Chapter - VIII

SUMMARY, CONCLUSION AND POLICY IMPLICATIONS
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This part of the present study contains two sections. First section includes the summary of the main findings of the previous chapters. In the second section policy implications are drawn in the light of the main findings.

Technological changes play a key role in promoting agricultural growth in any country. As cultivable land is limited in supply and is less fertile in some regions, techniques of increasing yield are inevitable for the growth in agricultural production. In densely populated underdeveloped countries modern technological oriented methods of agriculture not only provide enough food but also contribute to earn enough foreign exchange. The individual farmer as well as the nation is bound to reap the benefits of new farm technology.

In India the ushering of a new era of modern technology during mid-sixties marked the beginning of agricultural revolution. The sharp increase in the use of modern inputs like high yielding variety seeds, fertiliser, irrigation, pesticides, farm machineries etc. have boosted the production and productivity in agricultural sector. However, there is an apprehension that modern technology has generated new problems like imbalance in cropping pattern and inequality in distribution of farm income. Doubt has been expressed
regarding the employment effect of new technology. Keeping these problems in mind the present study has been undertaken.

In the first stage of analysis the progress of modern technology and level of agricultural production in India has been examined. This analysis is based on secondary data collected from various departments of Government. In the second stage the impact of technological change on cropping pattern, farm income distribution and farm employment have been assessed on the basis of primary data collected from the study region.

The study region is situated in northern part of Dharwad district of Karnataka State. It incorporates two blocks viz., Nargund and Gadag blocks. These two blocks come under single agro-climatic zone. However, these two blocks are polar type regions in respect of technological progress in agriculture. Nargund block is highly advanced and Gadag block is quite backward in the use of modern inputs like HYV seeds, fertiliser, irrigation, pesticides etc. Selection of this type of region enabled the researcher to study the impacts of new technology by comparing the advanced region with the backward region. Data pertaining to cropping pattern, farm income, cost, employment etc. were collected from 240 respondents, 120 from advanced region and 120 from backward region. Multi-stage sampling method was used to
select the respondents. 1992-93 is the year chosen for investigation.

Simple techniques like averages, percentages and coefficient of variations are used in this study. Techniques like Lorenz curve and Gini ratios have been employed to study the distribution of farm income. Besides this, 'Z' test (Large sample test) has been used to test two important hypotheses.

Section - I

Summary of the Main Findings:

1. India is experiencing substantial progress in agricultural technology since mid-sixties. Use of vital inputs viz., HYV seeds, fertiliser and irrigation has grown appreciably during the post-green revolution period (1967-68 to 1990-91). Area under HYV cereals has increased by 35.44 times during 1966-67 to 1990-91. Per hectare consumption of fertiliser has increased from 1.9 Kgs. in 1960-61 to 69.66 Kgs. in 1990-91. Area under irrigation also increased in recent years. During pre-green revolution period (1949-50 to 1964-65) the use of these inputs was very meagre.

Technological progress in agriculture has improved the productivity and contributed significantly to the increase in the production of foodgrains in
recent years. Compound growth rate of yield of total foodgrains stood at 2.6 percent per annum during post-green revolution period and it was only 1.52 percent per annum during pre-green revolution period. The area under total foodgrains grown at the compound rate of only 0.20 percent during post-green revolution period, whereas it was 1.41 percent during pre-green revolution period. Compound growth rate of production of total foodgrains was 2.8 percent during post-green revolution period and 2.93 percent during pre-green revolution period. As the growth rate of the area of total foodgrains is negligible during post-green revolution period, it is concluded that increase in production is due to improvement in yield.

2. In Karnataka, where the present study is conducted, the traditional agricultural practices are being replaced by modern technology. Rising trend has been observed in respect of use of key inputs like high yielding variety seeds, fertiliser and irrigation in recent years. The Index of area under HYV increased from 100 in 1967-68 to 1837 in 1992-93. The Index of consumption of fertiliser went up from 100 in 1961-62 to 3389 in 1991-92. Net irrigated area increased at the average rate of 4.88 percent per annum during 1960-61 to 1990-91.
In Karnataka production of cereals has recorded compound growth rate of 2.1 percent per annum during 1960-90. Area under cereals experienced negative growth rate of 0.3 percent and yield increased at compound growth rate of 2.7 percent per annum during the same period. Thus, increase in yield because of technological change is solely responsible for rise in production of cereals in Karnataka. Yield of some important cereals like jawar, ragi, bajra and rice increased at the rate of 2.2 percent, 2.3 percent, 2.8 percent and 1.6 percent per annum respectively during 1960-90.

3. Coefficients of variation among the districts of Karnataka, in respect of yield and use of key inputs are estimated. Wide disparity is found in yield as well as in use of inputs. However, this disparity both in yield and in use of inputs has reduced in recent years. Coefficient of variation among the districts in respect of yield was 41.04 in 1980-81 and it reduced to 36.31 in 1989-90. In respect of per hectare consumption of fertiliser, coefficient of variation has reduced from 60.17 in 1980-81 to 50.13 in 1990-91. Coefficients of variation among the districts in respect of area under HYV and irrigation also have declined in 1990-91 as compared to 1965-66.
4. Results of empirical study reveal that cropping pattern has undergone significant changes due to the introduction of new farm technology. The changes are found in terms of allocation of area under different crops and allocation of area under different varieties of crops. In advanced region area under cereals is 61.57 percent of total cropped area, whereas in backward region it is only 42.85 percent of total cropped area. Area under cash crops is 28.97 percent of the total cropped area in advanced region, whereas it is only 11.71 percent of the total cropped area in backward region. In advanced region allocation of area under pulses and oil seeds is only 3.65 percent and 5.81 percent of the total cropped area respectively. On the other hand, in backward region area under pulses and oil seeds is 16.20 percent and 22.85 percent of the total cropped area. In this regard new technology induced the farmers to shift the cropping pattern in favour of cereals and cash crops at the cost of pulses and oil seeds.

In advanced region, the area under cotton, maize, wheat, jawar, sunflower, gram, groundnut and green gram is 28.74 percent, 24.92 percent, 21.2 percent, 15.09 percent, 4.04 percent, 2.44 percent, 1.77 percent and 1.2 percent of the total cropped area respectively. On the other hand, in backward region
area under same crops is 9.37 percent, 0.09 percent, 16.44 percent, 26.17 percent, 10.88 percent, 4.43 percent, 9.20 percent and 11.41 percent of the total cropped area respectively. Technological advance has tilted the cropping pattern in favour of cotton, maize and wheat at the cost of jawar, groundnut, green gram, sunflower and gram. High yielding variety cotton, maize and wheat are grown in advanced region, whereas in backward region local varieties are much favoured.

On the basis of the above findings the proposed hypothesis number one of the present study, that is, "Technological change in agriculture has made a significant impact on cropping pattern" is accepted.

5. Analysis of cropping pattern according to farm sizes indicates that percentage of area under food crops is more on small farms than what it is on large and medium farms in both the regions. On the other hand, percentage of area under cash crops is less on small farms than what it is on medium and large farms in both the regions.

6. The cropping intensity of advanced region is substantially higher than that of backward region. It is 166.53 in advanced region and 123.5 in backward region. Analysis of cropping intensity according to the size of the farms also indicates that for advanced
region it is higher on all size groups of farms as compared to the same in backward region. It is found that in advanced region cropping intensity is 175.25, 175.84 and 162.56 on small, medium and large farms respectively. In contrast, in backward region cropping intensity is 131.86, 128.9 and 121.26 on small, medium and large farms respectively. In both the regions cropping intensity of large farms is lower than what it is on small farms. Technological change in agriculture has raised the cropping intensity.

7. It is found that the technological change has made substantial impact on cropping practices. Agricultural operations like watering, fertiliser application, interculturing, plant protection etc., have become more important in the advanced region than in the backward region. The sample farmers in the advanced region are busy both in the kharif and the rabi seasons. In the backward region farmers are not so active.

8. Technological change in agriculture has led to proper utilisation of land. In advanced region during the kharif season the extent of current fallow land is 24.38 percent of the total cultivated area and in rabi season it is 9.09 percent of the total cultivated area. As against this, in backward region current fallow land is 54.56 percent and 21.78 percent of the cultivated area during kharif and rabi seasons respectively. The percentage of fallow land is more on
large farms than what it is on small farms in both the regions.

The area under double cropping is 73.16 percent of the total cultivated area in advanced region, whereas it is only 41.56 percent of the total cultivated area in the backward region. In advanced region area under double cropping is substantially higher on all the size groups of farms as compared to the same in backward region. It is noticed that the percentage of double cropped area is more on small farms than what it is on large farms in both the regions.

9. It is found that in advanced region yield per acre is substantially higher than that of backward region. Per acre yield of cotton is almost three times higher in advanced region. Yield of wheat, maize and jawar is three and quarter times, two and quarter times and one and half times higher respectively over the backward region. Direct relationship is found to exist between the yield and the farm size in advanced region and inverse relationship is noticed between the yield and the farm size in backward region. The study reveals that technological change in agriculture has not only increased the yield per acre but also has changed the relationship between farm size and yield.
10. On an average Cost $A_2$ per acre of cropped area is 150.13 percent more in advanced region than what it is in backward region. Study of cost according to farm sizes shows that Cost $A_2$ per cropped acre is 82.45 percent higher on small, 117.07 percent higher on medium and 168.22 percent higher on large size farms over the backward region. It is found that Cost $A_2$ per cropped acre increases with the size of holdings in advanced region, whereas it is maximum on medium size farms and the minimum on large size farms in backward region. Cost analysis also reveals that expenditure on hired labour is the biggest cost (24.05%) and it is followed by value of fertiliser (20.08%) in advanced region. In backward region hired labour charge is the biggest cost (28.24%) and it is followed by bullock labour charge (15.31%).

11. Estimations of farm income denote that in advanced region, taking all the size groups of farms together, farm business income per acre of cropped area is 179.49 percent higher over that of backward region. Analysis according to farm sizes also indicates that in advanced region farm business income per cropped acre is 71.02 percent higher on small, 127.68 percent higher on medium and 212.79 percent higher on large size farms. 'Z' test (Large sample test) is applied to verify the difference between advanced and backward
regions with regard to average farm business income. The calculated value of 'Z' is greater than the table value. Hence, the proposed hypothesis number two of the present study, that is, "There is no significant difference between the technologically advanced and backward regions in respect of mean farm business income per acre" is not accepted even at one percent level of significance. Technological change in agriculture has enhanced farm business income.

12. Analysis of the distribution of farm business income has revealed that such distribution is unequal in both the regions. In advanced region the lowest 61.67 percent of the farm families got only 22.26 percent of total farm business income, whereas the top 38.33 percent of the farm families shared 77.74 percent of farm business income. In backward region the lowest 55.82 percent of the farm families got 21.23 percent of total farm business income and the top 44.15 percent of farm families shared 78.77 percent of farm business income.

In advanced region 7.77 percent of the total population got very low per capita income, that is, Rs. 350 and below, whereas 18 percent of the total population got very high per capita farm business income of above Rs. 6,000. In backward region 5.68 percent of the population falls in the lowest per
capita farm business income group of Rs.350 and below and 4.2 percent of the population falls in the per capita income group of Rs.4,500 and above.

13. Lorenz curves are drawn to examine the impact of new technology on the distribution of farm business income. It is found that Lorenz curves for advanced as well as backward region deviate from the line of equal distribution. However, Lorenz curve for advanced region is farther to the line of equal distribution than that of the backward region. This proves that disparity in farm business income is more in advanced region as compared to the same in backward region.

14. Gini's coefficient and coefficient of variation are estimated to measure the inequality in the distribution of farm business income. Gini's coefficient on household farm business income basis is 0.5364 for advanced region and 0.4626 for backward region. On per capita income basis Gini's coefficient is 0.5200 for advanced region and 0.4529 for backward region. Gini's coefficients for advanced region are greater than those for backward region. Coefficients of variation of households on the basis of farm business income are 117.93 and 91.98 for advanced and backward regions. Coefficient of variation for advanced region is higher than that for backward region. The advanced
region is showing more inequality in income distribution than the backward region.

On the basis of the Lorenz curves, Gini ratios and Coefficients of variation, the proposed hypothesis number three of the present study, that is, "The distribution of farm business income in technologically advanced region is more unequal than what it is in backward region" is accepted. Technological change has increased the inequality in the distribution of farm business income.

15. Analysis of distribution of farm business income according to farm sizes reveals that inequality exists on all size groups of farms in both the regions. Further, the distribution of farm income is more unequal on large and small size farms than what it is on medium size farms in both the regions.

16. The estimates of utilisation of human labour indicate that on an average utilisation of human labour per acre of cropped area is 35.07 man-days in advanced region and 21.37 man-days in backward region. In advanced region utilisation of human labour is 64.10 percent higher over the backward region. On small, medium and large farms labour utilisation is 41.25 percent, 60.85 percent 65.54 percent higher respectively over the backward region.
The difference between advanced and backward regions in respect of mean employment per acre of cropped area is verified by applying 'Z' test. The calculated value of 'Z' is greater than the table value. Hence, the proposed hypothesis number four of the present study, that is, "The mean employment per cropped acre of technologically advanced region is equal to that of the backward region" is not accepted even at 1 percent level of significance. Technological change in agriculture has enhanced the employment in crop production.

17. Cultivation of cotton requires more labour per acre than that of wheat. Further, employment effect of new technology is more on cotton cultivation than what it is on wheat cultivation. In advanced region cultivation of cotton requires 76.47 percent more labour over the backward region, whereas cultivation of wheat requires 71.91 percent more labour over the backward region.

18. It is found from the field observation that in advanced region use of hired labour is 121.01 percent higher and use of family labour is 14.99 percent higher over the backward region. Technological change has made positive impact on the employment of both hired and family labour. However, it's impact is much higher on hired labour than on family labour.
Study reveals that an inverse relationship exists between the use of family labour and the size of holdings in advanced as well as in backward region. Between the use of hired labour and the size of holdings, existence of direct relationship is confirmed. Use of family labour is more than the hired labour on small and medium size farms. As against this, use of hired labour is more than the use of family labour on large farms in both the regions.

Impact of new technology on family and hired labour use is positive on cotton as well as on wheat production. However, the implications of new technology are greater on both family and hired labour employment in cultivation of cotton than in wheat cultivation.

19. The impact of new technology on composition of human labour employment is also noticeable. Employment of male as well as female labour is greater in advanced region than what it is in backward region. Employment of male labour is 59.79 percent higher and employment of female labour is 75.42 percent higher over the backward region. New technology enhanced the employment of male and female labour. However, impact on female labour is more than the impact on male labour.
Study according to farm sizes reveals that the use of female labour decreases with the increase in the size of holdings in both the regions. This is mainly due to decrease in the use of family female labour with increase in the farm size. The use of male labour per acre increases with the size of holdings in advanced region and decreases with the size of holdings in backward region.

20. Operation-wise employment of labour per acre points out that the modern technology enhanced the employment in all operations except in preparatory tillage, manuring and sowing operations. Increase in labour use is maximum in irrigation (872.22%) followed by fertiliser application (475%), plant protection (400%), inter-culture (100%), harvesting and threshing (90.78%) and such other operations (29.61%). Employment of labour declined slightly in preparatory tillage, sowing and manuring operations. The reduction in labour use in these operations is due to the use of mechanical technology (tractor) in these operations.

21. Tractorisation has displaced the human labour by 11.76 percent in advanced region. Labour displacement is maximum on large farms (14%), followed by small farms (11.68%) and medium farms (9.39%). In backward region tractorisation displaced the labour by
15.46 percent. Displacement of labour is maximum on large size farms (16.08%), followed by small size farms (10.75%) and medium size farms (10.02%). In terms of percentage decline in labour is more in backward region than what it is in advanced region.

Tractorisation reduced the use of both family and hired labour. However, percentage decline in family labour is more than percentage decline in hired labour in both the regions.

Conclusion:

Technological change in agriculture has enhanced the productivity and production in farm sector. It has increased the gross farm income and farm business income of the cultivators. Application of modern inputs has made positive impact on both family and hired labour and male and female labour employment. However, use of tractor displaced the human labour. The displacement of human labour (in terms of percentage) due to tractorisation is more in backward region than in advanced region. New agricultural technology tilted the cropping pattern in favour of cereals and cash crops at the cost of oil seeds and pulses. It has increased the inequality in the distribution of farm business income among the different categories of farmers.
Section -II

Policy Implications:

The findings of the present study will lead to the following implications for policy purpose.

1. Intensification of the Technological Change in Agriculture:

The findings of the present study reveal that the technological change has enabled the intensive use of land and enhanced the production in farm sector. It is a well known fact that in India the scope of extensive cultivation to increase production is very much limited. Hence, intensive use of land is the only alternative to achieve the required growth in agriculture. Therefore, there is strong need to intensify the technological changes to step up agricultural production, promote agro-export and above all to usher in an era of agrarian prosperity.

2. Stress on Introducing New Technology into Small and Marginal Farms:

It is found in this study that the use of modern inputs is very less on small farms than what it is on large and medium size farms in technologically advanced region. Farm business income is also quite less on small farms. In India small farmers are more in number than the big farmers and sizable portion of agricultural land is owned by small farmers. To increase the income of small farmers and to
bring equality in the distribution of income so as to promote agricultural production, it is suggested that greater stress may be laid on introducing new technology on small farms. Adequate finance and extension facilities should be provided to small and marginal farmers to enable them to adopt modern technology.

3. Extending the Modern Technology to New Crops:

The present study indicates that the technological changes encouraged the production of cereals and cash crops, whereas it discouraged the production of pulses and oil seeds. At the national level also the output of pulses is stagnant and the quantum of production of oil seeds is also not satisfactory. Import of edible oil has been a regular feature which puts strain on our balance of trade. There is an immediate need to extend the HYV programme to these crops. Greater emphasis may be laid on the extension of modern technology to crops like fruits, vegetables, flowers etc. which get immense export potential.

4. Transfer of New Technology to Rainfed and Dry Regions:

Study results indicate that the gap between the irrigated farming and rainfed farming has widened due to the introduction of new technology. This has resulted in uneven regional development. Dry-land/rainfed areas constitute about 70 percent of net sown area and contribute about 42 percent of food production. Farmers
residing in these regions are very poor. To achieve growth, equity, stability and employment it is suggested that new technology should be transferred to dry-land and rainfed regions on high priority basis. Greater emphasis should be given on delineation of agro-climatic regions and to propose cropping pattern best suited for each region. There is a need to evolve region specific new varieties of seeds with multiple resistance to pests and droughts. Various efforts initiated to develop dry-land and rainfed farming should be intensified. Revolution in dry/rainfed farm technology should be the main feature of the second phase of ‘Green Revolution’.

5. Provision of Modern Inputs:

One of the difficulties in extending the modern technology is the inadequate supply of modern inputs like HYV seeds, chemical fertilisers, pesticides etc. There are many hurdles at various stages which hamper the steady supply of these inputs to the farmers. Therefore, it is suggested that the production and distribution systems of agricultural inputs should be strengthened and adequate inputs should be made available to the farmers at right time, right place and right price. The single window concept of supply of seed and other inputs at Mandal Panchayat level may be tried.
6. Accent on Irrigation and Water Management:

Irrigation is the important component of modern technology and it is the key factor in promoting agricultural development. Therefore, high priority should be given to achieve full utilisation of irrigation potential. There is a need to step up public and private investments in irrigation. Water being a scarce resource, every effort should be made for efficient water management. In dry-land and rainfed areas farming depends on rainwater. Therefore, rainwater should be properly harvested.

7. Scientific Farm Management:

Modern technology involves high cost inputs like HYV seeds, fertilisers, pesticides, improved implements etc. Farmers have to learn to use these costly inputs to get the maximum return. Water and land managements assume greater importance in recent years. In view of this it is suggested that the farm management training should be imparted to the farmers. Agricultural Universities and extension service centres are suitable institutions to impart education and training to farmers. It is found that women are equally important in agricultural operations like sowing, transplanting, inter-culture, harvesting etc. Therefore, it is felt that proper education and training should be given to women working on farm and upgrade their skill. Farmers should apply management skill to reduce cost, improve efficiency and maximise production and productivity.
8. Revitalising the Rural Credit Institutions:

Technological change in agriculture demands greater credit facilities. To purchase modern inputs, farmers especially medium, small and marginal farmers require timely and adequate credit. Hence, there is a strong need to revitalise the rural credit institutions like Co-operative banks and Grameena banks. Rural banks should cover all the farmers with proper credit service. Special attention should be given to simplify the procedures with regard to advances and recovery of loans. High priority should be given for lending towards the purchase of new inputs.

9. Land Reform Measures:

New technology is said to be scale neutral. However, for the efficient cultivation and proper use of new technology, size of the holding should be viable. Therefore, it is suggested that the small and marginal holdings which are not viable should be raised and properly organised. Small and marginal farmers should be encouraged to form co-operative farming societies or groups. They should be permitted to lease land among themselves.

10. Strengthening the Crop Insurance System:

New technology involves greater risk than conventional technology. Therefore, small and poor farmers hesitated to
take up risky venture of introducing new technology. Moreover, dry-land farmers suffer due to frequent crop failures in view of recurrent droughts. In view of this, the system of crop insurance should be strengthened.

11. Need to Revamp the Agricultural Extension System:

The conventional extension method of carrying the new messages to the farmers by the Agricultural Assistants has been inadequate. Even the new methods like Training and Visit System, the system of selecting Contact Farmers etc. did not show much improvement. In view of this it is suggested that the extension system should be renovated. The present system of extension through individual contact should be converted into group contacts. Specific technology should be disseminated through demonstrations. Greater stress should be given on developing extension programmes by involving farm women and youths. Extension facilities should be made available to small and remote farmers. There is a need to set up Training Institutes Cum Demonstration Centre at the district level to meet the training needs of districts.

12. Greater Emphasis on Yield Increasing and Labour Using Technology:

It is found in the present study that the modern technology has increased the human labour employment and has made the respondents to be busy in kharif and rabi
seasons. However, tractorisation has reduced the human labour employment. Therefore, it is felt that greater emphasis should be laid on seed, fertiliser and irrigation technologies with selective mechanisation. Encouragement should be given for developing and marketing improved tools. Such improved tools should be suitable to small and medium size farmers.

13. Encouragement to Private Sector Investment:

To improve the farm productivity, there is a need to step up the private sector investment in research, extension, irrigation, seed multiplication, agro-processing, floriculture horticulture etc. However, public sector investment in agriculture, as a proportion of the total investment should not decline.

The above suggestions will go a long way in extending the new agricultural technology and promoting agrarian prosperity in the country.