

## HOW GREEN IS THE GREEN REVOLUTION IN KARNATAKA ? : A REGIONAL INQUIRY

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**ABSTRACT :** The paper shows how despite an increase in the yields of most crops accompanied by noticeable shifts in cropping pattern, the positive changes and the gains are not comparable to states like Punjab and Haryana or even the delta regions of Godavari, Krishna & Cauvery, largely because of inadequacy of irrigation. The quantum jump witnessed in the yields are confined to only maize, rice and sugarcane which occupy only 13% of the agricultural area. The yields of other crops have largely remained stagnant. Paucity of irrigation has also hindered the spread of multiple cropping.

The phrase *green revolution* was first used by William S. Gaud of the US Dept. of Agriculture in 1968, while referring to the rapid change then going on in the agriculture of India, Pakistan, Turkey and the Philippines due to introduction of the scientifically evolved exotic seed varieties called *High Yielding Varieties* (HYVs) of specially wheat and rice, precisely *Mexican wheat* and *IR-8* rice from the Philippines. These new dwarf varieties matured early and responded to chemical fertiliser doses in terms of grain yield. Further, they required assured moisture at specific time interval and chemicals to protect them from pests and diseases as they were highly vulnerable to these. In all these respects they vastly differed from the local seeds, and also their yield potential was much higher. The new seeds specially of wheat, were adopted by the farmers at an unprecedented scale. In this process, agriculture of the involved areas underwent a drastic change, it becoming more modern,

more productive and also more commercialised than it was ever before.

An attempt has been made in this paper to answer the question - How green is the green revolution in Karnataka? The study is divided into two sections. The first part analyses in general the all - India perspective of the impact of the change in technology. The second section deals with the situation in the state of Karnataka and its four agro - climatic regions<sup>2</sup> with special reference to some key indicators/elements of the change/technology vis-a-vis the other states and India as a whole.

### Section I

#### GREEN REVOLUTION : AN ALL-INDIA PERSPECTIVE

##### Achievements

The HYV programme, which was launched in the country in 1966-67, brought about a major change, a transformation affecting almost

every sphere of Indian agriculture. Between 1966-67 and 1971-72, India's wheat production rose from 113.9 lakh tonnes to 264.1 lakh tonnes and of rice from 304.4 lakh tonnes to 430.7 lakh tonnes. Fertiliser consumption increased from 3 lakh tonnes in 1961 to 28 lakh tonnes in 1972-73; electric pumps number energised rose from 4.2 lakh to 21 lakh; tube-wells number from 19,000 to 7.18 lakh and tractors from 31,000 to 1.73 lakh.

The Pearson Committee Report (1969) hailed it as 'one of the authentic marvels of our time'. Its most important effect was to be seen in the attainment of self sufficiency in cereals (Khusro 1972), which enabled us to have a break from the ship-to-mouth situation. In the words of Dantwala (1979) 'widespread adoption of HYVs has helped to step-up cereals' production, stimulated investment and substantially increased the use of modern inputs'. It enabled us to move forward ahead of our population growth and demand for food (Shah 1984).

### Lacunae in New Technology

In spite of several spectacular achievements, *green revolution*, as it is now widely agreed, has its deficiency segments, and it has also thrown up problems, the removal of which is a major challenge facing the country. The new technology suffers from two specific lacunae : (i) it is so-far available in only two crops namely, wheat and rice, and (ii) its modern input and irrigation requirements are staggering often beyond the reach of small and marginal farmers. In effect, therefore, it is neither product neutral nor region-neutral and uneven effects of growth on products, regions and classes of people..... follow as a consequence' (Ladejinsky, 1973). Its impact is only marginal in nearly 70 per cent of the cropped area, which lacks irrigation facilities,

and on a similar proportion of farmers, who lack the necessary wherewithal to adopt an adequate package of modern inputs and risk-bearing capacity. The main lacuna in the *green revolution* is that it is an unfinished business so far. As DP Singh (1980) says 'we should not delude our-selves into believing that the *green revolution* has been accomplished in India. All that has happened is that we have found a technically feasible and viable technology and have tapped only a fraction of the total potential'. Ladejinsky (1977) adds 'if the new technology is to live up-to its productive role it must be fed properly with the well-known inputs'. A number of sample surveys carried out recently by the Indian Agricultural Statistics Research Institute (IASRI) have revealed that the single most important factor behind the slow and disparate growth is the input differential (IASRI, 1975), which alone can explain the extreme yield variation even under generally similar conditions under both types of technology. Bhalla and Alagh (1979) have clearly shown how 69 districts with the relatively high productivity level, accounting for 20 per cent of cultivated area and 36 per cent of out put, consume 44 per cent of fertilisers, employ 50 per cent of tractors, and 45 per cent of irrigation pumps and have 38 per cent of India's irrigated area. It is now widely agreed that India's food production can be raised many-fold if the input application and cultural practices can be improved for which the scope is considerable not only in the low growth pockets but even in the areas generally rated high (Swarup and Pandey 1981).

### Second Generation Problems

A serious second generation problem resulting from an uneven growth is the imbalance between the production of wheat and rice on

the one hand and of the most other crops, particularly coarse cereals, pulses and oilseeds, on the other. Drastic cropping pattern changes and locational shifts have taken place in the irrigated tracts as the high-yield cereals, particularly wheat, have wrested area from these other crops, specially coarse cereals as also from pulses and oilseeds in the earlier stages. The HYV seeds in the latter group of crops have either not been developed so far at all, or they are not good enough for farmers to risk their adoption (Sud, 1986). Their cultivation, as a result, is fast becoming uneconomic and given-up often in favour of wheat or rice. Also, a peculiar Ricardian process had been operating now for several years as almost all the low yield field-crops are being pushed to lands of low, marginal productivity. Discriminatory allocation of inputs in favour of wheat, rice, sugarcane and in some areas cotton, is further contributing to keep the yields in these other crops low and their cultivation financially unattractive (Narain, 1972). Imbalances in agricultural production have become a serious problem for the country. The Central Government's intervention to remove these through a modified price policy has not made much impact on this situation and a permanent solution to this problem lies only in the development of suitable high yielding varieties of the low yield crops. It is also imperative to continually replace the seeds even in the case of wheat and rice as pests and diseases develop very fast in the high yielding varieties (Dasgupta, 1980). Attention should also be focussed on the traditional varieties, wherever the HYVs are not available so far.

Constantly growing disparities in economic development within and between regions, is another serious problem that the spatially uneven dissemination of the new technology has thrown up. 'Green revolution' has barely

touched the eastern region for want of suitable rice varieties and the arid and semi-arid areas of the western and southern India (Dayal, 1985) due to non-availability so far of viable high yield technology for rainfed areas (Jodha, 1979). The ratio between the lowest and highest yield rates among the states for the 1975-78 period according to a study amounted to 1:3.2 in rice, 1:3.7 in wheat, 1:3.4 in cereals, 1:3.2 in pulses, sugarcane and foodgrains, 1:3.4 in oilseeds, 1:4.9 in cotton and 1:1.6 in jute (Saini, 1980). How restricted spatially is the growth in production is shown by Bhalla and Alagh (1979), the annual growth between triennials ending 1965 and 1973 was substantially high (over 4.5 per cent) in only 43 districts of the 282 covered in the study, it was medium (1.5-4.5 per cent) in 106 districts, low (0.0 -1.5 per cent) in 62 districts, and negative in 71 districts. The regional variation in crop yields between 1966-67 and 1977-78 according to Joshi and Kaneda (1982) has declined marginally in only wheat; it has remained stagnant in rice and has considerably increased in most other cereals, indicating that the disparities in the performance of crops other than wheat and rice is on the rise.

Regional disparities in crop yields can be reduced by evolving suitable disease-resistant high yield strains in rice for the moist eastern parts and by developing irrigation facilities and a suitable dry-farming technology for the arid and semi-arid Western and Southern regions.

## Section II

### GREEN REVOLUTION IN KARNATAKA

The preceding analysis shows how disparate has been the growth and what are the problems thwarting the spread and the success of the new technology in different parts of the

country. We can now briefly examine the success in Karnataka state, the study area, vis-a-vis the country as a whole and some other states and between and within Karnataka's four homogeneous regions together with the lacunae and problems, which have acted as hindrances in the adoption and success of the new technology in the State. The growth in the spread of the high yield technology in the various crops and the rise in the yields due to these is to be viewed in relative terms both across the country and the State, and over time. We specifically focus on three important aspects of the change.

We first examine the growth in the area under the high yielding varieties, which indicates the spread of the new technology, and irrigation coverage of all the HYV/hybrid crops included in the inquiry and per hectare consumption of fertilisers, which two conditions have affected the adoption and the success in the new technology most. Second, we deal with the growth in the yield per hectare of all crops, which *per se* reflects the degree of success in the new technology, and finally, we deal with the growth in the cropping intensity and the total volume of change in the crop-landuse, which have been largely affected by the growth in the crop yield.

### **Area under High Yielding Varieties**

The High Yielding Varieties Programme, launched in the country in 1966-67, aimed at the promotion of the cultivation of the HYV seeds and, with few exceptions, the progress in agriculture in the various parts of India, is in direct proportion to the rate of adoption of these seed varieties.

High Yielding Varieties in rice and wheat and hybrids in jowar, bajra and maize, were introduced in the State in 1965-66 and hybrids in ragi a decade later in 1975-76. From 1966-

67 to 1989-90 the area under the HYVs and hybrids in the 6 crops in the State increased from about 68,000 hectares to 31.4 lakh hectares. It rose from 26,000 hectares to 8.45 lakh hectares in rice; 22,000 hectares to 6.25 lakh hectares in jowar; 18,000 hectares to 2.55 lakh hectares in maize; 10,000 hectares to 3.5 lakh hectares in bajra; and 10,000 hectares to 65,000 hectares in wheat. The hybrid ragi area increased during the 1975-76 to 1989-90 period from 4.75 lakh hectares to 10.13 lakh hectares.

The success in the adoption rate in the HYVs and hybrids in the State, however, was not satisfactory when compared to the several other states and also because of the disparity within the State itself. Only about 55 per cent of the total area under the 6 crops was HYV/hybrid-based in Karnataka in 1989-90 compared to 63 per cent in Maharashtra, 92 per cent in Tamil Nadu and 95 per cent in Punjab. It was even below the all-India average of 61 per cent. The situation, as tabel 1 shows, was no less disparate within the State with the Malnad region having nearly 81 per cent and the North Maidan only 40 per cent. The growth was unsatisfactory particularly in jowar and wheat, only 27 per cent of the former crop was under hybrids in the State in 1989-90 compared to 64 per cent in Maharashtra, where the climate and soil conditions are not much different, and 76 per cent in Tamil Nadu, the all-India average being 48 per cent. Only 24 per cent of the crop was under hybrids in the North Maidan region of the State. This region has nearly 90 per cent of the State's total area of jowar.

In many taluks of this region, specially in Bijapur, Gulbarga and Raichur districts, less than 5 per cent of the crop was hybrid-based. Low rate of adoption of the hybrids in the North Maidan, particularly in the *rabi* crop

was mostly responsible for the low State-average.

Green revolution is often called *wheat revolution* because of the stupendous growth in the crop due to the HYVs in several states, particularly Punjab and Haryana, where almost the entire area of the crop, which occupies 44 per cent and 31 per cent respectively of their TCA had been brought under these varieties within only a few years of their introduction. Karnataka seems to have been bypassed by this change as only about a third of the crop was HYV-based even after 24 years of their introduction and its per hectare yield was only a pittance. Only 26 per cent of the crop was under the HYVs in the North Maidan region of the State, where most of its area is found. The coverage was much smaller in the region's Belgaum, Bijapur and Gulbarga districts below 5 per cent, for example, in Indi taluk of Bijapur and Gadag and Hubli of Dharwad districts, where the crop has a large area.

Even in a crop like rice the State's record is not satisfactory with only 71 per cent of the crop's total area under HYVs in 1989-90 compared to the entire crop being under such varieties decades ago in states like Tamil Nadu, Andhra Pradesh and Punjab. Several taluks of Belgaum, Dharwad, Uttar Kannada and Bidar districts in the State still have up-to a half of the total rice area under local seeds.

In case of Bajra, only 13 per cent of the crop was based on hybrids in Bidar and Belgaum, which two districts have nearly 16 per cent of the State's total bajra area and the state-average of 68 per cent, though higher than the all-India average, is infructuous because of the low, below all-India average yield.

Only in maize and ragi the adoption rate of the hybrids in Karnataka is above the average of

several other states and the yields are the highest in the country in the former crop and nearly so in the latter. Also the growth in these two crops has been more uniform, specially when compared to the other four crops.

The chief reason for the low rate of adoption of the HYVs and hybrids in the above 6 cereal crops in the State is their unsuitability for rainfed areas. Their dependence on timely, assured moisture supply is critical in the case of rice and maize and some irrigation support is essential even in the others and so these crops are either not grown at all or they yield poorly in rainfed areas. The considerable cost in terms of seed, fertiliser, plant protecting chemicals and also irrigation provision is another serious handicap in the new varieties. Adverse trade-term versus the competing crops, specially oilseeds and pulses in more recent years, has further added to the disenchantment with the HYVs and hybrids in the 6 cereals in the State, in specially the rainfed areas. An additional factor for the low adoption rate in case of jowar is the consumer resistance to the hybrid varieties for gastronomic reasons.

It is note-worthy that the 6 cereal crops, in which the HYV and hybrid varieties have been adopted, cover only about 44 per cent of the State's total cropped area and even if and when their entire area is covered by the new seeds, the situation will not be like in Punjab or Haryana - the few crops in which the yields have gone up occupying most of the area. There is, therefore, a need to concentrate not only on the cereal crops like jowar, bajra and wheat but also on the many other non-cereal ones, in which the high yield varieties either have not been evolved so- far, or they are not good enough for the risk. A peculiar case is that

Table 1

## HYV Area Region-wise, 1989-90

(Area in '000 hectares)

Crop/	Coastal Region In hect	Malnad N				Maidan S				Maidan State
		HYV-area		HYV-area		HYV-area		HYV-area		HYV-area
(1)	(2)	In % of total	In hect	In % of total						
Rice	139.4	58.85 (33.9)	230.4	71.15 (70.7)	202.7	66.47 (78.3)	272.9	85.89 (99.0)	845.4	71.44 (75.6)
Jowar	0.5	99.8 (1.8)	39.9	74.15 (19.4)	513.9	24.31 (18.9)	71.4	41.75 (18.2)	625.7	26.75
Bajra	-	-	-	-	347.8	72.0 (13.2)	3.1	10.0	350.9	68.2
Maize	0.2	17.8 (5.3)	12.8	100 (93.2)	167.4	93.52 (40.4)	60.7	100.0 (77.5)	255.3	95.4
Ragi	0.1	30.5 (33.3)	230.0	94.5 (1.32)	56.6	91.7 (2.44)	726.9	84.3 (11.8)	1013.6	86.83 (8.9)
Wheat	-	-	0.06	14.5 (83.0)	64.1	25.98 (91.3)	0.6	100.0 (83.6)	64.8	38.22
Total Six Crops	140.2	58.92 (33.72)	513.2	80.90 (32.6)	1352.5	39.91 (37.97)	1149.8	77.67 (44.99)	3155.8	55.32 (34.82)

Note : Figures in brackets indicate irrigated proportion of crop<sup>3</sup>.

Source for basic data : Directorate of Eco., and stat., Govt. of Karnataka.

of cotton in which, though the hybrid variety DCH-32 has a very high potential when compared to the local seeds, its input requirements, specially in terms of pesticides, are so prohibitive that not many growers can afford its cultivation. The result is that nearly half of the total crop is still under the local varieties. In case of sunflower several open-pollinated hybrid varieties have been introduced since 1972-73,

when the crop was first grown in Karnataka but these have not made much headway in coverage and yield. The story of the other oilseeds and pulses also is the same with no success in sight so-far. There is obviously a need for doubling up the research effort to evolve varieties of cereals, pulses and oilseeds suitable for the rainfed areas and acceptable to the consumers.

Sugarcane, an important cash crop grown entirely irrigated, is an exception in as much as all its requirements of inputs are fully met not only because of the huge cost-benefit advantage that it enjoys over all the other crops, but also as it is virtually a crop of the rich, *elite* farmers in the State.

### Irrigation Coverage

Irrigation is a *sine qua non* for the HYVs and hybrids, more so in the case of rice and maize and to some extent also in the other crops. Assured and timely supply of moisture is essential, specially as it acts as a catalyst for the application of both fertiliser and protecting chemicals, which are essential for the new varieties cultivation. Irrigation is an essential component in the new technology's triad combination of seed-fertiliser-irrigation. The HYV programme has been less successful in Karnataka both in terms of coverage and hectare yields because of the irrigation constraint. The State has, it must be noted, only about 21 per cent of its gross cropped area irrigated compared to 94 per cent in Punjab, 75 per cent in Haryana, 44 per cent in Tamil Nadu and 41 per cent in Andhra Pradesh all of which have a much larger area under the HYVs and also higher than Karnataka's yields in several crops.

The situation is very desparate crop-wise. The HYV-*kharif* rice crop accounts for 55 per cent of the total rice area in the State. Only 68 per cent of it is irrigated and the proportion is reduced to only 35 per cent in Chikmagalur district, 16 per cent in Uttar Kannada district and 9 per cent in Belgaum district. The coverage is practically nil in most taluks of Uttar Kannada district; in Mudigere taluk of Chikmagalur district it is only 2 per cent and in Koppa it is just 13 per cent. The Khanapur and Belgaum taluks of Belgaum district have respectively

9 per cent and 16 per cent of the crop irrigated.

The summer HYV rice crop is extremely important from the yield point of view. The crop, however, so-far occupies only 27 per cent of the total HYV area in the State due to the irrigation constraint, it being a 100 per cent irrigated crop.

Hybrid jowar is mostly a rainfed crop in the State with only about 18 per cent of its area under irrigation. Only 7 per cent of the *rabi* hybrid crop is irrigated in Gulbarga district. In Dharwad and Belgaum districts also the irrigation coverage is poor-17 per cent and 15 per cent respectively. Though the crop here is grown mostly in the *kharif* season, it is often adversely affected by dry spells.

The situation in ragi is equally bad with hardly 8-9 per cent of the hybrid crop covered with irrigation due mostly to a much higher proportion in a few taluks of Chitradurga, Tumkur and Kolar districts. The crop is grown virtually dry-farmed in several taluks of Tumkur (Chiknayakanhalli, Gubbi, Tiptur, Tumkur and Turvekere), all taluks of Bangalore and Hassan districts and in H D Kote, Mysore and Periyapatna taluks of Mysore district.

Hybrid maize cultivation is by far the most satisfactory in Karnataka in view of the entire area of this crop being under the new varieties and the yield rate, which is nearly the highest in the whole country. However, even here there are gaps, eg. only 11 per cent of the crop is irrigated in Mysore district. The situation is more serious in its Periyapatna taluk, which has a huge area under the crop. The crop is also raised almost dry-farmed in Hassan district and in all the other Malnad districts.

HYV - wheat has received a considerable attention in recent years but the adoption rate remains low in the crop in its core area in Bidar, Bijapur, Dharwad, Gulbarga and Raichur districts mainly because of the irrigation constraint in the North Maidan region.

The DCH - 32 cotton hybrid variety faces a problem similar to wheat with a low adoption rate in the core districts of Dharwad, Bijapur, Bidar, Raichur and Gulbarga due to the irrigation constraint to some extent.

Sugarcane, as mentioned earlier, is a prize cash crop in the irrigated tracts of Karnataka. It is not only a 100 per cent irrigated crop, but also hectare-yield in the crop, despite the decline in recent years, remains among the highest in the country.

The position in a host of other crops including small millets, almost all the oil seed crops, and pulses remains dismal with only an insignificant proportion of the crop excepting groundnut, sunflower and Bengalgram, being irrigated. There has been some improvement in the above mentioned three crops mainly because of the favourable trade-term in recent years. There is an urgent need to extend irrigation protection to all these crops along with jowar, bajra and ragi to step-up their yield and production.

### **Fertiliser Consumption**

Chemical fertilisers play a key role in the successful cultivation of the HYVs and hybrids and the potentialities of these varieties can not be realised fully if the plant nutrients through fertiliser application are not fed to them adequately. Yields were low in all crops, including also the 6 crops in which the HYVs were introduced in 1965-66, in the preceding years mainly because the old varieties did not adequately respond to the chemical fertilisers.

Though the consumption of fertilisers has sharply increased in the State, from only 25 kg per hectare of N P K in 1977-78 to 64.37 kg/hect in 1989-90 and 78 kg/hect in 1990-91, the situation could not be viewed satisfactory in view of the fact that the quantum remains much below the prescribed doses in the rainfed crops even in the case of the HYVs and hybrids. The rainfed crops, it must be remembered, occupy nearly a four-fifth of the total cropped area in the State. The situation remains unsatisfactory particularly in the low yield rainfed crops like jowar, bajra, ragi and even rice in some areas. High costs and lack of awareness has also contributed to this problem to some extent. For good results, proper knowledge of the application, right time and right manner and quality of fertiliser is essential. The irrigation constraint is coming in the way of the adoption of the HYVs and hybrids and alongwith that also in the application of fertiliser consumption, though there has been a lot of improvement in the situation and rainfed crops now consume perhaps more fertiliser in the State than in many other parts of the country.

The consumption per hectare in the State in the last year of the study period was only 42 per cent of the level in Punjab, and 56 per cent in Tamil Nadu. Haryana, Uttar Pradesh, West Bengal, Andhra Pradesh and Kerala applied much higher dozes of fertiliser than Karnataka. Adequate dozes of the region - specific requirement will have to be applied for stepping-up the yield and production. There is a need to increase the quantum of the N P K dozes in specially the North Maidan districts of Bijapur, which has the lowest per hectare consumption of only 30 kg per hectare and also in Dharwad, Gulbarga, Bidar, Tumkur and Uttar Kannada districts, in which the level is below the State-average. The disparity between Bijapur and Mandya (185 kg/hect)

1:6.6 is too large and will have to be reduced by increasing the consumption in several districts to obtain a more equitable growth in crop yields in the State.

Although authentic data on the consumption per hectare crop-wise are not available, there is reason to believe that crops like sugarcane, HYV rice and hybrid maize and cotton take by far the major share of the total consumption not only because they are raised mostly irrigated but also due to the cost-advantage they enjoy against most other crops. There is need to correct this imbalance to raise the production in all the crops in the State.

### Crop Yields

How patchy and incomplete is the spread of the HYVs and hybrids and how uneven are the provisions of the other two essential components namely, irrigation and fertiliser, we have seen in the preceding part of this analysis. We shall now examine the disparity in the crop yields with reference to these factors crop wise.

As table 2 shows only five crops, rice, hybrid maize, hybrid ragi, sugarcane and hybrid cotton have substantially high, above all-India average yield in Karnataka. The cause for concern, however, arises from the fact that the average yield of rice in the State has been nearly stagnant since the early 1970s, it has in fact recorded a marginal decline for the 1980-90 decade and its level remains much below the yield in several other States, particularly Punjab, Haryana, Tamil Nadu and Andhra Pradesh. The chief reason for the lower yield and also for a lower growth in it in Karnataka, when compared to the above mentioned four other states, is the lower input level in the three key elements of the new technology ie, the HYV coverage, irrigation

provision and fertiliser consumption, specially in the *kharif* crop, which occupies 80 per cent of the crop's total area in the State and a much larger proportion in the Coastal and Malnad regions of it. The summer crop, it must be noted, has a yield on par with the level in Timal Nadu, but it covers so-far only a small portion (20 per cent) of the crop. Irrigation appears to be the main constraint in the crop due to which the HYVs and the fertiliser consumption also remain low and the *rabi* crop has a small area.

A quantum jump in the hectare-yield can be seen in the State in only maize. Karnataka now has the highest yield, more than double the all-India average and 130 per cent higher than the yield in Himachal Pradesh with the second highest level. The crop is almost entirely irrigated and hybrid-based and also it is known to be a heavy feeder of fertilisers. The crop so-far, however, occupies only a small area (only about 2 per cent of TCA) and its yield has plateaued in recent years the growth declining from 5.2 per cent per annum in 1960-70 to -0.2 per cent per annum in 1980-90. Irrigation paucity is a major hurdle for expanding the maize area.

The performance in ragi has been unique in as much as nearly the whole crop is now hybrid-based, its yield per hectare is above all-India level and this is achieved inspite of it remaining mostly a rainfed crop, though the highest yield in the crop is obtained in a few taluks of Chitradurga, Tumkur, Kolar and Mandya with a considerable irrigation support.

Sugarcane is an entirely irrigated crop, it is based on improved varieties and has a yield level 38 per cent above the all-India average, though it is about 15 per cent lower than the yield in Tamil Nadu, the only State with a higher level, and it had a decline during the study period (from 95 tonnes/hect in

1966-69 to 86 tonnes/hect in 1987-90). The crop's huge requirement in irrigation also poses problems of denial of protective irrigation to the many other crops and alkalinity and salinity due to water logging in sugarcane-cropped areas, specially the North Maidan region.

Among the other crops, the hectare-yield has made an impressive rise in cotton because of

introduction of hybrids, since specially 1981, and it now stands above the all-India average, though still less than half of the yield in Punjab and about 62 per cent of the yield in Gujarat. The main problem in the crop is its huge requirement in pesticides due to which along with the irrigation problem many small and marginal farmers can not take up its cultivation and therefore, nearly half of the

Table 2

## Crop Yield in Karnataka, All-India and Other States 1987-90

(In Kg/hectare)

Crop 1987-90	Karnataka		All-India		Other States	
	Yield/hectare in Kg	C G in 1966-90	% 1980-90 hectare in Kg	per annum in Kg 1987-90	Yield/hect with highest yield per	1987-90
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rice	2048	1.44	-0.6	1637	Punjab	3148
Jowar	726	0.96	-2.6	776	Tamil Nadu	1008
Ragi	1092	2.77	-1.1	1025	Tamil Nadu	1614
Bajra	538	2.33	3.2	544	Tamil Nadu	1090
Maize	2788	1.65	0.1	1343	Karnataka	2788
Wheat	541	2.15	-2.3	2121	Punjab	3600
All-cereals	1113	2.00	-0.5	1843	Punjab	3543
Tur	392	-0.74	-3.0	741	Uttar Pradesh	1263
Bengalgram	380	0.06	-2.6	678	Bihar	803
All-pulses	348	0.04	-1.3	552	Uttar Pradesh	839
Groundnut	842	0.94	2.1	972	Orissa	1273
Sunflower	372	-	-5.3	380	Maharashtra	465
Safflower	529	7.92	-1.0	512	Maharashtra	536
Sesamum	414	1.48	2.6	273	Orissa	520
Sugarcane (tonnes/hect)	86	-0.40	1.3	62	Tamil Nadu	107
Cotton	229	5.20	9.4	211	Punjab	518
Dry Chillies	292	0.21	-	836	Andhra Pradesh	1509
Coconut (nuts/hect)	5150	0.73	-	5848	Tamil Nadu	9158

C.G. - Compound growth rate

\* Source for basic data and compound growth for 1980-90 for Karnataka - Directorate of Eco.&amp; Stat., Govt. of Karnataka.

\*\* Source for basic data for All-India - Directorate of Eco. &amp; Stat., Min. of Agriculture, Govt. of India.

crop is still under the low yield *desi* varieties in the North Maidan region, its core area.

One of the worst performances in the State has been recorded in jowar, the largest crop in the State area-wise. The hectare yield in the crop currently is about 70 per cent of the yield in Maharashtra, Tamil Nadu and Uttar Pradesh. It has risen during the 24-year study period by only 27 per cent with a decline for the 1980-90 decade, because of an extremely low rate of adoption of the hybrid varieties, these covering only 27 per cent of the total crop and because the crop is raised almost entirely rainfed with only 7 per cent of it irrigated. The hybrids have also been unable to make a headway because of consumer resistance to the grain for gastronomic reasons. More irrigation and better varieties, acceptable to the consumers will have to be developed to raise its yield and production and the attention naturally should be on the North Maidan region, where most of this crop is raised.

Bajra cultivation faces a peculiar situation with low yields despite a high rate (68 per cent) of hybrid adoption because of its rainfed cultivation, specially in the North Maidan region. Irrigation constraint similarly has thwarted the cultivation of HYV-wheat, only 34 per cent of the crop being under such varieties and, therefore, one of the lowest yields in the whole country. This crop is also concentrated in the North Maidan region.

Though improved varieties have been introduced in most of the pulse and oilseed crops, their impact so-far has been unimpressive and the yields remain around or below the national average, which itself is very low, because of the unsuitability of these to rainfed areas, in which these are mostly grown, and also due to paucity of irrigation.

In an earlier study by the author it has been proved that the composite yield of 11 crops (rice, jowar, ragi, maize, bajra, wheat, tur, Bengal gram, groundnut, sunflower and safflower) is higher in the South Maidan region compared to the other three regions. A better performance of the HYVs, particularly rice, ragi and maize, which are concentrated here is responsible for this. The Malnad region and the Dakshin Kannada district of the Coastal region come next while the North Maidan region and the Uttar Kannada district of the Coastal region have the lowest level of yield in the State. Low yield of particularly jowar in the North Maidan and of rice in the Uttar Kannada district explain this situation largely. The four regions, it must be noted have more or less a similar distribution pattern in the area under the HYVs, irrigation development and fertiliser consumption.

### **Cropping Intensity**

Increased yields should normally act as an incentive for multiple cropping. This conjecture, however, presupposes a uniform situation in the many physical and cultural factors, particularly ecology, irrigation, size of land holdings, number of agricultural workers etc, which is lacking in the State. Low irrigation development is the worst hurdle in the cultivation of crops in the dry season.

The study reveals that inspite of a 205 per cent increase in the area sown more than once during the study period, the intensity of cropping in the State remains only about half of the all-India average and only a fraction of the level in states like Punjab, Haryana and West Bengal. Within the State, the Coastal region, specially its Dakshin Kannada district with a high rain fall and relatively better developed irrigation system based on well-irrigation has the highest level. The Malnad region, specially its Kodagu district with the

lowest irrigation development in the State, has the lowest development. Besides Kodagu, Chikmagalur, Hassan, Bijapur, Bangalore, Kolar and Tumkur districts also have a low level below the State-average. The recent expansion of irrigation in the North Maidan and Malnad has led to a faster growth of multiple cropping in these regions, though the level still remains below the State-average excepting districts like Shimoga, Bellary and Raichur with a more rapid growth in the irrigation development. The South Maidan had a moderate growth and the Coastal region only a marginal increase. Multiple cropping development is also being thwarted by the cultivation of crops like sugarcane and rice, particularly in the North and South Maidans as these two crops consume disproportionately higher amount of water and - thereby curb the cultivation of the other crops in the dry season.

#### **Total Volume of Change in Crop Land Use**

The cropping patterns in the State have undergone significant changes since the introduction of the new technology. The area of oilseeds, pulses, sugarcane, coconut and chillies has increased, while the proportion of cereals and cotton has fallen. In all about 16 per cent of the total cropped area was involved in these changes, which is high when compared to the all-India average of only 8 per cent and also in relation to many other states. Within the State, it amounted to over 18 per cent in the Malnad region, 17 per cent in the North Maidan, 16 per cent in the South Maidan and 8.5 per cent in the Coastal region indicating that cropping patterns in the last mentioned region have remained more or less stagnant and less affected by the new technology.

The study also shows that the leading crops with a decrease trend were, jowar, cotton and rice and the major gainers were the newly

introduced crop sunflower, by far the most important, and sugarcane, maize, tur, coconut and mulberry. The leading losers and gainers at the regional level were respectively : rice and coconut in the Coastal region; rice and horsegram in the Malnad; jowar and sunflower in the North Maidan; and ragi and groundnut in the South Maidan.

The trend of the changes in Karnataka was different from that of India as a whole in two important respects ie, (i) Unlike in the case of the country as a whole, the main cereal crops in which the HYVs were introduced did not register any sharp increase in their area, and (ii) the crops in which sharp gains in area were registered were non-cereal commercial crops and the increase in these became pronounced from around 1980-81.

Of the three main cereal crops namely jowar, rice and ragi, the first crop indicated a sharp fall in its area while the other two showed a nearly stagnant situation. A relatively low increase in their hectare yield and an unfavourable trade-term in relation to their competing crops, namely sugarcane, oilseeds and pulses were responsible for this trend. Though the hectare yield in bajra and wheat had a substantial increase, its level in physical terms was still low and insufficient to compete with oilseeds and pulses.

Only in maize the increase in the hectare-yield was sharp and the cost-benefit ratio favourable in relation to the competing crops and it therefore, led to a rapid expansion in its area from only 24,000 hectares in 1966-67 to 75,000 hectares in 1972-73 and 2.53 lakh hectares in 1989-90 registering an increase of 8.46 per cent per annum for the study period. The growth perhaps would have been even faster but for the irrigation constraint.

Sharp increase in the area of sunflower, sesamum, safflower, sugarcane, tur, Bengalgram, chillies and coconut reflected the favourable trade-term and a more recent phenomena in all except sugarcane. A disturbing feature of this trend is the persistence of low often below average yields in these crops, except of course sugarcane. HYVs/hybrids have either not been introduced or they have proved unsuitable, specially for the rainfed eastern parts of the State in all these crops excepting sugarcane.

Cotton recorded a sharp fall in its area despite a sharp increase in its hectare yield because of the high cost of the cultivation of its hybrid varieties and low yield from the *desi* varieties making its cultivation unaffordable for many small and marginal farmers in case of the first and uneconomic in the second.

## CONCLUSIONS

Whereas the hectare yields have gone up in almost all crops in Karnataka and there have been sharp area shifts in the cropping patterns in the recent years, revolutionary changes of the type witnessed in states like Punjab, Haryana or even in the deltas of the Godavari - Krishna and Cauvery are so far absent in the State due mainly to paucity of irrigation.

Only 3 crops namely, maize, rice and sugarcane, have witnessed a quantum jump so far in yields for which the new technology is so well-known and they occupy only about 13 per cent of the State's total cropped area. The yields in the vast majority of the other crops

remain low and stagnant. Paucity of irrigation is chiefly responsible for restricting the area of these three crops and also for the low yields in the many others.

Sharp shifts in the cropping patterns in the State have taken place only recently and more due to the change of the trade terms in oil seeds and pulses, which have replaced cereals and cotton in the eastern parts of the State - sunflower, groundnut, tur and Bengalgram replacing jowar and cotton in the North Maidan and groundnut making inroads into ragi area in the South Maidan.

Paucity of irrigation is also responsible for the low incidence of multiple cropping in the State, which is another major indicator of the new technology impact.

## NOTES

1. This study is a part of the research project on 'Green Revolution in Karnataka : A Spatial Analysis' recently completed by the author with grateful assistance from the Indian Council of Social Science Research.
2. The four agro-climatic regions on which this study is based are - the Coastal region including Uttar and Dakshin Kannada districts; the Malnad region including Chikmagalur, Hassan, Kodagu and Shimoga districts; the North Maidan including Belgaum, Bellary, Bidar, Bijapur, Dharwad, Gulbarga and Raichur districts; and the South Maidan covering Bangalore, Chitradurga, Kolar, Mandya, Mysore and Tumkur districts as they existed in 1966-67.

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