very low in available Phosphorus and 76% of the samples acidic in reaction. The study has further indicated probable relationship between soil P and yield. 

2.5.15 Soil tests, fertilizer recommendation - Response in terms of oil fertility and crop improvement in the coffee tracts of Kerala and Tamil Nadu.

The Paper presents that 66% of coffee soils in Kerala was low in available phosphorus and 27% in available Potash and in Tamil Nadu, 42% of the soils tested was acidic in reaction and 40-41% was low in phosphorus and potassium. Correlation studies revealed that average P had no relationship with yield, while average K had a significant linear relationship with yield. Soil pH also correlated significantly with yield in Pulneys.

2.5.16 Fertility status in Andhra Pradesh.

The data indicated that in general, the soils were neutral in reaction (pH), normal in electrical conductivity, medium to high in organic carbon (%) and available Phosphorus (P) and high in available potassium.

2.5.17 Nutritional management of plantation crops.

Concepts involved in the determination of nutritional requirements of crops, influence of shade and its contribution to crops through the nutrient transfer in response to fertilizer application, limitations of soil testing, agronomic practices and their influence on fertilizer use efficacy, effect of various moisture regimes on nutrient absorption, etc., are discussed. Importance of initiating nutrient balance studies in plantation crop agro-eco system, standardization of new techniques such as EUF (electron ultrafiltration) method as a tool for refining fertilizer recommendations, recognition of micronutrient flexes in soils of plantations crops are identified as future strategies.

2.5.18 Fertilizer practices in Kerala.

The soil fertility levels of various coffee growing zones of Kerala is evaluated by the MSTL. Majority of the soils (70.3%) were acidic in soil reaction. Available P ranged from 1.36-2.29 and available K from 1.20-2.35, 43.6% of the estates of less than 5 acres did not apply any fertilizer and limings was not done in 68.9%. Yield was less than 100 kg/acre in 36.0% and between 101-250 kg/acre in 42.4% of these holdings. In next category (5-10% acres), 60.8% received fertilizer ranging from 31-120 kg NPK/acre, 57.3% estates were not limed in this group. In the holdings of 10-25 acres, 74.80% applied fertilizer ranging from 46-250 kg/acre. Liming was done in many of these holdings. Yield was 251-500 kg/acre and in 34.2% and >500 kg/acre in 21.6% of these holdings. This investigation revealed a higher degree of fertility consciousness among the large growers.

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2.5.19 Fertilizer Usage in Tamil Nadu

The soil status in coffee zones of Tamil Nadu as evaluated by MSTL is discussed. Soil analysis indicated that only 26.5% of the soils tested was acidic in soil reaction. Majority of the holding was adequately supplied with P and K. In new clearings, 55% did not receive any fertilizer. The crop average was <100 kg./acre in 40%, between 101-250 kg/acre in 33% and between 251-500 kg/acre in 21% of the holdings.36

2.5.20 Crop nutrient removal

Chemical analysis of berries of different cultivars of *C. arabica* for macro and micronutrients was carried out. It could be inferred that on an average, 600 kg of ripe cherry of various Arabica cultivars removed around 40 kg n, 5.33 kg P₂O₅ and 52 kg K₂O. Use of the above crop removal data as a criteria for arriving at optimal fertilizer recommendation doses is contemplated.37

2.5.21 Rationalization of application of fertilizer inputs in coffee.

While dwelling upon the rationalization of application of fertilizer inputs in coffee, it is stated that it has to be attempted based on soil and leaf test data and crop realized. Also, the fertilizer use efficiency (FUE) both in arabica and robusta, nutrient contribution by litter from the mixed canopy system and removal of nutrients by crop of both the species and nutrient additions based on soil test data are discussed. Accordingly, application of 230-175 kg of N, 80-120 kg of P₂O₅ and 120-170 kg of K₂O (to both arabica and robusta) is recommended for a unit area producing 1,000 to 1,250 kg of clean coffee.38

2.5.22 Soil fertility parameters of Chikmaglur.

40 small estates growing Arabica coffee were selected at random and 5 years data pertaining to quantity of fertilizers applied, yield were collected. Yield and soil test based NPK application dozes were significantly and positively correlated. A significant positive correlation was found between yield and available K in these soils.39

2.5.23 Low cost technology for coffee cultivation in Pulneys

The proposal of LCT for coffee cultivation in the Pulneys emphasizing on cost reduction in the important cultural operations is not a theoretical proposition. These methods are being adopted at RCRS, Thandigudi, over the last 5 years successfully. Resorting to only slash weeding to control weed growth, maintaining only a single canopy of permanent shade doing away with lower canopy of temporary shade, broadcasting fertilizers and avoiding hard pruning, the labour component is considerably reduced, thereby bringing down the cost cultivation by about Rs.1500/acre. At the same time, the productivity is maintained above average with a 4 year mean yield of 765.740.60 and 400-500 kg clean coffee/acre in the case of Cauvery and sln.5.40

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2.5.24 **Fertility management of coffee - The Kerala growers way.**

This study reveals that the productivity level of majority of the growers was below the national average. The probable reasons may be non-adoption of soil testing, but application of lime, choosing right fertilizer but applying it in low quantities. Most of the soils were acidic with low level of available Potassium.\(^{41}\)

2.5.25 **Method of fertilizer application.**

The observational trial conducted at Regional Coffee Research Station, Thandigudi, showed that broadcasting to applying the fertilizer under the entire canopy had an edge over drip circle application. Broadcasting of fertilizer for over 7 years at RCRS farm, clearly revealed that broadcasting of fertilizer had no adverse or deleterious effect on coffee; in fact, the average yield was found to be substantially higher than that of neighbouring plantations.\(^{42}\)

2.6 **Major Nutrients**

**General**

2.6.1 **Fertilization in coffee - trends and potentials.**

From the research results, it is reported that for a crop of 100 kg/hectare, 160:100:160 of NPK is recommended for coffee. The sources of NPK are also discussed.\(^{43}\)

2.6.2 **Studies with proprietary macro/micro nutrient formulations.**

A replicated trial using 10 various proprietary formulations were initiated to see their effect on growth and yield of arabica coffee. Although numerical increase was found with multiplex, zimag, agromin, etc., no significant different was found due to the use of these formulations and apparently had no effect on quality of coffee.\(^{44}\)

2.6.3 **Influence of major nutrients on the availability of minor nutrients.**

The results indicated that under CCRI conditions, continuous application of NPK over a period of years enhanced extractable Fe and Mn in soil without influencing the Cu and Zn levels.\(^{45}\)

**Nitrogen**

2.6.4 **Foliar sprays of Urea for Arabic coffee in South India.**

An exploratory trial to determine the absorption pattern of Nitrogen from Urea sprays, the optimum concentration of Urea at which considerable quantities of Nitrogen can be supplied to coffee as foliar sprays was conducted at the Central Coffee Research Institute. The maximum absorption of Nitrogen sprayed as Urea occurred within 48 hours of the spray. The study also indicated that Urea could be applied through the foliage at concentration upto 5%, without causing any injury. Slight scorching was observed in young foliage.\(^{46}\)

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2.6.5 **Biuret toxicity in Arabica coffee**

Effect of foliar sprays and soil applications of Urea containing concentrations of Biuret was studied using 15 month old *Coffee arabica* cv. Kents seedlings. This was compared with foliar sprays and soil applications of pure Biuret and available samples of Urea. Foliar applications of Urea containing Biuret at 2.5% and above and soil applications of Urea with 10% Biuret and above resulted in Biuret toxicity. The symptoms of toxicity and the sequence of its development have been described. While for foliar sprays, coffee was found to be tolerant to Biuret contents of up to about 2% in Urea, that for soil applications, an accumulation of about 1.5 g of Biuret in the soil appeared critical. The present study showed coffee to be more sensitive to Biuret toxicity than citrus, tea and vegetable crops.\(^{47}\)

2.6.6 **Continuous heavy application of fertilizers on various forms of Nitrogen in the soil.**

Pot culture studies using field soil samples collected from the trial plots on the effect of continuous heavy application of fertilizers indicated that there was a considerable build up of all forms of Nitrogen as a result of considerable heavy application of Nitrogenous fertilizers. The native soil Nitrogen was found to be adequate to meet the low requirements of the slow growing coffee seedlings. The correlation studies showed that both total and mineralizable Nitrogen after 12 days incubation and available Nitrogen determined by using alkaline Potassium permanganate were reliable indices for predicting the availability of Nitrogen in the soil to coffee and were better than Organic Carbon which was very poorly correlated with uptake of Nitrogen by all the 3 crops grown. Thus, accumulation of residual Nitrogen did not have any significant effect on the growth, dry matter production and Nitrogen uptake by coffee.\(^{48}\)

2.6.7 **Compatibility of Nitrogenous fertilizers with alkaline Bordeaux.**

A laboratory study was carried out to find out the extent of loss of Nitrogen from different Nitrogen fertilizers when added to Bordeaux of varying alkalinity. It was observed that the loss of Nitrogen as Ammonia from Ammophos and Sampurna increased with increase in pH of Bordeaux. No loss was noticed from Urea even at pH higher than 12.0 under lab conditions. Considerable loss occurred from Ammophos and Sampurna when the pH was readjusted to initial values. Excess lime present in Bordeaux (0.5%) prepared by mixing equal quantity of Copper sulphate and lime caused greater loss of Nitrogen. It was also recorded that addition of Ammophos brought down the pH of alkaline Bordeaux considerably. But the pH drop in 1:1 Bordeaux was negligible. Urea did not affect the pH of Bordeaux.\(^{49}\)

2.6.8 **Effect of Biuret**

Effect of different concentrations of biuret on seed germination and growth of seedlings was studied in sand culture and nursery. Addition

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of Urea solution containing biuret >2.5% delayed and reduced the germination. Soaking seeds in solution of biuret of different concentrations also delayed germination. Increased biuret concentration in Urea caused a progressive reduction in seedling growth and dry matter and slightly decreased Nitrogen content of leaf. Toxicity symptoms were noticeable and root growth was sparse at and above 2.5% biuret concentration.50

Phosphorus

2.6.9 Efficiency of sources of Phosphorus

Three incubation studies with soils of pH 6.2, 5.2 and 5.6 were carried out to study the efficacy of various sources of Phosphorus under laboratory conditions, in relation to their availability. Nitrophosphate was found to be superior to other sources of Phosphorus in maintaining availability of Phosphorus in all the 3 soils. There was practically little release of available Phosphorus from Rock phosphate when the soil pH was more than 5.6. It was also seen that the level of available Phosphorus after application of various sources of Phosphorus depended on the initial level of available Phosphorus, indicating the need for higher level of Phosphorus application to soils low in available Phosphorus.51

2.6.10 Foliar sprays of Superphosphate to Arabica coffee in South India

An exploratory trial to determine the suitability of Superphosphate for foliar sprays was conducted at the Central Coffee Research Institute. Superphosphate was found to be suitable for foliar sprays at concentrations of 0.5% and 1.0%.52

2.6.11 Phosphorus and Zinc Interactions.

Soil incubation studies with varying rates of Phosphorus at different fixed levels of Zinc revealed that Phosphorus even at 2400 ppm, did not alter the extractable soil Zinc appreciably, possibly due to the presence of Zinc mostly as organically bound or occluded Zinc in the soil under experimentation. However, growth studies with arabica seedlings on the differentially treated incubated soils showed that leaf Zinc reduced with increasing amounts of added Phosphorus, suggesting a possible interaction of P-Zn within the plant system. Application of heavy doses of Phosphorus enhanced the leaf Phosphorus and growth of coffee seedlings despite its depressing effect on leaf Zinc, upon the addition of ZnSO₄ (7H₂O) indicated that the possibility of soil application of Zinc salts to improve the Zinc status of soil and plant.53

2.6.12 Phosphorus fixation and release

A laboratory investigation was made to study the fixation and release of P₃₂ labeled KHPO₄ in a coffee growing oxisol in presence of certain soil amendments at different incubation periods. The percentage recovery of applied Phosphorus in 0.1M CaCl₂ and Bray-Extractants decreased with increased period of contact with soil. About 70-80% of applied

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Phosphorus could be recovered from the soil by sequential extraction up to 21 days of incubation. Application of Sodium citrate to soil gave higher recovery of applied Phosphorus than CaCO$_3$ and FYM by both the extractants. When fixation of Phosphorus is very high at the initial stages of Phosphorus application, soluble Phosphorus should not be applied to this soil too far in advance of planting to avoid Phosphorus deficiency at the beginning of crop growth.\textsuperscript{54}

2.6.13 Long term application of Phosphorus

Phosphorus fractionation studies conducted on coffee soils which received high doses of MRP over 30 years and lime once in 2 year was found to contain Ca-P in dominant proportion, followed by Al-Fe bound Phosphorus and reductant soluble Phosphorus. Correlation studies revealed that Bray-I and Al-Fe bound Phosphorus fractions positively and significantly correlated with dry matter yield and Phosphorus uptake by Robusta coffee.\textsuperscript{55}

(II) Agricultural Economics

2.7.1 Yield per acre of coffee in India

The average yield/acre of coffee in India varies appreciably from year to year as various factors influence the coffee yield. They may be climatic conditions and the occurrence or sufficiency of rainfall in each season, the location of the estate, the age of the plant, type of coffee grown, the size of the estate and so on. Analyzed according to States, the average yields in Coorg are easily the highest and those of Madras are the lowest, both in respect of Arabica and Robusta. The main reason for such a disparity may probably be the greater attention that is being paid to Coorg for cultivation and larger manuring and spraying up of the coffee estates.\textsuperscript{56}

2.7.2 Cost of production of Arabica coffee in India

The study reveals the present trend in plantations of increased expenditure on chemical fertilizers and spraying materials with consequent beneficial effects on the yield/acre. The increase in labour welfare, upkeep and depreciation costs are no doubt due at least in part to the planter’s obligations under the Plantation Labour Act to provide increased amenities and housing to the estate labour. Attempts are being made to study the trends in the case of small estates also, but the data available so far are too insufficient to draw useful conclusions and lack in accuracy.\textsuperscript{57}

2.7.3 Economics of coffee production and manuring

While India area under coffee is about 2.5% of the world’s area, production is only about 1%. Our present area of 2,50,000 acre produces 40,100 tons. International consumption being 25,000 tons, we can export only 15,000 tons. Since prices have increased considerably, the ratio

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between cost of production and prices realized does not seem to have altered materially. Our present yield is 330 lb/acre for Arabica and 400 lb/acre for Robusta, with 375 lb/acre for two together. The increase in yield can be done to a great extent by good manuring. A balanced mixture containing NPK in 2:3:4 produces more crop than a mixture containing more Nitrogen than Phosphorus and Potassium. The mixture applying 50N, 75P, 100K kg/acre is enough to produce an average crop of 7-8 cwts/acre under normal conditions.58

2.7.4 A quarter century of coffee production in South India.

That green revolution has occurred in coffee is shown by figures of production and yield/ha during past 25 years. A yield index of 685 and a production index of 821 speak for themselves. This great leap forward has become possible due to scientific advances and advisory services of Research Department of Coffee Board.59

2.7.5 Management practices in coffee production in India.

As never before, the role of management has assumed a great importance in coffee cultivation in South India and it is the manager’s ingenuity which today is the most decisive and challenging factor determining estate performance, ending mounting pressures of increasing costs. The most important management factors which influence crop response from a given field are variety and age of plants, fertilizer and spray treatments, pruning and liming practices and shade intensity.60

2.7.6 Scale economics in cost of production of coffee among small holdings.

A study to test the economy of scale in cost of production of coffee on small holdings using functional technical analysis showed that the cost of production of coffee on small holdings of below 25 acres decreased due to increase in productivity levels, which was not influenced by the variation in the size of the holdings.61

2.7.7 Pricing efficiency of Indian coffee market

The pricing efficiency of Indian coffee markets was interpreted in terms of spatial integration. The bivariate correlations of monthly prices among geographically separated markets at pool sale, whole sale and at retail levels used as indices of market integration showed a high degree of pricing efficiency. The relative efficiency is maximum at pool sale level because of better control by the Board. The efficiency was in the order of declining trend from whole sale to retail for want of adequate control of the Board. The location of distribution points and in situational constraint of differential sales tax were found to influence the movement of prices in unison. The markets located in Karnataka were more efficient than those within Tamil Nadu were. Markets between different States were less integrated than those within the States. The analysis of three principal grades of coffee revealed that plantation-A being relatively more in supply, was less efficient than Arabica cherry-A and Robusta cherry-A

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2.7.8 Factors affecting price variation in coffee between pool sales auctions during any particular month.

The analysis of variance of prices secured for all lots of coffee sold at pool waste auction during a month revealed the importance of grading, storage locations and auction centres in explaining the price variation. The extent of variation due to the latter two factors is interpreted in terms of differential sales tax in important consuming States. The advantages of conducting auctions at Bangalore and Coimbatore centres are absent at Vijaywada and hence, the need to look in greater detail into the cost economy for its possible elimination in view of mounting marketing costs is pointed out. There is a need for a rational grading based on consumer needs.

2.7.9 Growth of coffee output in India

Growth rates in area and production of Arabica and Robusta in India in the past few decades revealed that Robusta outstripped Arabica in area and production. Analysis of trend yields and co-efficiency of variation brought out the declining rate of marginal productivity and the magnitude of year to year yield of coffee respectively. The above conclusions were found to be valid for the individual coffee growing States.

2.7.10 Productivity response surfaces in Robusta coffee.

Productivity response surfaces functions are fitted to field survey data of Robusta (Coffea canephora) with yield, nutrient quantity and age of the bushes as variables. The major objectives are to indicate the choice of polynomial functions to study the yield response in different regions. The results bring out the importance of age of the bushes as a variable in the functional analysis. Among the two types of functional forms, the bush-based response function in which the above variables are expressed in kg/ha. The yield maximum of nutrients and age groups are derived for two regions form the respective functions. Given the levels of inputs, yield response varies in the two regions studied. Region-wise bush-based fertilizer recommendations and rationalization of fertilizer nutrient application are the major suggestions emerging out of this study.

2.7.11 Studies on crop out-turn relationship with yield and bean size in exotic Robusta coffee.

Five exotic collections of Robusta were assessed for out-turn ratios at different stages of processing under sundry and washed method. Under dry processing, 41.8% cherry, 46.7% green coffee yield was recorded. By wet processing, 21.8% parchment and 86.6% obtained green coffee. Differences in out-turn among the accession were statistically not significant. Correlationship tests between crop level and

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out-turn, ‘A’ grade beans and out-turn and grade ‘A’ beans with yield level were undertaken. Crop level was negatively and significantly correlated with out-turn, bean size was positively and significantly correlated with yield level and finally, out-turn showed positive significant relationship with yield in a two accession (S.1902 and S.1932) only. One accession (S.1977) did not show any relationship between these parameters. Processing methods did not show any consistent and specific effects on out-turn.66

2.7.12 Yield gap and constraints to potential productivity in small holder coffee plantations.

The study has proved that there exists a yield gap of more than 700 kg/ha of clean coffee in small holdings of Kodagu district. Yields can be substantially improved and yield gap could be bridged by increased fertilizer use in the case of Robusta and increased fertilizer use coupled with adequate plant protection and soil conservation measures in the case of Arabica. These factors in turn depend upon the availability of capital and technical information.67

2.7.13 Blossom and backing showers : An analysis of its impact on coffee yields.

Correlations were worked out to determine the relationship between early rainfall, week of occurrence of blossom rain and its amount, quantum of backing showers and its time of occurrence and previous year’s yield on production levels of Arabica and Robusta. Data on rainfall and crop of 20 consecutive years of two farms of research department was statistically analyzed. Analysis showed that no relationship between the above factors and yield in Arabica, while in Robusta, a significant and positive impact of week of occurrence of blossom rainfall on crop level was found at both locations indicating delayed showers would result in loss of crop. At one farm, March rainfall and previous year’s December rainfall showed a positive impact on Robusta crop level. While, rainless interval between blossom and backing showers had a significant negative effect on yield. The lack of influence of factors on Arabica yields at both locations is attributed to sufficiency of blossom rainfall and its time of arrival for the coffee in most of the years of study.68

2.7.14 Factors affecting coffee consumption in India.

Factors influencing coffee consumption in India are studied in order to suggest measures to increase coffee consumption in India. Multiple regression analysis was used with consumption of coffee as the dependent variable and income, prices of coffee, tea, sugar, taste and lagged consumption as independent variables. Results indicate that previous consumption, which was considered to represent coffee and tea are the factors influencing coffee consumption. Generic promotion, increase of internal release through cooperative stores and propaganda units of Coffee Board are suggested to improve the coffee consumption.69

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2.7.15 Trends in coffee production.

In the present study, an attempt was made to elucidate the trends in coffee production and area and yield effects in increasing the output. The study revealed that though area under coffee is increasing, it is combined with large variations over a period of time. Variation in the productivity did not show significant decrease. Analysis of the area and yield effects indicated that during 1954-55 to 1964-65 period, yields effect was dominant in case of Arabica than in Robusta. During 1964-65 to 1974-75 period, area effect increased considerably in case of Arabica while yield effect in Robusta. During 1974-75 to 1984-85 period, area effect dominated the yield effect in the case of Arabica and yield effect dominated in Robusta. In the case of Robusta, interaction effect also increased considerably.70

2.7.16 An analysis of yield gap in coffee.

The findings of the study showed that the overall yield gap index for coffee among the planters was as high as 62.85%. This implied that there is a scope to increase the coffee yield by more than two times. Further, the yield gap in respect of Robusta was relatively higher than that of Arabica. Hence, there is need to give more emphasis for the education of Robusta growers. The extent of yield gap was related to application of fertilizers and liming in Arabica, while it was the application of fertilizers and use of sprinkler irrigation in Robusta.71

2.7.17 WTO, GATT and IPR impact on Indian Coffee - New Paradigm on Production, Marketing and Related Issues

For the Indian coffee industry, the WTO era promises a stage of high excitement, opportunities and challenges. Of central significance to India’s coffee industry has been the WTO Agreements on Agriculture, Trade Related Intellectual Property Rights (TRIPS and the Agreement on Technical Barriers to Trade (ATBT). The WTO Agreement on Agriculture which calls for reduction of tariff and non-tariff barriers poses major challenges to Indian Coffee, which may have to face competition from ported coffee from other origins. The TRIPS with its accent on Industrial Patents and Sui Generis Legislation on Plant Variety Production and Geographic Indications can alter the systems of cultivation of coffee. The ATBT with its emphasis on technical standards such as ISO-14000 also offers challenges by way of informational audits and certifying systems of Indian coffee. This paper examines the impact of these WTO Agreements on India’s coffee industry in the coming millennium.72

2.7.18 Futures trading in coffee

Financial express have developed a number of techniques to manage price volatility in commodities market. One of the most important risk management techniques used world-over to hedge price risk is futures

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trading. In order to help the players in coffee market, futures trading in coffee is being conducted by Coffee Futures Exchange India Limited (COFEI) from June, 1998. COFEI acts as a buyer to the seller and seller to the buyer of coffee. The important benefit of futures trading conducted by COFEI is that the exchange ensures guaranteed performance of the contract by the parties. Futures trading in coffee is of recent origin in India and has a lot of potential. This paper examines the *modus operandi* of coffee futures contact and discusses how COFEI helps in managing price risk.73

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(III) General Press

2.8 Miscellaneous Interesting Items

2.8.1 Problems of Coffee Producers

“The image of the small Coffee growers facing up to the mechanizations of the distant international market is similar to that of a man pushing a rock uphill. The grower is powerless against any slight tremor of market forces which can bring the rock tumbling down crushing him and his family.

The report highlights the problems facing Coffee growers as a result of the way we trade in Coffee. After examining how the trade operates, the report illustrates with testimonies from the Colombian, Uganda and Indonesian farmers etc., and its impact on the lives of farmers. The most serious of the obstacles of the farmers highlighted are price, access to market land, quality and lack of affordable credit.

In a way to combat these problems, the study focuses on Fair Trade initiative by the grower which meet guaranteed fair terms of trade, and offer supportive recommendation (with making no apology that recommendations have a particular focus as the foundation itself is a player in fair trade) on how relevant players within the UK can take meaningful steps to ensure that the Coffee we drink returns a decent deal to the farmers.

The recommendations of the foundations are: consumers demand for product need to find an expression in ways that hold hope for the Coffee farmers; manufacturers need to stabilize the market and improve farmers’ return; retailers need to develop parallel policies with respect to the impact of their trade on the small farmers; and Government needs to be reversed in the lack of support and extend support by all means and particularly for :practices involved in fair and ethical trading”.

2.8.2 Low Prices, Uncertainty and Output Paths

“An analysis has been carried from the review of all available data on cost of production; a calculation of output reactions to varying amount of labour and capital inputs, together with coefficient reflecting land fertility and the condition and density of trees has been made. And from the result of the review 1,000 random outcomes were calculated. These outcomes were obtained by applying a production function as Q=A x L^b x K^c. Where ‘Q’ is an output per unit of land, ‘A’ is a multiplier based on land fertility and the age and condition of tree, L is the labour input, b is the co-efficient of labour, ‘K’ is the capital input and ‘C is the coefficient of capital.

The study has revealed a range of total producer costs for Arabica from 21.6 cents/lb to 76.8 cents/lb based on the group which distinguished from level of productivity

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low, medium and relatively high. It is also observed that the average price for standard Arabicas during the first 8 months of the year 2000 was just over 93 cents/lb, ex-dock. By deducting shipping and associated cost of 10 cents/lb, cost of internal marketing 10 cents/lb from Ex-dock, it is shown growers can expect to receive 70 cents/lb but most of small holders’ receive less than 50 cents/lb...

It is concluded that low prices and uncertainty are prevailing in producing countries and it is a serious matter for countries in general and growers in particular, not only because they are suffering from lower receipts but also from greater difficulty in marketing investment decision. And the same also has a major unsatisfactory implication for importers in the future, at least in the shorter-term. As Coffee market is not characterized by self-correcting in a reasonably short-time span as economic theory and its equilibrium reveals that and these farmers are not immune from the generality of low prices, though they receive a premium for effort and skill…”

2.8.3 Specialty Robusta: A Trump Card for Asia?

“... About 75 percent to 80 percent of gourmet Coffee exports originated in central or South America, the Caribbean, and Hawaii, and over one half of the 20-25 percent, remaining are produced in Africa and Asia’s part barely 10 percent. Though the consuming side has become imperative to offer more individual types and varieties with the medium income market discerning in its tastes but also price conscious. Hence, there is a serious imbalance which deprives Asia-the region of the extra prestige and income carried by gourmet Coffee as the regions ratio of Robusta to Arabica is the world’s highest. This is due to the pre-eminence of Arabica in the sector of designer Coffee, the pioneer gourmet origin such as Ethiopia, Kenya, Jamaica, and Colombia, it also because of special Coffee marketing chains of importing countries.

As there are excellent and mediocre Arabica, the same holds true for Robusta, and that rigorous plant selection, good collection habits and careful processing, further more there is no affecting aroma, flavor and other taste components, then when Robusta should be considered inferior to Arabica and kept away from gourmet Coffee, when the rewards are worth it.

For all Asian Robusta producers, large and small, the opportunity is in gourmet Coffee as there was a time, less than ten years ago, when gourmet Coffee exporter from Costa Rica or Guatemala were a complete novelty and involved no more than a fewbags”. 76

2.8.4 Selecting and Diminishing: A Supply Side Approach to the Coffee Problem

“Coffee producing countries are facing a chronic depression in prices due to over production. The concern here is the vicious cycle being

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experienced by the producing countries, and the widespread use of low quality products resulting in low consumption and this in turn contributes more for the low prices. However, the only one which can stop this complex cycle which is apparently generated by the industry is the producing countries by eliminating the availability of inferior Coffees. It is crucial because of inelasticity of demand, the perennial nature of the Coffee plant and the non-perishable nature of Coffee beans.

This study attempts to explain how this could be attained. In simple numbers producers were supplying 9.5 million bags of Coffee, and about 16 million bags of rejects (triage) i.e. in total it was estimated 111 million bags. While the demand was about 105 million bags and there was a surplus of about 6 million bags for the year. If the 16 million bags of triages were not available, the market would not have been depressed. So it can be concluded that the producing countries ought to get involved in improving the quality of Coffee bean that go to the industry and it necessitates to cooperation among producers and also involvement in promoting domestic consumption.  

2.8.5 Integration of Indian Coffee trade with global trends-Issues and challenges.

“It must be borne in mind that in the more of liberalization and globalization, greater is the need for integration with global market. Such integration is not only from the point of likely increase in domestic Coffee production in future but also in the view of the emergence of Vietnam and Indonesia as large producers with large exportable surplus. Taking into consideration all these major developments, this paper draws a conceptual framework for 2 stage integration (i.e., primary and secondary level) of Indian Coffee trade with global market.

The preconditions in achieving primary integration and corresponding mechanisms are depicted as under for reliable Supplies: production levels are to be sustained or improved, industry should generate and disseminate vital information, and honor export commitments. Parity between domestic and international prices: minimize competition between domestic buyers and exporter through self-regulation or state regulation. Regulatory environment to provide competitive edge and remove bottlenecks: export procedures and taxation laws should not hinder exports, and enforce strict measures to check ‘switch deals’. And for a sustain direction of exports, sustained efforts to develop “dependence” on Indian Coffee. The preconditions in achieving secondary integration and corresponding mechanisms to achieve high level of integration are depicted as under for total quality management: close co-ordination between exporter, curers and growers to upgrade quality, value added export: export of specialty Coffees, and export of soluble Coffees, buyer specific marketing strategy: development of major buyers in the importing countries in tune with the direction of exports. And for business promotion: seller-buyster information exchange

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and interaction.

The major area of weakness in achieving market integration is lack of representative and effective industry association which needs to be sorted out. The high level market integration requires a much closer co-ordination between the producer, curer, and exporter for quality improvement.  

2.8.6 Coffee Marketing in India - A study with special reference to the State of Karnataka

“In a nutshell, the objectives of the study are to examine the trend in prices; impact of the wild fluctuation; reasons for fluctuation; effect of globalization, liberalization and IT revolution; role of Government; problems faced by the growers; ways and means to counter the crisis; and give viable suggestion to the Coffee market crisis. In order to evaluate the inter-sectarian variation and fulfill the needs of the objectives, the study had developed questionnaires for exporter, curer and Coffee growers and sample had been chosen from the acres of Bangalore, Chikmagalore and Coorg..."

The testing of the hypothesis was based on a majority of the views expressed by the respondents. The prices are falling steadily due to excessive production around the world - accepted by all the respondents. The prices are also falling due to the inadequate tapping of the potential national market. It was accepted at all the levels by concluding that it was one among the many factors. The prices are falling due to quality seeds in India - there was no clear evidence to suggest a relationship between quality and the fall in prices of Coffee. The prices are low due to lack of the presence of voluntary cooperative societies - there was no close connection with cooperatives and the fall in prices. The prices falling due to lack of aggressive marketing - this was one among the factors that lead to fall in prices of Coffee. The prices are falling due to less concentration on specialty Coffees - (the conclusion was not able to be determined al lack of awareness on the topic). The Government should interfere, and should have more involvement, and stabilize prices - this was not related to fall in prices of Coffee. The globalization, liberalization and IT revolution are not being adequately utilized - there is no clear evidence to suggest any relationship with the subject with fall in prices of Coffee."

2.8.7 Quality - The Key to Progress

“Is it true that the quality in Coffee has been increasing over the period of time in the consuming market? How the qualities respond to price in these markets? These are the question to be addressed to examine the trend in the upcoming topic ‘quality of Coffee to be served for consuming market. The data have been calculated from monthly unit values of imports divided by the ICO Composite indicator, lagged two months. An indication of quality changes over almost 31 (21) years was the result. From the changes in purchasing patterns by all ICO importing Shivaji University, Kolhapur."
members, it was also observed that relative quality as measured by the basic idea had increased by about 1/3 between 1967 & 1997. It was also observed that the quality of Coffee improved markedly during the early 1990s, when global prices were low, and had decreased in some later months, when global prices were comparatively high. At the ending period, methods for treating Robusta to allow it to be added to blends in larger quantities have been developed. The greater use of Robusta reflected the large differences in global prices between it & Arabica. It is also evident that in Finland there has been a steady increase in quality over time, the movement in Germany has also been positive but comparatively moderate, and trend line for Spain suggests that the quality of purchase has almost doubled.

What does the data mean? Large roaster, for much of the Coffee consumed is processed by large roaster have within the confines of global prices, generally improved quality— a little in some cares more so in other. Thus, it is clear that the consumer is prepared to buy better Coffee. The quality is an important factor in maintaining consumption when global prices rise. The received wisdom was that the buyers-consumers and retailer do not know all the attributes of the quality except the aspect of taste and aroma like Coffee sellers- farmer, merchants and roaster know the quality of their product and they also to avoid sellers miss-presentation of produce, Product reliability and description is to be guaranteed either explicitly, by the labeling by certificate or by implication...

2.8.8 An analysis of the attitude towards Coffee futures trading

"...In the liberalized economy, futures market can give greater transparency to the mechanism of price discovery which is being the free market instrument.

This project is an exploratory research, which seeks to find out what will be the views of the members of Coffee Futures Exchange India Ltd. towards the futures trading of Coffee and reasons for non-participation of existing members in trading. The study aims at assessing the impact of the futures trading on the Coffee industry; analyzing member’s behavior with respect to COFEI; identifying the reasons for disinterest of the members towards Coffee’s futures trading; and to suggest suitable strategies. The research was descriptive. The survey is conducted using questionnaire to respondents such as Grower, Exporters, Domestic traders, Agents, Curers etc. who are the members of COFEI. The sample of 60 is drawn from ordinary members, 18 from trading members and 2 from trading cum clearing members by using random sampling method.

The survey was undertaken for members of COFEI from Bangalore, Coorg, Chikmagalore, and Hassan. The study reveals that only less than 5 percent growers and traders from the Coffee industry were involved; share of ordinary members double than the other category of members; there has been severe drought in the trading in exchange; online trading, information about trading, timing, location etc. play a minor role in

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making trading cumbersome; only 55 percent of the respondent members are well conversant with futures trading and hedging system; awareness about the futures trading is very low among the members; the price quoted in exchange was less than the price of the physical market; trading members anticipate discount on trading charges on the floor of exchange; there was a need to open some more branches to increase easy accessibility; trading in exchange lack in liquidity; dominance of the few players is one of the important problems for ordinary members for being inactive; contract structure is one of the minor problems; and futures is not useful to small growers who expect immediate reward.

The study suggests that the members should be educated on the concept of futures trading. There is necessity to increase the number of trading centers, minimizing the distance for the growers to deposit the stocks in their warehouses, and the procedures have to be simplified. This will certainly enhance the trading acceptances of the members, it is concluded.\textsuperscript{81}

2.8.9 Modeling of the Coffee Futures Market using Neural Network

Coffee trading is unique in many ways. The prices have been subject to manipulation by suppliers, buyers and speculators. The prices are also determined by the region of production as the quality of Coffee depends on it. The volatility in Coffee prices results in a lot of risk for the Coffee traders. The future market provides a hedging mechanism to the Coffee traders all over the world. The COFEI has commenced trading in middle 1998 to provide hedging facilities to exporters who handle about 70 percent of Indian Coffee production.

The main objective of this study was to identify the factors affecting Coffee futures prices in India, and build a Neural network model that will capture the effects of the identified variables. The tool chosen Neural networks is a better technique over the other techniques, as this technique can capture non linearity and are relatively easier to use, and also be trained to identify the relations by feeding them historical data. The general steps followed in developing a Neural network model are as follows: problem identification, choosing an appropriate Neural network model, preparing data for training the network, training the network model, testing and generalization ability of the model by using it on some test data, and optimization of the architecture. The volume is very low. If COFEI gets de-linked from the CSCE, it may not be possible to use the same method to predict prices\textsuperscript{82}

2.8.10 German Coffee Market with a Focus on the Current Market Position of Indian Coffee.

“Germany is the second largest market for India’s Coffee during 1990s, also the largest Coffee market in Europe and second largest Coffee consuming country in the world next to USA. But in recent year’s exports Shivaji University, Kolhapur.
of India’s Robusta to Germany is decreasing. It is primarily caused by aggressive marketing out of Vietnam. This study has focused on main themes such as ‘the German Coffee market and the current, position of India’s Coffee in Germany’ which, brought the pros of India’s Coffee in German market such as traditional Coffee country, generally reliable qualities, different varieties of Coffees, good preparation of qualities, top quality Robusta, several varieties of specialty Coffees, shipment in bulk and good statistical material through Indian Coffee Board. The identified cons of India’s Coffee in German market such as Arabica Coffee only available about 6 months, loosing characteristics by longer storage, too high volatility in price, seen as a Brazil substitute in Arabica sector, sometimes only taken if cheap compared to other origins (opportunity Coffees) and some black sheep unreliable exporters.

The author comments with some suggestions that could help India to overcome the current difficult market conditions particularly stiff competition from Vietnam and Brazil. The suggestions are, India should continue to improve quality and guarantee consistent reliability of each delivery, overall export performance should be maintained, the quest for niche and specialty products, and the potential future needs for serving the consumer markets and particularly Germany and Europe -examine food safety criteria, the question of traceability, and the subject of OTA / Ochratoxin

2.8.11 Coffee in Russia - from Peter, the Great, to Present Days

“... Russia which is becoming one of the major markets for Coffee in the world is also the key market for Indian Coffee, not only in terms of quantity but also in its unit value realization. India captured a strong market share where bulk of our quantity is sold in this market alone. However, at present the battle for share would be tougher for India as other Coffee producing countries are competing and as the Russian market is entering a stage of ‘advanced emerging market but not just due to collapse of the Soviet Union and Russia’s financial crisis in 1998.

This paper made a comprehensive presentation on the Russian marker for Coffee. In the recent past- during the Soviet times, Coffee habit was characteristic of Soviet ‘intelligentsia’ or the middle and upper class urban population. The green and roasted Coffee bean were coming primarily from India, there were powder soluble Coffee undergeneric brand ‘soluble Coffee’. In 1980’s Brazilian powdered Coffee entered USSR with the Moscow Olympic and became the next benchmark for Coffee standard. And collapse of the Soviet Union and market economies opened the room for new entrants. In the early 1990s the big multinationals, first Nestle and KJS set foot in the market introducing the first granulated Coffee. These days (at the present) Russia is the most prominent market for Coffee, where instant Coffee hold 90 percent market share and R & G holds 8 percent market share. The magnitude of Russian market reveals 146 million populations and its generally positive

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economic outlook. This century represents the highest long-term potential to become the number 1 Coffee market in the world! Although Russia is a traditional tea-drinking market with Tea/Coffee ratio in cups still 5:1 but there is a great potential for Coffee. The peculiarities of Russian Coffee market are slow in reacting to the world Coffee prices as it is simply an importer market, experiencing an outstanding boom of the local repackaging industry, a great degree of Coffee smuggling across the border due to high import duties, it is yet to be adopted and upgraded to the internationally accepted standard for Coffee.

It is concluded that Russia is the market with great potential and key growth market world wide. Price would continue to be a factor in growing the market so Indian Coffee would need to be priced competitive. As Coffee is still perceived to be a luxury item, attracting grey market transactions, the industry would need to counter this threat jointly. The Russian consumer is getting more evolved and choosy and this opens up the market in terms of Coffee quality and variety.

2.8.12 Understanding the Specialty Coffee Market in Europe

"... You are not dealing with the people that see price as the only criterion they base their buying on. They will be asking you what your Coffee taste like, what the story behind it is, and what exactly it is that make your Coffee so special and different from others. In short quality and personality. Although there is no uniform Coffee in Europe, there is a vast social and economical difference: extremely affluent north, an affluent central, a war stricken south, and recovering from decades of failed economical politics in east, for instance, Russia use to buy a soluble Indian Coffee that few others would touch, but it does not mean that the entire Russian market is like that. Europe has vast differences in the understanding of quality, as reorganization of specialty Coffee in one country may not be so in the next, for instance, Nordic region is a 100 percent Arabica market. And also it has a vast differences in Coffee drinking habits, for instance, soluble Coffee will take some 85 percent to 90 percent of the UK market but in the Nordic market it is less than 5 percent, Italy is a 99 percent espresso market but in Central Europe it is from 5 percent to 35 percent, and in Nordic market drip filter Coffee amounts for 90 percent almost always drunk without cream/sugar but in southern Europe this is almost none existent. This article also has focused on contradictory trend in Europe, what importers are looking for and the answer is quality, traceability and credibility. And how do you find these buyers. One can find them by asking, by testing their Coffees, by talking to them at Coffee bars, at conventions, at your booth when you exhibit.

It is concluded that the author seen no reason for Indian Coffee not to success in Europe as India has some fine Coffees, the advantage of the language, the advantage of technology, the advantage of understanding market and the advantage of being closer to Europe than to the US. But India also has the disadvantage of not using marketing skills and not
2.8.13 Diversity in the Cup: Indian Coffees and the North American Specialty Market

“The American specialty Coffee movement started in the 1960s as a reaction against mass-marketed blends of cheap Coffee sold in supermarket. In 1998, 23 percent of retail unbrewed Coffee sold in the US was specialty and 38 percent of brewed Coffee sold by the cup was specialty which is over all more than mass-marketed commercial Coffee. Typically specialty Coffee consumers are sophisticated and well-off financially, someone who chooses products more on the basis of prestige and pleasure than on the basis of price and someone who defines his identity by his choices as consumer. Thus, typically these consumers are looking for high quality, unique in cup, unique in its story, and story reflect positive environmental/social values based Coffees ...

The received wisdom was that on what factors does the specialty green Coffee buyer base his decision which comprises quality, distinction, story, price, consistency, purpose for which the Coffee is purchased, featured single origin Coffee, cause Coffee, regularly offered single origin, premium blended constituents, price blend constituents etc.

The final focus of the study is on how the purpose for which the Coffee is purchased influences the relative importance the buyer places on the aforementioned five factors such as quality, consistency, distinctiveness, story, and price. And how do various categories of Indian Coffees fit into this picture.”

2.8.14 The ‘Latte Revolution’? Winners and Losers in the Restructuring of the Global Coffee Marketing Chain

“... For a variety of reasons, the analysis of the Coffee marketing chain is important. The reasons may be Coffee production (more than 90 percent) and consumption takes place in south and north respectively - the rationale to be an insight on north-south economic relation; Coffee has been the second most traded commodity; it was one of the first regulated commodities; a number of developing countries relay on Coffee for a high portion of their export earnings; and Coffee producing countries Governments have historically treated Coffee as a strategic commodity.

The main methodological instruments used in this paper are drawn from the literature on Global Commodity Chain (GCC) analysis, which analyze the transformation of the structure and the organization of the global Coffee marketing chain. The first section in this paper aims at mapping the general development of the chain from the producer to the retail levels and focus on selected global issues. The next two sections lay out a brief history of Coffee and the fundamental characteristics of Coffee production and trade. In the section four, the role of international regulation of the Coffee market is analyzed. The section five and six deal with the restructuring that has taken place in the organization of the Shivaji University, Kolhapur.
global Coffee market in the last decade and the resulting changes in power relations within the chain. The section seven exploded how Coffee consumption is evolving in the north, section eight with some strategic option that may facilitate Coffee farmers and the governments in regaining a larger share, and the final section assesses the contribution offered by the Coffee case study to wider debates that are taking place in the GCC literature. The paper also suggests some policy directions to address the emerging imbalances.”

2.8.15 Coffee Export Strategy for 9th Five Year Plan

“The liberalization-globalization policy of Government has led to an overall exports vision of 20 percent growth in exports. However, in several sectors of economy where India enjoys natural strategic advantage, this growth is expected to be much higher. Coffee is one among such sectors with the given strengths such as old tradition of Coffee growing-FAQ; evenly balanced Arabica-Robusta production; reputation for quality adherence; good base for soluble Coffee industry; and high export base.

Taking into consideration all the developments and its vision on the topic, such as Indian Coffee in the world market; vision of Indian Coffee exports is converting Coffee exports vision into action; loss and gain of Indian exports in major markets; commodity-country matrix-an ABC analysis; and export strategy matrix, the article has drawn an operational plan for export target achievement. The action areas for converting Coffee export vision into action, and necessary institutional support for achieving the same, along with the export strategy for Indian Coffee in ninth plan depicted comprehensively.”

2.8.16 Export Competitiveness and Demands for Quality Attributes of Indian Coffee.

“... Indian Coffee is typically mild and not too acidic, and possesses a full bodied taste and a fine aroma. When it comes to comparing quality of Indian Coffee, Indian Robusta was best in the world and Arabica was next only to Colombia and Kenya. In spite of all these positive attributes Indian Coffee still had not received the desired recognition from international buyers. However, there is necessary to see that stringent quality standards are maintained by the Indian Coffee industry so that Indian Coffee will be reputed in the world market, as in the future when the supply exceeds demand, and then only the quality Coffee will sell. Ensure that the quality of Coffee maintained is all the more important because of our domestic industry only consumer one-third (not it is just about one -fourth) of our production and a major share is exported.

Keeping in view these imperatives the present study was designed mainly to exporter’s quality preference in Coffee, decomposition of export growth and growth rate of world’s and India’s production and exports have been analyzed. The ‘hedonic model’ was used to determine

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the implicit price of the quality characteristics in Coffee and ‘conjoint analysis* was used to document the quality preference of exporters of Coffee. The ‘growth rates’ were estimated using the exponential growth model. ‘Constant market share model’ was used to decompose the export growth of Coffee. The analysis was carried out based on the data obtained from two successive auctions conducted by the Coffee Board in August 1997, and other primary data along with data from secondary sources. And the study period was from 1984 to 1996.

The hedonic regression coefficient revealed that blacks, types of Coffee (i.e. cherry or parchment), defects & place (Chikmagalure) factors in Arabica Coffee were the strongest determinants of price. And in case of Robusta Coffee, it was size of the bean, berry borer content, blacks, type of Coffee; defects and place of origin (Coorg) had a significant effect on the prices. However color, size and bleaching of the bean had a smaller influence on prices of Arabica Coffee with parchment commanding better price than Robusta. The revealed results in the pricing behavior of both Arabica & Robusta were that the prices better represented the quality characteristics in Arabica than Robusta Coffee. The exporters’ preference of Coffee for exports shows that a Arabica Coffee origin had the highest relative importance followed by color, appearance, price and defects respectively, and in Robusta Coffee color followed by origins. Prices were ranked last in case of Robusta and second last in Arabica, indicating that the exporters were willing to pay a premium for better quality Coffee having a good color and desired origin. Decomposition of the export growth of Coffee showed that in the first period (1984-87) the competitiveness was low for India, and in the subsequent period it was seen an improvement. With the stagnation in the world imports when the supply condition increases, India will have to improve its competitiveness in the world market.”

2.8.17 WTO on Agriculture: Probable Implications for Coffee industry

“... The Agreement on Agriculture (AOA) centers around three issues relating to market access (tariffication), domestic support and export competition. There are several other issues like Intellectual Property Rights (IPRs), Sanitary and Phyto-sanitary Measures (SPS), Food Security and Genetically Modified Organisms (GMOs) that have powerful implications for India’s agriculture. Coffee is classified under agriculture and comes under the purview of AOA. Therefore, implications of WTO in agriculture may have to necessarily encompass the interests of Coffee industry also.

In the background of the likely implications of WTO on Coffee, the workshop of Coffee Board focused on three important issues namely 1. market and trade related issues applicable to Coffee, 2. sanitary and Phyto-sanitary measures applicable to Coffee and 3. intellectual property rights with special reference to plant variety protection on Coffee. The market access is the major market and trade related issue. Owing to

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potential consumption base for Coffee. In India there is a danger for lower and highly discounted Coffee being imported in larger quantities. Therefore, to safeguard the domestic industry, India has rightly preferred the tariff route which is the bound rate for green Coffee 100 percent and for soluble Coffee 150 percent. Although, WTO calls for member countries to limit supports that distorts the trade, a number of policy instruments as support prices, unit subsides, monopoly procurement operations and restrictions on imports and exports to control domestic prices and cost of production, are used by countries as a domestic support, as, at the same time WTO provides exemption to such of the domestic support policies that do not distort the trade at minimal levels. Further, these Aggregate Measures of Support (AMS) policies are classified in three major groups-boxes such as AMBER BOX policies comprising subsidy and other supportive measures; BLUE BOX policies which are temporary and subject to future reforms; GREEN BOX policies which are not subject to reduction commitments which include research and extension support, disaster payments, structural adjustment programs etc. Overall, it could be surprised that Coffee sector in India is yet to derive adequate benefits from the domestic support policies. Some of the recommendations on sanitary and phyto-sanitary measures were improved infrastructure, build technical competence, develop data base to fix tolerance level for contaminants in Coffee, Good Agricultural Practices (GAP) and Good Manufacturing Practices (GMP) to meet the requirements of importing countries.

The workshop calls for WTO and related studies to cope with the emerging challenges such as to quantify how far the reduced tariffs has helped in accessing a developed- consuming markets; and to access our major competitors cost structure of production and the level of support extended to Coffee industry. And also calls for a separate WTO cell created in Coffee Board for further deliberations on WTO issues with specific reference to Coffee industry, which should be constituted two groups-one group specifically to deal with market, trade related issues, domestic support and the other group to specifically deal with the intellectual property rights, SPS measures and genetically modified Coffee...”

2.8.18 Opportunity for Coffee in India

“The emerging markets for Coffee in India are varied with strong regional basis and also with the varied attitude and consumption habit and practices as south India is traditionally stronger one while rest of India is virgin Coffee market. The article is based on the findings of market research in urban India. Firstly, this study made an attempt to explore and put in summarized form the consumption habit and practices, and attitude towards Coffee with the Indian Coffee consumers in the traditional as well as virgin market. The attitudes to Coffee, and the consumption habits and practices in the traditional and virgin market are pointed out precisely. With this given background the study all brought a

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precise profile of opportunity in the market.

Finally, the study explores the imperatives for energizing Coffee consumption in India by focusing on consolidating traditional markets. Need of the day in that line are improving the availability of prepared Coffee through quality assured Coffee chains; infusing excitement in the category (counter the tea threat); improving the distribution of Coffee; and giving a brighter and more frontage to Coffee retail points. And by focusing on market development in non-traditional markets through leveraging out-of-home occasion to increase penetration, and using experience as a driver to educate customers about the ways of preparing good Coffee. The other- detailed focus on non-traditional markets are: the retail space, consumer education, product form, and reasons to focus on the youth...”91


“Cafe culture is emerged as a much needed drive in the Coffee industry as it serves the core purpose of demand promotion, which is also attractive enough to the innovative entrepreneurs. As the Coffee shop (also called cafe culture) operation evolved in a phenomenal growth pace, it is strategic to adopt the most suitable management practices along with an experiment of new concepts for their future success.

The paper threw light on the importance of new management concept in the smooth operation of Coffee shop, by taking Coffee shop as a business model, which is the improved way of running the business.

The very definition of adoption and implementation of sound business practices have changed and they are no longer what they used to be some decades ago, to gain an edge over the rivals in the business. Perhaps, some new ideas also depend on the type of business and organizational structure as one’s success idea may not prove to be successful to others. In this age of cut-throat competition, the organizations are required to stay one step ahead of their rivals by improving their services with the customer oriented approach and offering better quality products than the others...”92

2.8.20 Retailing in India: The Emerging Revolution

Retailing is one of India’s least evolved industries. In fact, it was not even considered a real industry. The industry suffers from lack of management talent, poor access to capital, unfavorable regulation and denial of access to best practices. There was a lack of clarity on what the industry does, how big it could be, and what a concerted programme for change would look like. However, it is country’s largest source of employment after agriculture, has the deepest penetration into rural India, and generates more than ten percent of India’s GDP. Therefore for the past few years, there have been a number of attempts to build retail businesses. Entrants have included Indian business houses, foreign retailers through joint ventures, new entrepreneurs and government

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The booklet has made an attempt to get a sense of what these would look like if India were to reach the productivity levels of China and Thailand, both of whom have successfully made the journey in the last ten years, and wanted to provide a robust base on the key categories, in terms of their size, growth, retail structure and key players; insights into the emerging trends; and to provide a perspective on what this industry could become, using the global industry as a backdrop.

To achieve the said purpose, the study has brought all the emerging trends-global in general and Indian market place in particular in the industry. And the finding of the study is as follows. Indian retail is on the cusp of a transformation. The combination of increased consumer demand, improved sourcing options and increasing availability of real estate are creating the foundation for significant growth in the organized retail sector. The grocery will be the largest of these opportunities, and organized sector could be as large as $18 billion by 2010, split across a variety of formats. To capture this opportunity, a company would need to develop significant sourcing scale, build world-class customers management capabilities and make significant investments to extract value from the unprocessed agri-products chains. There is also an appeal that the value that retail can add to the economy should not be underestimated, as this drives the transformation of the agricultural supply chain, remove the inefficiencies in the distribution of consumer goods, and improve overall labour productivity and employment all in the name of providing consumer with a better range of products at better prices in a better ambience. Hence, the real challenge lies in implementing the change agenda to capture these benefits. For this purpose changing the real estate laws, restructuring the tax regime, allowing FDI into retail, accessing and developing new skill and investing significantly in infrastructure will be worth carrying with a concerted industry-wide effort and a partnership with the government...

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