Aspects of Agriculture and Irrigation In Karnataka

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Abstract

Land and Water are the two most important natural resources in the development of Agriculture. The success of the agriculture mainly depends on proper and scientific utilisation of these resources. Crop productivity can be best optimised on watershed basis when these resources interact in a synergetic manner. In this paper, we discuss the food production activity in Karnataka. Particularly, from the point of view of water usage. The impact of large irrigation projects is also discussed. The preliminary analysis shows that water and fertilizer play an important role in agricultural production. But addition of irrigation has not resulted in any increase in overall food grains production. This means that we need to look at microlevel practices. Trend and regression analysis also show that effects due to these factors are marginal.

Introduction

Agriculture is still a major activity in developing countries like India. Basic needs of human beings - food and energy - are met from agriculture. It forms a major part of the state domestic product. For example the share of agriculture in the State's domestic product was 37% in 1984-87.

Table 1 shows that the agricultural population was 62.5% for India and 71.1% for Karnataka in 1981. Agriculture accounted for only 45.5% of population in the world in 1981 and is decreasing at a slow rate. A reduction of 2 to 3% can be seen for India and Karnataka.

Agriculture needs several inputs - Water is considered an essential input. Initially, small tanks and canals were used for irrigation. New technologies in civil engineering brought in giant irrigation projects. Large dams impounded waters in rivers thereby creating large reservoirs. Canals from these dams are taken through long distances to fields in command areas. These reservoirs normally submerge large prime forest areas. Secondly, if the canals are not constructed properly, water leaks from the canals resulting in water logging of agricultural land near the dam. Salinity of soils is becoming a serious problem now.

Agricultural implements and fertilizer production need industrialization. Industries imply use of natural resources. Industries consume energy. Energy has to come from coal, firewood, oil or electricity. Again electricity may come from large hydro projects which destroy forest areas. Use of pesticides leads to pollution of different kinds - sickness amongst people, generation of new DDT resistant strains of mosquitoes and insects, etc.

Hence it is essential that ecologically friendly agricultural practices be developed, popularised and used extensively. Many agencies and individual farmers invent and use many such practices. Some examples are:

(i) use of biodegradable pesticides

(ii) use of organic fertilizers

(iii) efficient use of fertilizers increasing intake by the plant, reducing wastage and avoiding drainage of fertilizers

(iv) multicrop farming

(v) growing of many species of trees - especially those which provide leaf manure, fix nitrogen in the soil and provide cattle feed and firewood - in the neighbourhood of farms. Sir M. Visvesvariah encouraged such practices in Mandya district.

(vi) better water management practices like desilting tanks, lining of canals, use of drip irrigation, creation of small ponds and recharging ground water.

In this paper, we are looking at the food production activity in Karnataka. Particularly, from the point of view of water usage . The impact of large irrigation projects is also discussed. Table 2 compares India and some other countries in agricultural production.

Agricultural Production in Karnataka

Let us start with some statistics regarding agricultural activities. Table 3 gives the distribution of land holdings in Karnataka for the year 1955-56 and the year 1980-81. The skewed distribution is very well known, we see that 30.8% of the land holders occupied 75.1% of the land in 1955-56. In 1980-81 19.6% of landholders occupied 58.7% of the land. Secondly, small land holders have increased from 11.64 lakhs to 25.46 lakhs (more than double) and from 47.3% to 59.1%. Similarly area has increased from 11.19 lakh ha (10.3%) to 22.76 lakh ha (19.4%) - nearly double. Hence improvements in agricultural practices should be directed towards this class. Further the average size of holding is decreasing from 4.4 ha in 1955-56 to 2.73 ha in 1980-81. The number of farmers to be reached is very large - 43.09 lakhs in 1980-81 and increasing; but fortunately we have a reasonably good agricultural extension service, a well operated agricultural marketing service and until now a well maintained credit service; so we have established mechanisms to reach these farmers effectively.

Table 4 gives the distribution of land holdings in various districts of Karnataka and the growth from 1970-71 to 1980-81. Belgaum, Bijapur, Dharwad, Tumkur and to some extent, Bangalore, Gulbarga, Raichur, Mandya dominate on the number of holdings. Bangalore has shown a decrease of about 16% in the percentage weightage, but the actual number has increased marginally. Similarly Kolar also has a marginal increase in the number of land holders. Bellary shows a large increase in the number of land holders. Districts like Gulbarga, Hassan, Mandya, and Mysore also show increases in the number of land holders.

Table 5 contains area of operation in these districts. Dharwad shows a reduction in the area (about 8%). Except Bidar and Chitradurga, all other districts show an increase in the area of operation. Bijapur, Dharwad, Belgaum, Gulbarga and Raichur dominate in the area.

Table 6 provides the comparison between total area and net area sown for all districts for the year 1984-85. In districts like Bidar, Bijapur, Dharwad, Gulbarga, Raichur and Belgaum land use for agriculture is greater than 74% of the total area. Land use for agriculture is lower in the malnad districts of Uttara Kannada, Shimoga, Kodagu, Dakshina Kannada and Chikmagalur.

Table 7 gives us the area under different crops during the period 70-71 to 88-89. Total area under cereals varies from 59.71 lakh ha in 1970-71 to 54.47 lakh ha in 1988-89 reaching a peak of 68.28 lakh ha in 1987-88. Similarly the area under food grains also shows only marginal changes from - 74.16 lakh ha to 71.54 lakh ha. This means that whenever we create a large irrigation potential, we are not creating additional areas for cultivation (like conversion of fallow lands or C-D class lands). Area under Sugarcane has increased from 1.04 lakh ha to 1.42 lakh ha reaching a peak of 1.98 lakh ha in 87-88. The sufferer of the agricultural policies seems to be the minor millets - area has reduced from 5.43 lakh ha to 2.27 lakh ha - a steady decline. Area under Bajra has come down to 3.99 lakh ha from 5.62 lakh ha. Despite fears, area under ragi has gone up from 10.64 lakh ha in 1970-71 to 11.88 lakh ha in 1988-89; but it shows large variations in the last five years - 11.83 in 1984-85, 10.96 in 1985-86 (a reduction of 9%), 11.66 in 1986-87 (an increase), 10.48 in 1987-88 (a reduction of about 12%) and 11.88 in 1988-89. Area under oil seeds also shows an increase from 13.98 lakh ha to 21.77 lakh ha.

Let us now look at the crop production displayed in Table 8. The production of total cereals during the last ten years is stagnant. The production depends on rainfall - with wide fluctuations. Same trend is true for total food grains production also - there is a downward trend noticeable here. Sugarcane production during the ten years - 77/78 to 88/89 - has shown some improvements - it has reached a peak production of 173 lakh tons in 1987-88 from around 100 tons in 78-79. Coconut production has shown a significant increase - from around 80 lakh tons in 77-78 to 109 lakh tons in 87-88.

Production is not an indication of the efficiency. Yield values for several years for different crops are tabulated in Table 9. Yield figures for Karnataka and India are given in this table. Whereas, the average yield for rice in India has shown an increase from 1120 to 1550 kg/ha, the average yield for rice for Karnataka fluctuates - probably dependent on monsoon/rainfall. Karnataka has a better yield for maize, 2559 kg/ha compared to 1069 kg/ha. But on the whole, no significant improvements in yields are seen. This only confirms the figures presented in Tables 7 and 8.

Another way of looking at food production is given in Table 10. We identify the decade 1969-70 to 1979-80 as one period (period I) and the decade 1979-80 to 1988-89 as another period (period II). We detail the percentage changes during these periods as shown in Table 10. There is an increase in the production in period I due to increase in yields. But the situation is poor in period II. There is a decline in yields and production. There was a wide fluctuation in rainfall during this period. The average per capita production of food grains declined from 184.5 kg in 1967-70 to 160.8 kg in 1986-89. CMIE (Centre for Monitoring Indian Economy) rates the overall performance of Karnataka's agriculture in the latest decade ending 1988-89 as poor.

Irrigation

Water is an essential ingredient for food production. Initially, natural rains provided water supply to agriculture in forest areas. There was no conscious effort to tap water resources. As the population increased, civilizations came up on the banks of rivers. Rain water is available only on the day of rain, but river water is available for a longer duration. Hence dependability increases with river water. In the case of perennial rivers, one can say that production is assured. Further increase in population led to the growth of communities away from riverside also. Then we have the situation of one set of communities depending on rain water only for its agriculture and another on rivers. The first one had an unpredictable situation - if rains were delayed or rainfall was poor in a particular year, the resultant droughts caused major short falls in production and occasional famines.

It is not always possible to use river water effectively. When water is needed - during non monsoon season -, it may not be available in a river in requisite quantities. When river water is not required for agriculture - during rainy seasons -, rivers may overflow causing floods and most of the flood water will flow into the seas. In order to even out the demand-supply function, minor irrigation through tanks was conceived. Many tanks and reservoirs were built to harvest rainwater. It was also possible to have a sequence of tanks connected by canals and waters going to rivers were diverted to these tanks.

Tank based irrigation brought in stability in agricultural production. Tank water was used for other purposes as well - bathing, washing etc. Even now, tanks play a significant role in irrigation.

Technology brought in construction of large dams impounding large waters in a reservoir. Krishnarajasagar on Cauvery is an early example. Our five year plans emphasized this mode of irrigation so as to exploit the maximum amount of water in a river system. A major irrigation project, today, consists of a large/very large dam normally constructed in hilly areas so as to take into account volume efficiency available in valleys, submerging thousands of hectares of mostly forest lands and taking the reservoir water to fields over hundreds of miles by means of canals. Since the activity can be coordinated in a project mode, this is becoming the main mechanism of irrigation in our country.

Since monsoon is not uniform and the tanks and dams tap only rain water, it is possible not to have water for irrigation during drought years. Hence the other component of the water cycle. Water percolates into the soil and forms an extensive grid of underground streams. This is known as ground water. This is a natural way of storage and hedge against drought. Ground water can be tapped by means of wells and bores. We may draw water manually or by means of a mechanised pump. Let us now look at the irrigation situation in Karnataka.

Irrigation in Karnataka

Table 11 contains information pertaining to water availability in several river systems in Karnataka. It also reveals the current utilisation and proposed projects. Even though the average annual yield is around 97,352 M Cu M, most of it (56,600 M Cu M) comes from west flowing rivers. Hence the utilisable water potential is 45,300 M Cu M.

Table 12 illustrates the trend of increase in irrigated area in Karnataka. The net area sown has increased very marginally - an increase of 5.37% in about 29 years. The increase in area under multiple sowing has been quite high - from 3.33 lakh ha to 8.71 lakh ha (an increase of 161.56% in 29 years). Area irrigated has also gone up from 7.11 lakh ha to 15.9 lakh ha - an increase

123.63%. This compares well with the multiple sown area. We can see that the irrigated area under multiple sowings per year is only 4.8% of the total area under multiple sowing in 1955-56 and this has gone up to 40.64% in 1983-84. Hence it is obvious that most of the increases in area for multiple sowing is coming from irrigation.

Table 13 gives a break up of irrigated area by different sources for the years 1986 to 1989. We see that still minor irrigation accounts for most of the irrigated area. Table 14 looks at the increase in irrigated area for different sources. We can see that 45.15% of area came under tank irrigation in the first plan period. But this share of tanks is reduced - to 19.26% in 1984-85. The distribution of area under each source for the districts is illustrated in Table 15. We can see that the number of tanks has decreased in the state marginally. It has however increased in some districts like Bangalore, Belgaum, Bidar, Hassan and Kolar. But ground water tapping is increasing by leaps and bounds.

Whereas the area under minor irrigation is substantial, the investment is low as in evidenced from Table 16. The past fifteen years show that a steady increase in the ratio of spending - favouring major projects - the ratio is around 1:4 to 1:6. Minor projects need more attention.

Table 17 illustrates the percentage utilisation of different distributions of major projects. We can see that we have reached the potential in most of them. Now there may be a decline due to salinity and not an increase. We need to look for new projects.

Another way of improving production of food crops is to increase the yield in irrigated areas. Table 18 gives a comparison of yields for some crops in Karnataka and some other states and Table 19 calculates the possible increase in production in irrigated areas. It shows a possibility of doubling production by improving the yields.

Another aspect of reaching a larger area being experimented now is the dryland development program. Table 20 contains the area under development. Table 21 summarises the data pertaining to area, production, yield of foodgrains, fertilizer use, irrigated area for 33 years from 1955-56. The same is depicted pictorially in figure 1, and for the period 1970-71 to 1988-89 in fig 2. Population in Karnataka is increasing at the rate of 7.85 lakhs per year (Fig. 1). The production of total food grains is stagnant for the last 15 years.

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To see the effect of irrigation and fertilizer on production, trend analysis was done. Production follows an exponential function with respect to fertilizer consumption

$$\text{Production is given by } P = 71.25 \exp\left(\frac{F - 4.24}{2}\right)$$

where F is the fertilizer consumption.

With respect to irrigation (I), it has an inverse relationship given by

$$P = \frac{1}{0.438 \times 10-4\ (I - 24.2)2 + 0.0144}$$

Since the coefficient is very small, we can assume that irrigated area has no influence on production. Another reason may be the diversion of irrigated land to cash crops cultivation

Trend Analysis for Yield

To see the effect on yield, trend analysis was done with yield as the dependent variable. Yield has a quadratic variation with fertilizer consumption as shown by

y = 470 + 221.7 x F - 24.94 F2

This means that larger inputs of fertilizer may not lead to desirable effect on yield. Very large value of F will, in fact, reduce the yield. A precise relationship should be established.

The relationship between yield (y) and fertilizer (F) consumption for the period 1955-56 to 1972-73 comes out to be linear as

y = 504.6 + 111.3 x F

Whereas the same relationship for the second period 1973-74 to 1988-89 is quadratic given by

y = 552.5 + 205.1 * F - 24.91 x F2

This again reinforces the previous conclusion. During the first period, fertilizer usage was very small and so we have a linear increase in yield. But additional use of fertilizer leads to the second relationship which states that there is an upper value for fertilizer usage for maximum yield.

A similar quadratic relationship between yield (y) and irrigation (I) results in

y = 433.7 + 65.61 x I - 1.196 x I2

If we devide the entire period into two periods 1955-56 to 1972-73 and 1972-73 to 1988-89 as before, the relationships are

y = 372.7 + 18.51 x I (linear) (period 1)

y = -165.8 + 100.3 I - 2.21 I2 (period 2)

This also suggests an upper bound for irrigation. But results are inconclusive. We need more data to confirm this and arrive at a meaningful conclusion.

A regression analysis to see the effect of irrigation and fertilizers on yield was made as follows:

Regression Analysis

If we want to compare the effects of both fertilizer consumption and irrigated area, we should do multiple regression. A linear multiple regression analysis leads to the following results.

y = 442.21 + 35.94 F + 13.26 I (for the entire period)

= 538.2 + 51.15 F - 1.71 I (1956-1970)

= 800.83 + 7.64 F + 3.7 I (1970-1989)

This shows that the effects are marginal. Again no firm conclusion can be drawn from this, since available data are not adequate enough to arrive at accurate analysis.

Similar regression analysis for production gives us the following relationship:

P = -98.26 + 2.207 A + 0.28 F - 0.09 I + 0.0219 R

where A - total area, R - rainfall

We can see from the above that we are getting marginal increases from irrigation and fertilizers. We need to improve our practice through the use of environmentally and ecologically sound methods so that long term yields also improve.

Conclusion

The preliminary analysis shows that water and fertilizer play an important role in agricultural production. But addition of irrigation has not resulted in any increase in overall food grains production. This means that we need to look at microlevel practices. Trend and regression analysis also show that effects due to these factors are marginal.

These statements can lead to decision conclusions only after detailed studies based on data at the level of a taluk or district. Such a study will reveal the requirements and limits. Microlevel experimentations by individual farmers have shown increased yields through proper application of water and organic fertilizers.

Emphasis should be towards total land use and corresponding land developments in dryland areas; conserved use of water through efficient water management techniques; proper localised recharging; and use of proper drainage facilities and cropping patterns.

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