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RECENT TRENDS IN AREA, YIELD AND PRODUCTION OF CEREALS IN KARNATAKA: A REGIONAL ANALYSIS

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Indian agriculture has undergone a drastic change in recent years due to the introduction of the HYV crops in 1966-67 and a rapid increase in the irrigated area and use of modern inputs. The yield per hectare of almost all crops has gone up and there has been drastic changes in the cropping pattern. The growth, however, has not been uniform spatially and also among the different crops due to deficiencies in the technology itself and the problems inherent to the farming system of different regions, and has consequently resulted in sectoral shortages and imbalances in production on the one hand and growth in economic disparities between the regions on the other.

There is need to study in depth the progress in each crop and region to understand the problem more clearly, which is necessary for undertaking remedial measures for ensuring the availability of all agricultural products in adequate measure and for a more equitable and faster growth among all crops and regions.

The present inquiry is an attempt in this direction. It first analyses the changes and trends in the area, yield and production of cereals for the period 1966-90 at the State- level and then examines in depth the situation in the four homogeneous regions of the State using taluka-and district-level data.

The inquiry is purely empirical in nature its conclusions based on compound growth rates for the two periods of 1966-90 and 1980-90 for trends, and coefficients of variation for 1966-90 for year - to - year variability. Yield gap has been computed with reference to the best-practice taluka/ district to assess the potential available for increase with the existing technology. Production change has been broken into yield and area effects to examine the cause of the change.

STATE - LEVEL TRENDS

With nearly half of the total cropped area of the State, cereals occupy a predominant position in the cropping pattern of Karnataka despite a decline of about 5 per cent (from 61.32 lakh hectares to 58 lakh hectares) during the study period. Area expansion in major cereals similar to the 'green revolution' states like Punjab and Haryana, was not evident in Karnataka, as table 1 below shows, due to the irrigation constraint in rice and maize, in which the State had high, above national average yields, and because of low financial returns in the several other dry farmed crops, specially jawar, ragi, bajra and wheat. It is notable that in spite of a sharp increase, maize occupies less than 2 per cent of the total cropped area and rice area has stagnated around 10 per cent. Cereals area, as table 2 shows, declined during the study period by 0.21 per

cent per annum on account of decline in the area of jawar, bajra and wheat. Ragi, also a dry farmed crop, fared better with an increase of 0.48 per cent per annum because of the success in the new hybrid varieties in the crop.

A sharp increase in the trade - terms of the dry farmed non - cereal crops, specially oilseeds and pulses, was responsible for the shift of area from cereal to these other crops in the 1980s, (Govt. of Karnataka 1992, Sawant and Achuthan 1995, Nadkarni and Deshpande 1996). Bajra area shrank by over one lakh hectares (3.9 per cent per annum) and the area of wheat declined by 79,000 hectares (4.1 per cent per annum) during the 1980-90 decade for the same reason. To some extent, the shifts indicated a back-lash effect or a reversal of trend from the 1970s in oilseeds and pulses, which were losing area in the wake of the 'green revolution'. Shortage in both the groups led to a spurt in their market prices and hence higher financial returns from their cultivation.

Crop land-use patterns in Karnataka appear wasteful in cases where the land is underutilised in view of the low yields in more than half of the State's total cropped area, where rainfed cereal crops are grown. Improvement in the HYVs of these crops and expansion of irrigated area in the State's semi-arid, unirrigated tracts, where these crops are concentrated is essential to step up the yield and production of these crops.

As table 1 shows, the yields in all cereals remain low below all-India average in Karnataka because of low, below the average cereal yield in jowar, Bajra and wheat, which together occupy more than half of cereals' total area. The State produced only 1113 kg of cereals per hectare in 1987-90 compared to 1843 kg in the country as a whole. All cereals yield recorded a growth of 2.8 per cent per annum in the wake of new technology during the 1970-80 decade, but, as table 2 shows, it plummeted subsequently, falling at the rate of 0.5 per cent per annum for the 1980-90 decade. During this period the yield of jowar fell annually by 2.6 per cent, of wheat by 2.3 per cent, of ragi by 1.1 per cent and of rice by 0.6 per cent.

The droughts in 1982-83, 1985-86 and 1987-88 were a major factor contributing to the decline in the all-cereals yield in the 1980-90 decade. Rice had the decade's lowest yield in 1985-86 and 1987-88. The sharpest fall in jowar yield was recorded in 1982-83, 1985-86 and 1987-88; ragi had the lowest yield in 1982-83, 1984-85 and 1988-89; wheat similarly had a steep fall in 1985-86 and 1987-88. Year-to-year variability in the yields was in fact a significant trait of the trend in these crops in the whole country (Mehra 1981, Hazel 1982, Nadkarni and Deshpande 1982, 1983, Rao *et al* 1988, Vani and Vyasulu 1996).

A major constraint in cereals cultivation in the State is the paucity of irrigation. Irrigation protects crops from droughts, ensures the highest yields under all technologies, and serves as a catalyst in the new seed - fertiliser technology. All the low yield crops in the State (jowar, bajra, wheat and small millets) are mostly rain-fed crops and hence, as explained above, severely affected by droughts.

Paucity of irrigation has also affected the HYV Programme in the State and thereby contributed to the persistence of low yields. Only 27 per cent of the area of jowar and 38 per cent of the area of wheat was under the HYVs in 1987-90 compared to over 60 per cent in Maharashtra and over 75 per cent in Tamil Nadu in the former crop, and over 90

Table 1

Volume of Change in Area Yield and Production of Cereals in Karnataka 1966-69 to 1987-90

Crop	Area in hectares 1987-90	Change in % over 1966-69	Yield in Kg/hect 1987-90	Change in % over 1966-69	Production in tonnes 1987-90	Change in % over 1966-69
1	2	3	4	5	6	7
Rice	1156229 (62.23)	1.04	2048 (1637)	35.44	2257839 (97)	37.40 (3)
Jawar	2303295 (7.49)	-12.69	726 (776)	26.92	1582529 (233)	10.84 (-133)
Ragi	1144601 (9.11)	9.34	1092 (1025)	83.52	1188085 (87)	100.20 (13)
Bajra	482733 (8.40)	-7.98	538 (544)	73.00	247317 (118)	59.68 (-18)
Maize	237556 (76.93)	536.29	2788 (1343)	110.89	631876 (28)	1036.79 (72)
Wheat	250673 (31.02)	-18.33	541 (2121)	60.06	128460 (186)	27.13 (-86)
Total cereals	**5800826 (22.41)**	**-5.04**	**1113 (1843)**	**66.12**	**6131686 (114)**	**49.30 (-14)**

Note : Figures in brackets in column 2 indicate crops irrigated area proportion in per cent; in column 4, crops yield in all-India in Kg/hect; and in columns 6 and 7 the contributions of yield and area respectively to increase / decrease in production in per cent.

Source : Directorate of Eco. and Stat. Govt. of Karnataka.

per cent in Punjab and Haryana in the latter. Irrigation paucity also reflects clearly in the low yield in bajra inspite of over 60 per cent of the crop being covered under HYVs by 1989-90.

To a certain extent, the fall in yield during the 1980-90 decade must have been due to extension of cultivation of cereals, specially rice, jowar and ragi, to marginal lands as all these crops had an increase in their area during this decade.

Though the consumption of fertiliser has sharply increased in the State, from only 25 Kg per hectare of N P K in 1977-78 to 64 Kg/ hect in 1989-90, it is so far less than half of the consumption in states like Punjab, Haryana and Tamil Nadu with higher crop yields. Dry farmed cereal crops yield much lower financial returns than the cash crops like sugarcane and cotton and, therefore, are subject to neglect in terms of all types of inputs and attention vis-a-vis these crops. Rainfed cereals face a vicious circle situation in the resource scarce farming economy.

Karnataka currently contributes only 3-4 per cent to India's total cereals production in 5-6 per cent area due to, as pointed out earlier, low below national average yields in jowar, bajra, wheat and small millets, which together occupy more than 50 per cent of the State's

cereals total area. During the study period, as table 1 shows, cereals' production in the State rose from 41.06 lakh tonnes to 61.31 lakh tonnes, annually rising at 1.68 per cent, which growth was lower than the increase at the all-India level (2.95 per cent per annum). A disconcerting aspect of the trend was the decline in all the cereal crops (by 0.3 per cent per annum) except maize for the 1980-90 decade. Cereals production rose by 2.4 per cent per annum for the 1970-80 decade, the annual growth being as high as 10.1 per cent per annum in maize; 7.3 per cent in ragi; 6.5 per cent and 6.4 per cent respectively in bajra and wheat, and 0.6 per cent in jowar. During the 1980-90 decade on the contrary, the growth in maize production was reduced to 5.5 per cent per annum and in all the other crops there was a decline, its annual rate being as high as 6.5 per cent in wheat.

As pointed out earlier, an increase in yield was mainly responsible for the increase in cereals production for the 1966-90 period, whereas a fall in yield was responsible for the decline (of 0.3 per cent per annum) in it for the 1980-90 decade. A break up of the rise in the production between the initial and terminal trienniums of the study period, as table 1 shows, indicated that the rise in the yield was responsible for the entire increase in production, the area contribution being negative.

REGIONAL TRENDS IN AREA

Though cereals cultivation dominates the cropping patterns all over the State, their areal strength varies from over-80 per cent of TCA in Supa taluk of Uttar Kannada district to only 13 per cent in Pavagada taluk of Tumkur district. Only in small pockets cereals are replaced by the other crops as the dominant ones. These, for example, include the coffee dominated parts of Kodagu and Chikmagalur districts; pulses concentrated areas in Bidar district; tracts of groundnut and cotton domination in Dharwad district; and groundnut dominated cultivation in the eastern parts of the districts from Bellary to Kolar abuting the State's border with Andhra Pradesh. In almost all these and similar other cases, an expansion in the cultivation of these crops at the expense of cereals in the 1980s has led to their dominance.

Among the four regions the highest concentration of cereals as table 3 below shows is in the Coastal region, despite a fall of 18.6 per cent. A high rainfall and rice monoculture largely account for this pattern. In the Uttar Kannada district, the proportion of cereal cropped area rises to over 80 per cent of TCA in Supa and Karwar taluks and 60-70 per cent in all the others, except Honnavar, which has less. In the Dakshin Kannada district Karkal and Mangalore have above 60 per cent of TCA under cereals, while the other taluks, except Sullia, have 50-60 per cent, after a sharp decline in rice area in all. Only 56 per cent of TCA was under cereals cultivation in this region in 1987-90 compared to 71 per cent in 1966-69 due to a sharp decline in rice area(of 26 per cent) in Dakshin Kannada district. A host of other crops including groundnut, coconut, sugarcane and pulses seem to be gaining area at the expense of cereals, specially rice in the whole region.

The Malnad region also has a high concentration of cereals (mostly rice and ragi) cultivation. The regional average (of 50.17 per cent of TCA) is exceeded in Shimoga district due to an expansion in rice area and in Hassan despite a fall in the area of ragi and rice. All the western high rainfall taluks in the former district have 60-70 per cent of TCA under all cereals cultivation. Cereals cultivation is restricted by plantation crops,

Table 2

Trends in Area, Yield and Production of Cereals in Karnataka 1966-90

(In compound growth rates in per cent per annum)

Crop	Area		Yield		Production	
	1966-90	1980-90	1966-90	1980-90	1966-90	1980-90
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Rice	0.30 (4.62)	0.1	1.44 (13.10)	-0.6	1.27 (13.93)	-0.5
Jawar	-0.30 (10.77)	2.3	0.96 (18.87)	-2.6	0.55 (12.78)	-0.2
Ragi	0.48 (6.34)	0.3	2.77 (25.33)	-1.1	3.20 (28.96)	-0.8
Bajra	-0.53 (16.25)	-3.9	2.33 (21.95)	3.2	1.78 (26.97)	-0.9
Maize	8.46 (48.65)	5.4	1.65 (24.13)	0.1	10.00 (48.78)	5.5
Wheat	-1.06 (13.74)	-4.1	2.15 (25.08)	-2.3	1.06 (32.93)	-6.5
Total Cereals	**-0.21 (3.58)**	**0.1**	**2.00 (16.70)**	**-0.5**	**1.60 (15.92)**	**-0.3**

Note : Figures in brackets indicate coefficients of variation in per cent for 1966-90.

Source for basic data and compound growth rates for 1980-90
: Directorate of Eco. and Stat., Govt. of Karnataka.

specially coffee, in Chikmagalur and Kodagu districts, though even here, it rises to over 60 per cent in Sringeri and Holenarsipur taluks. Nearly two thirds of Malnad's TCA was under cereals cultivation in 1966-69, which proportion fell to only 50 per cent by 1987-90 due mainly to a sharp decline in the area of rice and ragi in Hassan district and of rice in Kodagu and Chikmagalur. The trend seems to be towards a greater diversification with oilseeds, coconut and sugarcane gaining in areal strength at the expense of the two dominant cereals.

More than 85 per cent of the State's cereals area lies in the sprawling North and South Maidan regions (their respective shares - 60 per cent and 25 per cent). Cereal's area has declined in both the regions (by 9 per cent and 5 per cent respectively) during the study period. The TCA proportion under these crops in the two regions was 47 per cent and 48 per cent respectively in 1987-90 compared to 55 per cent and 63 per cent respectively in 1966-69. Unlike in the Coastal and Malnad regions the pattern is more diversified here, specially in the North Maidan with several crops forming the cereals group with jowar as the leading crop in the North Maidan and ragi in the South Maidan. Rice is often the only other important cereal crop in the South Maidan, while several

crops including bajra, wheat, maize or even navane occupy a large area in the North Maidan. Also the areal strength of cereals is often inversely proportional to the area under oil seeds, pulses and cotton in the North Maidan and oilseeds and pulses in the South Maidan.

Only a small number of taluks (about 20) have a high proportion of TCA (above 60 per cent)under cereals in these regions, mostly in Bijapur, Raichur and Bellary districts, of the North Maidan and Bangalore, Mandya and Chitradurga districts of the South Maidan. A vast majority of taluks in these districts and also in several others like Belgaum and Mysore, have a medium proportion (40-60 per cent) of the cropped area under cereals. The trend is towards a greater degree of diversification in all with a reduced share of the cereal crops in almost all cases in 1987-90 as compared to 1966-69.

A steep reduction in the area proportion of cereals due to trends in favour of the other crops can be seen very distinctly in the North Maidan in the districts of Dharwad and Belgaum due to expansion of the area under oil seeds, (mostly sunflower) and in Bidar and Gulbarga due to increase in the cultivation of pulses (tur and Bengalgram). In the South Maidan very drastic similar changes can be seen in the belt of taluks from Molakalmuru in Chitradurga district to Srinivaspur in Kolar, groundnut cultivation increasing here several fold, to the level of mono-culture in Bagepalli (Kolar) and Pavagada (Tumkur).

REGIONAL DISPARITY IN YIELDS

Cereals represent a group of crops marked with an extreme disparity in the hectare-yield, which seems to be on the rise in at least some crops. During the study period, it rose from 26.18 per cent to 29.6 per cent in rice, 24.4 per cent to 34.67 per cent in jowar and 21.35 per cent to 26.18 per cent in bajra.

Though there has been an increase in the hectare yield in all districts for the period as a whole, the growth was far from uniform, the South Maidan districts usually showing a higher increase (of 88 per cent compared to only 53 per cent in the North Maidan, 34 per cent in the Malnad and 27 per cent in the Coastal regions). The growth was sharp, above 2 per cent per annum, in only Belgaum, Dharwad and Raichur districts in the North Maidan, and in Mandya district in the South Maidan.

A more disturbing aspect of the trend was a decline in most districts during the 1980-90 period - above 2 per cent per annum in Bidar, Dharwad, Gulbarga, Chitradurga, and Mandya districts. As discussed earlier, mostly rain-fed cultivation of these crops (only 23 per cent of their total area being covered with irrigation so far) and therefore, a severe impact of droughts in 1980-90, was responsible for this situation.

Due mainly to a very low level prevailing in the major cereals of the region (jowar, bajra, wheat and small millets) the yield level remains the lowest in the North Maidan. In 1987-90, the region produced only 826 Kg of cereals per hectare compared to 1113 Kg the State average, and 1427 Kg, 1607 Kg and 1765 Kg per hectare respectively in the South Maidan, the Malnad and the Coastal regions. Relatively higher yields in these regions is attributable to the area under rice cultivation with also a contribution to some extent from ragi cultivation in the Malnad and South Maidan. Both these crops have higher yields than in jowar, bajra, wheat and small millets. The Coastal region has almost the entire cereals

Table 5

Yield Gap in Cereals 1987-90 (yield in kg/hectare)

Crop	State average Yield	Highest yield	Taluk/Dist	Yield gap in %
Rice	2048	3150	K R Nagar	50.8
Jowar	726	3159	Davangere	335.1
Ragi	1092	2542	Harihar	132.8
Bajra	538	1218	Sindhur	126.4
Maize	2788	5342	Davangere	91.6
Wheat	541	1296	Chincholi	139.6
All cereals	1113	1932	Kodagu dist	73.6

Source for basic data : *Directorate of Eco. and Stat. Govt. of Karnataka.*

area under rice; in the Malnad rice and ragi are the dominant crops, specially in Shimoga, Chikmagalur and Hassan districts.

Whereas the low rate of adoption, unsuccessful new seeds and lack of irrigation and other inputs were responsible for the low yields in the cereal crops, particularly in jowar, bajra, wheat and small millets, it is ironical that in almost all crops much higher than the State-average yields have been recorded, as table 5 shows, in different parts of the State. The maximum scope for stepping up yields is found in the non-rice crops in the North Maidan. The production can be raised substantially in all the cereal crops even by reducing the yield gap partly.

REGIONAL DISPARITY IN PRODUCTION

On account of differences in yield and area, the contribution to the cereals production in the State differs among its four regions from only 6.5 per cent in the case of the Coastal region to 44.7 per cent in the North Maidan. Higher Yields are responsible for a much higher share in production than its 4.7 per cent area in the Coastal region. Similarly in only 10.8 per cent area, Malnad produced 15.6 per cent production and the South Maidan contributed about a third of the production in about a fourth of area.

The North Maidan region, where the low yield cereal crops are concentrated and where high yield cereals like rice and maize occupy only a small area, contributes only 45 per cent to the State's production of cereals in 60 per cent area.During the study period, all-cereals' production in the region rose by 29 per cent (from 19.69 lakh tonnes to 27.4 lakh tonnes) due to increase in yield, the area having a negative contribution of 29 per cent. Production increased in all districts of the region, except Gulbarga. However, most of the increment came from only 3 districts namely, Raichur, Belgaum and Bellary. Bijapur, one of the leading producers of cereals, had only a moderate increase and in Dharwad and Bidar its extent was only marginal. Augmented yields were responsible for the increase in production in all the six districts with a positive trend and the area share was either negative (in Bijapur and Dharwad) or only marginally positive (in Belgaum, Ballary, Bidar and Raichur). Area

decline led to the fall in production in Gulbarga, one of the largest producers of cereals in the region. Contrary to the trend for the whole period, the 1980-90 decade indicated a sharp production decline in Bidar (3.4 per cent per annum) and Dharwad (2.9 per cent per annum) in addition to Gulbarga (3.8 per cent per annum). Production in crops like jowar, bajra, wheat and small-millets, which are concentrated here, was more seriously affected in this region, specially its Bidar. Gulbarga and Dharwad districts experienced significant structural changes in cropping patterns due to inroads by pulses and oilseeds as explained earlier in State-level trends.

South Maidan is another important region in cereals production. With ragi and rice as its chief cereal crops, the region has above 33 per cent of the State's total cereals' production in only about 26 per cent area. Cereals' production nearly doubled in this region during the study period, it rising from 10.29 lakh tonnes to 20.34 lakh tonnes and most of the increase (93 per cent) was due to an increase in the yield level. Also the positive trend was shared by all the districts with a 3.78 per cent per annum growth in Chitradurga and 2.70 per cent per annum rise in Mandya, while Kolar had a 1.56 per cent per annum rise. The remaining two districts (Bangalore and Mysore) had a small growth of less than one per cent per annum. This growth would have been much higher, but for the declining trend during the 1980-90 decade in four districts (Bangalore, Chitradurga, Mandya and Mysore) and a stagnant situation with only 0.2 per cent per annum rise in Tumkur district. Only Kolar district showed a strongly positive trend with a 5.6 per cent per annum growth.

The Malnad region accounted for about 16 per cent of the State's total cereal's production in about 11 per cent area due to its higher than State-average yield, particularly in rice and ragi, its chief cereal crops. Another welcome feature of the trend was that the entire increment to production was contributed by the augmented yields, while area remained more or less stagnant. Production increase in Chikmaglur and Shimoga contributed most of the regional increase, in both districts it was largely due to increased yields. The volume of increase was much smaller in Hassan and Kodagu, in both entirely due to yield augmentation, the area contribution being negative. For the 1966-90 period, cereals' production registered an annual increase of 2.18 per cent in Chikmaglur district, 1.67 per cent in Hassan and 1.29 per cent in Shimoga, while Kodagu had a low increase of 0.79 per cent. The trend during 1980-90 decade contrasted with the above pattern, all the four districts of the region registering a decline, which was quite sharp in Hassan (3.3 per cent per annum) and Kodagu (2.3 per cent per annum).

Between the initial and terminal trienniums of the study peroid, cereals production in the Coastal region remained more or less stagnant (3.99 lakh tonnes for the last triennium against 3.84 lakh tonnes for the first) with an increase of only 4 per cent and an annual growth of only 0.58 per cent in Uttar Kannada. An increase in yield led to the production rise entirely in the district with a negative area contribution and largely in the last decade.

Future Prospects

As explained before a considerable disparity obtains in the State in the yields of all the cereal crops. The production in these crops could be stepped up significantly if the potential of gaps between the yields of the best practice taluk/district and all other taluks/ districts is narrowed even partly. Narrowing this gap is also essential for ensuring a more

uniform growth. Stepping up the yields of jowar, bajra, wheat and small millets in the North Maidan is essential for this purpose. Lacunae in the crops including unsuitable and low yield crop varieties, and in the regions, specially irrigation coverage and ecology problems, should be given adequate attention to realise this goal.

NOTES

1. This paper is a part of the research project on 'Green Revolution in Karnataka: A Spatial Analysis' recently completed by the author with financial assistance from the ICSSR.
2. Compound growth rates have been calculated by fitting exponential functions to the index numbers (based on 1966-69=100) in log linear form Y=a+bx; r=(b-1),100 represents the compound growth rate of 'Y' in per cent per annum, where log 'Y' is the dependent variable and 'X' is the independent time variable.
3. Variability is denoted here by co-efficient of variation (CV = SD/X . 100), where SD is the standard deviation and X is the arithmetic mean of the time series data - index numbers based on 1966-69 = 100.
4. Yield gap is an expression of the difference between the yield of the best practice taluk/district and all the other taluks/ districts. It is calculated as-

$$I(yg) = \frac{P(by) - A(oy)}{P(by)} \times 100$$

where I(yg) is the index of yield gap; P(by)is the yield in the best-practice taluk/district and A(oy) is the yield in the other taluks/districts. Yield gap has been calculated for all crops for the last triennium of the study period.

5. The formula used for breaking up the yield and area contributions to the change in production is as below-

Pn - Po = (Yn-yo) An+Ao/2 + Yn+Yo/2 : Where production, area and average yield are denoted by 'Pn','An' and 'Yn' in the new year 'n' and 'Po','Ao' and 'Yo' in the base period 'o' respectively. The first component when divided by (Pn-Po) is taken as contribution due to yield change and expressed in per cent when multiplied by 100. Accordingly the area-share.

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