CHAPTER - VIII

SUMMARY OF FINDINGS AND CONCLUSIONS
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The new agricultural technology, launched during mid-sixties, has brought about a significant break-through in yield and production of crops, particularly wheat and rice, in the developing world and India is no exception. This resulted in green revolution in developing countries, including India. As new agricultural technology, which is based on high pay-off inputs model, is capital-intensive and involves the use of modern resources or inputs like fertilizers and exotic varieties of seeds, it is confined to irrigated areas, profitable crops and resourceful farmers. As such, it shifted productivity advantages hitherto enjoyed by the small farmers under traditional technology in favour of the big farmers.

The rate of growth (compound) of area under food and non-food crops in general and important crops like rice, wheat, sugarcane and groundnut in particular was higher during pre-green revolution period as compared to different phases of green revolution as also in the entire green revolution and overall periods. High-yielding varieties, introduced in mid-sixties with moderate coverage, account for over 90 per cent of the area in the case of wheat, 64 per cent in respect of rice and between 50 and 61 percent in respect of Jawar, bajra and maize. Area under high yielding varieties, which was over 7 per cent 1968-69 rose to over 70 per cent in 1991-92.

With the launch of new agricultural technology the input use, especially seeds, fertilizer and pesticides substantially increased. This also necessitated higher outlays in farming and led to increased demand for credit. The institutional agencies have been playing an active role in the supply of credit - both crop loans and term loans - to agriculture to enable the farmers resort to modern technology. The biological-chemical technology has also led to high degree of farm mechanization in agriculturally advanced states like Punjab, Haryana and Western Uttar Pradesh and districts like Thanjavur in Tamil Nadu and West Godavari in Andhra Pradesh.

Since the advent of new agricultural technology, the yield rates of food crops as well as commercial crops have gone up considerably. The yield of rice rose from 668 kgs per hectare in 1950-51 to 1078 kg in 1964-65 during pre-green revolution period. Due to drought conditions the yield has fallen to 862 kgs in 1965-66. During
green revolution the yield increased by around 55 per cent in phase-I, 33 per cent in phase-II and 24 per cent in phase-III. In the case of wheat the yield rose by nearly 25 per cent during pre-green revolution period, by 85 per cent in phase-I, about 35 per cent in phase-II and a little over 21 per cent in phase-III during green revolution.

In the initial period of green revolution, the performance of wheat was better than that of rice. But, subsequently rice has overtaken wheat in the growth of yield. The notion expressed by Keith Griffin that the performance of wheat was better than that of rice in respect of yield and output holds good in the initial period and does not hold in the later period of green revolution period. The yield rates of cereals as also food grains were higher during green revolution when compared pre-green revolution period. With regard to sugarcane and groundnut we notice better performance during green revolution period as compared pre-green revaluation period. Wheat and groundnut achieved a higher compound growth during green revolution period than that during pre-green revolution period. Whereas the performance during pre-green revolution period was better than that during green revolution period in the case of rice and sugarcane. However, the growth in the yield rates was higher for cereals as foodgrains during green revolution period than that during pre-green revolution period.

Production of rice has gone up from around 21 million tonnes to 31 million tonnes between 1950-51 and 1965-66. In the green revolution period, production increased substantially and stood at a little over 99 million tonnes by 2008-09. The performance of the wheat was much better than that of rice as wheat production rose from a mere 6 million tonnes to 80 million tonnes during the period from 1950-51 to 2008-09. Cereals as also foodgrains have shown better performance during the green revolution period. We find a similar situation in the case of sugarcane and groundnut. In terms of compound growth, with the exception of wheat, the growth achieved during pre-green revolution period was higher than that registered during green revolution period. Only wheat crop could perform well during green revolution period as compared to pre-green revolution period, corroborating the finding of Keith Griffin that in the case of wheat there is a dramatic break-through. As such, there is green revolution in respect of this crop. In the case of rice the growth is moderate during green revolution period.
Several macro-level and micro-level studies have been carried out at international, national and regional levels to evaluate the effects of new agricultural technology on resource use efficiency, yield and income in agriculture. However, most of these studies were conducted in progressive regions where new technologies are widely adopted. Studies in rainfed areas are scanty. In the light of these facts and in view of varied agro-climatic and socio-economic conditions in India, more and more area-specific micro-level studies, particularly in rainfed areas are required to be carried out.

Andhra Pradesh, formed in 1956, is the fifth largest state in the country, both in terms of area and population. The state was formed by combining three regions, viz. Costal Andhra, Rayalaseema and Telangana with widely varied endowments, historical legacies and institutional arrangements. The state has an area of 2.75 lakh sq. km, forming 8.37 per cent of the total geographical area of the country. The state's population according to the 2001 Census was 7.62 crore, constituting 7.41 per cent of the population of India. The percentage of cultivators declined from 40.12 per cent to 22.70 per cent, whereas the proportion of agricultural labourers' increased from 28.59 per cent to 39.60 per cent between 1961 and 2001. As a result, the ratio of agriculture labourers to cultivators increased from 0.71 to 1.74. The proportion of agricultural workforce to total workforce rose from 41.69 per cent in 1961 to 63.56 per cent in 2001.

Normal rainfall in the state during the period from 1955-56 to 2008-09 varied between 879 mm and 940 mms. However, the actual rainfall ranges from 680 mm to 1104 mm. The main sources of irrigation in Andhra Pradesh are tanks, canals, tube wells and other wells. The percentage of net area irrigated by wells (both tube wells and other wells) increased from 10.34 in 1955-56 to 48.19 in 2008-09. On the other hand, the percentage of net area irrigated by tanks declined from 38.88 per cent to 13.44 per cent and that of canals declined from 47.03 per cent to 34.65 per cent during the same period. The irrigated area under of rice which was 94 per cent of the area under rice in 1955-56, went up to 96.85 per cent in 2008-09. With regard to sugarcane, the irrigated area fell from 99 per cent to 96 per cent. Similar trend is noticed in the case of groundnut.
Forests formed 20.98 per cent of the geographical area of the state in 1955-56 and 23.18 in 2008-09. Net sown area declined from around 42 per cent of total geographical area to about 40 per cent during the same period. The proportion of area sown more than once increased from around 9 per cent to 27 per cent leading to increase in the gross cropped area and in the cropping intensity in the state. There is a declining trend in the inequalities in the distribution of operated area in the state.

The growth of area under food crops which was 0.61 per cent in pre-green revolution period turned negative (-0.49 per cent) in green revolution period. Regarding non-food crops, pre-green revolution period experienced negative growth while green revolution period had positive growth. The area under rice has grown at a compound rate of 3.11 per cent during the pre-green revolution period, 1.31 per cent during phase-I and 0.40 per cent phase-II of green revolution. There was a negative growth (-0.074 per cent), which is not statistically significant during phase-III. In the case of jowar, excepting pre-green revolution period, negative growth which varied between -1.39 per cent and 6.61 per cent is observed during different phases of green revolution. The growth of area under cereals was positive (1.30 per cent) and highly significant during pre-green revolution period. A negative growth is observed in two phases of green revolution, as the compound growth rate was -0.19 per cent in phase-I and -6.8 per cent in phase-II. It turned out to be positive in phase-III (0.40 per cent). In the case of sugarcane, a statistically significant growth (compound growth rate 5.12 per cent) is noticed during the pre-green revolution period. During Phase-I and phase-III, the area under sugarcane registered compound growth rates of 0.77 per cent and 1.34 per cent respectively during green revolution period. During phase-II, the growth was negative (-1.74 per cent). In the case of groundnut, an insignificant negative growth was found during pre-green revolution period (compound growth rate -4.36 per cent) and the first phase of green revolution (compound growth rate -0.45 per cent). During phase-II, area under groundnut has grown at a (compound rate of 5.44 per cent), which was significant at one per cent level. During phase-III, a highly significant negative growth (compound growth rate -2.54 per cent) was observed. The high yielding varieties covered 3628 thousand hectares in the case of paddy during 1995-56 and it increased to 4130 thousand hectares during 2008-09, indicating a growth of 13.82 per cent. The same trend is noticed in the case of maize. However, a reverse trend is noticed in the case of jowar, bajra and wheat.
With the onset of green revolution, use of various resources or inputs increased substantially. Between 2001-02 to 2007-08 certified seed production increased from 7 lakh quintals to 11 lakh quintals. Fertilizer consumption has gone up from around 3 lakh tonnes to about 31 lakh tonnes between 1970-71 and 2008-09. However, pesticide consumption has fallen from 4054 MTI to 1381 MTI during the period from 1999-2000 to 2008-09. Since the new technology is capital-intensive, credit requirement has gone up considerably. Institutional agencies including co-operatives, commercial banks and RRBs have been playing an active role in meeting credit requirements of agricultural sector in order to ensure timely operations of cultivation. Farm mechanization has become necessary, particularly among large farmers, under new agricultural technology. The general experience in India is that the areas which had a high degree of agricultural mechanization in the past, such as Punjab, Haryana or West Godavari were among the first to respond favorably to the new high-yielding varieties of seeds.

With the increased dosage of inputs, the yield rates under new agricultural technology have increased considerably. Per hectare yield of rice rose from 995 kgs to 1447 kgs between 1950-51 and 1964-65 during pre-green revolution period. In the year 1965-66, the yield has fallen due to drought conditions. We notice a similar trend in respect of other crops viz, Jowar, groundnut and sugarcane and also cereals and foodgrains. During green revolution period, the yield of rice increased from 1460 Kgs to 1947 Kgs in Phase-I, 2058 kgs to 2367 kgs in Phase-II and 2392 to 3239 Kgs in Phase-III. Similar trend is observed in respect of jowar, cereal and foodgrains. In the case of sugarcane, yield remained more or less same with some variation. Groundnut exhibited increasing trend in its yield in Phase-I and declining trend in Phase-II and also during Phase-III. To study the growth trends in yield during pre-green revolution and green revolution periods, compound growth rates were computed. Our results suggest that in the case of rice, jowar and cereals growth of yield was higher during green revolution period than that during pre-green revolution period. In the case of foodgrains, sugarcane and groundnut the performance during pre-green revolution period was better than that during green revolution period.

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The growth in production during pre-green revolution period was mainly due to area effect and during green revolution period it was mainly due to yield effect. During pre-green revolution period production of rice rose from 22 lakh tonnes to 40 lakh tonnes. During green revolution period, production has risen to 70 lakh tonnes by the end of Phase-I, 99 lakh tonnes by end of Phase-II and 142 lakh tonnes by 2008-09 in the third phase. Similar trend is noticed in the case of other crops, the exception being jowar in which case we notice a fall in production. The trend in the growth of production, as indicated by the compound growth rates, suggest that the growth of Output during pre-green revolution period was higher than that during green revolution period.

Chittoor district is the southernmost district of Andhra Pradesh, bounded on the east by Nellore district of Andhra Pradesh and Chengalpattu district of Tamil Nadu; on the west by Salem district of Tamil Nadu and Kolar district of Karnataka; on the south by North Arcot district of Tamil Nadu; and on the north by Anantapur and Kadapa districts of Andhra Pradesh. Chittoor district consists of 66 revenue mandals and 1540 villages, of which 1499 are inhabited. The district is divided into three revenue divisions, viz. Chittoor (20 mandals), Tirupati (15 mandals) and Madanapalli (31 mandals).

Chittoor district is smallest in area but most populous among Rayalaseema districts of Andhra Pradesh. The population of the district, according to 2001 census, was 37,45,875, forming 4.91 per cent of state’s total population. Out of total population of the district, 29, 34,845 (78.35 per cent) are rural and 8,11,030 (21.65 per cent ) are urban. In the year 2001, the density of population of the district was 247 persons per sq.km, as against 201.5 in Rayalaseema and 277 in Andhra Pradesh. The percentage of literates to total population has increased from 25 per cent in 1971, to 32 per cent in 1981, to 43 per cent in 1991 and 66.8 per cent in 2001. Out of the total population district, workers accounted for over 46 per cent in both 1991 and 2001. About 68 per cent of workers were engaged in agricultural sector in 1991, whereas in 2001 the share of this sector has come down to 53 per cent.

The climate of the district is dry and healthy. The rainfall varied between 777.9 mm. during 1971-72 and 1016 mm. in 1989-90 and shows an up and down
trend indicating erratic nature of monsoons. The proportion of area irrigated by tanks declined from 55.63 per cent in 1955-56 to 12.85 per cent in 2008-09. Tube wells, share of which was hardly 1 per cent in 1955-56, accounted for over 69.33 per cent by 2008-09 and became the predominant source of irrigation. Wells, which accounted for over 31 per cent in 1955-56 increased to 62.79 per cent in 1994-95 but declined to 17.63 per cent during 2008-09. Red Loam and Red sand soils formed 57 per cent and 34 per cent respectively of the total land area in the district. These soils are suitable for groundnut, paddy and sugarcane cultivation.

The proportion of area under forests in the geographical area of the district stood at 28.85 per cent in 2008-2009. The net area sown to total geographical area rose from 25.46 per cent to 25.77 per cent between 1955-56 and 2008-09. Chittoor district looks better in the distribution of operated area when compared to state and the country.

During pre-green revolution period, the area under food crops decreased from 3.33 lakh hectares to 3.02 lakh hectares in Chittoor district. Consequently, the proportion of area under food crops in the total cropped area declined from 75.66 per cent to 63.83 per cent. The percentage of area under non-food crops increased from 24 to 36.17. During the green-revolution period, the proportion of area under food crops in the total cropped area declined from over 70 per cent to 51 per cent, while that of non-food crops rose from 30 per cent to 49 per cent. The area under food crops declined at a compound rate of -0.05 per cent during pre-green revolution period and -1.081 per cent during green revolution period. The area under non-food crops, on the other hand, recorded positive and significant growth (4.05 per cent) during pre-green revolution period. During green revolution period, although the growth was positive, it was very low (0.09 per cent) and insignificant.

There is no consistency in the growth of area under rice, groundnut and sugarcane and this may be due to erratic monsoons in the district both during pre-green revolution and green revolution periods. The area under rice has grown at a compound rate of 1.96 per cent per annum before the advent of green revolution and at 0.22 per cent in green revolution phase-I. There was negative growth in phase-II (-2.56 per cent) and phase-III (-4.54 per cent). Groundnut experienced highly significant positive growth during pre-green revolution period (6.87 per cent) and also during phase-I (2.56 per cent) and phase-II (2.80 per cent) during green
revolution. We notice a negative growth, which is not statistically significant in phase-III (-1.81 per cent). A similar trend is noticed in the case of sugarcane not only during pre-green revolution period but also during different phases of green revolution, entire green revolution period and overall period.

Owing to increase in the area under high-yielding varieties and the consequent increase in the demand for improved seeds, the quantity of seeds distributed in Chittoor district increased considerably, especially in the case of rice and bajra. The consumption of fertilizer in the district improved considerably mainly due to spread of new agricultural technology. Between 1997-98 and 2007-08 the number of bank branches in Chittoor district increased from 169 to 201. Around 97,864 farmers have received loans worth Rs.15,452.90 lakhs from public sector banks and 6447 farmers received loans worth Rs.1,095.30 lakhs from private sector banks.

The adoption of new agricultural technology, which involves the use of modern inputs like high-yielding varieties of seeds, fertilizers, pesticides, mechanization and improved credit facilities, has led to substantial increase in the yield rates of important crops. During pre-green revolution period, the per hectare yield of rice rose from 1348 kgs in 1955-56 to 1572 kgs in 1964-65. As the subsequent year happened to be a drought year, the yield has fallen to the lowest level of 1147 kgs. The per hectare yield increased from 1651 kgs to 1732 kgs in phase-I, from 2110 kgs to 2171 kgs in phase-II and from 2626 kgs to 3002 kgs in phase-III of green revolution. The yield of rice has grown at a compound rate of 0.29 per cent during pre-green revolution period, 2.60 per cent in phase-I, 1.50 per cent in phase-II and 1.02 per cent in phase-III during green revolution. Our results suggest that the yield of rice registered a higher rate of growth not only during different phases of green revolution but also in the entire green revolution and the total periods, when compared to pre-green revolution period.

In the case of groundnut, there was a decline in the yield per hectare from 1713 kgs to 598 kgs in pre-green revolution period. It rose from 1034 kgs in 1966-67 to 1329 kgs in 1971-72, but has fallen to 699 kgs in 1980-81 during
phase-I. It increased from 1243 kgs in 1981-82 to 1254 kgs in 1987-88 and has fallen to 789 kgs 1989-90 during phase-II. The yield of groundnut went up from 1391 kgs to 1432 kgs in 1995-96 but subsequently we find a down trend in yield towards the end of phase-III. In the case of groundnut, the growth in yield was negative in pre-green revolution period as well as in different phases of green revolution period.

As regards sugarcane, the per hectare yield increased from 8764 kgs to 14981 kgs in pre-green revolution period, 11801 kgs to 20107 kgs in phase-I, 20855 kgs to 24945 kgs in phase-II and from 25479 kgs to 69982 kgs in phase-III. The yield of sugarcane has grown at a compound rate of a little over 6 per cent during pre-green revolution period and varied between 1.83 per cent and 2.54 per cent during the first two phases of green revolution. During phase-III, it went up at the rate of 17.24 per cent.

The spread of high-yielding varieties and the consequent increase in yield rates has led to increase in production of various crops in the district, although the area under the crops such as rice, groundnut and sugarcane have shown a decreasing trend during the green revolution period. During pre-green revolution period, production of rice rose from 149818 tonnes in 1955-56 to 264203 tonnes in 1964-65. However, the production declined to 134068 tonnes in 1965-66. Similar trend is noticed in the case of the other two crops. During green revolution phase-I, production of rice has increased from 247495 tonnes to 316946 tonnes between 1966-67 and 1979-80. In the following year production has fallen to 157656 tonnes. Similar trend is noticed in the case of groundnut. Sugarcane production exhibited inconsistent trend as production has shown ups and downs and stood at 1318175 tonnes in 1980-81. In green revolution phase-II, the output of fell from 256821 tonnes in 1981-82 to 88152 tonnes in 1986-87 due to shortfall in rainfall. In the subsequent three years, it increased and reached 212000 tonnes by 1989-90. In the case of groundnut, output increased from 282728 tonnes in 1981-82 to 318696 tonnes in 1987-88, but has fallen to 273000 tonnes in 1989-90. Sugarcane output decreased from 1884908 tonnes in 1981-82 to 1750118 tonnes in 1989-90. During green revolution phase-III, the output of rice rose from 146000 tonnes in 1990-91 to 164903 tonnes in 2008-09. Groundnut production increased from 387000 tonnes in 1990-91 to 427000 tonnes in 1995-96 and has fallen to 164878 tonnes in 2008-09.