CHAPTER – VI
SUMMARY, FINDINGS AND POLICY SUGGESTIONS

6.1 INTRODUCTION

Though the share of agriculture in national income has been declining in the process of development in India, still it provides livelihood to 58% of population directly or indirectly. Agriculture and allied sectors have contributed 13.9% (at constant prices 2004-05) to GDP during 2013-14. Agriculture sector was given first priority during the first five year plan and larger public investments are made to improve the irrigation facilities with the objective of enhancing the productivity. However, until 2000 there was no agricultural policy at the national level. The first National Agricultural Policy (NAP) was announced during 2000 in order to provide direction to agricultural sector. Policies are important for the development of a sector as they reflect the agenda of the government. Policies also give direction to the sector by influencing the stake holders. Agricultural policy influences various stakeholders in the sector through the prices of agricultural inputs and output. Soil is one of the important natural resources, it is an important input for agriculture. Imbalance in the usage of chemical fertilizer leads to decline in soil fertility, this has direct impact on agricultural production and also in the development of agriculture sector.

Review of literature relating to agriculture policy is classified into three groups.

1. The studies related to Agriculture, Agricultural Policy and Cropping Pattern
2. The studies on Fertilizer Policy and Fertilizer Consumption.
3. The studies about Soil Fertility Management Practices.

From the review it could be observed that majority of the studies have attempted to understand the agriculture policy at the macro level. Those studies have mainly focused on price analysis, impact of subsidies on resource use, marketing aspects etc. Some attempts have been made to link agricultural policy and Soil Fertility Management Practices (SFMP) in other countries. However very few such attempts have made in the Indian context. The present study tries to fill this gap by analyzing the impact of Indian agricultural policy on Soil Fertility Management Practices (SFMP) at both macro level as well as at micro level.
The main objective of this study is to analyze the impact of agricultural policy on soil fertility management practices in India. The supporting objectives are

- To review the Agricultural policy in India.
- To analyze the relationship between fertilizer prices, fertilizer consumption and agricultural production at the macro level.
- To analyze the impact of Agricultural policy on Soil Fertility Management Practices (SFMP) in Mandya and Ramanagara Districts.
- To identify the factor influencing the Soil Fertility Management Practices (SFMP) in Mandya and Ramanagara Districts.

The study is based on both primary and secondary data. Macro level analysis is based on the secondary data collected from various sources for the period from 1966 to 2014. Micro level analysis is based on survey conducted in two sample districts viz., Mandya and Ramanagara.

Descriptive statistics like mean, Standard Deviation (SD), Coefficient of Variation (CV), Compound Annual Growth (CAG) rate were used to analyze the secondary data. Causality and Co integration were estimated to identify the long run relationship between fertilizer consumption and food grain production. Correlation technique was used to understand the relationship between fertilizer consumption and price. Ordinary Least Square (OLS) regression models were estimated to identify the factors influencing the soil fertility management at the micro level.

**The following null and alternative hypotheses were formulated and tested**

**Hypothesis 1**
H₀ = Fertilizer consumption is not inversely related to fertilizer prices.

H₁ = Fertilizer consumption is inversely related to fertilizer prices.

**Hypothesis-2**
H₀ = Education level of the growers has not influence on the Soil Fertility Management Practices (SFMP).

H₁ = Education level of the growers has an influence on the Soil Fertility Management Practices (SFMP).
Hypothesis-3

$H_0 = \text{Soil fertility management practices are not influenced by the size of land.}$

$H_1 = \text{Soil fertility management practices are influenced by the size of land.}$

Regression Model

The following regression model to explain the factors influencing the soil fertility management practices is specified.

$$\text{Ratio of fertilizers} = \alpha + \beta_1 \text{Ed}_i + \beta_2 \text{Sl}_i + \beta_3 \text{Fc}_i + \beta_4 \text{Fy}_i + \beta_5 \text{Pe}_i + u_i$$

Ratio of fertilizers = Actual ratio of Chemical fertilizer and FYM used by the sample farmers

$\text{Ed}_i =$ Education level of the farmers

$\text{Sl}_i =$ Size of the Land

$\text{Fc}_i =$ Fertilizer Cost

$\text{Fy}_i =$ FYM Cost

$\text{Pe}_i =$ Perception about efficient fertilizer to maintain soil fertility

$u_i =$ error term

$\alpha =$ constant

$\beta_1, \beta_2, \beta_3, \beta_4$ and $\beta_5 =$ to be estimated coefficients

Chapterization

The thesis has been organized into the following six chapters

The first chapter presents introduction, objectives, hypotheses and methodology.

The second chapter is devoted to the review of literature including both theoretical as well as empirical literature.

The third chapter reviews the agricultural policy in India and Karnataka.

The fourth chapter analyses the linkages between fertilizer prices, fertilizer consumption and food production at the macro level.
The fifth chapter is based on the primary data. Socio economic back ground of the sample farmers, the crops grown, SFM practices adopted, perceptions of the farmers, factors influencing the soil fertility management practices and the impact of agricultural policy on soil fertility management practices at the farm level are presented in this chapter.

Summary of findings and policy suggestions are presented in the sixth chapter.

6.2 SUMMARY OF THE FINDINGS

Important findings that emerged out of the secondary data analysis and from primary data analysis are presented below.

6.2.1 Findings Based on Secondary Data Analysis

- The data revealed changes in the land use pattern in India. According to the available statistics the reporting area increased from 284 million hectares in 1950-51 to 305 million hectares in 2010-11. The percentage of area under forests has shown an increase over a period of five decades. Due to various measures to protect the forests, the share of forests in the available area has increased from 14.24 percent in 1950 – 51 to 22.89 percent by 2010 – 11. However the disturbing trend is that the share of area under non-agricultural use has been increasing over the same period. While it was only 3.29 percent in 1950-51, it increased to 8.63 percent by 2010-11. Similarly the area under the category of land under miscellaneous tree crops & groves not included in net area sown also decreased from 6.97 percent to 1.05 percent.

- The analysis of area under food and non food crops revealed that there is a shift in the area in favour of non food crops from food crops. While the average area under food crops between 1987-88 and 1999-2000 was 139.24 million hectares, it increased marginally to 141.01 million hectares between 2000-2001 and 2012-13. But the area under non food crops increased from 46.45 million hectares to 50.60 million hectares during the same period. The area under food crops has registered an increase of only 1.77 million hectares, where as the area under non food crops has registered an increase of 4.15 million hectares. The share of area under non food crops increased from 24.98% to 26.39%.
It is observed that as per the estimates of Indian Council of Agricultural Research (ICAR, 2010), out of total geographical area of 328.73 million hectares, about 120.40 million hectares is affected by various kinds of land degradation resulting in annual soil loss of about 5.3 billion tonnes through erosion. This includes water and wind erosion (94.87 M ha), water logging (0.91 M ha), soil alkalinity (3.71 M ha), soil acidity (17.3 M ha), soil salinity and mining and industrial waste (0.26 M ha).

Statistics on soil degradation across the states revealed that soil degradation is not uniform across the country. Some of the states have more degraded land compared to others. As reported by Bhattacharya (2015), Madhya Pradesh and Chhattisgarh have more degraded land. The data showed that out of the total geographical area of 328.7 Mha, 146.8 Mha was degraded area by various sources. Madhya Pradesh and Chhattisgarh states has highest degraded area (26.2 Mha), Uttar Pradesh and Uttarakhand states were in the second place in degraded area and its share was 15.3 Mha, Andhra Pradesh and Telengana were in the third place in degraded area (15.0 Mha), Karnataka state has 7.6 Mha of degraded area. In the absence of total cultivated area in different states the share of degraded land in the total area in respective states is not known.

Regarding the soil fertility status in terms of nutrients in India it is observed that the availability of nitrogen in the soil is low. As per the estimates the availability of nitrogen content was 280 kg/ha. The phosphorus content in the soil was in the medium level (25-50 Kg/ha) but the availability of potash content in the soil was high (more than 28 kg/ha). This data clearly shows that the imbalance in the availability of major nutrients. In the Karnataka state the availability of nitrogen and phosphorus content was in medium level but potash content was in high level.

The data observed that Karnataka agriculture is dominated by marginal and small farmers. According to 2010-11 agriculture census small and marginal holdings account for 76.44% of total holdings and the operated area under this category is only 40.05% of the total operated area. While semi-medium, medium and large holdings account for 23.57% of the total holdings and the operational area under this category is 59.95% out of the total operational area.
Analysis of trends in land distribution in Karnataka revealed that between 1995-96 and 2010-11 the share of marginal farmers in the total number of holdings has increased from 41.95% to 49.14%. Similarly their share in the area also increased from 10.30% to 15.22%. Accordingly the share of large farmers with more than 10 ha has decreased from 1.70 percent to 0.86%. The share of large farmers in the area declined from 13.15% to 8.17% during the same period. The share of small farmers in area increased from 20.48% to 24.83% and the share of medium farmers declined from 28.82% to 23.87%.

Land use pattern in Karnataka showed that area under forests has increased over a period of time. While it was 27.09 lakh hectares in 1960-61, it has increased to 30.72 lakh hectares in 2011-12, an increase of 3.63 lakh hectares. Land put to non agricultural uses has increased from 8.12 lakh hectares in 1960-61 to 14.33 lakh hectares in 2011-12. Barren and uncultivable land, miscellaneous, tree crops and groves have decreased. Total cropped area has increased to 120.29 lakh hectares in 2011-12 from 105.88 lakh hectares in 1960-61. Cropping intensity has also increased from 103.52% to 121.30%. Net area sown has decreased marginally to 99.41 lakh hectares from 102.28 lakh hectares in 1960-61.

Regarding the area under food grains and non food grains in Karnataka it is observed that the area under food grains declined from 78.80 lakh hectares in 1960-61 to 70.37 lakh hectares in 1990-91. But from the 2000-01 onwards the area under food grains increased and during 2010-11 the estimated area under food grains was 82.36 lakh hectares. During the five decades from 1960-61 to 2010-11, area under food grains increased at a compound annual growth rate of 0.98%. The area under oil seeds grew at an annual growth rate of 5.39% during the same period. Area under oil seeds was peak at 25.51 lakh hectares in 1990-91 period. Area under cotton has shown a negative growth rate. But the area under sugarcane and tobacco have shown a considerable increase during the five decades. The area under sugarcane increased from 0.72 lakh hectares in 1960-61 to 4.23 lakh hectares in 2010-11 an annual growth rate of 42.47%. Similarly area under tobacco also increased at an annual growth rate of 26.19% during the same period.
The data showed that Karnataka soils are severely deficient in zink. As per the estimates there is more than 50% (52.24%) zink deficiency in the soils of Karnataka. Higher deficiency of zink is observed in Mandya (99.16%), Tumkur (76.71%), Shimoga (63.20%), Davanagere (78.71%), Chickmangaluru (67.76%) and Dakshina Kannada (62.16%). The next important nutrient which is found deficient is Nitrogen which is deficient by 41.17%. Among the districts Kolar (83.42%), Tumkur (94.41%), Bijapur (64.67%), Mysore+Chamarajanagara (62.38%) and Shimoga (57.66%) are the highly deficient districts. Deficiency of Potash is observed in Bagalkot (83.51%), Gadag+Haveri (64.10%), Dharawad (56.28%) and Bijapur (70.30%).

The Government of India has introduced NPMSHF to improve the soil status. The data showed that 35 laboratories were set up in 2010-11 and 17 in 2013-14. The project also proposed to strengthen the fertilizer quality control laboratories. The project gave greater importance to demonstrations and 274 demonstrations were conducted in 2010-11 and 472 in 2013-14. The project aimed at promotion of Integrated Nutrient Management (INM). During 2011-12, 82000 ha were brought under INM. An amount Rs 16.89 crores was spent in 2010-11 and during 2013-14 an amount of Rs 19.15 crores was spent. Exclusively for oilseeds, pulses, oil palm and Maize (ISOPOM) an amount of Rs 55.8 crores was spent in 2010-11 and 27.00 crores during 2013-14.

Regarding the allocations to Southern states under NPMSHF during 2015-16 the data showed that among Southern states, Karnataka was sanctioned highest amount of Rs 7.53 crores. The next is Andhra Pradesh with an amount of Rs 4.61 crores. Largest number of soil testing laboratories were proposed in Karnataka and Tamil Nadu. While 15 mobile soil testing laboratories were proposed in Karnataka, 12 were planned in Tamil Nadu and 7 in Andhra Pradesh. 29 static laboratories were proposed in Karnataka and 24 in Tamil Nadu.

Estimates of crop wise consumption of fertilizers has revealed that horticulture crops like fruits and vegetables and plantation crops like tea and coffee are the largest consumers of fertilizers in India. Per hectare consumption of fertilizers
is highest in the production of tea at 324.5 kg per hectare. Vegetables production consumed 312.8 kg and fruits production has consumed 310.2 kg per hectare. On the other hand, 281.2 Kg per hectare is used in the production of coffee and 239.3 kg per hectare in the production of sugarcane. These five crops have accounted for more than 50% of the total fertilizer consumption. While the share of tea in the total consumption was 14%, the share of coffee is 12%. Sugarcane accounted for 10%. Total fruits and vegetables accounted for 14% each. The usage of chemical fertilizer per hectare is low in the production of food grains (182.8 Kg per hectare) and cotton (192.6 kg per hectare) compared to other crops. Rubber production has consumed the lowest fertilizer of 100.9 kg per hectare.

- The data showed that over a period of fifteen years per hectare consumption of fertilizer has increased considerably. While an amount of 95 kg/ha was used in 1999-2000, it increased to 144 kg/ha by 2010-11. This trend clearly shows that the higher yield in agricultural production is attained at the cost of increased usage of chemical fertilizers.

- Regarding the usage of organic fertilizers, there are vast differences across the states. At the all India level Assam, Chhattisgargh, Gujarat, Jharkhand, Andhra Pradesh, Odisha, West Bengal and UttarKhand are the main users of organic fertilizers during 2013-14. Among the southern states and union territories, highest organic fertilizer consumption is reported by Andhra Pradesh. A quantity of 7203 thousand MT of organic fertilizer consumption was reported in Andhra Pradesh during 2013-14. On the other hand least consumption of organic fertilizers is reported in Kerala. But without looking at the actual area under cultivation the intensity of the usage in not clear. While Tamil Nadu reported the usage of 1439 thousand MT, Karnataka reported 1165 thousand MT of usage of organic fertilizers. The ratio of organic and chemical fertilizers in India is 1:22 in 2013-14. Puducherry has the highest ratio of 1:9 and Karnataka has lowest ratio of 1:0.36 among all states.

- The study observed that the amount on fertilizer subsidy increased from Rs 371 crores in 1974-75 to Rs 72,079 crores by 2014-15. There is a considerable increase in subsidy during the decade 1974-75 and 1984-85. Introduction of
Retention Price Cum Subsidy (RPS) during early 1970s has added to the increase in the subsidy from Rs 371 crores in 1974-75 to Rs 1927 during 1984-85. During this period the subsidy increased at an annual growth rate of 39%. During the later years, the decontrolling of the fertilizers has reduced the growth of subsidy. Though the total amount of subsidy increased from Rs 5769 crores in 1994-95 to Rs 15,779 crores in 2004-05, the growth rate between 1994-95 and 2004-05 was 22%. However, the burden of subsidy has grown at a rate of 35% between 2004-05 and 2014-15 due to the operation of Nutrient Based Subsidy (NBS) scheme.

- The analysis of fertilizer consumption revealed that there is a continuous increase in the consumption of NPK in India. It is also observed that average nitrogen consumption is higher in all the three decades (1984-85 to 1993-94, 1994-95 to 2003-04 and 2004-05 to 2013-14). The average nitrogen consumption increased from 70.48 lakh metric tonnes during the first decade (1984-85 to1993-94) to 107.36 lakh metric tonnes in the second decade (1994-95 to 2003-04) and to 151.72 lakh metric tonnes in the third decade of 2004-05 to 2013-14. However during this period CV also increased from 6.48% in the earlier decade to 13.39%, indicating greater variability in the consumption of nitrogen. Compound Annual Growth Rate (CAGR) in the third period (3.89%) is higher than the earlier period (1.76%). In the case of phosphorus, average consumption increased from 25.95 lakh metric tonnes to 62.04 lakh metric tonnes. But there is greater variability in the consumption of phosphorous also. The coefficient of variation was 19.07% which shows greater variability. On the other hand there is a decrease in the CAGR in the third decade. While it was 3.97% in the first decade, it was 3.89% in the second and 1.86% in the third decade. Average potash consumption is less compared to nitrogen and phosphorus. It increased from 10.09 lakh metric tonnes in 1984-85 to 1993-94 decade to 14.17 in 1994-95 and 2003-04 decade and 26.27 lakh metric tonnes in the decade of 2004-05 to 2013-14. Though CV declined in the second decade it again increased to 24.76% in 2004-05 to 2013-14 decade indicating greater inter year variation. Among the three, potash has shown greater inter year variability in consumption. During the last decade potash has registered negative growth rate. The overall fertilizer
consumption increased from 106.52 lakh metric tonnes to 240.03 lakh metric tonnes during the three decades and inter year variability also declined. Compound Annual Growth Rate declined in the second decade considerably (2.42%) but increased to 2.96% in the decade from 2004-05 to 2013-14.

- The analysis of government intervention and prices of fertilizers revealed that between 1973-74 and 1981-82, prices of urea increased continuously and started declining from 1982-83, though increased marginally from 1985-86 onwards. After that there is a continues increase. Same trend is observed in the case of DAP. Though MOP prices remained low in all periods, after 2009-10, the prices of MOP are higher than urea, but still lower than DAP. Due to the Retention Cum Subsidy Scheme (RPS) introduced in 1977 for all nitrogenous fertilizers, the prices of urea and DAP remained equal and MOP is lower. The Government of India de-controlled the prices of potash and phosphorous in 1992 on order to reduce the burden of subsidy. Therefore the prices of phosphorus and potash increased. The increased prices continued till 2010 when Government of India introduced Nutrient Based Subsidy (NBS) scheme. This is applicable to decontrolled phosphorus and potash fertilizers. After 2010, the prices of phosphorus and potash fertilizers increased considerably.

- The correlation analysis between prices and usage of chemical fertilizers showed that there is a significant relationship between the prices of urea and DAP and the consumption of these two respectively. However, the correlation between the prices of MOP and its consumption is weak indicating that the usage of MOP is not influenced by the prices of MOP. While farmers are sensitive to the prices of urea and DAP, they are not sensitive to the prices of MOP. The usage of Potash is not changing with the change in the prices of Muriate of Potash (MOP).

- Analysis of the usage of NPK ratio showed that there is an excess usage of Nitrogen and Phosphorus during all the years between 1986-87 to 2003-04, though it has reduced after 2004-05. The subsidy provided on Urea and DAP has led to excess use of these two. During the year 1996-97, the NPK ratio was 10:2.9:1 which shows a gross over use of nitrogen and phosphorus.
Regarding the growth in food grain production vis-à-vis fertilizer consumption, it is observed that the growth rate has reduced after 2000. While fertilizer consumption has grown at an annual growth rate of 5.83% between 1986-87 and 1999-2000, it has grown at an annual growth rate of 2.79% between 2000-2001 and 2013-14. Food grain production also registered a marginal reduction in growth rate from 2.95% to 2.34% during the same period. But the growth rate of food grains production is always lower than the growth rate of fertilizer consumption. Between 1986-87 and 1999-2000 when fertilizer consumption recorded a growth rate of 5.83%, food grains production increased by 2.95%. Similarly, between 2000-2001 and 2013-14 when fertilizer consumption increased by 2.79%, food grain production increased by 2.34% annual growth rate.

Co-integration analysis carried out to understand the long run relationship between fertilizer consumption and food grains production in India during the years from 1986-87 to 2013-14 showed that the null hypothesis of no co-integrating vectors have been rejected against one co-integrating vector. Both the test results indicated the existence of at least one co-integrating vector in the model at 1% of significance. The one co-integration vector implies that the fertilizer consumption and food grain production are related in the long run.

The pair wise granger causality test has identified the causation of fertilizer consumption on food grains production at log 2. This shows that the fertilizer consumption has a significant influence on food grain production. On the other hand food grain production does not seem to influence fertilizer consumption.

The trends in fertilizer consumption in Karnataka has shown that the average nitrogen consumption during 1991-92 and 2013-14 was 7.05 lakh tonnes, and phosphorous was 3.87 lakh tonnes. The average consumption of potash was 2.44 lakh tonnes. The average consumption of nitrogen was higher than other fertilizers because the prices of nitrogen fertilizer were low compared to phosphorus and potash. However the compound annual growth rate of nitrogen for the entire period was higher (3.43%) compared to phosphorus (1.92%) and potash (1.83%). This shows that the usage of nitrogen is increasing considerably in Karnataka.
Variability in the consumption of fertilizers in Karnataka measured with the Coefficient of Variation indicated that the consumption of nitrogen fertilizer has a greater stability indicated by lower coefficient of variation compared to other fertilizers. While the coefficient of variation of nitrogen was 28.93%, it was 40.16% for phosphorus and 40.77% for potash.

The data showed that there is imbalance in the ratio of NPK used in Karnataka. But unlike at the all India level, the usage of nitrogen and phosphorous are lower than the recommended levels. Though it is observed that the usage of all the three has increased during the past two decades, they are not used in recommended proportions. Except in one or two years the usage of nitrogen is much lower than recommended proportion. Phosphorous is also under used in Karnataka.

6.2.2 Findings Based on Primary Data Analysis

Socio-economic background of the sample farmers revealed that majority of the farmers are from Other Backward Communities (OBC) group. Out of the total 344 farmers 268 (77.9%) farmers belong to OBC, 42 (12.2%) belong to Scheduled Caste and 34 (9.9%) belong to Scheduled Tribes. The share of OBC is more in Mandya and the share of Scheduled Tribes is less.

It is observed that out of total 344 sample farmers, majority of the farmers are in the age group of 40 to 50 years. While 92 (53.2%) farmers in Mandya districts are in this group, 98 (57.3%) farmers in Ramanagara are in this group. The share of above 50 years group is around 25% in both districts.

Education level of the sample farmers indicated that out of the total 344 sample farmers 71 (20.6%) are illiterate farmers and 23 (6.7%) have pursued primary education. Another 93 (27.0%) farmers completed High school. The sample comprises 10.7% graduates and 0.6% post graduates. The share of degree holders is more in Ramanagara compared to Mandya. There are two post graduate farmers in the sample.

The data related to the income levels of the farmers showed that out of total 344 farmers 172 (50.0%) farmers are earning between Rs. 50,000 to Rs.1 lakh per year. Another 128 (37.2%) farmers are earning Rs 1 to Rs 5 lakhs. The
share of those earning more than Rs. 5 lakhs per year is 4.4%. All the sixteen farmers in this category are from Ramanagara district.

- Majority of the respondents are marginal farmers. Out of the 344 sample farmers, 196 (57.0%) farmers are having below 1 hectare of land. The small farmers with 1 to 2 hectares of land are 26.7% of the sample. The sample comprises 42 (12.2%) medium farmers having four to ten hectares of land. Eleven farmers from Mandya and 31 from Ramanagara are Medium farmers. The large farmers who have more than ten hectares of land are 14 (4.1%) and out of this, eight are from Mandya and Six from Ramangara districts. The data clearly shows that majority of the cultivators are less than two hectares of land.

- It is observed that majority of the respondents (88.7%) are owner cultivators and 11.3% have leased in land. In Mandya district 152 (87.9%) farmers are owner cultivators and in Ramanagara 153 (89.5%) farmers are owner cultivators. The share of tenant cultivators is 12.1% in Mandy and 10.5% in Ramanagara.

- Source wise irrigation showed that bore well is the major source of irrigation in Ramanagara and canal is the major source in Mandya. Nearly 30% of the farmers in Ramanagara district do not have any assured source of irrigation. They are depending on rainwater for cultivation. The share of farmers without assured irrigation is 3% in Mandya district. Majority of the small and marginal farmers do not have assured irrigation. There is a positive relationship between the area and irrigation. Higher the land owned, greater is the dependence on assured irrigation.

- The data showed that paddy and ragi are the subsistence crops grown by majority of the farmers. Mulberry, coconut, mango and sugarcane are the commercial crops. Out of this, mango and coconut are the horticulture crops. The sample comprises 101 farmers growing paddy, which is 29% of the total farmers. Sugarcane is grown by 142 (41.28%) farmers. While 37% are growing ragi, 16.57% are growing coconut, 12.5% are growing mango and 20.64% are growing mulberry. Size group wise analysis showed that while 22.44% of the marginal farmers are growing paddy, 57.14% of the large
farmers and 42.39% of the small farmers are growing paddy. Sugarcane is grown by 42.85% of the large farmers and 52% of the small farmers. Ragi, which is a subsistence crop is grown by 26.52% of the marginal farmers, 53.25% of small farmers, 35.7% of medium farmers and 21.42% of the large farmers. Coconut, which is a horticultural crop is grown by 69.04% of the medium farmers, 35.71% of large farmers and 16.30% of the small farmers. Mango is another horticultural crop, is grown by 42.85% of the large farmers, 30.95% of the medium farmers and 16.30% of the small farmers. Mulberry, which is a commercial crop is grown by 26.53% of the marginal farmers, 14.28% of the large farmers, and 5.79% of the medium farmers.

- The study observed that the average per hectare fertilizer consumption of small farmers is higher than that of the large farmers. Similarly the cost also differed. While marginal farmer has spent Rs. 9600 per hectare on fertilizers, a large farmer spent Rs. 4875 per hectare. Same is the case with other crops. The difference is more between marginal and large farmers compared to the difference between marginal and medium farmers.

- The data showed that the marginal and small farmers are using more FYM per hectare compared to the large and medium farmers. The average expenditure on FYM per hectare is high among the marginal, small and medium farmers compared to the large farmers.

- The chemical fertilizer usage practices of the sample farmers showed that the farmers are using excess of chemical fertilizers than what is recommended for the soils of Mandya and Ramanagara districts. It is observed that large farmers are using less excess compared to the marginal, small and medium farmers and the excess is highest for sugarcane crop. The excess is highest among the small farmers in the case of paddy. While large farmers are using only 71% excess than what is recommended, small farmers are using 180.77% excess. Marginal and medium farmers are using 151% and 156% excess than recommended. In the case of sugarcane marginal and small farmers are using highest excess. While marginal farmers are using 212% excess than recommended, small farmers are using 198.68% excess. The large farmers are using 134% excess. In the case of mulberry the excess usage is highest among
the small farmers. It is 235.57% over the recommended doses. The marginal farmers are using 142.71% excess than recommended and large farmers are using 102% excess. But in the case of coconut, deficiency in the usage of chemical fertilizer is observed. Deficiency is more among the medium and large farmers. While the deficiency is 66% among large farmers, it is 48% among the marginal and 59% among the small farmers.

- It is important to use chemical fertilizer along with the FYM in certain proportions for the efficient utilization of both. The recommended proportion for paddy in the area of Mandya and Ramangara districts is 1:50 indicating that for every one kg of chemical fertilizers, 50 kg FYM is to be used. The data showed that in all the crops the farmers are using much lower than the recommended dose of FYM. It is interesting to observe that the deficiency is high among the large farmers compared to the marginal, small and medium farmers. For example in the case of paddy while marginal farmers are using 65% less than the recommended, large farmers are using 80% less. Same is the case with sugarcane. The deficiency ranges between 82% and 75%. Lesser deficiency is observed in the case of mango and mulberry. While in mulberry it ranges from 23% to 40%, in mango it ranges 33% to 70%.

- In order to understand the imbalance in the use of chemical fertilizers and the organic fertilizers, the ratio of FYM to Chemical fertilizers used by the sample farmers was calculated and compared with the recommended dose which is the optimum combination. The data showed that there is excess use of chemical fertilizers in all the crops. In the case of paddy while a ratio is of 1:50 indicating the usage of 50 Kg organic fertilizer for one Kg of chemical fertilizer is recommended, the actual usage is 1:8 in the case of marginal farmers and 1:6 in the case of large farmers. This indicates gross imbalance in the use of chemical and organic fertilizers. Same is the case with Sugarcane. While the recommended dose is 1:53, growers of all the size groups are using 1:4 which is much lesser than the recommended. In the case of mulberry the deviation is relatively less. While the recommended dose is 1:37, the actual usage ranges between 1:11 and 1:12. Less deviation from the optimum is
observed in the production of coconut also. While the optimum is 1:23, the actual usage is between 1:13 and 1:16.

- The data related to loan details of the different group of farmers showed that among 344 farmers, 155 (45.1%) farmers have availed loans, and the remaining 189 (54.9%) farmers have not availed credit facility. Highest number of marginal farmers (48%) have availed loan whereas only 35.7% of large farmers have availed loan. In Mandya district out of 173 farmers, 61 (35.3%) of farmers have availed loan and none of the large farmers have taken loan but in Ramanagara district out of 171 farmers, 94 (55%) farmers have availed loan and 5 (83.3%) large farmers have taken loan which is highest percentage among all other farmers group. The data clearly shows that majority of the marginal and small farmers have availed loan.

- The study observed that more number of marginal (96.80%) and small (97.22%) farmers have taken loans when compared to other groups. It is also observed that majority of the farmers (92.90%) have availed credit from cooperative societies. The reason behind this is that cooperative societies are providing credit at low rate of interest when compared to banks. Among 155 farmers only two have taken loans from banks and both of them are large farmers.

- The data revealed that majority of the farmers have used the loan for the purpose of purchasing fertilizers 88(56.77%) and to meet labour cost 39(25.16%). None of the large farmers in Mandya district have taken loan.

- It is observed that the average yield of marginal, small and medium farmers is higher than the yield attained by the large farmers. In case of paddy the average highest yield attained by medium farmers (9.06 Tonnes/ha) and small farmers (8.64 Tonnes/ha) is very close. But in sugarcane cultivation the yield of large farmers (125.97 Tonnes/ha) is higher than the average yield attained by the other three group of farmers. The average yield of marginal farmers is 121.73 Tonnes/ha and medium farmers is 119.37 Tonnes/ha. Small and medium farmers have recorded higher average yield of ragi (2.89 and 2.92 Tonnes/ha) compared to small farmers (2.64 Tonnes/ha). Ragi yields of large farmers is very low (1.78 Tonnes/ha). However, it can be observed that in the
case of ragi the yield difference among all the four types of farmers is marginal. Similar pattern is observed in mulberry also. The average yield of Mulberry is nearly 0.80 Tonnes/ha and there are marginal differences in the average yield recorded by different groups of farmers. But in the case of mango average yield differences are high. The average yield ranges between 20.59 Tonnes/ha by marginal farmers to 14.25 Tonnes/ha by the large farmers. In the case of coconut the average highest yield is attained by medium farmers (12955) and the lowest yield is attained by large farmers (9532).

Regarding the marketing of the crop it is observed that medium and large farmers are selling more than 90% of the crop produced and on the other hand marginal and small farmers are selling 83 to 85% of the produce. Mango, sugarcane and cocoon are 100% commercial crops. Therefore the entire produce is marketed. It is observed that the large farmers received relatively higher price compared to the marginal, small and medium farmers. While majority of the paddy growers are selling to the rice mill, only a few of the marginal (6.81%), small (5.12%) and medium (20%) farmers are selling to middlemen. In the case of sugarcane, the share of those selling to local jaggery house is more among small and medium farmers. Majority of the farmers of the entire category are selling to the factory. Ragi is another important subsistence crop. Though it is a subsistence crop, majority of the farmers are selling to the market. Only a few of the marginal (5.76%), small (2.04%) and medium (4.0%) farmers are not selling. Coconut is another important commercial crop where there is greater variation in prices. The percentage of farmers selling to middlemen is higher among marginal farmers and 20% of the large farmers are also selling to middlemen. But due to their bargaining power they are able to get better price than other farmers. Sale of mango is mainly through middlemen for the marginal, small and medium farmers. While 50% of the large farmers are selling through middlemen, 89% of marginal, 87% of small and 77% of medium farmers are selling through middlemen. Sale of cocoon is mainly through APMC market only. All the farmers growing cocoon are selling through APMC market.
The data showed that large farmers received relatively higher price compared to the marginal, small and medium farmers. In the case of paddy large farmers have received Rs 14,087 per tonne of paddy. But the marginal farmers have received Rs 13,732 and small farmers received Rs 13,767. The medium farmers have received marginally higher price of Rs 14,095 per tonne. Same is the case with sugarcane where large farmers have received Rs 2458 and marginal farmers have received Rs 2296 per tonne. Small and medium farmers have received better price of around Rs 2300 compared to the marginal farmers. In the case of ragi, the price range is Rs 17,400 of large farmers and Rs 15,562 of marginal farmers. In the case of coconut while large farmers received Rs 13,271 for thousand nuts, marginal farmers received Rs 11,562. In the case of mango crop, small farmers received Rs 49,066, large farmers received Rs 43,333 and medium farmers received Rs. 27,916. During the data collection it is observed that farmers are growing mulberry crop for their own sericulture activities. They are not selling the mulberry leaves. The farmers rear silk warms and the final product of this activity is production of cocoon which they are selling to the regulated market located in Ramanagara. Therefore the price of cocoon is considered for the analysis of output. The data shows that, though all the sample farmers are selling to regulated market, there are differences in the price of farmers. While large farmers received an average price of Rs 3,25,000 per tonne, marginal farmers received Rs 2,94,420 and medium farmers received Rs 2,90,000. The small farmers received Rs 3,11,430. The difference is due to differences in the time of sale and also in the quality of cocoons. If the cocoons are not reared properly the buyer cuts price on the grounds of cleanliness and the appearance of cocoon.

The data revealed that Primary Agricultural Cooperative Societies are playing an important role in meeting the seed and other credit requirements of the sample farmers. The dependence on cooperative societies for seed is more in Ramanagara. Out of 80 farmers, 51 farmers are purchasing seed from co-operative societies, nine farmers are purchasing from neighbor farmers. Another nine farmers are using own seeds and eleven farmers are purchasing from agriculture extension office. In Mandya district out of 101 paddy growers, 81 farmers are purchasing seed through co-operative societies.
The data showed greater usage of chemical pesticides by large farmers compared to the other farmers in all crops. While 90% of the paddy growers are using chemical pesticides, 100% of large farmers are using it. In the case of sugarcane only 20% of the marginal farmers are using and 72% of medium and 100% of large farmers are using chemical pesticides. Same in the case of Mulberry. Only 60% of the marginal farmers using. But in mango cultivation 89% of marginal farmers are using chemical pesticides.

Regarding the sources of chemical fertilizers and pesticides it is observed that most of farmers are purchasing from their local chemical fertilizer shops and very few farmers are purchasing from co-operative societies. According to the farmers transportation is the main cost in bringing the fertilizers from outside. Therefore they depend more on local dealers.

The study revealed that more farmers in dry district are maintaining livestock than those from wet district. While 75.7% farmers in Mandya are owning livestock, 86.5% in Ramanagara are owning livestock. It may be due to the necessity of supplementing the income from agriculture. Animal husbandry provides supplementary income generating activity in dry agriculture as only one crop in grown in these regions.

Regarding the soil fertility issues, majority of the farmers (84.3%) are of the opinion that red soil mixed with sand is the most fertile soil and therefore sometimes they bring in red soil from outside and spread it in the field to improve the fertility. Production is the important criteria for the farmers to assess the fertility of the soil.

The data showed that majority of the sample farmers feel that fertility of their soil is maintained and there is no decline over a period of time. Only five farmers in Mandya district and 16 farmers in Ramanagara district have opined that the soil fertility has declined. Rest of the sample farmers felt that it is maintained. It is interesting to observe that among those who felt that there is a decline, majority are educated. While only 18% of the illiterates said there is a decline in Ramanagara district, 25% degree holders and 31% educated up to PUC expressed so. According to these farmers indiscriminate use of chemical
fertilizers and unscientific method of farming are responsible for the decline in fertility.

- The study observed that all the sample farmers from Mandya district who said that there is a decline have attributed it to both the excess use of chemical fertilizers and unscientific farming system. According to them there is no improvement in farming systems though a lot of money is spent on research. The research is not focused on minimizing the external inputs without affecting the yield. Therefore with the perception that to maintain the yield it is important to use more chemical fertilizers so farmers are using more chemical fertilizers.

- Maintenance of the soil fertility is attributed to better management practices by majority of the farmers (317) and only six farmers attributed it to both better practices and irrigation facility. According to the farmers better management practices means using chemical fertilizer along with organic fertilizers, crop rotation etc. Since majority of the farmers have attributed it to better management it is important to know how many of these farmers got their soil tested and use the recommended doses.

- The percentage of farmers who got the soil tested is low in Mandya district (8) compared to Ramanagara district (21). As expected, out of those who got the soil tested, majority are educated farmers. This clearly shows that farmers are using their traditional knowledge which they acquire from the earlier generation.

- Regarding the perceptions about soil fertility management, the data revealed that out of 344 sample farmers 72 (20.93%) farmers felt that only organic fertilizer improves soil fertility. But according to 14 (4.06%) farmers by using chemical fertilizer alone soil fertility can be improved. Majority of the farmers (75%) felt that usage of both the organic and chemical fertilizer is important to protect soil fertility.

- According to the sample farmers who got the soil tested, they went for soil testing to know about the soil type so that they can decide the quantity of fertilizer and nutrient supplement to be used based on the deficiency. The
The share of those who are practicing is more in Mandya 4 (57.14%) compared to Ramanagara 3 (42.85%).

- The main reasons cited for the non adoption of recommended dose based on the soil status is the perception that these recommendations are useful only in the long run. The other reason cited was the cost. According to one farmer in Ramanagara district, the recommended doses add to higher cost of cultivation.

- The study showed that Minimum Support Prices (MSP) does not influence the cropping pattern by creating incentives to farmers. The cropping decisions of the farmers in Mandya and Ramanagara districts are influenced more by tradition than by the government policy of announcing MSP.

- The data showed different soil fertility management practices used by the sample farmers for paddy crop in Mandya district. Among marginal farmers 27 (61.36%) farmers are using FYM in combination with Chemical fertilizer, and 13 (29.54%) farmers are using FYM, Chemical fertilizer along with Crop rotation methods. According to these farmers crop rotation of growing legumes improves nitrogen fixation in the soil. Therefore they practice this to maintain soil fertility. Another 4 (9.09%) farmers are using all the three methods and also leaving the field fallow some times. Though they are not leaving the fallows for many years, some years they don’t grow second crop. According to them this helps the soil to get its fertility back.

- In the case of sugarcane cultivation majority of the farmers in all size groups are adopting the practice of using FYM, chemical fertilizers and burning crop residues to improve the soil fertility.

- The data related to SFM practices of those growing ragi it is observed that majority of the farmers are adopting the practices of using FYM with chemical fertilizers.

- In the case of coconut cultivation it is observed that majority of the marginal and small farmers are adopting the strategy using FYM with chemical fertilizer combined with the intercrop cultivation. While 87.5% of the marginal farmers adopted this, 46.66% of the small farmers adopted this. On the other hand 13% of the small and 7% of the medium farmers are using tank
silt and adopting intercrop without chemical fertilizer. Similarly 48% of the medium farmers are adopting different methods of drip irrigation, use of tank silt, chemical fertilizer and also FYM.

- In mango cultivation nearly 33% of the small farmers are not adopting any fertility management practices. According to them every alternative year there will be a good crop naturally. But 40% of the growers are using intercrop, FYM and chemical fertilizer to maintain the fertility of the soil. In the case of large farmers majority (66.66%) are adopting the strategy of growing other crops in the mango garden and also ploughing with greens, which is known as green manuring. In this process the farmers plough the nitrogen fixing plant into the soil. Majority of the marginal farmers (44.4%) are adopting growing of intercrops with the application of FYM and Chemical fertilizers as a strategy for maintaining soil fertility.

- Mulberry is a pure commercial crop. With regulated market for coconuts farmers get return on this crop immediately. Therefore we find investment on irrigation in the cultivation of mulberry. About 46% of the marginal farmers are adopting drip irrigation, use of FYM and Chemical fertilizers as strategy, 54% are dependent on use of both FYM and Chemical fertilizer only. Even small and medium farmers also have invested on drip irrigation. In the case of small and medium farmers around 80% are using drip irrigation also along with FYM and Chemical fertilizer. All the large farmers are using drip irrigation also.

- Regarding the sources of information about Soil Fertility Management (SFM) practices of different crops, it appears that the farmers growing traditional crops like paddy, ragi and sugarcane are depending on family members. But in the case of commercial crops like coconut, mango and mulberry farmers are depending on either neighboring farmers or their family members. Only one farmer reported gathering information from TV. Nearly 30% of the coconut growers and 36% of the mulberry growers are consulting the neighboring farmers apart from family members, mainly father. On the other hand 14% of the mango growers are consulting the neighboring farmers for getting information about usage of fertilizers, crop protection etc.

197
As a policy measure to improve the knowledge levels of the farmers Raitha Samparka Kendras (RSK) were strengthened during the Agriculture Policy 2006. Out of 344 sample farmers 42.15% of farmers are aware about RSK and the rest 57.84% are not aware about RSK. Among those who are aware majority are literates. For example while 7.04% of the illiterates are aware, 64.70% of PUC holders, 91.66% of degree holders are aware of it and all the PG holders are aware of this. Same trend is observed in both districts. Only 5.55% of illiterates in Mandya and 8.57% of illiterates in Ramanagara know about RSK. This clearly shows that RSK is catering to literate farmers.

The data clearly showed that only educated farmers are utilizing the services of RSK. The farmers are consulting RSK for other crop related issues like appropriate chemical to used for specific pests or about fertilizer prices etc. But none of them are consulting for SFM related issues.

It appears that majority of the consulting farmers are satisfied with the services of RSK. Out of the farmers who consulted 65.21% are satisfied and 23.91% felt that the services are not bad. Only 10.86% felt that the services are bad. In Mandya district, 65.21% said that they are satisfied and 26.08% said that the services are not bad. In Ramangara district also 65.21% are satisfied and 21.73% are said that the services are not bad.

Same as RSK, Kissan Call Centre (KCC) were introduced by the government of India to make agriculture knowledge available at free of cost to the farmers as and when desired. Out of 344 sample farmers 215 (62.5%) farmers are aware about KCC and remaining 129 (37.5%) farmers are not aware about KCC. The data related to who have contacted KCC for various issues shows that, 42.85% are Degree, 31.95% PUC, 9.83% high school, 8.33% primary education and all the PG holders are contacted KCC. 12.5% of illiterate farmers are also contacted about KCC. This is clearly shows that majority of the educated farmers are contacted the KCC.

Several researchers have tried to identify the factors influencing the soil fertility management practices in different countries. The important factors identified are educational level, contact with extension agent, farming experience, farm size, off farm activities, location of the farm, access to
credit, availability of extension services and training pertaining to soil fertility management etc., (Adeolo, 2010; Wiredu, et al 2014; Odendo et al., 2009; Geta, 2013). Based on the literature a regression model was developed and tested with the primary data collected from the sample farmers. The ratio of chemical fertilizer to organic fertilizer is considered as a proxy for the soil fertility management practice. Ratio of chemical and organic fertilizers is considered as dependent variable, education level, size of land, fertilizer cost, FYM cost, perceptions about which fertilizer improves soil fertility are considered as independent variables. The results showed that education level of the farmers has an influence on the SFM practices. The other significant variables are the cost of FYM and the cost of chemical fertilizers.

- Regarding the influence of different policies, the data showed that there is no significant difference between the farmers of Mandya and Ramanagara districts except in the case of credit policy. While 36% of the farmers in Mandya reported the influence of credit policy and the availability of cheaper credit on SFM practices, 54% of the Ramanagara district farmers reported this. For majority of the farmers in both districts input subsidies and availability of FYM from their own livestock are the main factors influencing the decisions about SFM. There are differences in the farmers of Mandya and Ramanagara in the case of output prices. According to 39% of the farmers in Mandya, output prices influence their SFM decisions. If they get remunerative prices they take up more SFM measures. This belief is shared by 59% of the farmers in Ramanagara districts.

- The data revealed an interesting factor that the knowledge levels of the farmer has least influence on the SFM decisions. Only 10% of the sample farmers said that they take SFM decisions because they know the importance of SFM and whatever may be the prices, they practice SFM practices. This trend is observed more in Ramanagara district. While only one farmer in Mandya district said that his knowledge influences, 34 farmers from Ramanagara district said so. From the above observation it can be concluded that public policy on input subsidies and prices has an influence on the SFM decisions of
the farmers. Efforts to improve the knowledge levels should be supported with appropriate and targeted subsidies for promoting SFM practices.

6.3 POLICY SUGGESTIONS

The present research made an attempt to understand the factors influencing the soil fertility management decisions of the farmers. One of the important factors influencing the soil fertility is the use of chemical fertilizers. Therefore the study focused on the fertilizer policy apart from the agriculture policy. Based on the findings of the secondary and primary data analysis the following suggestions are made. While some of the suggestions require policy changes, some of them require changes in the implementation.

1. Though the agricultural policy 2006 introduced the concept of soil health card which provides information about the soil status and recommended appropriate dosage, majority of the sample farmers in Mandya and Ramanagara are not aware of the soil health card. Therefore it is recommended that efforts are to be made to popularize the concept of soil health card among the farmers. As it is observed that the farmers are using excess of chemical fertilizers, it is important to provide information about the soil health status and the need for the use of appropriate dose of fertilizer. This reduces the excess use of chemical fertilizers.

2. The analysis clearly brought out the fact that Minimum Support Price (MSP) is not very effective. During the interaction with the farmers it is observed that farmers are not responding to MSP mainly because of the problems in the administration of MSP. According to the farmers when they sell to the procurement agency at MSP, they are never paid the full amount. Usually they get only partial amount and the full amount is paid only after one year or more. So, it is important to look into the delay in the payment of full amount as delay will have a negative impact on the decisions of the farmers. It is important to investigate the reasons for the delay in the payment of MSP. On the other hand it is also important to announce the MSP for specific crops earlier so that farmer can take decisions about the crop management.
3. The study also observed that many of the sample farmers are availing loan from local cooperative societies. A deeper look into the issue revealed that the farmers prefer cooperatives than commercial banks because of the possibility of loan waiver in the case of cooperative societies. Due to the possibility of the loan getting waived the farmers are taking loan and purchase chemical fertilizers and use them indiscriminately. Therefore it is suggested that the loan waiver should be discouraged.

4. Encouraging soil testing is very important to reduce the burden of increased use of chemical fertilizers by the farmers. The study revealed that many farmers are not getting the soil tested as they have to travel to the taluk. Even those who are aware of the need for testing also are not able to do this. The farmers also have expressed about the long delay in receiving the results of their soil test. To encourage more farmers to undertake soil testing and get the recommended dose of fertilizers, it is important to have soil testing facilities in each gram panchayat and sufficient staffs are to be appointed so that the results can be given without delay.

5. Even those who got the soil tested also are not practicing the recommended dose as they feel that the recommendations are useful only in the long run and they affect the yield negatively in the short run. Therefore efforts should be made to popularize the importance of soil testing and drive away the misconceptions about the use of recommended dose.

6. It is observed that farmers are depending on the local cooperatives for the supply of inputs. Therefore it is possible to link the soil testing with the sanctioning of the loan. If the soil testing is made mandatory for the sanctioning of loan, many farmers would get their land tested. Once they are aware about the recommended dose and how much excess they are using, they will reduce the excess use.

7. The data showed that educated farmers make good soil fertility management decisions. Promoting education in general and providing information about the best practices through local panchayat will help in reducing the excess use.
8. The study observed underuse of organic fertilizer and overuse of chemical fertilizers. This is due to the availability of subsidy on chemical fertilizers and non availability of organic fertilizers. It is suggested that efforts should be made by the local bodies for the production and sale of organic fertilizers at subsidized prices. Both urban and local bodies can identify an agency for the collection of household waste and other waste and prepare the organic manure in production plants. The produced organic fertilizers should be supported at subsidized price to the farmers.

9. Raitha Samparka Kendras (RSK) are proposed in Agricultural policy 2006 so that they can bring the scientific knowledge to the farmers. RSK can play a very important role in farmer’s decisions as the subject experts can visit the farm and suggest appropriate action. It also develops rapport between the scientific community and the farmers. For effective functioning of the RSK it is suggested that there should be one RSK in each village and the RSK should be staffed sufficiently.

10. Prices of the output sold by the farmers influence the decisions of the farmers. It is important to ensure remunerative prices to the farmers.

11. More research studies are needed to quantify the trade-off between use of chemical fertilizers and the output so that convincing argument can be developed for the promotion of organic cultivation.