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Problems and Prospects of Agricultural Development in Bihar

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MAP OF BIHAR
SHOWING AGRO-CLIMATIC ZONES AND DISTRICTS
1974

ZONE I
NORTH WEST ALLUVIAL
PLAIN DISTRICTS
1. WEST CHAMPARAN
2. EAST CHAMPARAN
3. GOPALGANJ
4. BIHAN
5. SARAN
6. BITMARHI
7. MADHUBANI
8. RANCHI
9. DHARAN
10. SAMASTIPUR
11. SAMASTIPUR

ZONE II
EAST ALLUVIAL
PLAIN DISTRICTS
12. PURNA
13. KATIHAR
14. SAHARSA
15. BEGUSARAI
16. MUNGER
17. BHAGALPUR
18. OARA
19. AURANGABAD
20. ROHTAS
21. BHURIDAH
22. PATNA
23. NALANDA
24. NAGINAH

ZONE III
SOUTH WEST ALLUVIAL
PLAIN DISTRICTS
25. GAYA
26. KATIHAR
27. SAHARSA
28. ROHTAS
29. BHURIDAH
30. PATNA
31. NALANDA
32. NAGINAH

ZONE IV
PLATEAU
DISTRICTS
33. HAZARIBAGH
34. GIRDHI
35. SANTHAL PARQANA
36. DURBAN
37. PALAMAU
38. DHANBAD
39. NOBHUM
40. JANIPUR
41. SINGHBHUM
EXECUTIVE SUMMARY

The present study in respect of Bihar is a part of the state specific sectoral study of agriculture initiated by the National Bank in different states at the behest of Hon'ble Union Minister of Finance. Concentrating on the crop sector it was set with the broad objectives of examining growth performance of agriculture - food and non-food crops, sources of growth, crop pattern and area shifts, changes in land-use pattern, growth in use of inputs such as fertilizer, irrigation, HYV seeds and credit, and analyse operational holdings and tenancy status in the state. The analysis was based on secondary data covering the post-green revolution period 1971-93 at the state level and 1977-91 at zone/district level. Major findings of the study alongwith policy implications are summarised below.

Performance of Agriculture:

2. The growth performance of foodgrains production in the state at 0.48% per annum was one of stagnation till 1982-83. The period from 1983-84, however, witnessed accelerated growth rate at 2.73% with low coefficient of variation. It compared well with the growth rates experienced in agriculturally developed states during the eighties. Significantly, much of the increase in foodgrains production during 1984-93 in the state was in rabi season (4.93%), whereas in kharif season production continued to stagnate (0.59%). Accelerated growth rate in rabi foodgrains output was seen in both area and yield increase. Stagnant kharif foodgrains production was largely due to sharp decline in kharif area at (-)1.32% per annum. Analysing the growth performance across different agro-climatic zones, the study observed plateau districts to lag behind. The zones of alluvial plains particularly the South-West Plains recorded accelerated growth rates which was comparable to the rate of growth achieved by agriculturally developed states during the eighties. Significantly, high growth districts generally did not form one geographical cluster.

3. With only 10% area under non-food crops the agriculture of Bihar continued to be largely subsistence in character. Production of some specific non-food crops, however, registered an increase in specific regions. For instance, sugarcane picked up fast in the North-West, and rapeseed/ mustard in the East Plains. Over the years, area shifts were taking place in favour of superior cereals.

4. Among the cereal crops, wheat (3.80%), followed by paddy (3.50%) showed relatively high growth rates. For wheat, both area and yield contributed to growth. In case of paddy growth was due to yield increase, as area showed shrinkage. Summer and winter paddy production witnessed impressive growth performance in the state.
5. Among pulses, production of arhar and gram witnessed reversal largely due to area shrinkage. Districts in the plateau region, however, showed steady growth trend in their production.

**Status of Agriculture**

6. Despite accelerating growth rates in foodgrain as well as non-foodgrain production, the status of agriculture in Bihar was not comparable to agriculturally developed states or even all-India average. With similar area, West Bengal produced more than double of paddy output in Bihar. Similarly, Haryana with half of the area produced almost equal of wheat output to Bihar. The case of other crops such as maize, arhar, gram, sugarcane, rapeseed/mustard, potato, etc. was not different. It was largely because yield of these crops in Bihar was much less than those in agriculturally developed or other states. Moreover, the yield gap between the potential and the actual was large at 50-70% in the state, depending upon the crop and irrigated condition.

**Factors influencing growth of agriculture:**

7. Examining the impact of a set of independent variables on the value of agricultural output, it was observed that fertilizer consumption as also coverage of HYV seeds were the important determinants of agricultural growth in the state. Normal rainfall was equally important to provide stability to the accelerating agricultural growth in the state. Irrigation was not observed to influence the agricultural growth in the state, perhaps, because it has remained stagnant since the mid-eighties.

**Growth in Input Use:**

1. Fertilizer:

8. Consumption of fertilizer increased from 9.06 kg/ha. in 1970-71 to 57.02 kg/ha. in 1992-93. However, it lagged far behind Punjab (162.2 kg/ha.), Haryana (107.0 kg/ha.), Uttar Pradesh (86.0 kg/ha.) and all-India average (67.1 kg/ha.). Across zones/districts it was relatively high in regions with high foodgrains production. It was positively related with irrigation network as well. Some of the districts with low irrigation network in the plains as well showed relatively high consumption of fertilizers, influenced possibly by normal rainfall.

9. In terms of composition, however, fertilizer use was unbalanced in the state, more in favour of nitrogen (67.5%) and deficient in phosphorus (22.5%) and potash (10.0%). Unbalanced use of fertilizer was excessive in
zones/districts with high production of foodgrains as also irrigation network. With elasticity of foodgrains yield to nutrient ratio index being negative the adverse impact of such an unbalanced use of fertilizer was clearly discernible and, therefore, called for gearing up the agricultural extension network in the state, promoting balanced use of fertiliser as also enhanced use of manure and compost in the state.

ii. Irrigation:

10. Despite vast irrigation potential the availability of irrigation in only 43.0% of net sown area was much less in the state. Over the years, it was not increasing either. Again, the fall in net irrigated area by 1.04 lakh hectares for canal, 0.49 lakh hectares for tubewells, 1.62 lakh hectares for other wells and 0.38 lakh hectares for tank/pond irrigation during 1977-91 was a serious cause of concern and called for necessary policy initiative to reverse such trends.

11. Irrigation intensity was low at 122% in the state as against 180.0% in Punjab and 163.0% in Haryana. Districts with high component of cash crops showed relatively high irrigation intensity. Prominent among these districts were Gopalganj (170.0%), Katihar (178.0%) and Purnea (161.0%).

12. Irrigation was used mostly for food crops with their share at around 93.0% in 1990-91. Among the foodgrains it was cereals (93.0%) and among cereal crops it was paddy (46.0%), followed by wheat (40.0%) having dominant share in irrigation. In the plateau zones, however, most of the irrigation was going to non-food crops. With elasticity of irrigation positive on yield, fertilizer consumption, crop intensity and crop diversification, any development strategy aimed at output maximization called for further strengthening of irrigation network in the state.

iii. HYV Seeds:

13. Area under HYV Seeds was expanding in the state with its significant influence on agricultural output. Across different zones/districts the use of HYV seeds was positively correlated with irrigation. In terms of area coverage, however, it was much less as compared to the agriculturally developed states. Again, HYV seeds were available for restricted number of crops, that too under irrigated condition. With almost half of the state under dryland, the available HYV package was quite inadequate for the state. Moreover, seed multiplication rate as also replacement rate was low in the state. In addition to poor supply network, the absence of proper storage facilities and multiplication of quality seeds were reported to be the major constraints in the state.
iv. Flow of Credit:

14. There was a wide gap between credit requirements as estimated by various committees and actual credit flow in the state. In terms of credit available per hectare, it was just Rs. 312/- in Bihar as against Rs. 5,961/- in Kerala, Rs. 2,155/- in Tamil Nadu and Rs. 1,189/- in Punjab in 1992-93. With co-operatives and Regional Rural Banks becoming red, the onus responsibility of credit disbursement seemed to be shared largely by commercial banks in the state. In the context of deposits increasing and advances remaining stagnant, their involvement however remained desirable.

Operational Holdings and Tenancy Status:

15. The state witnessed fast increase in the number of operational holdings thereby reducing the average size of holding and making them operationally non-viable. Skewness in land distribution continued to be serious in the state. High incidence (around 60%) of tenancy cultivation dominated largely by absentee landlords (estimated at around 16.60 lakh ha.) further choked the growth prospects, as such segment of land remained out of investment gamut. High fragmentation of land (17-20 parcels on an average) was still worse, as it restricted and hindered dissemination of modern technology in the state agriculture.

Changing Land Use Pattern:

16. Availability of agricultural land was low at 62.50% in Bihar as against 86.70% in Punjab and 68.10% in U.P. With high current fallow and culturable waste, the net sown area was still low at 45.20% only. The net sown area showed shrinkage at (-) 0.79% per annum largely due to expanding current fallow, area under miscellaneous trees and land under non-agricultural use. In some districts increasing barren land as well explained the declining net sown area. Shrinking net sown area with population increasing fast implied land-man ratio getting further adverse for agriculture in the state. Gross cropped area was declining more as a result of stagnant and inefficient irrigation.

Policy Implications:

17. Despite accelerated growth rate due to enhanced use of modern inputs particularly during the eighties the agriculture of Bihar with low level of output continued to be subsistence in character. The relatively low yield coupled with shrinking area largely explained low level of agricultural output in the state. Lower yield was on account of low use of modern inputs, mainly irrigation, fertilizer and HYV seeds. This was further compounded by
poor flow of institutional credit in the absence of farm investible surpluses. High incidence of concealed tenancy dominated by absentee landlords, and further compounded by high land fragmentation restricted farm investment and diffusion of modern technology to a large extent. Inefficient use of inputs as also indivisible and inappropriate technologies in the local conditions further restricted the growth process. The case of HYV seeds deserves mention, as they were available for restricted crops only, that too under irrigated conditions. Non-divisibility of available mode of irrigation in fragmented land holdings was another example. Declining net as well as gross cropped area nullified the gains of enhanced use of modern inputs.

18. Policy initiatives, aiming at maximisation of agricultural output in the state need, therefore, be emphasised on checking decline in net and gross sown area on the one hand and enhanced use of yield augmenting inputs like irrigation, fertilizer and HYV seeds with more pronounced support from institutional finance on the other. Efficient and balanced use of modern technologies become all the more imperative to sustain the development process. Consolidation of land holdings, providing legal status to tenancy cultivation, opening up institutional finance to lease cultivators and promotion/propagation of technologies suitable in the local conditions with adequate R&D support would further accelerate and consolidate the growth process.

Points of action

19. The following broad points of action could thus be drawn on the basis of foregoing observations and policy implications:

i) Area specific plans/programmes may be drawn and implemented to check water logging and facilitate drainage of flood water, particularly in the north-west, east and south-west plains by promoting percolation tanks or any other such measures appropriate in the local conditions. A separate drainage plan need also be formulated and implemented in the state.

ii) Area specific plan/programmes may also be drawn and implemented to check increasing barren land and soil erosion, particularly in the plateau districts.

iii) Scheme of low cost protective/supplemental irrigation may be given special emphasis to save the crop from wide inter-spell of rainfall.

iv) Initiatives may be taken to expedite land dispute cases to facilitate cultivation of all such lands.

v) R&D effort may be stepped up to facilitate availability of nucleus HYV seeds for a wide range of crops, particularly under unirrigated conditions.

Demand-supply gap for HYV seeds is wide in the state. Given the present
status it is likely to further widen. There is thus a need to enlarge the activity of seed multiplication with necessary credit support from banks.

vii) Infrastructure facilities, mainly storage/godowns at district/block level must receive priority to protect the seeds from spoilage.

viii) Supply arrangements of seeds along with provision of seed certification as well need fresh consideration.

ix) Tenant cultivators as well may be brought under the gamut of production credit by relaxing short term credit norms in the state.

x) Use of compost may be encouraged, particularly by including it as part of the scale of finance for production credit.

xi) Security norms may be relaxed to facilitate institutional credit support to tenant cultivators for land based investment activities.

xii) Regular maintenance of irrigation investment, private or public could be ensured by making it part of the investment cost. Besides, separate schemes covering only infructuous minor irrigation investments may be implemented.

xiii) Separate minor irrigation schemes, involving low cost treadle pumps for marginal and small farmers with fragmented holdings need be promoted in the local economy.

xiv) Economy and efficiency in irrigation are the prime need for the state agriculture. In view of high irrigation cost in the state due largely to use of diesel pumps the schemes for farm electrification need be encouraged.

xv) Efficiency in irrigation under private investment could be achieved by making management of irrigation as part of extension network. In case of public tubewells group management under panchayats could be more effective to bring efficiency in irrigation.

xvi) In order to sustain the accelerated growth process of food as well as non-food crops, as observed particularly in the case of wheat, sugarcane and rapeseed/mustard, there is a need to adopt area and crop specific development plan for all such crops with emphasis on area with larger share in its production.

xvii) Non-food crops such as chilies and tobacco in which the state once excelled in their production but are witnessing reversal in the present deserve separate plan attention.

xviii) For resurrecting declining trend in kharif area, in addition to flood protection measures there is a need to change the cropping pattern and encourage protective irrigation in the state.

xix) For enhanced flow of institutional credit, in addition to relaxing credit norms to cover tenant cultivators, there is a need to amend Chotanagpur Tenancy Act and relaxing Stamp Duty Act to suit the credit delivery system.
MAJOR FINDINGS AND POLICY IMPLICATIONS

The study was set with the objective of assessing performance of agriculture in Bihar by examining the trend and pattern of growth in area, production and yield of foodgrains as also major food and non-food crops across different agro-climatic zones/districts in the state. It also aimed at analysing the cropping pattern and area shift, changes in land use pattern, growth in input use, credit flows operational holdings and tenancy status in the State. The analysis was based on the secondary data from published sources, mainly the Directorate of Economics and Statistics, Government of Bihar. The period of analysis was the post-green revolution era of 1971-93 at the State level and 1977-91 at the zone/district level.* For the purpose of analysis the period under reference was divided into two sub-periods. The first sub-period referred to 1971-83 at the State level and 1977-83 at district level. The second sub-period referred to 1984-93 at state level and 1984-91 at district level. The log linear function was fitted to arrive at the trend rates of growth in area, production and yield of foodgrains as also major crops during the period under reference. In addition, influence of modern inputs such as irrigation, fertilizer and HYV seeds on yield of foodgrains was also examined by fitting double log regression equation. Major observations thus arrived at are summarised as below:

A. MAJOR FINDINGS

a) Performance of foodgrains

2. The growth performance of foodgrains production in Bihar at 0.48% per annum was one of stagnation till 1982-83. The period since 1983-84 however heralded the beginning of a new era triggering increase in foodgrains production in the State at 2.73% per annum. Rate of growth in foodgrains production showed accelerating trend during this period. With growth rate showing low co-efficient of variation during the second sub-period the increasing trend in foodgrains production could be considered to have stabilised in the State.

3. Much of the increase in foodgrains production was experienced in rabi season (4.93%), as production of foodgrains in kharif season continued to stagnate (0.59%). Increase in foodgrains production in rabi season was on account of both area and yield expansion.

4. Despite yield of kharif foodgrains showing increasing trend at 1.90% per annum, production of kharif foodgrains remained stagnant (0.59%). It was due to sharp decline in area under kharif foodgrains ((-1.32%).

* Data at zone/district level was available for 1976-77 to 1990-91.
5. Share of the north-west plains (31.77%) and south-west plains (29.82%) in total foodgrains production of the State was relatively more as compared to other agro-climatic zones. Districts showing high share in foodgrains production of the state included Rohtas (7.30%), Bhojpur (5.65%), Purnea (5.14%) and Santhal Parganas (4.77%).

6. Rate of increase in foodgrains production in the second sub-period was high in the zones of the plains with the south-west taking the lead (5.74%). Plateau zone continued to lag behind with trend growth rate at 3.27% only.

7. Districts to experience relatively high rate of growth (above 5.0%) during second sub-period included Madhubani, Samastipur, Patna, Nawadah, Nalanda, Purnea, Saharsa and Giridih. They did not form one geographical cluster, except a smaller patch of Patna, Nalanda and Nawadah. Districts with high growth were not necessarily those with high foodgrains production or with high growth in yield.

8. Districts to show relatively high increase in yield of foodgrains (above 4.50%) included East Champaran, Madhubani, Samastipur and Vaishali in the north-west; Munger in the east; and Gaya, Santhal Parganas, Giridih, Hazaribagh and Palamu in the plateau region. Districts to show relatively high rate of increase in area under foodgrains included Darbhanga and Muzaffarpur in the north-west; Saharsa in the east; and Nalanda and Nawadah in the south-west plains.

b) Crop-wise performance

9. Among the cereal crops paddy, maize and wheat were the important ones. All these crops showed increasing trend in output. Rate of growth was relatively more for wheat (3.50%) and maize (3.80%) during the second sub-period. For paddy the growth rate was 2.59% per annum. Increase in paddy and maize output was largely on account of yield increase, as area showed stagnant behaviour. Maize showed significant area shrinkage. In case of wheat both area and yield contributed to the growth in output.

10. Growth in wheat output during the second sub-period in Bihar was comparable to those in agriculturally developed states like Punjab and Haryana. However, in case of paddy and maize it lagged far behind other major states.

11. The State lagged behind in terms of yield of these crops also. While yield for wheat in Bihar was 1790 kg/ha., it was 3760 kg/ha. in Punjab.
and 3570 kg/ha. in Haryana in 1990-93. For paddy it was 1001 kg/ha. in Bihar as against 3293 kg/ha. in Punjab, 3117 kg/ha. in Tamil Nadu and 1743 kg/ha. at all-India level.

12. Growth in paddy output was region specific with districts of the south-west plains leading over other zones. Districts with relatively high growth rate in paddy output included Nalanda, Nawadah, Saran, Munger and Palamu.

13. Although winter paddy was dominant in terms of production, rate of growth in production was more for autumn and summer paddy. Yield level also was relatively high for summer paddy. Again, while area declined in respect of winter paddy, it showed increasing trend for both summer and autumn paddy.

14. While winter paddy was cultivated widely across different agro-climatic zones, cultivation of summer and autumn paddy was region specific. For autumn paddy the districts of the north-west plains dominated whereas for summer paddy the districts of the east plains dominated.

15. Production of wheat was district specific, largely in the north-west and south-west plains. Districts with high share in State wheat production included Rohtas (9.92%), Bhojpur (7.43%), Begusarai (5.95%), East Champaran (5.65%), Gopalganj (5.65%), Saran (5.44%) and Siwan (5.27%). Rate of growth was relatively high in less predominant districts such as Sitamarhi (10.39%), Nalanda (9.51%), Nawadah (8.75%) and Hazaribagh (12.02%). Both yield and area increase contributed to growth in wheat output. The rate of growth in wheat production in all such districts was comparable to that in agriculturally developed states.

16. Production of arhar experienced reversal in Bihar, however, at slackened rate in the second sub-period. Decline in arhar production was due to area shrinkage, as yield was found to be increasing. Production of Arhar was region specific with districts of the north-west plains in the lead. These districts as well showed declining trend in arhar production. Compared to other states growing arhar, while Bihar was ahead in terms of yield level, it lagged far behind in production, as area under the crop was much less.

17. Like arhar, cultivation of gram was region specific with the south-west plains alone producing two-third of the State's production. While the State lagged in terms of area under gram, it was way ahead of other states in terms of yield. Reversal in gram production was observed in zones/districts with low area under gram. The zones/districts with dominant share in gram production showed increasing trend in both area and yield.
18. Bihar, ranking ninth among the states, was emerging fast in rape-seed/mustard production, growing annually at 7.34% during the eighties. The yield level in the State compared well with other major states. Both area expansion and yield increase contributed to the growth. Production of rapeseed/mustard was region specific with districts of the north-west and east plains having dominant share. Rate of growth in these districts compared well with major states.

19. In terms of area, yield and production of sugarcane Bihar was next to Uttar Pradesh, Maharashtra and Tamil Nadu. Moreover, production of sugarcane in the State showed declining trend upto 1986-87 with wide year to year fluctuation. From 1987-88 onwards it, however, took an upswing with production reaching the level of 6031.8 thousand tonnes in 1992-93. The upswing in sugarcane production during the second sub-period was attributable to both area expansion and yield increase. Production of sugarcane was region specific with adjacent districts, namely, East Champaran, West Champaran and Gopalganj in the north-west plains having dominant share. Growth of sugarcane production in the state during the eighties was comparable to those in major sugarcane growing states.

20. Bihar has been traditionally growing jute. Jute production showed increasing trend, however, at slackened rate during the second sub-period. Increase in jute production was more due to yield increase, as area remained more or less stagnant. Production of jute too was region specific with the east plains having dominant share. Districts such as Puranea, Katihar and Saharsa were prominent in jute cultivation.

21. In potato production, the State was only next to Uttar Pradesh and West Bengal. It showed increasing trend in both the sub-periods. Increase in potato production was more on account of area expansion, as yield showed declining trend. The yield was disappointingly low (9.15 t/ha.) in the State as compared to major potato growing states. Across different zones, the north-west plains had the lead in its production. Among the districts Samastipur, Puranea, Nalanda and Hazaribagh were leading. In terms of rate of growth, however, Madhubani, Samastipur, Begusarai and Palamu were leading, largely due to area expansion.

22. The State excelled in chilli production till the early seventies. By the turn of eighties, however, it was relegated to the bottom. The rate of decline in chilli production became sharp in the second sub-period (-11.99%), contributed by decline in both area and yield. Further, production of chilli has been region specific with the east and south-west plains leading. Among districts of these zones it was produced largely in Begusarai and Rohtas.
23. The crop group of narcotics and beverages was not significant in the State. Among them, tobacco alone found place of relative prominence and the State ranked fifth in the country in its production. While most of the tobacco growing states recorded significant increase in tobacco production, Bihar showed declining trend during the eighties. It was largely due to sharp decline in the yield level, as area showed increasing trend. Production of tobacco was, however, specific to the north-west plains. Among the districts, Samastipur and Vaishali occupied prime position in tobacco production and both the districts showed increasing trend in its production. Contrary to the general scenario, both area and yield of tobacco in these districts showed increasing trend during the second sub-period.

c) Cropping pattern and area shift

24. With only 8.20% area under non-food crops, the agriculture of Bihar was largely subsistent. Among the foodgrains, cereal crops dominated (80.50%), whereas pulses formed only 11.27%. Across different zones, non-food crops were relatively more dominant in the north-west and east plains. Further, specific non-food crops were grown in specific districts. For instance, while sugarcane was cultivated in a cluster of districts such as West Champaran, East Champaran and Gopalganj, rapeseed/mustard was concentrated in Purvanchal and Begusarai. Similarly, in jute while it was a cluster of districts such as Purnea, Katihar and Saharsa which dominated in its production, Begusarai and Rohtas figured prominently in chilli production. Case of potato and tobacco was no different. In potato production while it was Samastipur, Purnea, Gaya, Hazaribagh and Ranchi which figured prominently, districts such as Samastipur and Vaishali dominated in tobacco production. Districts of east plains were more dominant in cultivation of diversified crops such as jute, chilli and rapeseed/mustard.

25. Analysis of area shifts across different crop groups suggested that cereal crops gained in area, and crop groups such as spices and pulses lost their area during both the sub-periods, however, relatively less in the second sub-period. Crop groups such as oilseeds, fibres and fruits-vegetables as well showed loss of area during the second sub-period. Between the superior and coarse cereals, the former gained in area marginally while the latter lost their area almost in similar measure. Among the superior cereals while wheat gained in area, small millets lost area prominently. Among the pulses, other pulses gained in area and major pulses such as gram and arhar lost their area. Among the oilseeds, rapeseed/mustard gained in area and crops such as linseed and nigerseed lost their area. Among the fibre crops jute alone gained in area while mesta and sunhemp lost their area. Similarly, among the spices while chilli lost its area, turmeric gained in area. Sugarcane as also tobacco gained in area, particularly during the second sub-period.
d) Yield increase - crop-wise comparative analysis

26. Analysing the comparative increase in yield of major crops the broad conclusions are as follows:

i) There was declining trend in yield in respect of jowar and bajra among food crops and chillies, tobacco and potatoes among non-food crops. Rate of decline was relatively high for jowar (-6.47%), modest for bajra (-1.97%), chillies (-2.49%) and tobacco (-2.98%), and marginal for potatoes (-0.19%).

ii) Crops recording high rate of growth in yield included maize (5.14%), small millets (4.27%), rapeseed/mustard (3.07%) and sugarcane (6.02%).

iii) Increase in yield was relatively modest for paddy (2.27%), ragi (2.46%), wheat (2.19%) and other pulses (2.23%).

iv) Rate of yield increase was marginal for barley (1.89%), arhar (1.00%), gram (1.35%), nigerseed (1.74%) and jute (1.65%).

e) Land use pattern

27. The study revealed the following broad conclusions in respect of trend in land use pattern:

i) Availability of land for agriculture was relatively low in the state. As against 86.70% in Punjab and 68.10% in Uttar Pradesh it was only 62.50% in Bihar. Further, it was on the decline in the state from 65.9% in 1970-71 to 62.5% in 1990-91.

ii) With high proportion of current fallow and culturable waste, the net sown area was still less at 45.26%. Again, it showed declining trend (-0.79%) during 1971-93. Part of the shrinkage in net sown area was due to expanding area under miscellaneous tree crops (1.70%) and land under non-agricultural use (0.47%).

iii) Declining trend in net sown area was uniform across different agro-climatic zones, however, relatively more in the plateau districts (-1.44%).

iv) Across different districts the rate of decline in net sown area was relatively high in Sitamarhi (-1.47%) of the north-west plains; Munger (-3.47%) of the east plains; and Santhal Parganas (-1.83%), Ranchi (-1.89%) and Giridih (-1.70%) of the plateau zone. The decline in net sown area was clearly visible in increasing current fallow, barren land, land under miscellaneous tree crops and land under non-agricultural use.

v) There were districts to record high rate of decline in current fallow. They included Gopalganj, Siwan and West Champaran in the north-west; Munger in the east; Nalanda and Nawadah in the south-west; and Dhanbad and
Hazaribagh in the plateau. On the other hand districts such as East Champaran, Madhubani and Sitamarhi in the north-west; Begusarai in the east; and Ranchi in the plateau recorded relatively high increase in current fallow.

vi) There were districts to show increasing trend in area under barren land. Prominent among them included Darbhanga, East Champaran, Sitamarhi and Vaishali in the north-west; Aurangabad and Rohtas in the south-west; and Dhanbad in the plateau zone.

vii) Analysis of cropping intensity revealed that while states like Punjab, Haryana, West Bengal and Orissa recorded significant increase in cropping intensity, it remained by and large stagnant at around 135% in Bihar. This was clearly visible in declining net sown area as well as gross cropped area in the State. The decline in gross cropped area was observed in all the agro-climatic zones, however, more prominently in the plateau zones. Districts to record high rate of decline in gross cropped area included Madhubani and Sitamarhi in the north-west; Munger in the east; Aurangabad and Gaya in the south-west; and Ranchi, Santhal Parganas and Giridih in the plateau zone.

f) Trends and pattern of growth in input use

28. The broad conclusions of the study with regard to trend and pattern of growth in input use in the State are as under:

Fertilizer

i) Fertilizer consumption increased significantly in Bihar from a mere 9.06 kg/ha. in 1970-71 to 57.2 kg/ha. in 1992-93. It still lagged behind states like Punjab (162.2 kg/ha.), Haryana (167 kg/ha.), Uttar Pradesh (86.0 kg/ha.) and all-India average (67.1 kg/ha.).

ii) Across different agro-climatic zones fertilizer consumption was relatively high in the south-west (87.36 kg/ha.) and low in the plateau (25.66 kg/ha.) zone. In districts such as Patna (135.86 kg/ha.), Nalanda (116.74 kg/ha.), Nawadah (92.71 kg/ha.), Begusarai (103.62 kg/ha.) and Bhojpur (87.98 kg/ha.) fertilizer use was comparable to those in agriculturally developed states.

iii) Consumption of fertilizer was high in zones/districts showing higher yield level. Elasticity of foodgrains yield to fertilizer use was positive across different zones/districts. Elasticity of fertilizer use to irrigation was also positive across different zones/districts.

iv) Composition of fertilizer use in the State was unbalanced, more in favour of nitrogen (67.5%) and deficient in phosphorous (22.5%) and potash (10.0%). Across different agro-climatic zones, unbalanced use of fertilizer was more in
the south-west plains showing high foodgrains production, irrigation network
and fertilizer consumption. Districts with excessive share of nitrogen (above
85.0%) included Muzaffarpur and Vaishali in the north-west; Munger and
Bhagalpur in the east; and Bhojpur, Gaya, Nalanda, Nawadah, Patna and
Rohtas in the south-west plains.

v) The adverse impact of excessive use of nitrogen on yield of foodgrains was
clearly observed in different agro-climatic zones/districts as elasticity of
foodgrains yield to nutrient ratio index was negative.

Irrigation

vi) With only around 43.0% of net irrigated area, the coverage of irrigation was
low in the State when compared with vast irrigation potential that the State
is endowed with. Compared to states like Punjab, Haryana and Uttar
Pradesh it was much less.

vii) Of the several sources of irrigation, tubewells followed by canal dominated in
the State. Tubewell irrigation alone showed increasing trend while all other
sources, including canal was declining.

viii) Across different agro-climatic zones/districts, the south-west plain was rela­
tively more irrigated (81.14%). It was the least in the plateau zone (7.19%).
Given the high irrigation potential of the north-west and east plains, cover­
age of irrigation at around 45.0% in these zones was low.

ix) Analysing the growth in canal irrigation, it is observed that while at State
level it showed increasing trend, the north-west and plateau zones showed
shrinkage. Districts to show high decline in canal irrigation included East
Champaran, West Champaran and Gopalganj in the north-west plains; and
Santhal Parganas in the plateau zone. In effect there was a fall of 1.04
lakh hectares in canal irrigation (9.50% of canal irrigation) in all such dis­
tricts during 1979-91.

x) Tubewell irrigation increased in most of the districts, mainly in the plain land.
There were, however, districts such as Muzaffarpur, Munger, Aurangabad
and Rohtas where it showed shrinkage during 1977-91. The aggregate de­
cline in tubewell irrigation in the State during this period was 0.49 lakh hec­
tares which formed 3.53% of total tubewell irrigation in the State.

xi) Irrigation through other wells was prominent in a few districts only, mainly in
the plateau zone. However, most of these districts registered a decline in it,
aggregating to 1.62 lakh hectares. This formed 124.5% of the irrigation
through other wells in 1990-91.

xii) Irrigation through ponds/tanks also showed sharp decline in the state, aggre­
gating to 0.38 lakh hectares during this period. It formed 33.10% of the
aggregate irrigation through ponds/tanks in the State in 1990-91.
xiii) Irrigation intensity was low at 124% for the State as against 180% in Punjab, 163% in Haryana and 140% in Uttar Pradesh. Moreover, over the years it remained stagnant. Across different districts it was relatively high in Gopalganj (170%), Katihar (178%), Purnea (161%) and Rohtas (157%). It was quite low in Saran (93%), Sitamarhi (106%), Vaishali (107%) and Begusarai (107%). Districts with high irrigation intensity were largely those having largely canal and tubewell irrigation.

xiv) Irrigation was used mostly for foodgrain crops with their share in gross irrigated area at 93.07% in 1990-91. Among the foodgrains it was the cereals (92.89%) and of the cereal crops it was paddy (45.55%), followed by wheat (40.08%) and maize (6.84%) which had dominant share in irrigation. Similar was the pattern of irrigation use across different agro-climatic zones, except the plateau where miscellaneous crops had a share of 29.20% in gross irrigated area. In districts such as Dhanbad, Ranchi, Hazaribagh and Giridih share of miscellaneous crops in gross irrigated area was still high exceeding 50.0%.

xv) Examining the level of irrigation for different crops, the study showed that wheat with 85.52% of its area under irrigation had highest coverage of irrigation. For maize and paddy it was 43.15% and 35.47% respectively. Among the non-food crops, rapeseed/mustard and tobacco had higher levels of irrigation which also showed increasing trend.

xvi) The study observed positive influence of irrigation on yield, fertilizer consumption and crop intensity. Crop diversification is not found to be influenced by irrigation.

**HYV Seeds**

xvii) Area under HYV seeds was expanding in the state. However, compared to states such as Punjab, Haryana and Uttar Pradesh coverage of HYV was quite low in Bihar.

xviii) Paddy, despite being a dominant crop, had low HYV area at around 34.0% only as against 94.0% in Punjab and 87.0% in Uttar Pradesh.

xix) While for paddy and wheat HYV area was increasing, in respect of maize it showed declining trend.

xx) Across different agro-climatic zones the HYV area was increasing in respect of paddy, wheat as well as maize in the plain land, but the plateau districts showed declining trend in respect of all these crops.

xxi) Expansion in HYV area for wheat and paddy was region specific. Spread of HYV area was relatively high in districts showing high production of such crops.
xxii) Amidst general scenario of declining trend in maize HYV area, districts with high production showed increasing spread of HYVs.

xxiii) Districts with high irrigation network showed higher coverage of HYV seeds. Similarly, crops with high irrigation showed higher coverage of HYVs. Again, association between fertilizer consumption and coverage of HYVs was strong.

xxiv) Given the yield augmenting effect of HYVs, farmers of Bihar do not seem to wait for irrigation for its use, as HYV area was observed to show high positive elasticity even in districts with low irrigation network, including plateau districts.

**Flow of institutional credit**

xxv) The gap between the credit requirements, as estimated by the Sen Committee/Task Force/Potential Linked Credit Plan, and the actual flow of credit has been wide in the State such that not even 50% of the estimated credit requirements was being disbursed.

xxvi) Compared to other major states the flow of credit in the State was much less. While it was as high as Rs. 5,961 per hectare in Kerala, Rs. 5,155 in Tamil Nadu and Rs.1,189 in Punjab, it was just Rs. 312 in Bihar in 1992-93.

xxvii) The share of agriculture in the total credit flow was high at 67.6% in 1992-93 in the State. However, it showed wide year to year fluctuation which may be causing uncertainty in the use of modern inputs.

xxviii) Role of co-operative credit has reached dwindling level with their share reaching an almost negligible proportion.

xxix) With co-operatives and Regional Rural Banks (RRBs) assuming back seat, the commercial banks alone are playing active role in credit dispensation in the state. However, their involvement remains unbalanced, as advances are remaining stagnant while deposits are increasing.

xxx) District-wise analysis of credit flows clearly suggested that agriculturally more prosperous zones/districts got higher share of credit. It was evident from the relationship between share of the district in total foodgrains production and credit flows in the State.

xxxi) Zonal/Regional biasness in the flow of credit was not reflected in the State. The plateau zone had almost similar share in total credit flows as in other zones. Some of the districts in the plateau zone showed much higher flow of credit per hectare than those in the plain land.
Mounting overdues have become endemic for the State with recovery level as low as 5.0% for PACS and 20.0% for BSLDB. Although commercial banks showed relatively better recovery performance at around 55.0%, it was not as good as in states like Haryana, Punjab and Kerala.

Operational holdings and tenancy status

29. Analysis of operational holdings and tenancy status in the state suggested the following:

i) Number of operational holdings was increasing in the state thereby reducing the average size of holding and making them operationally non-viable. The total area under operational holding on the other hand was declining.

ii) The increasing numerical strength of marginal and small farmers was relatively high in Bihar (86.70%) than the national average (76.20%). The problem was further compounded by increasing sub-divisions and fragmentations.

iii) Although number of large farmers and area operated by them showed sharp decline, the fact that large farmers forming only 0.6%, owned 10.5% of the total operational land indicates the continuation of skewed land distribution in the State.

iv) Concentration of land was district specific with Purnea, Gaya and Muzaffarpur leading among them. The same districts showed fast increase in the number of operational holdings as well.

v) Land possession rate as well as land distribution rate was relatively low in Bihar as compared to other major states. According to studies, the declared surplus land in the State (158.0 thousand ha.) was also observed to be much less than the estimated surplus land (731.0 thousand ha.).

vi) Operational holdings are also highly fragmented with an average of 17-20 parcels. This must have hindered diffusion of modern technology and restricted application of mechanical mode.

vii) Despite prohibition of tenancy cultivation under Bihar Tenancy Act, the incidence of concealed tenancy was high at around 60% in the State. Form of tenancy was largely oral in the State to escape the law. The dominant form of oral tenancy was share cropping (97%) with fixed share in produce as rent. Under such tenancy, according to studies, while the share cropper was left with a net return of 15%, the return to the land owner after deducting cost of land revenue and input costs worked out at around 35.0%.

viii) Despite sharing the input costs, the use of modern input was less in the case of share croppers, resulting into lower productivity. This was largely due to insecurity attached to tenancy cultivation.
ix) The menace of absentee cultivation was equally high in the State. It was estimated at around 16.6 lakh hectares which comes to around 25.0% of the tenant holdings. This segment of land was out of the gamut of any investment, as the sharecropper did not have the surplus nor could they obtain any credit support because of security norms. The land owner was also not interested in investment on these pieces of land.

B. POLICY CONCLUSIONS:

30. The study has revealed that foodgrains production in Bihar has in recent years accelerated and is on stable growth path. However, seen in the context of per capita availability of foodgrains as also the potential that it holds with climatically rich conditions, the production of foodgrains in Bihar can by no means be called adequate. With almost equal area, West Bengal and Uttar Pradesh produced double of paddy output than in Bihar. Similarly, with half the area, Haryana produced almost similar level of wheat as in Bihar. The case of non-food crops is no better with both area and yield relatively much less in the state. The basic ills of foodgrains sector could thus be identified as low yield on the one hand and shrinkage in area on the other. In the case of non-food crops low yield as well as low area, largely unirrigated conditions explains the stagnant situation.

31. Lower yield of food as well as non-food crops could be seen in low off-take of modern inputs, mainly irrigation, fertilizer and HYV seeds. Irrigation was not increasing in the state. It was largely because the flow of investment for creation of irrigation potential (both public and private) was low. Some of the created irrigation potential was found to be getting infructuous thereby nullifying the effect of newly created potential. This calls for regular repair and maintenance of the old irrigation structure on the one hand and larger flow of funds for creation of new irrigation potential on the other. The problem of irrigation was further compounded with low irrigation intensity, more so in the plateau zone, which, in turn could be attributed to operational inefficiency and poor management of the irrigation structure. Declining water table, drying tank/pond/reservoir due to non-preservation and non-availability or release of canal water, also affects the irrigation intensity adversely in the state. Low irrigation could as well be attributed to relatively high cost of irrigation in the state, which is largely using diesel pumpsets. This necessitates replacement of diesel by electric pumpsets. Another reason for low exploitation of ground water as well as pond/tank/reservoir resources for irrigation was inappropriateness of the available technology to exploit these resources, especially in the context of high sub-divisions and fragmentations of land on the one hand and large spread of different parcels of land that farmers operate. This calls for propagation of low cost appropriate irrigation technology suitable to the local conditions in the state.
32. Fertilizer consumption, although increasing, was relatively much less in the state. Low off-take of fertilizer consumption in the state could partly be seen in inadequate flow of institutional credit. Irregular and untimely credit supply further restricted the use of fertilizer and diversion of credit to non-productive use. Prevailing supply mechanism of fertilizer, largely through co-operative network was also not efficient to cater to the needs. Increasing unbalanced use of fertilizer, more in favour of nitrogen adversely affected the crop yield and soil fertility. Unbalanced use of fertilizer was more in regions with larger share of foodgrains production and high irrigation network. Long term adverse effect of unbalanced use of fertilizer on soil fertility gives more cause of concern.

33. The use of HYV seeds was also inadequate in the state. It was available for limited crops only and largely under irrigated conditions. Given the vastness of crop cultivation under unirrigated and dry conditions, there is a strong need for developing and promoting HYV seeds suitable in such situation. Paddy, being the most dominant crop, deserves greater attention in this respect to replace the traditional varieties of paddy with low yield potential. Moreover, the replacement rate of HYV seeds was also inadequate. In the absence of proper infrastructural support the seed multiplication was also inadequate in the state.

34. The facilitating role of institutional credit needs much more strengthening in the state. Agricultural production in the state was increasing despite decline in credit flow. This implies that farmers in Bihar have not waited for institutional credit to enhance use of modern inputs. They have used either their own farm surpluses or income from remittances or depended on borrowing from informal sources. The re-emergence of private borrowing, in the absence of institutional credit, is clearly discernible in the state. The demand for credit in view of increasing use of modern inputs in the state and its resultant impact on enhanced agricultural production confirms the credit absorption capacity of the State. The constraint lies largely in the supply network that may be compounded by the assumptive understanding that Bihar agriculture does not offer adequate business opportunity. The large flight of bank deposits from the resource poor state like Bihar does not conform to this understanding as well. The scenario of credit flow in the state has not undergone a change despite a number of concessory initiatives in the scheme of refinance.

35. The poor flow of institutional credit could be because of the dominance of tenancy form of cultivation of which absentee cultivation is equally pervasive and prominent in the state. Such tenancy cultivators do not have necessary surpluses for farm investments. Nor does the owner cultivator, particularly the absentee ones have the motivation to invest on such piece
of land, as most of them have alternate sources of income, mainly in the service sector. The prevailing security norm for bank loan is prohibitive to cover such types of farmers. Given the socio-political setting it may not be expected to bring fundamental changes in the land relation in the state in the short run. This warrants for making amendments in the prevailing security norm that allows financing to oral tenants as well.

36. With fast increase in rapeseed/mustard area as also resurrection in the production of sugarcane and jute, agriculture in few pockets of the state is getting increasingly diversified. However, the pace of diversification is relatively slow in the state. With the different zones of the state excelling in the production of different crops, the prospects of the state agriculture in further diversification, and even of absorbing Hi-tech agricultural projects and linking to export markets cannot be undermined. For instance, districts of the eastern plains, mainly purnea have excelled in production of jute, rapeseed/mustard, potato and banana in recent years. Similarly, East champaran, West champaran and Gopalganj of the north-west plains have experienced revival in sugarcane production. Districts such as Rohtas and Begusarai have excelled in chilli production. Vaishali and Samastipur excel in tobacco production. Muzaffarpur produces good quality of litchi. In such districts crop specific programmes providing forward and backward linkage support, could bring further impetus in crop diversification process.

37. The other disturbing scenario was the shrinkage in area available for cultivation. Net sown area as well as gross cropped area showed declining trend. Had area under cultivation remained unchanged, given the increase in yield of crops, the crop production in the state could have recorded more impressive performance. The decline in area under cultivation was visibly seen in increasing current fallow as well as barren land, coupled with increase in area under miscellaneous trees and land for non-agricultural use. The increase in current fallow and barren land assumes greater importance. The increase in current fallow land could be seen largely in inadequate drainage facility, largely in the north-west and east plains, as a result of which flood water gets inundated in such low lying areas rendering the land uncultivable or inaccessible for cultivation. Increase in barren land is resulting from increasing alkalinity/salinity, sand deposits/dumes, rising water table, particularly in the east plains as a result of canal irrigation and erosion of soil, particularly in the plateau zone. Policy imperatives thus warrant for a multi-pronged strategy for checking increase in both current fallow and barren land. The need for such a strategy is felt more strongly, particularly in the context of lower net sown area at around 45.0% and higher dependence of population on agriculture for livelihood. Success of green resolution in Punjab was as much due to implementation of drainage scheme and land consolidation in the state through land reform measures as in the use of modern inputs.
C. POINTS OF ACTION

38. On the basis of the broad findings of the study and policy implications thus arrived at, the following major points of action could be suggested:

I) Augmentation of Land Resources

39. There is an urgent need to check the declining trend in net sown area, caused largely by increasing current fallow, area under miscellaneous trees and land under non-agricultural use. Increasing land dispute cases too have led to non-cultivation of land by absentee landlords. The following points of action may be necessary to check the decline in net sown area.

(i) Current fallow, particularly in the plains, is largely due to recurring flood or drought, wide inter-spell of rainfall leading to abandonment of cultivation, and water-logging due to poor drainage, especially in low lying flood prone areas and tail end of canal irrigation. The question of water logging and drainage need to be addressed more seriously. The problem of wide inter-spell of rain could be tackled by promoting the mechanism of protective irrigation to exploit ground water or surface water resources, particularly in the plains.

(ii) Settlement of land dispute cases as also providing secure tenancy with package of incentive programme would also check net sown area from declining.

(iii) Investment programmes/schemes for converting land under miscellaneous trees into cultivable areas may be launched to the extent it is environment friendly.

40. Canal irrigation, particularly in the east plains has brought the ills as well partly by increasing water table leading to alkalinity/salinity of soils and partly by sand deposit. Disposal of canal water at the tail end has also converted the vast land uncultivable. The following measures may be initiated in all such areas by launching area specific schemes.

i) Implementation of area specific schemes to facilitate land treatment at farm level.

ii) Facilitating change of cropping pattern best suited to new condition.

iii) Separate scheme of investment may be launched to cover farmers whose land is affected by canal water by way of sand deposits or erosion.

iv) Land at the tail end of the canal need separate plan attention.

41. Increasing menace of soil erosion is the root cause of land turning barren in the plateau, caused largely by deforestation as well as abandon-
ment of mines. Scale of investment required for treating the abandoned mines or for afforestation programmes may warrant the involvement of corporate sector. This needs to be examined separately.

42. The study clearly revealed that while paddy, maize, small millets, other coarse cereals, arhar, gram, linseed, chillies, etc. showed shrinkage in area; crops such as wheat, rapeseed/mustard, jute and turmeric showed expansion in area. In order to check the decline in area of these crops as also providing necessary impetus to sustain the process of accelerated growth in some of these crops, there is a need to further enlarge crop specific and area specific development programmes after identifying constraints to growth of these crops.

ii) Strengthening flow of inputs

43. Although crop yield has of late been increasing in the state, it is yet to reach the level of agriculturally developed states. Relatively low crop yield in the state is clearly attributable to low use of modern inputs. The following action points are suggested separately for specific inputs.

44. Fertilizer is a major component of modern yield augmenting package. However, its use is observed to be not only low but also unbalanced in the state. The unbalanced use of fertilizer is more in favour of nitrogen and deficient in potash and phosphorous, particularly in intensively cultivated regions. Application of manure and compost is absent. Quality of fertilizer and timeliness of its supply is necessary to enhance the use of fertilizer in a more balanced manner. The following steps would be desirable for enhanced and balanced use of fertiliser in the state:

(i) Tenant cultivators as well may be brought under the gamut of production credit by relaxing norms.

(ii) Supply arrangements for fertilizer also need radical changes to ensure quality as well as timeliness.

(iii) Simultaneous use of compost and manure may be popularised, making them as component of crop loan.

45. Irrigation is basic of the yield augmenting modern package. It was, however, not only low but also inefficient and costly in the state. The following package of programmes would be essential to step up irrigation in the state.

(i) Creating new irrigation potential need to be stepped up, involving more of private investment with adequate and timely credit support.
(ii) Credit support for investment in irrigation may be extended to include tenant cultivators as well.

(iii) Separate schemes for infructuous investments may be implemented to facilitate their utilisation.

(iv) As a measure to reduce cost of irrigation, programme of large scale farm electrification may be emphasised.

(v) Low cost treadle pump, appropriate for fragmented small holdings may be encouraged under plan efforts.

46. Use of HYV seeds was low in the state. Moreover, it was restricted to few crops, that too under irrigated conditions. Paddy, despite being the dominant crop, received neglect in the dissemination of HYVs, particularly the winter variety. Multiplication and replacement rate of HYV seeds were also low. The quality of the HYVs as well has been questioned. The following points of action could be important in the dissemination of HYV seed technology in the state.

(i) The R&D effort to evolve drought resistant HYV seeds for a variety of crops, mainly paddy is of paramount importance.

(ii) Seed multiplication programmes, including those in the private sector may be tagged with bank scheme for necessary financial support.

(iii) Seed certification may be made stringent and scientific.

(iv) Infrastructure for storage of seeds at district/taluk level must be created involving bank support to protect the seeds from spoilage.
CHAPTER I

INTRODUCTION

The growth rate in Net State Domestic Product (NSDP) at factor cost (at 1980-81 prices) in Bihar was 3.12% per annum during 1971-81. It increased to 4.21% during the ensuing period i.e. 1981-91. The per capita income at constant prices (1980-81) increased from Rs.919 in 1980-81 to Rs.1142 in 1991-92, recording an annual growth rate at about 2.0% as against just 0.93% per annum during 1971-81. The growth rate in NSDP of the State was, however, not encouraging when compared with that of all-India average (4.42%) and those in more developed states like Maharashtra (5.10%) and Punjab (5.31%).

1.2 The sectoral analysis of the NSDP suggests that much of the growth in Bihar emanated from the industrial and service sectors which had grown annually at 7.9% and 5.5% respectively during 1981-90. The NSDP from agriculture had grown marginally at 0.16% only during the same period. On the other hand, while industrial sector contributed 17.38% and service sector 28.48% to the NSDP, the share of agriculture sector was high at 51.14% in 1980-81. The relative share of industrial sector in NSDP increased to 25.46% and that of service sector to 34.01% in 1989-90. Consequently, the agriculture sector witnessed a decline in its share to 40.53% in 1989-90.

1.3 Of the total population of 864 lakhs in 1991, around 278 lakhs (32.3%) were main workers in the state, of which 81.1% were engaged in agriculture either as cultivators or as agricultural labourers. With such an overwhelming size of workforce depending on agriculture, and other sectors offering little scope to absorb the growing workforce, the policy thrust has to centre largely around the expansion of agriculture sector in the State. However, it is perceived that performance of agriculture in Bihar, despite the vast potential, has been slender in the preceding few decades. For example, while the growth rate in foodgrains production during 1970-73 to 1990-93 was recorded at 2.60% as all-India average, 4.83% for Punjab, 3.93% for Haryana and 3.35% for Uttar Pradesh, it was only around 1.0% in Bihar. With share of population at 10.21% the State contributed only 6.17% to the country's foodgrains output in 1990-93. Thus while Punjab had per capita per annum availability of foodgrains at 957 kg., followed by Haryana at 575 kg., it was only 121 kg. in Bihar in 1990-91. It was much less than the national average at 201 kg. per annum. Before policy prescriptions are suggested to augment the agricultural production in the state one is led to ask a number of questions as to the status of agriculture and how it has grown across different agro-climatic zones in the state.
becomes equally pertinent to understand growth performance of major crops in the state. The question of input use pattern in the state is no less important to understand the development status of agriculture in the state.

Objectives of the study

1.4 The broad objectives of the present study are thus outlined as follows:

i) To examine the trend of growth in area, production and yield of foodgrains as also major crops in different agro-climatic zones and districts over a period of time in the post green revolution period.

ii) To analyse cropping pattern and examine the area shifts across major crops and crop groups.

iii) To analyse the trend in land use pattern across different zones/districts.

iv) To examine growth in input-use across different agro-climatic zones/districts and its relationship with foodgrains production.

v) To analyse operational holdings and tenancy status in the State.

Methodology

a) Data Base

1.5 District-wise time series data on area, production and yield of major crops as also aggregate of foodgrains, area under different land use classes, sourcewise availability of irrigation, use of various inputs such as irrigation, fertilisers and HYV seeds in agriculture were collected from the Directorate of Economics and Statistics, Government of Bihar, Patna. State level data has been updated by using various issues of Centre for Monitoring Indian Economy (CMIE), Mumbai. Data on credit flows were collected from published sources such as Task Force Report, Statistical Statements relating to Co-operative Movement as published by the National Bank, Currency and Finance of the Reserve Bank of India, etc. For analysis of operational holdings and tenancy status in the State, data from the Agricultural Census Report as also those contained in various published studies/reports were used.

b) Reference period

1.6 The performance of agriculture in Bihar was studied for the post green revolution period in the country i.e. since the early seventies. For State level analysis, therefore, the beginning year was taken to be 1970-
71. In case of zones/districts 1976-77 was taken as beginning year, because it was from this year that the required data on area, production and yield of crops was available in respect of 31 districts which have been considered for spatial analysis. The end year for analysis at State level was taken to be 1992-93, the year for which latest data was available. In the case of zones/districts, the end year was taken to be 1990-91, as it was upto this year that the data at zone/district level was available. Since there was no abnormal rainfall in any of the years during the period under reference, data in respect of all the years was considered for analysis. For analytical purpose the period of study was divided into two sub-periods. The first sub-period was taken to be 1970-71 to 1982-83 at the State level and 1976-77 to 1982-83 at zone/district level. The second sub-period was considered as 1983-84 to 1992-93 at State level and 1983-84 to 1990-91 at zone/district level. The demarcation between the two sub-periods was made on the basis of distinct pattern of increase in foodgrains production as observed from the year 1983-84.

c) Selection of Zones/Districts

1.7 The growth performance of Bihar agriculture has been studied at the State as well as zone/district level. The zonal classification, as defined by Rajendra Agricultural University, Pusa and discussed in Chapter II has been adopted for the present purpose. Selection of districts was complex, as they kept changing since early seventies. Bihar had originally 17 districts which increased to 31 districts in 1973, 38 districts in 1978, 42 districts in 1990 and 53 districts in 1993. For the present study 31 districts as they existed in 1973-74 were considered, because the required data at district level was uniformly available for these districts alone for the period under reference.

d) Selection of crops

1.8 In addition to studying foodgrain production as such, a detailed study was also attempted for specific major crops. Major crops were defined following different criterion for different crop groups so as to give proper representation to different crop groups in the present study. In respect of cereal crops, all such crops having cropped area exceeding one lakh hectares were included. Following this, cereals such as paddy, maize and wheat emerged as major crops in the State. For pulses, data were available in respect of arhar and gram alone. Therefore, these crops alone among the pulses were considered. Production of oilseeds is fairly high in the state. Prominent among them are rapeseed/mustard, linseed, rigerseed, sunflower seed, etc. As rapeseed/mustard occupied almost 50% of the oilseeds area, only this crop has been selected for detailed study. Jute, being
the single most important fibre crop is also included as the major crop. Among spices crops, the State figured prominently in respect of chillies, turmeric, coriander and garlic. From among these crops only chilli is considered, as it occupied the maximum area (around 60%) among spices crops. Sugarcane and potato are the other non-foodgrain crops considered as major crops for the present study, as they covered relatively large area at 142.2 and 167.23 thousand hectares respectively in 1990-93. Among the beverage and narcotics crops, tobacco with 15.6 thousand hectares under its cultivation was the only crop which could be considered as major crop. Thus major crops identified for detailed study include paddy, maize, wheat, arhar and gram among the foodgrain crops; and rapeseed/mustard, sugarcane, jute, potato, chillies and tobacco among the non-foodgrain crops. These crops constituted 86.53% of the gross cultivated area in the state.

e) Analysis of growth rates

1.9 Performance of agriculture was examined in terms of compound annual rate of growth (CARG) in area, production and yield of foodgrains as also major crops during the period under reference. As explained earlier, it was obtained for the total period under reference as also two sub-periods separately in order to comprehend the growth performance in recent years in particular. Exponential trend function was used to estimate the compound annual rate of growth. Inherently, it assumes that the compound growth rate is constant over time and the growth is a continuous phenomena.

Exponential trend equation takes the following form:

\[ Y = A e^{bt} \]

i.e \[ \log Y = \log A + bt \]

Where \( y \) = Area, production and yield of a crop in year 't' (three year moving average has been taken for netting out the seasonal and other fluctuation), 'A' is a constant and 'b' value in this equation expresses the rate of change and when multiplied by 100 gives the percentage growth rate.

f) Acceleration/deceleration of growth rates

1.10 Semi-log quadratic function of the form \( \log Y = a + bt + ct^2 \) was used to study the behaviour of trends in growth rates. The sign of 'C' in this equation conveys whether the trend is accelerating or decelerating with time.
g) Measure of Instability

1.11 Variability in the annual growth rates provides a measure of the degree of instability in production over the specified period. In the present case departure from the trend line has been considered as measure of instability. Accordingly, de-trended coefficient of variation was worked out for the production data series of different crops in different districts/zones using the following formula:

\[ CV = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100 \]

h) Valuation of Agricultural Output

1.12 Performance of agriculture was also measured in terms of compound annual rate of growth in value of agricultural output during 1977-91 at state/zone/district level. Value of agricultural output was obtained by considering 25 food as well as non-food crops which constituted around 98.0% of the total cropped area in the state. Using 1980-81 price of respective crop at state level the physical production of these crops were valued and added up to arrive at aggregate value of agricultural output. On this the compound annual rate of growth was worked out separately for food and non-food crops as also aggregate of agricultural output at state/zone/district level for total period under reference as also two sub-periods.

i) Multiple Regression

1.13 To determine the influence of specified parameters on the value of agricultural output per hectare the multiple regression technique was used in the following form:

\[ Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + \epsilon \]

where,

\( Y \) = value of agricultural output per hectare.
\( a \) = constant
\( x_1 \) = consumption of fertilizer per gross cropped hectare.
\( x_2 \) = percent of HYV area.
\( x_3 \) = percent of gross irrigated area to gross cropped area.
\( x_4 \) = percent deviation in actual rainfall.
\( b_1, \ldots, b_4 \) refers to respective coefficient
\( e \) = error term.
j) Method to study area shifts

1.14 Analysis of area shift was based on CMIE data at State level, as it gave wider scope for crop coverage with longer periods of analysis. The period from 1970-71 to 1992-93 is considered for the analysis. Analysis of area shift was made first for the crop groups and then for the major crops. Crop groups were classified as superior and coarse cereals among the cereal crops, total pulses, fruits and vegetables, oilseeds, fibres, spices and miscellaneous crops. Percentage share of these crop groups in the gross cropped area was worked out for different years and on this the trend growth rate was obtained to determine the direction and rate of shift. Similarly, for major crops percentage share in respective crop groups during the year under reference was worked out and the trend growth rate on this was obtained to assess the direction of area shifts across major crops.

k) Method to study land use pattern

1.15 The land use pattern was studied for the period from 1951-91 at State level. At zone/district level the period 1979-91 was considered, as the required data was available for that period only. Classification of land use, as adopted by the Directorate of Economics and Statistics, Government of Bihar was used for the analysis. Trend growth rates using log linear function was worked out for various category of land use at state/zone/district level for the period under reference.

l) Method to study expansion in the use of modern inputs.

1.16 Of the several modern inputs, three major ones such as fertilizer, irrigation and HYV seeds alone were considered for detailed study, as it was in respect of these modern inputs that the required data were available. Moreover, they are the major constituents of modern inputs in physical terms.

1.17 Expansion in fertilizer consumption was first studied in terms of its physical volume expressed in the form of per hectare of gross cropped area at state/zone/district level. The period under consideration was 1971-93 at state level and 1977-91 at zone/district level. In the second stage, trend growth rate was worked out on this data to determine the direction and rate of change.

1.18 Composition of fertilizer consumption was studied by working out shares of different fertilizer nutrients i.e. NPK at two points of time to examine whether there was balanced consumption of fertilizer in the State and in what direction it was moving across different zones/districts. To fur-
ther supplement the measure of imbalance in fertilizer consumption, the index of nutrient ratio was worked out for different zones/districts.

1.19 To better comprehend the question of how does the unbalanced use of fertilizer influence yield of foodgrains, the elasticity of index of nutrient ratio with respect to foodgrains yield for different zones/districts was worked out.

1.20 Elasticity of fertilizer consumption with respect to foodgrains production, irrigation and rainfall was also worked out.

1.21 Similarly, the elasticity of irrigation with respect to yield of foodgrains, fertilizer consumption, crop intensity and crop diversification were also worked out.

1.22 Relationship of HYV area with irrigation and fertilizer consumption at state/zone/district level was also worked out following simple regression equation considering the period from 1976-77 to 1990-91.

Chapter Scheme

1.23 Based on the analysis thus made, the present study is presented in twelve chapters, viz. I. Introduction, II. Profile of the State, III. Growth performance of foodgrains in Bihar - temporal and district-wise analysis, IV. Growth performance of major crops - temporal and district-wise analysis, V. Analysis of cropping pattern and area shift across major crops, VI. Yield expansion: crop-wise comparative analysis, VII. Trend and pattern of growth in land use - zone/district-wise analysis, VIII. Growth in fertilizer consumption, IX. Growth in irrigation, X. Expansion in the use of HYV seeds, XI. Flow of institutional credit, and XII. Operational holdings and tenancy status.
CHAPTER II
PROFILE OF THE STATE

The state of Bihar is stretched between 27°-31° and 20°-58° North Latitude and 88°-18° and 83°-20° East Longitude, with a total geographical area of 1.74 lakh square km. It is eighth in geographical spread among the states in the country. Physiographically, it is divided in three distinct regions viz. North Bihar, South Bihar and Chhotanagpur plateau regions. The Chhotanagpur plateau region is the largest in size, accounting for 46.0% of the state's geographical area, followed by North Bihar, accounting for 31.0% of the state's area. South Bihar is relatively small with 23.0% of state's area running parallel in stretch from east to west in the middle of the state.

II.2 North Bihar is the most fertile part of the state, largely falling under the Gangetic plains. Topography of North Bihar is entirely plain with drainage from west to east submerging in the river Ganges. South Bihar has also plain topography, but its drainage emanating from the plateau region has south to north direction, merging again into the Ganges. Topography of Chhotanagpur region on the other hand is undulating with several plateaus with altitudes ranging from 300m and 1000m above sea level having valleys in between.

i) Agro-climatic zones

II.3 While demarcating the agro-climatic zones of the country, the planning commission categorised the districts of Bihar into two zones and three sub-zones. The two zones are : Middle Gangetic plains into which falls sub-zone named North-East Alluvial, consisting of districts such as Aurangabad, Begusarai, Bhagalpur, Darbhanga, Gaya, Gopalganj, Katihar, Khagaria, Madhepura, Madhubani, Munger, Muzaffarpur, Nalanda, Nawadah, West Champaran, Patna, East Champaran, Rohtas, Saharsa, Samastipur, Saran, Sitamarhi, Siwan and Vaishali. This stretches from west to east in the northern plains as also in the south-west parts of the state. The second zone is ‘Eastern plateau and Hills’, consisting of two sub-zones. The first of such sub-zone is ‘North Central Plateaus’ with districts such as Deoghar, Dhanbad, Giridih, Gonda, Hazaribagh, Sahebganj and Dumka. The second such sub-zone is ‘Eastern Plateau’, consisting of districts such as Gumla, Lohardagga, Palamu, Ranchi and Singhbhum.

II.4 The Rajendra Agricultural University, Pusa, however, classified districts of Bihar into four comprehensive agro-climatic zones as shown in Table II.1.
Table 11.1
Agro-climatic zonewise distribution of districts in Bihar

<table>
<thead>
<tr>
<th>Zones</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. North-West Alluvial</td>
<td>West Champaran, East Champaran, Siwan, Saran,</td>
</tr>
<tr>
<td>plain districts.</td>
<td>Sitamarhi, Muzaffarpur, Valshali, Gopalganj, Darbhanga,</td>
</tr>
<tr>
<td></td>
<td>Madhubani and Samastipur.</td>
</tr>
<tr>
<td>2. East Alluvial plain</td>
<td>Purnea, Katihar, Araria, Kishanganj, Supaul, Saharsa,</td>
</tr>
<tr>
<td>districts</td>
<td>Madhepura, Begusarai, Munger, Jamui, Khagaria, Bhagalpur and Banka.</td>
</tr>
<tr>
<td>3. South-West Alluvial</td>
<td>Gaya, Jahanabad, Aurangabad, Rohtas, Bhojpur, Buxar,</td>
</tr>
<tr>
<td>plain districts</td>
<td>Bhabua, Patna, Maldaha and Newadih.</td>
</tr>
<tr>
<td>4. Plateau districts</td>
<td>Hazaribagh, Chatra, Giridih, Dhanbad, Bokaro, Patamuk,</td>
</tr>
<tr>
<td></td>
<td>Garhwa, East Singhbhum, West Singhbhum, Dumka,</td>
</tr>
<tr>
<td></td>
<td>Deoghar, Sahibganj, Godda, Ranchi, Gumla and Lohardaga.</td>
</tr>
</tbody>
</table>

ii) Climate

11.5 The climate of the state is hot summer, wet monsoon and dry cool winter with maximum temperature reaching above 45°C in June. The minimum temperature reaches below 5°C during January.

11.6 The climatic condition of the north-east alluvial sub-zone, as defined by the Planning Commission, is dry sub-humid to moist sub-humid with average annual rainfall at 1470 mm, mostly falling during monsoon season from mid-June to September-October, often causing severe flood mainly in the upper reaches, more often two-three times in a year. In the north-central plateau sub-zone, the climate varies between most sub-humid and dry sub-humid, with average annual rainfall at 1296 mm which is slightly less than the north-east alluvial sub-zone. The climate of eastern plateau is temperate with mercury rising as high as 45°C in June. Although, the average rainfall is similar to the north-central plateau, it is highly erratic causing frequent drought conditions.

iii) Dependence on Rainfall

11.7 With only 43.7% of the net irrigated area, that too having low intensity of use at 125%, the agriculture of Bihar depends heavily on rainfall. But, the pattern of rainfall was highly erratic in Bihar in recent years. There is either excessive rainfall, causing flood, especially in the north Bihar, damaging the standing crops or having deficient rainfall aggravating drought conditions, more so in the central and plateau regions of the state. Besides, delayed arrival of monsoon as also wide inter-spell have been intermitent in the preceding few decades. Besides, deficiency in rainfall -
both in the plateau and plain regions of the state, has been a common feature with wide year to year fluctuations. Details can be seen from Table II.2.

### Table II.2
Season-wise rainfall in Bihar

(Rainfall in mm.)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{PLATEAU} )</td>
<td>( \text{PLAINS} )</td>
<td>( \text{PLATEAU} )</td>
<td>( \text{PLAINS} )</td>
<td>( \text{PLATEAU} )</td>
<td>( \text{PLAINS} )</td>
<td>( \text{PLATEAU} )</td>
</tr>
<tr>
<td>June-Sept.</td>
<td>1102 1079</td>
<td>771 1069</td>
<td>895 1062</td>
<td>885 1019</td>
<td>665 1025</td>
<td>948 1018</td>
</tr>
<tr>
<td>\ [+0.21 ]</td>
<td>\ [+0.09 ]</td>
<td>\ [+0.15 ]</td>
<td>\ [+0.13 ]</td>
<td>\ [+0.35 ]</td>
<td>\ [+0.9 ]</td>
<td>\ [+0.9 ]</td>
</tr>
<tr>
<td>Oct.-Dec.</td>
<td>51 100</td>
<td>17 101</td>
<td>80 99</td>
<td>10 75</td>
<td>51 74</td>
<td>53 75</td>
</tr>
<tr>
<td>\ [-0.49 ]</td>
<td>\ [-0.83 ]</td>
<td>\ [-0.19 ]</td>
<td>\ [-0.86 ]</td>
<td>\ [-0.31 ]</td>
<td>\ [-0.29 ]</td>
<td>\ [-0.39 ]</td>
</tr>
<tr>
<td>Jan.-Feb.</td>
<td>3 45</td>
<td>8 43</td>
<td>35 45</td>
<td>3 32</td>
<td>13 30</td>
<td>42 31</td>
</tr>
<tr>
<td>\ [-0.93 ]</td>
<td>\ [-0.81 ]</td>
<td>\ [-0.22 ]</td>
<td>\ [-0.22 ]</td>
<td>\ [-0.36 ]</td>
<td>\ [+0.25 ]</td>
<td>\ [+0.5 ]</td>
</tr>
<tr>
<td>March-May</td>
<td>42 93</td>
<td>30 81</td>
<td>45 92</td>
<td>31 70</td>
<td>32 59</td>
<td>31 72</td>
</tr>
<tr>
<td>\ [-0.55 ]</td>
<td>\ [-0.56 ]</td>
<td>\ [-0.35 ]</td>
<td>\ [-0.56 ]</td>
<td>\ [-0.45 ]</td>
<td>\ [-0.56 ]</td>
<td>\ [-0.56 ]</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1198 1317</td>
<td>832 1306</td>
<td>1055 1298</td>
<td>939 1196</td>
<td>761 1189</td>
<td>1074 1194</td>
</tr>
<tr>
<td>\ [-0.19 ]</td>
<td>\ [-0.56 ]</td>
<td>\ [-0.51 ]</td>
<td>\ [-0.22 ]</td>
<td>\ [-0.36 ]</td>
<td>\ [-0.10 ]</td>
<td>\ [-0.10 ]</td>
</tr>
</tbody>
</table>

Note: Figures in bracket indicate the deficiency/sufficiency of rainfall in percentage.

### iv) Hydrological set-up

II.8 Hydrological set-up of a state/region becomes important in as much as it adds and augments productive quality of the land. The state of Bihar is rich in respect of both mineral and hydrologically rich formations. The entire plain tract i.e. 54.0% of the state's area is floating on ground-water resources. The plateau region on the other hand has abundant mineral resources of high commercial value. The general geological succession obtaining in the state could be described as shown in Table II.3.

II.9 Hydrologically, the state can be divided into four domains, namely: (a) Main alluvial basins, (b) Marginal alluvial terrain, (c) Hard rock terrain, and (d) Soft rock areas. The main alluvial basins vary in thickness from 20-30 m in the plateau region to nearly 2500 m in the north plain. It forms a single but heterogeneous aquifer system. Aquifers are available in abundance in both shallow and deep layer, capable of yielding good quantities of water, more so in latter cases. Marginal alluvial terrain is a low yield
area, suitable for series of open wells and small filter points. Such areas, however, are almost insignificant, restricted to Himalayan foot-hills of West Champaran district alone. Northern fringe of the alluvial tract near Himalayan foot-hills is, however, suitable for sinking of shallow heavy duty tubewells and bamboo borings. Hard rock terrain, found in the plateau region, is best suited for large diameter open wells, as the yield of aquifer is low. The plateau region, particularly in the western side of the state, has soft rock areas, where ground water occurs in the weathered mantle and in the sandstones.

Table II-3
Geological succession obtaining in Bihar

<table>
<thead>
<tr>
<th>Geological Formation</th>
<th>Lithology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Quarternary</td>
<td>Alluvial deposits comprising sand, clay, silt, gravel and coarse fragments.</td>
</tr>
<tr>
<td>2. Tertiary</td>
<td>Sandstone and claystone of West Champaran foothills.</td>
</tr>
<tr>
<td>3. Gondwanas</td>
<td>Coal measures forming series of small basins within the Archaean terrain spread across Palamu, Hazaribagh, Dhanbad, Giridih, Deoghar, Sahebganj and Dumka districts. (It consists of coal and sandstone in subordinate quality.)</td>
</tr>
<tr>
<td>4. Rajmahal traps</td>
<td>Basalt flows with winter trapopeans of sandstones, etc.</td>
</tr>
<tr>
<td>5. Vindhya</td>
<td>Sandstone, shale, limestone, etc. covering parts of Rohtas, Aurangabad and Palamu districts.</td>
</tr>
<tr>
<td>6. Archacans</td>
<td>Gneisses, granite, schist, phyllite, Dolomite, Amphibolite, etc. covering Singhbhum, Ranchi, Gumla, Lohardagga, Gaya, Nawadah, Aurangabad and parts of Munger, Bhagalpur and Patna districts.</td>
</tr>
</tbody>
</table>

II.10 Depth of water during pre-monsoon period varies from 1.90m in Sahar block of Bhojpur district in the south-west alluvial plains and the sub-zone of the north-east alluvial to 22.03 m in Chakulia block of Singhbhum district in sub-zone of Eastern plateau. Post-monsoon water levels vary from 0.18 m in Sabour block of Bhagalpur district to 11.03m in Atra block of Gaya district.

v) Soils

II.12 Broadly, there are six soil groups found in the state. They are; i) recent alluvium, ii) young alluvium, iii) old alluvium, iv) sub-Himalayan and forest, v) red and yellow, and vi) Tal land.

II.13 The entire range of plains, both in the north and south Bihar has an alluvial tract. But the plateau region has red and yellow soils. In some parts of the plateau, black forest soils are also found. Fertility of these soils is not comparable to the one found in the plains of Bihar. The last category of land, i.e. Tal land is found in the back-waters of the Ganges and Sone rivers, where land remains inundated during kharif season, and it is available for sowing only during rabi season. It is fertile rich but prone to pest and disease.

vi) Flood Prone and Tal Areas

II.14 A fairly large chunk of area (19.7%) in the state is flood prone. It is as high as 54.1% and 51.8% in the north-west and east alluvial plains respectively. Districts prone to flood are identified as East Champaran, West Champaran, Sitamarhi, Madhubani, Begusarai, Saharsa, Purnea and Katihar. Sources of flood could be seen in the flowing of a large number of flood prone rivers through the states, emanating largely from the neighbouring Himalayan kingdom of Nepal and even the north-west hinterlands of the country. Prominent of such rivers include Ganga, Gandak, Burhi Gandak, Bagmati, Adhwara, Kamla, Kosi, Mahananda and Punpun. Besides, there is a large chunk of low lying areas around the river of Ganga flowing through such districts as Patna, Begusarai, Khagaria and Bhagalpur, inundated by flood waters to recede only after December-January. This is known as Tal area. Problem of this area is distinct which need specific treatment suitable to their conditions.

vii) Drought Prone Areas

II.15 A sufficiently large part (50.2%) of the state is drought prone. It is as high as 86.1% in the plateau region and 72.4% in the eastern plains. In the south-west plains, around one-fourth is drought prone. Such districts include Bhagalpur and Munger in the eastern plains, Rohtas in the south-west plains and Dhanbad, Santhal Parganas, Singhbhum, Giridih, Palamu and Ranchi in the plateau region.
viii) Population

II.16 Bihar was second only to Uttar Pradesh in terms of the size of human resources with population at 864 lakh persons in 1991, growing annually at 2.1% which was a little lower than the national average of 2.2%. Significantly, there was reversal in the increasing rate of population growth in the State since eighties. It was projected at 940 lakh persons for 1995. It had a share of 10.21% of the country's population. Density of population was high at 497 persons per sq. km., only next to West Bengal (767 persons). Sex ratio was 911 females per thousand males as against 927 at all-India level. Like the all-India, the sex ratio in Bihar as well showed declining trend. Number of persons in the economically active age group of 20-59 was close to all India average at 42.0% for male and 43.9% for female. However, it was much less in comparison to states such as Maharashtra, Kerala, Tamil Nadu and West Bengal. Further, the State continues to be predominantly rural in character with only 13.1% of the population living in urban conglomeration and 86.9% living in rural segments. As against this, most of the major states such as Gujarat, Karnataka, Maharashtra and Tamil Nadu showed urban population consisting more than 30.0% of their population. A fairly large chunk of the population (22.2%) of the State belonged to Scheduled Caste/Tribe groups.

ix) Migration

II.17 In terms of the volume of gross migration, the state of Bihar stood fifth (38.4 lakh persons) only next to West Bengal, Uttar Pradesh, Maharashtra and Madhya Pradesh in 1981. However, the extent of gross migrants was not such that the state population could be characterised as highly migrating. Only 5.5% of the population formed to be migrants. Moreover, it was on the decline from 6.0% in 1971 to 5.5% in 1981. Volume of gross migrants increased only marginally by 13.75% over 1971-81. Moreover, outmigrants outnumbered immigrants by double the size in both the periods i.e. 1971 and 1981. While outmigrants constituted 3.6% of the State's population in 1981, immigrants constituted 1.9% only. The size of outmigration in Bihar was high only next to Uttar Pradesh in the country. On the other hand the flow of immigration was much less in the State. Net migrants thus stood at 1,182 thousand persons in 1981. Increase in the flow of immigrants and outmigrants has been almost similar at 13.2% and 14.1% respectively for the State over 1971-81.
CHAPTER III
GROWTH PERFORMANCE OF FOODGRAINS IN BIHAR - TEMPORAL AND DISTRICT-WISE ANALYSIS

Foodgrain crops occupied as high as 89.9% of the gross cropped area in 1990-91. A wide range of food crops such as paddy, maize, bajra, jowar, barley, wheat, ragi, gram and arhar are cultivated in Bihar. There are other less important and miscellaneous types of foodgrain crops as well being produced in Bihar. They are all clubbed in the group called small millets. Miscellaneous pulses are clubbed into other pulses. Aggregate of these crops give the total of foodgrain production. The present chapter attempts to analyse the pattern of growth in foodgrains production across different agro-climatic zones/districts of the state over the period since 1970-71.

1) Production

Table III.1 presents area, production and yield of foodgrains for intermittent years from 1970-71 to 1992-93 in Bihar. Based on this data, index number of area, production and yield with 1970-71 as the base has also been constructed and presented in Table III.1. It is observed that upto 1982-83 there was stagnation in foodgrain production in Bihar with wide fluctuations from as low as 71 lakh tonnes in 1979-80 to as high as 99 lakh tonnes in 1980-81, a variation of 39.5% in the minimum and maximum production. However, the period from 1983-84 experienced increasing foodgrains production, reaching the level of 122 lakh tonnes in 1990-91. With 1970-71 as the base, the index number of foodgrains production reached 156 in 1990-91.

The trend analysis of production of foodgrains for the period between 1970-71 and 1992-93 (Table III.2) suggests that during this period the foodgrains production was growing at compound annual growth rate of 1.53% only. It was much less at 0.48% per annum during the first sub-period. The growth scenario of foodgrain production became more impressive during the second sub-period with growth rate at 2.73% per annum. A close look at the physical data of production during 1984-93 clearly suggests that upto 1990-91 there was continuous rise in the level of foodgrain production. But the subsequent years i.e. 1991-92 and 1992-93 brought significant reversal in the production. Excluding these two years, the rate of growth in foodgrain production during 1984-91 worked at 4.70% per annum which was comparable to the growth rates experienced in agriculturally advanced states like Punjab (4.11%), Haryana (4.43%) and Uttar Pradesh (5.33%) during the same period.
Analysis of foodgrains production across kharif and rabi season suggests that much of the increase in foodgrain production in Bihar was in rabi season alone, as production of foodgrains in kharif season remained stagnant. For example, the production of foodgrains in kharif season was 5472.43 thousand tonnes in 1980-83, which increased to 5805.73 thousand tonnes in 1990-93 in the state. It grew at 0.59% per annum only. On the other hand, production of foodgrains in rabi season increased from 3016.37 thousand tonnes in 1980-83 to 4882.63 thousand tonnes in 1990-93, growing annually at 4.93%. Increase in foodgrains production in rabi season in Bihar during the eighties was comparable to that in Haryana (4.99%). It was even more than the growth rate achieved by Punjab (3.61%) during this period. However, it was much less than the increase experienced by West Bengal (8.66%) in rabi foodgrains production during the eighties.

Zone-wise/District-wise Spatial Analysis

Zone-wise/district-wise analysis of triennial average production of foodgrains (1988-91) as also share of different districts to state total or zone total suggests that districts such as Purnea in the east plains, and Rohtas and Bhojpur in the south-west emerged as the major granary of the State with a share in state foodgrains production at 5.14%, 7.30% and 5.65% respectively. East Champaran, Saharsa, Gaya, Nalanda, Patna, Santhal Parganas and Ranchi produced equally high level of foodgrains with each of these districts having a share of around 4.0% or more in State foodgrains output. On the other hand, districts such as Vaishali, Katihar, Nawadah, Giridih, Hazaribagh and Palamu produced less than 2.0% in the total State foodgrains production.

Analysis of zone-wise/district-wise trend growth rates in production of foodgrains as also detrended co-efficient of variation and rate of acceleration/deceleration over the period from 1976-77 to 1990-91 further suggests that there was a distinct pattern of increase in foodgrains production across different zones. The plateau region showed a declining trend in output of food crops at compound annual growth rate of (-)0.71% per annum. The other zones viz, north-west alluvial plains, East alluvial plains and South-West alluvial plains on the other hand showed positive growth rate at 2.18%, 1.36%, and 2.51% respectively during the same period. It was relatively less in the east-alluvial plains at 1.36%.

Analysing the growth performance separately for two sub-periods it was observed that the plateau districts which had negative trend in the growth of foodgrains production during the first sub-period showed impressive reversal to positive growth at 3.27% per annum in the second sub-period. The south-west alluvial plains reached accelerated growth rate at
5.74% per annum during the second sub-period. The zones of north-west alluvial plains and east alluvial plains as well experienced similar expansion in the output of foodgrains at 4.53% and 4.64% respectively during the second sub-period.

a) North-West Alluvial Plains

Among the eleven districts falling in this zone, only two districts, namely Sitamarhi and Samastipur had growth performance (0.10% and 1.35%) less than the state average (1.55%) during 1977-91. All other districts, namely West Champaran, East Champaran, Gopalganj, Siwan, Saran, Vaishali, Muzaffarpur, Darbhanga and Madhubani had some degree of homogeneity in growth performance, exceeding the state average. The districts of East Champaran and Siwan had still better performance level with growth rate exceeding 3.0%. However, if the growth pattern is separately seen for the two sub-periods it is striking to observe that most of the districts showed accelerated level of growth rate during the second sub-period as compared to the first sub-period. The rate of expansion in the second sub-period was, however, more in respect of districts such as East Champaran (4.90%), Madhubani (6.89%), Samastipur (5.43%), Gopalganj (4.64%) and Siwan (4.57%). These districts formed one homogenous geographical cluster.

b) East alluvial plains

The districts of this zone presented a different picture in terms of growth performance during 1977-91. While Munger showed a declining trend in output (-0.07%), districts of Purnea, Katihar and Bhagalpur experienced positive growth. Saharsa showed relatively better performance level (1.73%) exceeding even the state average. Begusarai offered a picture in contrast with growth rate at more than 5.0% per annum. The scenario took up-turn from 1983-84 among the districts of this zone as well. Of the six districts falling under this zone, three districts namely Munger, Purnea and Saharsa showed growth rates exceeding 5.0% during this period. Even Katihar which showed negative growth performance during the first sub-period, took a positive turn, growing at 2.81% per annum. Begusarai and Bhagalpur also showed modest increase at 3.92% and 3.48% respectively.

c) South-West alluvial plains

Districts falling under this zone showed homogeneity in growth rates of foodgrain production during 1977-91. Nawadah was an exception with least growth rate at 1.11% only. Other districts, namely Aurangabad (2.95%), Bhojpur (3.29%), Gaya (2.62%), Nalanda (2.98%), Patna (1.55%)
and Rohtas (2.34%) had growth rates much higher than the state average. The growth rates in these districts accelerated to a higher level during the second sub-period. A homogeneous tract comprising of districts such as Patna, Nalanda and Nawadah experienced spectacular growth rates. The growth rate in Nawadah was more significant as it lagged far behind during the first sub-period (-4.84%), but increased to 13.1% during the second sub-period. Aurangabad and Rohtas had modest growth rate at 3.15% and 3.65% respectively during this period.

d) Plateau districts

III.11 Of the seven districts falling in this zone, five districts experienced decline in the production of foodgrains (0.5% to more than 1.0%) during 1977-91. Of the remaining districts Hazaribagh showed positive growth (1.59%) which exceeded even the state average. Giridih showed positive growth rate but it was not significant. However, the mid and the late eighties witnessed reversal in the declining trend of the first sub-period to increasing trend in the second sub-period. Although in comparison to districts of the plains of Bihar, the growth performance of plateau districts during second sub-period was not encouraging, the fact that the declining trend in production got reversed is encouraging. Among the districts of this zone, Ranchi had the least growth rate (1.39%) and Giridih had the maximum growth rate (5.62%) during the second sub-period. Other districts of this zone had growth rates in the range of 2.69% (Singhbhum) to 4.96% (Palamu).

Instability in Foodgrains Production

III.12 Analysis of co-efficient of variation in the trend growth rates of foodgrains production during 1977-91 in different zones/districts clearly indicates that the growth in the production of foodgrains at 2.31% during this period was fairly stable for the State, as co-efficient of variation was 11.05% only. Across different agro-climatic zones as well, the growth rate in foodgrains production was stable with relatively low co-efficient of variation. It was relatively more stable in the north-west plains with co-efficient of variation at 8.61% only and less stable in the plateau districts with co-efficient of variation at 18.58%. The co-efficient of variation in the growth rate of foodgrains production was almost similar in the east plains (10.38%) as well as the south-west plains (13.22%). Across different districts the growth was relatively more stable in East Champaran, Saran, Siwan and West Champaran with co-efficient of variation less than 10.0% in each of these districts. It was relatively more unstable however in case of Darbhanga, Madhubani, Samastipur and Sitamarhi with co-efficient of variation exceeding 15.0%. Instability in the growth of foodgrains production was relatively more
among the districts of the south-west plains and the plateau. Co-efficient of variation was as high as 28.60% in Nawadah, 25.07% in Nalanda and 21.88% in Gaya of the south-west plains; and 32.80% in Dhanbad, 29.65% in Palamu, 26.45% in Giridih and 25.52% in Hazaribagh of the plateau region.

**Analysis of Acceleration/Deceleration**

III.13 To examine whether the rate of growth in foodgrains production during 1977-91 was accelerating/decelerating, the second derivative fitting a quadratic trend was worked out. Significantly the growth in foodgrains production was increasing at accelerated rate with ratio of acceleration at 0.35% for the State. Across different agro-climatic zones as well, there was acceleration in the increasing trend of growth rates in foodgrains production. Rate of acceleration was 0.25% for the north-west, 0.39% for the east, 0.43% for the south-west and 0.30% for the plateau districts. Rate of acceleration in the growth of foodgrains production was relatively high in case of Gopalganj (0.50%), Saharsa (0.69%), Gaya (0.63%), Nalanda (0.63%), Nawadah (1.06%), and Patna (0.67%). In the case of districts such as East Champaran (0.14%), Sitamarhi (0.15%), West Champaran (0.11%) and Rohtas (0.12%) the rate of acceleration was much less. None of the districts showed deceleration in the rate of growth of foodgrains production. The accelerating trend in the declining rate of growth in respect of plateau districts in particular gives cause of concern and warrants for reversal in such a trend.

**ii) Area under Foodgrain crops**

III.14 Area under foodgrains declined from 99.08 lakh hectares in 1970-71 to 85.77 lakh hectares in 1992-93. The decline in area under foodgrains crop in Bihar was more prominent and sharp in the late seventies. The log linear function fitted on this data suggests a negative growth rate in area under foodgrains at (-)0.44% per annum. Similar pattern is observed at all-India level with area under foodgrains declining annually at 0.16% per annum during the eighties. Other major states as well with the exception of Punjab, West Bengal, Uttar Pradesh and Orissa showed declining trend in area under foodgrain crops. It was as high as 3.68% in the case of Kerala.

III.15 The downward trend in area under foodgrains crop in the state was noticeable only during the first sub-period. It, however, started increasing in the second sub-period, albeit marginally, at 0.04% per annum. While most of the states showed a declining trend in area under foodgrains during the eighties, the positive rate of growth in Bihar in lines similar to West Bengal (0.84%) makes the state distinct.
Expansion in area under foodgrains in Bihar was more on account of increase in area under rabi crops during the eighties. For example, while area under kharif foodgrains declined from 6572.80 thousand hectares in 1980-83 to 5756.13 thousand hectares in 1990-93, declining annually at (-)1.32%, it recorded an impressive increase for rabi foodgrains from 2815.20 thousand hectares in 1980-83 to 3156.07 thousand hectares in 1990-93, increasing annually at 1.15%. Compared to major states the decline in area under kharif foodgrains was sharp in Bihar. On the other hand increase in area under rabi foodgrain crops was more impressive for the State.

Zone-wise/District-wise Spatial Analysis

Across different zones/districts East Champaran (3.84%), Muzaffarpur (3.37%) and West Champaran (3.17%) in the north-west plains; Purina (6.26%), Saharsa (5.44%), Munger (3.45%) and Bhagalpur (3.33%) in the east plains; Bhojpur (4.56%), Gaya (4.36%) and Rohtas (6.27%) in the south-west plains; and Santhal Parganas (5.29%), Singhbhum (3.68%) and Ranchi (6.27%) in the plateau zone had relatively high share in the area under foodgrain crops in the state.

Analysis of the trend rate of growth in area under foodgrains during 1977-91 suggests that there was shrinkage in its area in all the zones, ranging from (-)0.31% per annum as in the south-west alluvial plains to (-)1.67% as in the plateau districts. In the east alluvial plains the rate of decline in area under foodgrains was (-)0.56%. The same was (-)0.57% in the case of the north-west alluvial plains.

However, there was reversal in the declining trend in area under foodgrains during the second sub-period. The trend rate which was negative for the state (1.11%) during 1977-83 became positive (0.83%) during 1984-91. Plateau districts continued to experience declining trend even during the second sub-period at (-)0.68% per annum. Other zones showed positive trend growth rate during the second sub-period with the south-west alluvial plains showing higher trend growth rate at 1.88% per annum in area under food crops. The north-west alluvial plains had the least expansion (0.96%) in area under foodgrain crops during this period. Amidst declining trend, districts to show expansion in foodgrains area included Gopalganj, Muzaffarpur, Siwan, Begusarai, Saharsa, Aurangabad and Rohtas. All other districts showed sharp shrinkage in foodgrains area during 1977-91.

Yield level

The study also attempted to analyse yield level of foodgrains in Bihar for different years from 1970-71 to 1992-93. It was 0.80 t/ha. in
1970-71 which increased to a high of 1.30 t/ha. in 1990-91. With 1970-71 as the base, the index number of yield of foodgrains reached 163 points in 1990-91. The trend growth analysis, fitting log linear function on yield of foodgrains for the period from 1971-93 further confirms the impressive gain in yield levels in the State. It grew annually at 1.97% during this period. Analysis of the trend rate of growth rates separately for two sub-periods suggests that increase in yield level was relatively much less (0.64%) in the first sub-period. It, however, picked up impressively at 2.69% during the second sub-period. Excluding the abnormal years of 1991-92 and 1992-93, the trend rate of growth in yield level during second sub-period was still more impressive at 3.85% per annum.

III.21 When compared with the rate of growth in yield level in agriculturally developed states like Punjab and Haryana it was, however, not significant for Bihar. For example, it grew annually at 2.95% in Punjab, 3.99% in Haryana and 3.13% in Uttar Pradesh as against 2.19% in Bihar during 1983-93. In physical terms as well, the yield level of foodgrains in Bihar was not comparable to agriculturally developed states. For example, it was 0.90 tonnes/ha. in 1980-83 and reached the level of 1.19 tonnes/ha. in 1990-93 in Bihar, whereas the national average of yield for foodgrains was 1.03 tonnes/ha. in 1980-83 and 1.39 tonnes/ha. in 1990-93. In Punjab, yield level was as high as 3.46 tonnes/ha. for foodgrains in 1990-93, almost three times higher than Bihar. It was equally high at 2.49 tonnes/ha. for Haryana. Increase in yield level was more impressive for rabi foodgrains (3.70%) than kharif foodgrains (1.90%) in the State during 1983-93. In physical terms as well, the yield level was higher for rabi foodgrains (1.54 tonnes/ha.) than kharif foodgrains (0.99 tonnes/ha.). Similar was the trend at all-India level with rabi foodgrains production growing faster (3.28%) than kharif production (2.95%) during 1983-93.

Zone-wise/District-wise Analysis:

III.22 Over the period during 1977-91 there was increase in yield of foodgrains in all the zones, although at varying rates. While the north-west alluvial plains experienced highest rate of increase in yield at 2.82% it was the lowest for plateau districts at 0.96%. For the north-west alluvial plains and east alluvial plains, the rate of increase in yield level was equally high with annual growth rate at 2.75% and 2.92% respectively. Increase in the yield level was triggered-off since the mid-eighties in all the zones, as during the first sub-period it showed increasing trend only in respect of the north-west alluvial plains (1.02%), while all other zones viz. east alluvial plains, south-west alluvial plains and plateau districts showed declining trend in yield in the range of (-)0.91% and (-)1.58%. However, in the second sub-period it not only reversed from declining trend to increasing trend, but
also accelerated to higher rates in all the four agro-climatic zones in the range of 3.57% and 3.95%. The zone of plateau districts in particular experienced more accelerated rate of increase in yield from declining trend at (-)1.58% during the first sub-period to increasing trend at 3.95% during the second sub-period. Districts to show relatively high growth rates in yield were not necessarily those with high volume of foodgrains production. Some of the lesser foodgrains producing districts as well showed high growth rates in yield. They included East Champaran, Saran, Madhubani, Vaishali and Aurangabad.

**Factors Influencing growth performance of agriculture**

III.23. Discussion in the proceeding sections amply brought out that agriculture of Bihar (foodgrains) witnessed accelerating growth rates, particularly during 1984-93. With area declining, the accelerating growth rate was seen largely in yield increase. In order to ascertain factors influencing yield increase a set of factors such as fertilizer consumption per gross cropped hectare, percent of HYV area, percent of gross irrigated area to gross cropped area and percent deviation of actual rainfall from normal rainfall was regressed on the value of agricultural output per gross cropped hectare considering the period from 1976-77 to 1990-91. Details of the method to obtain value of agricultural output is presented in the methodology section of Chapter-I. Fertilizer consumption and area under HYV seeds were the most important inputs to influence the yield of agricultural output in Bihar. With irrigation remaining almost stagnant during the period under reference it did not emerge to influence the yield level in the state. As actual rainfall in Bihar was normal during the period under reference, this is observed to influence the growth of agriculture with stability in the state.

**Conclusions**

III.24 The study thus suggests the following broad conclusions:

i) The growth performance of foodgrains production in Bihar was one of stagnation till 1982-83.

ii) The upward trend started from the year 1983-84. The rate of growth achieved during 1984-93 in the state was comparable to the agriculturally developed states like Punjab and Haryana, but lagging behind West Bengal.

iii) Much of the increase in foodgrains production was due to increase in rabi foodgrains, as kharif foodgrains production continued to stagnate, which is similar to the picture emerging at national level.

iv) Both area and yield have contributed to increase in foodgrains production in rabi season during the late eighties.
v) Yield effect on output growth of foodgrains in kharif was less impressive than growth in the production of rabi foodgrains. Even the area under kharif showed shrinking trend.

vi) Rabi foodgrains put up better performance due to increase in yield in Bihar, though much less compared to the one achieved in Punjab and Haryana. It was still less compared to that of West Bengal.

vii) The south-west plains, followed by the north-west plains were the main centres of foodgrains production in the State. Among the districts, Purnea, Rohtas and Bhojpur were showing high share in State foodgrains production.

viii) Zones with dominant share in foodgrains production also showed high rate of growth in foodgrains production. However, at district level the scenario was different. Districts with lower share in foodgrains production as well showed relatively high rate of growth.

ix) Growth in foodgrains production was stable across different zones/districts, as coefficient of variation in the rate of growth was low. Further, there was acceleration in the rate of growth of foodgrains production across different zones/districts, as deceleration in the rate of growth was not observed in any of the zones/districts. However, acceleration in the declining trend in plateau districts was a discouraging phenomenon.

x) Rate of increase in the yield of foodgrains in Bihar was not comparable to those in states like Punjab, Haryana and Uttar Pradesh. Yield level of foodgrains was also much less in Bihar than in those states. However, the yield of foodgrains in select few districts, mostly in the south-west plains viz. Nalanda, Bhojpur and Patna compared well with the yield in other major states.

xi) With irrigation remaining stagnant inputs such as fertilizer and HYV seeds influenced more significantly the accelerated growth process in Bihar agriculture.
Table III.1
Area, production and yield as also trend growth rates in foodgrains production during 1971-93

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AREA (000 ha)</th>
<th>PRODN (000 tns)</th>
<th>YIELD (tns/ha)</th>
<th>INDEX NUMBERS OF</th>
<th>Area</th>
<th>Prod.</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71*</td>
<td>9908.30</td>
<td>7881.20</td>
<td>0.80</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1980-81</td>
<td>10025.00</td>
<td>9911.20</td>
<td>0.99</td>
<td>101</td>
<td>126</td>
<td>124</td>
<td></td>
</tr>
<tr>
<td>1990-91</td>
<td>9427.70</td>
<td>12258.90</td>
<td>1.30</td>
<td>95</td>
<td>156</td>
<td>163</td>
<td></td>
</tr>
<tr>
<td>1991-92</td>
<td>8732.00</td>
<td>10252.50</td>
<td>1.17</td>
<td>88</td>
<td>130</td>
<td>148</td>
<td></td>
</tr>
<tr>
<td>1992-93</td>
<td>8576.90</td>
<td>9553.70</td>
<td>1.11</td>
<td>87</td>
<td>121</td>
<td>140</td>
<td></td>
</tr>
</tbody>
</table>

* Moving average of 3 years ending.

Table III.2
Compound Annual Rate of Growth

<table>
<thead>
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<th>Period</th>
<th>Area</th>
<th>CARG Prod.</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71 TO 1992-93</td>
<td>-0.44</td>
<td>1.53</td>
<td>1.97</td>
</tr>
<tr>
<td></td>
<td>(0)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>1970-71 TO 1982-83</td>
<td>-0.16</td>
<td>0.48</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>(0.34)</td>
<td>(0.18)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>1983-84 TO 1992-93</td>
<td>0.04</td>
<td>2.73</td>
<td>2.69</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.005)</td>
<td>(0.001)</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate the level of significance.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Bihar</td>
<td>5472.43</td>
<td>5805.73</td>
<td>3016.37</td>
<td>4882.63</td>
<td>0.59</td>
<td>4.93</td>
</tr>
<tr>
<td>2. Haryana</td>
<td>1874.37</td>
<td>2521.40</td>
<td>4370.50</td>
<td>7113.80</td>
<td>3.01</td>
<td>4.96</td>
</tr>
<tr>
<td>3. Punjab</td>
<td>4407.33</td>
<td>7198.57</td>
<td>8717.50</td>
<td>12431.50</td>
<td>5.03</td>
<td>3.61</td>
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<td>4. U.P.</td>
<td>8836.00</td>
<td>13521.87</td>
<td>16401.23</td>
<td>22269.47</td>
<td>4.34</td>
<td>3.11</td>
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<td>5. W.B.</td>
<td>5368.07</td>
<td>8752.67</td>
<td>1527.73</td>
<td>3506.70</td>
<td>5.02</td>
<td>8.66</td>
</tr>
<tr>
<td>All-India</td>
<td>75642.00</td>
<td>97171.00</td>
<td>55159.33</td>
<td>77732.87</td>
<td>2.54</td>
<td>3.49</td>
</tr>
<tr>
<td>B. Area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Bihar</td>
<td>6572.80</td>
<td>5756.13</td>
<td>2815.20</td>
<td>3156.07</td>
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Source: Performance of Agriculture, May 1994, CMIE.
CARG: Compound Annual Rate of Growth.
CHAPTER IV  
GROWTH PERFORMANCE OF MAJOR CROPS -  
TEMPORAL AND DISTRICT-WISE ANALYSIS

In this chapter trends of growth in area, production and yield of major crops as also their spatial patterns are analysed using time-series data from 1970-71 to 1992-93 at state level and 1976-77 to 1990-91 at zone/district level. Major crops are identified to include: paddy, maize, wheat, arhar, gram, rapeseed/mustard, sugarcane, jute, potato, chillies and tobacco. These crops constituted 86.53% of the total cropped area in Bihar in 1990-93. Growth performance of these crops in terms of production, area and yield are separately analysed and discussed as under:

IV.1 PADDY

i) Production

IV.1.2 Paddy occupied 50.58% of the foodgrain area and 43.00% of the total foodgrains output in 1990-93. Besides, it was the main staple food for the local populace.

IV.1.3 Table IV.1.1 presents production of paddy for the intermittent years during 1971-93 as also the index number with 1970-71 as the base. It is significant to observe that the paddy output showed increasing trend from 41.54 lakh tonnes in 1970-71 to its peak level at 65.63 lakh tonnes in 1990-91, with index number touching 158 points. However, it showed wide year to year fluctuations, varying between the minimum output level of 30.65 lakh tonnes in 1982-83 and maximum of 65.63 lakh tonnes in 1990-91. Trend growth rate, based on a log linear function, suggested a positive growth rate of 1.19% per annum during 1971-93.

IV.1.4 Analysis further reveals (Table IV.1.2) that during the first sub-period the growth performance of paddy in the state was low at 0.37% per annum. The minimum output during the first sub-period was 30.65 lakh tonnes in 1982-83 and maximum was 56.35 lakh tonnes in 1980-81 with a variation of 83.8% between the two. However, the period since 1983-84 witnessed a clear emergence of a new era of continuously rising paddy production. The production of paddy during this period took a swing in upward direction from around 50.0 lakh tonnes in 1983-84 to 65.64 lakh tonnes in 1990-91. The trend rate of growth was 2.59% during this period. The production level, however, dipped low to 44.60 lakh tonnes in 1991-92 and 35.69 lakh tonnes in 1992-93 largely due to abnormally low rainfall.
IV.1.5 Despite impressive growth performance of paddy production during the second sub-period, the state continued to lag far behind other major states in terms of the level of paddy production. With total production of paddy at 48.64 lakh tonnes as the triennial average for 1990-93, the state of Bihar stood seventh in production, and second in area (51.39 lakh ha. in 1990-93) among the major states. Uttar Pradesh with highest area under paddy (52.48 lakh ha.) occupied second position in paddy production (97.58 lakh tonnes). West Bengal with third position in area under paddy (50.82 lakh ha.) produced the highest level of paddy output (113.74 lakh tonnes) in 1990-93. It is thus apparent that while area under paddy remains in the same range in Bihar, production of paddy was 2.34 times higher in West Bengal and 2.00 times higher in Uttar Pradesh than in Bihar. It was because of the higher yield level by around 80.0% in Uttar Pradesh and around 99.0% in West Bengal. It was still more (140.0%) in Andhra Pradesh as compared to Bihar. Again, rate of increase in paddy production during 1983-93 was much slower (1.20%) in Bihar as compared to Uttar Pradesh (5.52%), West Bengal (6.46%) and Punjab (6.19%). It was much less than all-India level (3.71%) as well.

Regional Pattern

IV.1.6 Analysis of production of paddy in different zones/districts during 1988-91 suggests that the south-west plains produced maximum paddy (13.29 lakh tonnes) with relatively less area under paddy (8.39 lakh hectares). This zone had a share of 33.0% in State’s total production of paddy with 24.42% of paddy area. The north-west plains was next to contribute at 26.13% to paddy production in the State. The east plains contributed only 17.92%. Among the districts, it was Rohtas (7.40%), followed by Gaya (6.22%) and Bhojpur (5.55%) in the south-west plains; Santhal Parganas (7.27%), followed by Ranchi (6.24%) in the plateau region which took the lead in paddy production in the State. Despite being rich in soil and favourable climatic conditions, the districts of north-west and east plains do not seem to come anywhere near the districts of the south-west and plateau zones in paddy production. However, within the zone, districts such as East Champaran (4.18%), followed by West Champaran (4.05%) in the north-west plains; and Purnea (4.56%) in the east plains emerged as major paddy growing districts.

IV.1.7 Zone-wise/district-wise trend growth rates in paddy production during 1977-91 indicated that while the zones of north-west alluvial plains (0.27%) and south-west alluvial plains (0.75%) showed increasing trend, albeit marginally, the zones of east alluvial plains (-0.50%) and plateau districts (-2.03%) showed declining trend in paddy production. Comparatively, the plateau districts showed significantly high rate of decline in paddy production.
IV.1.8 Analysing the trend rates of growth separately for the two sub-periods, it is significant to observe that during the first sub-period production of paddy showed declining trend in all the four agro-climatic zones. It was as high as (-)13.51% in the plateau districts, followed by (-)11.24% in the south-west alluvial plains and (-)10.41% in the east alluvial plains. In the north-west alluvial plains the rate of decline was relatively low at (-)7.82%. But the process reversed to increasing trend during the second sub-period in all the four agro-climatic zones, ranging between 7.09% (south-west alluvial plains) and 1.77% (plateau districts). It increased at 4.25% in the east alluvial plains and 3.53% in the north-west alluvial plains.

IV.1.9 Across different districts the rate of growth in production of paddy during 1977-91 was not necessarily high in districts with higher share in State Paddy production. Districts such as Gopalganj (2.94%), Siwan (5.41%), and Begusarai (6.58%) with lower share in state paddy production showed relatively high growth rate. Other districts with higher growth rate in paddy production included Saran (2.48%) and Nalanda (1.98%).

Instability in production of paddy

IV.1.10 The increasing rate of growth in paddy production does not seem to be stable in the State, as the co-efficient of variation was not low (16.77%). Across different agro-climatic zones, the growth was relatively more stable in the north-west plains with co-efficient of variation in the increasing trend rate of growth at 12.15% only. In the case of the south-west and the plateau districts, on the contrary, the growth in paddy production was relatively more unstable with co-efficient of variation at 21.31% and 21.18% respectively. For the east plains co-efficient of variation was relatively less at 16.07%. Across different districts, growth in paddy production was relatively more stable in East Champaran and Siwan with co-efficient of variation at 11.18% and 8.56% respectively. On the other hand, districts such as Samastipur, Begusarai, Nalanda, Nawadah, Santhal Parganas and Ranchi showed higher instability with co-efficient of variations exceeding 35.00%

Analysis of acceleration/deceleration

IV.1.11 Paddy production was observed to increase at accelerated rate (0.88%) in the State. Across different agro-climatic zones the rate of growth in paddy production was increasing at accelerated rate at 1.10% and 0.68% respectively in the south-west and north-west plains. On the other extreme the declining trend rates of growth in respect of the east plains and plateau districts were also found to accelerate at 0.84% and 0.86% respectively. The accelerating pattern of increasing/decreasing trend rates of
growth was also observed across different districts. Among the districts showing increasing trend rates of growth in paddy production the rate of acceleration was high in Darbhanga (0.97%) and Madhubani (0.90%) in the north-west plains; Bhagalpur (1.01%) in the east plains; Nalanda (1.51%) and Aurangabad (1.09%) in the south-west plains; and Hazaribagh (0.85%) in the plateau districts. Rate of acceleration in the increasing growth rate was relatively weak in respect of East Champaran (0.40%) and Begusarai (0.30%).

ii) Area under paddy

IV.1.12 Analysis of area under paddy during 1971-93 revealed that the minimum area under paddy was 43.83 lakh ha. in 1992-93 and maximum was 55.89 lakh ha. in 1977-78. The trend rate of growth in area under paddy for 1971-93 worked out to be negative at (-)0.15% per annum. However, working out trend growth rates separately for the sub-periods, it is observed to be positive for both the sub-periods, however, marginal at 0.14% and 0.27% respectively. It is further observed that year to year fluctuation in area under paddy has not been wide, excepting years of extremely adverse climate i.e. 1982-83 and 1992-93.

IV.1.13 Comparing the trend growth rate in area under paddy with other major paddy growing states it is observed that while Bihar showed shrinkage at (-)0.57% per annum during 1983-93, states like West Bengal and Punjab showed significant expansion at 1.27% and 5.05% respectively during the same period. It showed increasing trend in Andhra Pradesh (0.42%), Madhya Pradesh (0.55%) and Uttar Pradesh (0.47%) as well. Area under paddy was found to increase at 0.64% at all-India level during the same period.

Regional Pattern

IV.1.14 Districts with high paddy production as well showed high paddy area. Districts with relatively high share in paddy area included Rohtas (5.79%), followed by Gaya (5.07%) and Bhojpur (3.93%) in the south-west plains; Ranchi (8.59%), followed by Santhal Parganas (7.28%) and Singhbhum (4.14%) in the plateau; East Champaran (4.10%), followed by Madhubani (3.85%) and West Champaran (3.63%) in the north-west plains; and Purba (5.13%), followed by Saharsa (5.04%) in the east plains.

IV.1.15 Analysing the trend growth rates in area under paddy for different agro-climatic zones as also districts in the State for the total period under reference, it is observed that in all the four agro-climatic zones paddy showed declining trend in area during 1977-91, ranging between (-)2.96%
as in the plateau districts and (-)1.76% as in the south-west alluvial plains. Area under paddy declined at high rates in all the four zones in the first sub-period. It was high at (-)10.18% in the north-west alluvial plains and low at (-)6.87% in the south-west alluvial plains. The pattern, however, changed to increasing trend during the second sub-period in all the four zones. Rate of increase was relatively high at 2.56% in south-west alluvial plains. In other three zones viz. north-west, east and plateau districts it showed marginal expansion in area under paddy in the range of 0.83% and 0.65% during this period.

Across different districts, expansion in paddy area was relatively high in less dominant paddy growing districts, particularly during the second sub-period. Such districts included Darbhanga (2.39%) in the North-West; Begusarai (5.80%) and Saharsa (4.51%) in the East; and Aurangabad (3.03%) in the South-West Plains. Some of the districts dominant in paddy production as well recorded high rate of area expansion. They included Nalanda (4.45%) and Nawadah (4.39%) in the South-West Plains. Districts to record shrinkage in paddy area were either from the North-West plains or the plateau zone.

### Yield of paddy

Table IV.1.1 presents yield of paddy in the State in different years from 1970-71 to 1992-93. The minimum yield was 0.68 tonnes/ha. in 1982-83 and maximum was 1.23 tonnes/ha. in 1988-89. The yield level of paddy in the State does not demonstrate wide year to year fluctuations. Over the years during 1971-93, it increased at 1.34% per annum in the State. Between the two sub-periods, increase in yield was relatively high at 2.32% per annum during the second sub-period as against the stagnant rate of growth of 0.24% per annum in the first sub-period. However, compared with other major paddy growing states, the state of Bihar was found to lag far behind not only in terms of the level of yield but also in terms of the rate of increase in the yield level. Yield of paddy grew at 5.17% in West Bengal, 5.02% in Uttar Pradesh, 4.27% in Tamil Nadu and 3.62% in Madhya Pradesh during 1983-93. On the other hand Bihar showed a growth at 1.78% only in the yield of paddy during the same period. In terms of yield, while it was 3.293 t/ha. in Punjab, 3.117 t/ha. in Tamil Nadu, 2.753 t/ha. in Haryana and 1.743 t/ha. as all-India average, it was only 1.001 t/ha. in Bihar during 1990-93.

### Regional Pattern

Across different zones/districts the south-west zone displayed relatively higher yield (1.58 t/ha.) than the north-west plains (1.08 t/ha.) and
the plateau districts (0.98 t/ha.). In latter zones the yield of paddy was even less than the State average of 1.17 t/ha. Inter-district comparison suggests that districts of south-west plains displayed higher yield of paddy as compared to districts of other zones. It ranged between 2.03 t/ha. as in Nalanda and 1.44 t/ha. as in Gaya. Among the districts of north-west plains West Champaran (1.31 t/ha.), followed by Saran (1.26 t/ha.), Siwan (1.22 t/ha.) and Gopalganj (1.21 t/ha.) showed relatively higher yield of paddy. On the other hand Vaishali (0.81 t/ha.), Samastipur (0.81 t/ha.), Muzaffarpur (0.83 t/ha.) and Darbhanga (0.91 t/ha.) were at the lower end. In the east plains, Bhagalpur (1.43 t/ha.) and Munger (1.41 t/ha.) displayed relatively better picture. Saharsa on the other hand with yield at 0.74 t/ha. lagged far behind. Despite adversaries in terms of climate, districts of plateau zone did not lag behind those districts in the north-west and east plains as yield level was more or less similar in their cases. Santhal Parganas (1.17 t/ha.) and Gindhi (1.12 t/ha.) were way ahead in this respect.

IV.1.19 The trend rates of growth was positive in all the four zones during 1977-91. Rate of increase in yield was relatively high for the north-west alluvial plains (2.81%), followed by the south-west alluvial plains (2.51%). Performance of the east alluvial plains was modest with rate of increase in yield at 1.67%. For plateau districts, the rate of increase in yield was positive but marginal at 0.93% only.

IV.1.20 Analysing the rate of growth in paddy yield separately for the two sub-periods it is observed that the north-west alluvial plains showed increasing trend at 2.36% while all other zones showed declining trend during the first sub-period. Rate of decline was as high as (-)5.24% in the zone of plateau districts, followed by (-)4.37% in the south-west alluvial plains. Rate of decline was relatively modest at (-)1.74% in the east alluvial plains. The second sub-period, however, witnessed reversal to increasing trend in growth rates in the yield of paddy in all the zones ranging between 4.53% as in the south-west plains and 2.60% as in the plateau districts. Rate of increase was modest at 3.55% in east alluvial plains.

IV.1.21 Among the districts rate of growth in yield of paddy was relatively high in less dominant paddy growing districts. Such districts included Madhubani (4.61%), Saran (6.18%), and Siwan (4.12%) in the North-West; Bhagalpur (3.95%) and Munger (7.30%) in the East plains; Patna (5.55%) and Nawadah (10.29%) in the South-West plains; and Hazaribagh (5.96%) and Palamu (6.40%) in the plateau zone. In some of the dominant paddy growing districts as well, rate of growth in yield of paddy was high. They included Bhojpur (4.70%), Gaya (4.91%) and Nalanda (7.95%).
iv) **Seasonality of paddy production**

IV.1.22 Area, production and yield of paddy in three different seasons i.e. autumn, winter and summer during 1977-91 were also analysed. It is observed (Table iv.1.3) that winter paddy dominated both in terms of production (88.05%) and area (85.03%) in 1990-91. Autumn paddy was next in importance with 10.48% share in production and 13.63% share in area under paddy in 1990-91. Summer paddy constituted almost insignificant proportion both in terms of area (1.34%) and production (1.47%). Production of paddy showed increasing trend in all the seasons during 1977-91. However, the rate of increase was relatively high for autumn (4.08%) and summer (4.08%) paddy. Winter paddy grew at 1.92% per annum during the same period. The share of winter paddy production to total paddy production had a declining trend, albeit marginally, at (-)0.22%, whereas in respect of autumn (1.94%) and summer paddy production (0.95%) the share was increasing during the same period.

IV.1.23 Analysing the area of paddy under different seasons, it is observed that area of winter paddy showed declining trend at (-)0.74% during 1977-91. On the other hand, area of autumn and summer paddy showed increasing trend at 1.37% and 1.05% respectively during the same period. In terms of yield, summer paddy showed higher level (1364 kg/ha.), followed by winter paddy (1290 kg/ha.) in 1990-91. For autumn paddy it was relatively less at 958 kg/ha. Over the years during 1977-91, the rate of increase in yield was again higher for summer paddy (3.03%), followed by autumn paddy (2.71%). For winter paddy as well it showed increasing trend, however, relatively less at 2.67%

**Regional Pattern**

IV.1.24 Analysing the pattern across different zones/districts it is observed that more than one-third (36.37%) of winter paddy was produced in the south-west plains, with the plateau contributing around one-fourth (24.45%) of the total winter paddy production in the State. In the case of autumn paddy it was the north-west which produced around two-third (62.73%) of the output. Other zones showed negligible presence of autumn paddy cultivation. In summer paddy, the east plains dominated in production. The zone had a share of almost three-fourth (71.60%) in the State's summer paddy production. Analysis of the district-wise pattern suggests that districts such as Gopalganj (12.83%), East Champaran (11.01%) and West Champaran (9.97%) in the north-west; Ranchi (12.07%) in the plateau; and Purnea (8.65%) in the east plains figured prominently in autumn paddy production. In summer paddy production, districts of Katihar (42.46%), Purnea (20.52%) and Saharsa (6.83%) in the east plains; and West Champaran (8.80%) in the north-west plains dominated.
a) Production

IV.1.25 Production of winter paddy showed increasing trend in the north-west alluvial plains (1.59%), the east alluvial plains (0.97%) and the south-west alluvial plains (2.66%). However, it showed declining trend in the plateau zone (-0.38%). On the other hand production of paddy in autumn showed increasing trend in all the four agro-climatic zones ranging between 4.77% and 0.70%. Production of summer paddy, however, showed a picture in contrast. While the north-west (1.17%) and the east alluvial plains (10.37%) showed increasing trend, the zones of south-west and plateau districts showed declining trend. Rate of decline was significantly high at (-)11.98% in case of south-west alluvial plains and marginal at (-)0.18% for the plateau districts.

IV.1.26 Analysing the trend of growth separately for different seasons across different districts, it is observed that districts of the north-west alluvial plains showed increasing trend in autumn paddy production. Rate of increase was relatively high in Siwan (8.15%), followed by Gopalganj (7.93%) and Saran (6.77%), all forming one homogenous cluster. Among the districts of the east alluvial plains Begusarai (20.51%) and Bhagalpur (13.68%) showed high rate of increase in the production of autumn paddy. On the other hand Munger and Katihar showed decline at (-)10.00% and (-)4.05% respectively in autumn paddy output. Most of the districts in the south-west alluvial plains showed increasing trend. Of them, Gaya had the highest rate of increase (9.55%). Amidst such a pattern, however, Aurangabad and Bhojpur both forming a homogenous cluster showed declining trend in autumn paddy output. Performance of districts in the plateau zone was equally impressive with only one district, namely Singhbhum showing declining trend (-5.13%), while all others showing increasing trend ranging between 8.74% and 1.64% in autumn paddy production.

IV.1.27 Performance of winter paddy production offered a picture in contrast. While districts of the south-west alluvial plains showed increasing trend, ranging between 4.33% and 0.29%, there was a mixed pattern in other zones. In the north-west alluvial plains districts like Sitamarhi (-1.56%), Samastipur (-1.79%), Muzaffarpur (-0.23%) and Vaishali (-0.76%), all forming a cluster, showed declining trend. Other districts of this zone namely Darbhanga, Madhubani, East Champaran, Gopalganj, Saran, Siwan and West Champaran showed increasing trend in winter paddy production, ranging between 6.86% and 0.49%. In the east alluvial plains, Purina (-1.30%), Saharsa (-0.40%) and Katihar (-0.35%), all forming a cluster under Koshi Command, showed declining trend. On the other hand Bhagalpur, Begusarai and Munger, falling on both sides of the Ganga river, showed increasing trend in winter paddy production, ranging between 5.90% and 2.18% per
annum. Among the districts of the plateau zone, Santhal Parganas (-1.01%), Singhbhum (-0.79%), Palamu (-2.66%) and Ranchi (-0.16%) showed declining trend whereas Giridih (2.38%), Hazaribagh (2.03%) and Dhanbad (0.95%) showed increasing trend in winter paddy production.

IV.1.28 Increasing trend in summer paddy production at state level emerged largely because of impressive performance of some specific districts, as most of them showed declining trend in its production. The districts to record impressive performance included Darbhanga (6.14%), Madhubani (13.57%), Samastipur (3.14%), Sitamarhi (7.43%), Vaishali (3.20%) and West Champaran (1.05%), all of them forming one cluster in the north-west alluvial plains; Begusarai (6.67%), Katihar (15.36%) and Purnea (17.80%) in the east alluvial plains; and Santhal Parganas (9.56%) and Singhbhum (3.00%) in the plateau zone. All other districts in different agro-climatic zones showed declining trend. Rate of decline was high among the districts of the south-west alluvial plains, ranging between (-)25.47% and (-)2.61%. Districts to record significant decline in summer paddy output included Gopalganj (-13.01%) and Siwan (-12.07%) in the north-west; Aurangabad (-13.86%), Bhojpur (-25.47%), Gaya (-12.00%), Nalanda (-13.60%) and Patna (-14.16%) in the south-west; and Giridih (-21.47%) and Dhanbad (-15.38%) in the plateau zone.

b) Area

IV.1.29 Analysis of area under autumn paddy suggested that its area showed increasing trend in the north-west (2.84%) and it was marginal in the east alluvial plains (0.27%). It showed declining trend in the south-west (-1.37%) and plateau zone (-0.52%). Area under winter paddy declined in all the zones, except the south-west where it showed increasing trend, albeit marginally, at 0.19%. Rate of decline was (-)1.45% in the north-west, (-)0.55% in east and (-)1.11% in the plateau zone. The east plains showed to gain impressively in summer paddy area (5.90%), whereas all other zones showed declining trend. Rate of decline of summer paddy area was, however, similar in the north-west and the plateau zones at around (-)2.68%.

IV.1.30 District-wise analysis of area under summer paddy suggests that in the north-west plains all the districts showed increasing trend ranging between 6.24% and 0.27%. Districts namely Darbhanga (4.15%), Gopalganj (4.63%), Muzaffarpur (5.65%), Siwan (4.31%) and Vaishali (6.24%) gained more impressively. In the east plains, while Begusarai (20.37%) and Bhagalpur (14.23%) gained significantly in area, Munger was found to lose prominently at (-)11.92%. In the south-west plains only Gaya was found to gain impressively at 7.23% in autumn area, whereas Aurangabad and
Bhojpur lost area prominently at (-)8.69% and (-)7.49% respectively. In the plateau zone, although most of the districts showed increasing trend in autumn paddy area with maximum in Giridih (3.02%), high rate of decline in Singhbhum (-4.12%) offset the gain for the zone.

IV.1.31 Analysing the district-wise trend of winter paddy it is observed that most of the districts in the north-west showed declining trend ranging between (-)4.08% and (-)0.01%. Madhubani lost the area more prominently at (-)4.08%. Districts to show increasing trend included Siwan (1.74%), Saran (0.34%) and Muzaffarpur (0.38%), all of them forming one geographical cluster. In the east plains, Begusarai, Bhagalpur and Saharsa showed increasing trend whereas Katihar, Munger and Purnea showed declining trend. Rate of increase was relatively more prominent for Begusarai (4.74%). Among the districts showing declining trend in this zone Purnea figured more prominently. All the districts in the south-west, except Bhojpur and Patna showed increasing trend in winter paddy area. Rate of increase was significant for Aurangabad at 1.69%. Most of the districts in the plateau zone showed declining trend in winter paddy area ranging between (-)1.67% and (-)0.37%.

IV.1.32 Area under summer paddy showed to increase largely among the districts of the east plains. It increased significantly at 8.98% in Begusarai, 10.02% in Katihar and 14.20% in Purnea district. In the south-west plains none of the districts showed increasing trend. In the plateau zone it was only Santhal Parganas to show increasing trend (5.58%) in summer paddy area. Districts to lose prominently in summer paddy area included Gopalganj (-13.94%), Muzaffarpur (-10.81%) and Siwan (-14.80%) in the north-west; Munger (-12.28%) in the east; Aurangabad (-18.12%), Bhojpur (-24.09%), Gaya (-11.86%), Nalanda (-16.18%), Patna (-11.50%) and Rohtas (-13.10%) in the south-east; and Giridih (-20.22%) and Dhanbad (-14.64%) in the plateau zone.

c) Yield

IV.1.33 Yield of paddy in all the seasons showed an increasing trend in all the agro-climatic zones. However, while for some zones it was summer paddy to show greater increase, for others it was autumn or winter paddy. For example, for summer paddy the yield increase was impressive in the east (4.42%), followed by the north-west (3.85%). For the plateau zone as well it was impressive at 2.50%. In the case of autumn, the plateau zone (2.74%), followed by the south-west (2.07%) showed more impressive performance. For winter paddy it was the north-west (2.98%), followed by the south-west (2.47%) which showed more impressive performance in yield increase.
IV.1.34 Analysing the district-wise performance it is observed that most of the districts in the north-west showed increasing trend in the yield of autumn paddy, ranging between 4.02% and 0.18%. Higher rate of growth was recorded in Sitamarhi (4.02%), followed by Saran (3.71%) and Siwan (3.84%). Amidst such a trend, Muzaffarpur (-3.33%) and Samastipur (-3.74%) showed declining trend in yield of autumn paddy. In the east plains only Katihar showed declining trend in the yield (-3.83%), while all other districts showed increasing trend in the range of 3.38% and 0.14%. Among these districts Purnea, followed by Munger and Saharsa, gained in yield relatively more. In the south-west plains, all the districts showed increasing trend in yield in the range between 3.33% and 1.45%. Districts of plateau zone showed increasing trend more impressively in the yield of autumn paddy in the range of 7.67% and 1.40%. The growth in yield was significantly large at 7.67% in respect of Palamu. Singhbhum was the lone district in this zone to show declining trend at (-)1.01% in the yield of autumn paddy.

IV.1.35 For winter paddy yield level increased in most of the districts. Districts to show impressive performance included Madhubani (5.92%) and Siwan (5.12%) in the north-west; Munger (4.91%) in the east plains; Bhojpur (4.03%) and Nalanda (3.97%) in the south-west; and Hazaribagh (2.40%) and Giridih (2.35%) in the plateau zone. Districts to show declining trend in yield level included Muzaffarpur (-0.62%) and Samastipur (-1.78%) in the north-west; Saharsa (-0.63%) in the east; and Palamu (-0.99%) in the plateau zone.

IV.1.36 For summer paddy as well yield level increased in most of the districts in all the agro-climatic zones. Districts showing impressive performance included West Champaran (6.62%) and Saran (5.64%) in the north-west; Bhagalpur (6.00%) and Katihar (5.34%) in the east; Rohtas (4.47%) in the south-west and Singhbhum (3.25%) and Santhal Parganas (3.98%) in the plateau zone. However, the districts, namely Begusarai (-2.31%) in the east plains; Bhojpur (-1.38%), Gaya (-0.14%) and Patna (-2.66%) in the south-west plains; and Giridih (-1.25%), Ranchi (-2.52%) and Dhanbad (-0.74%) in the plateau zone showed declining trend.

Conclusions

IV.1.37 The following broad conclusions may thus be arrived at:

i) Paddy showed a growth rate of 1.19% during 1971-93 with wide year to year fluctuation in its production. Much of the increase in paddy production was in the second sub-period. Despite impressive growth performance during the second sub-period the State lagged far behind other major States in the level of paddy production, occupying second position in area and seventh position in production.
ii) The south-west plains with 24.42% of area contributed 33.0% of paddy production in the State. Among the districts it was Rohtas, Bhojpur, Santhal Parganas, Ranchi, East Champaran, West Champaran and Purnea showing higher production of paddy.

iii) All the zones showed declining trend in the first sub-period, but recorded increasing trend in the second sub-period. The east plains recorded higher growth rates than other zones. Districts registering high growth rates included Saran, Siwan, Munger, Nalanda, Nawadah and Palamu.

iv) Much of the increase in paddy production emanated from yield increase, as area shrank during this period. Rate of shrinkage in area under paddy was similar in all the agro-climatic zones at around 2.0% to 3.0% per annum during 1977-91. Districts with high shrinkage included Madhubani, Sitamarhi, Vaishali, West Champaran, Purnea, Patna, Bhojpur, Santhal Parganas and Singhbhum. Amidst such a scenario there were districts to show expansion in paddy area. They included Begusarai and Siwan.

v) Yield of paddy recorded impressive performance, specially during the second sub-period (2.32%). However, it lagged far behind other paddy growing States both in terms of the level of yield and growth rates. Across different agro-climatic zones, the rate of increase in paddy yield was more impressive for the north-west and south-west plains. Across different districts, Madhubani and Munger figured prominently in terms of rate of increase in paddy yield. However, in terms of yield level, it was the south-west plains which showed prominence. Districts such as Nalanda, Bhojpur and Patna showed relatively very high yield of paddy.

vi) Analysis of seasonality of paddy production suggests that winter paddy was more dominant both in terms of area and production. However, it was the summer paddy which showed high yield level. Further, increase in autumn and summer paddy production was more impressive than winter paddy. Again, while area under winter paddy showed declining trend, autumn and summer paddy showed increasing trend. In terms of growth in yield as well, both summer and autumn paddy were ahead of winter paddy.

vii) While winter paddy was cultivated uniformly across different agro-climatic zones/districts of the State, cultivation of summer paddy was largely area specific in the east plains. Katihar, Purnea and Saharsa alone had more than two-thirds (68.90%) of summer paddy area. In the production of autumn paddy the districts of the north-west dominated the scenario. However, Ranchi in the plateau zone dominated in autumn paddy with a share of 18.26% in the area and 12.07% in production. The other districts to produce autumn paddy prominently included East Champaran, Gopalganj and West Champaran in the north-west plains; and Purnea in the east plains.
Table IV.1.1
Area, production and yield as also trend growth rates in Paddy production from 1971 to 1993 in Bihar

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AREA (000 ha)</th>
<th>PRODN (000 tns)</th>
<th>YIELD (tns/ha)</th>
<th>INDEX NUMBERS OF AREA</th>
<th>PRODN</th>
<th>YIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>5274.70</td>
<td>4154.30</td>
<td>0.79</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1980-81</td>
<td>5550.70</td>
<td>5635.10</td>
<td>1.02</td>
<td>105</td>
<td>136</td>
<td>129</td>
</tr>
<tr>
<td>1990-91</td>
<td>5390.40</td>
<td>6563.50</td>
<td>1.22</td>
<td>102</td>
<td>159</td>
<td>155</td>
</tr>
<tr>
<td>1991-92</td>
<td>4792.20</td>
<td>4480.50</td>
<td>0.93</td>
<td>91</td>
<td>107</td>
<td>118</td>
</tr>
<tr>
<td>1992-93</td>
<td>4383.20</td>
<td>3569.10</td>
<td>0.81</td>
<td>86</td>
<td>103</td>
<td></td>
</tr>
</tbody>
</table>

Area and production figures are 3 year moving averages.

Table VI.1.2
Compound Annual Rate of Growth

<table>
<thead>
<tr>
<th>Period</th>
<th>Area</th>
<th>CARG (Prod.)</th>
<th>CARG (Yield)</th>
</tr>
</thead>
<tbody>
<tr>
<td>'1970-71 TO 1992-93</td>
<td>(0.175)</td>
<td>(0.001)</td>
<td>(0)</td>
</tr>
<tr>
<td>1970-71 TO 1982-83</td>
<td>(0.14)</td>
<td>(0.408)</td>
<td>(0.514)</td>
</tr>
<tr>
<td>1983-84 TO 1992-93</td>
<td>(0.27)</td>
<td>(0.094)</td>
<td>(0.045)</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate the level of significance.

Table IV.1.3
Year-wise Area, Production and Yield of Paddy in different seasons

<table>
<thead>
<tr>
<th>AUTUMN</th>
<th>WINTER</th>
<th>SUMMER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
<td>Area (lakh ha)</td>
<td>Prod (lakh t)</td>
</tr>
<tr>
<td>1970-77</td>
<td>6.31</td>
<td>3.89</td>
</tr>
<tr>
<td>1971-72</td>
<td>6.30</td>
<td>4.24</td>
</tr>
<tr>
<td>1972-73</td>
<td>5.99</td>
<td>3.94</td>
</tr>
<tr>
<td>1973-74</td>
<td>5.69</td>
<td>3.39</td>
</tr>
<tr>
<td>1974-75</td>
<td>5.98</td>
<td>4.78</td>
</tr>
<tr>
<td>1975-76</td>
<td>5.97</td>
<td>4.11</td>
</tr>
<tr>
<td>1976-77</td>
<td>5.79</td>
<td>3.82</td>
</tr>
<tr>
<td>1977-78</td>
<td>6.45</td>
<td>4.95</td>
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<td>1978-79</td>
<td>6.60</td>
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<td>1979-80</td>
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<td>1980-81</td>
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<td>1981-82</td>
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<td>1982-83</td>
<td>6.72</td>
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<td>1983-84</td>
<td>7.33</td>
<td>7.04</td>
</tr>
<tr>
<td>1984-85</td>
<td>6.71</td>
<td>6.43</td>
</tr>
<tr>
<td>1985-86</td>
<td>7.01</td>
<td>4.98</td>
</tr>
</tbody>
</table>

CARG 1977-91 | 1.37 | 4.08 | 2.71 | -0.74* | 1.92* | 2.67 | 1.05* | 4.08 | 3.03 |

NOTE: * Significant at 5.0% level.
IV.2 MAIZE

Maize was the third most important food crop in Bihar both in terms of area (684.37 thousand ha.) and output (1195.5 thousand tonnes). It constituted 7.76% and 11.3% of the country's foodgrain area and production respectively in 1990-93. The trend and pattern of its growth over a period of time across different agro-climatic zones/districts in Bihar as well as at the State level is discussed below.

i) Production of Maize

IV.2.2 Table IV.2.1 presents production of maize alongwith index number in Bihar for the intermittent years during 1971-93. Maize production remained stagnant in the State till 1987-88. It hovered around 800-900 thousand tonnes all these years. However, it showed upward movement from 1988-89, reaching the level of 1326.10 thousand tonnes in 1992-93. Trend growth rate, as presented in Table IV.2.2, worked out at 1.56% per annum for the period 1971-93. Between the two sub-periods the trend growth rate accelerated to 3.80% per annum during the second sub-period as against just 1.29% per annum during the first sub-period. However, it was much less as compared to growth rate experienced at the national level (2.93%) during 1983-93. It was still less in comparison to the growth rates experienced in states like Madhya Pradesh (4.22%), Karnataka (8.27%), Uttar Pradesh (4.64%) and West Bengal (7.62%) during the same period. In terms of production, however, Bihar continued to be second only to Uttar Pradesh.

Regional pattern

IV.2.3 Across different zones/districts, maize cultivation was concentrated largely in the north-west and east Plains, contributing 41.46% and 44.45% respectively of the total maize production in the State. The South-west (3.32%) and plateau (10.37%) zones were not prominent in maize production. Among the districts, it was Samastipur (12.17%) in the north-west; and Begusarai (17.98%) and Saharsa (10.85%) in the east which occupied place of prominence in maize production.

IV.2.4 Analysing the growth trend at zone level, it is observed that north-west alluvial plains and the east alluvial plains, both falling north of the Ganges, experienced increase in maize production during 1977-91, although at varying levels. While the growth rate was relatively high at 2.33% for the east alluvial plains, it was less for the north-west alluvial plains at 1.85% per annum only. The other two zones, namely, the south-west alluvial plains and the plateau districts experienced decline in maize production during the
same period. In case of the south-west alluvial plains it declined at (-)4.41% per annum. The decline was (-)1.79% per annum in the plateau districts. During the second sub-period the growth trend accelerated more in the east alluvial plains to 5.62% per annum. It was relatively low at 1.62% for north-west alluvial plains. The south-west alluvial plains and the plateau region continued to show declining trend even during the second sub-period at (-)3.84% and (-)2.84% respectively.

IV.2.5 Districts with high share in state maize production showed faster rate of growth in maize production during 1977-91. They included Begusarai (6.84%), Saharsa (5.22%) and Samastipur (2.80%). Other districts such as Muzaffarpur, Darbhanga, Gopalganj, East Champaran, West Champaran and Katihar as well showed relatively high growth rate in maize production.

Instability in Production

IV.2.6 Co-efficient of variation in maize production is observed to be 11.78% for the State, suggesting relative stability in the increasing trend of maize production in Bihar. Across different zones, co-efficient of variation in the increasing trend of maize production was relatively less in respect of the east plains (15.55%) and relatively more in respect of the south-west plains (24.12%). In the case of the north-west plains the declining trend in maize production was more stable with co-efficient of variation at 12.35% only, whereas it was relatively more unstable in the case of the plateau districts with co-efficient of variation at 22.76%. At the district level, however, the level of instability in the increasing or decreasing trend in maize production was relatively much high. For example, among the districts showing increasing trend the minimum co-efficient of variation was 17.13% as in Muzaffarpur and maximum was 37.15% as in Giridih. Similarly, among the districts showing declining trend, the minimum co-efficient of variation was 21.08% as in Saran and maximum was 64.15% as in Bhojpur.

Analysis of Acceleration/Deceleration

IV.2.7 For the state the maize production was observed to be increasing at accelerated level at 0.15%. Across different zones it was found to increase at accelerated rate only in the east (0.33%), as the north-west showed deceleration (-0.05%) in the increasing trend. The declining trend in respect of the south-west plains was observed to be accelerating at 0.43%. It showed deceleration at (-)0.07% in respect of the plateau districts. Districts viz. Samastipur, Begusarai and Saharsa with high performance in maize production, showed acceleration in their increasing trend. Rate of acceleration was relatively more in respect of Saharsa at 0.95%, as against 0.33% in Begusarai and 0.05% in Samastipur. In Madhubani and Sitamarhi
the increasing trend in maize production was observed to be decelerating significantly. In respect of Aurangabad, Nawadah and Ranchi the declining trend in maize production was found to be accelerating.

ii) Area under Maize

IV.2.8 Maize occupied an area of 990.8 thousand hectares, forming 8.98% of the gross cropped area of the State in 1970-71. As is evident from Table IV.2.1, area under maize showed gradual decline from 990.80 thousand ha. in 1970-71 to 724.7 thousand hectares in 1992-93. It declined annually at (-)1.83% during 1971-93. The rate of decline became more sharp in the second sub-period with trend growth rate at (-)1.42% per annum as against (-)0.71% in the first sub-period. The declining trend in area under maize in Bihar assumes seriousness when compared with the scenario observed in major maize growing states. It showed increasing trend in Karnataka (6.23%), Maharashtra (5.43%) and Tamil Nadu (5.34%) as against declining trend in Bihar.

Regional Pattern

IV.2.9 Zones/districts showing high maize production also showed high level of area under maize, although not proportionately due to yield differentials. The north-west and east plains occupied the maximum area under maize - 35.36% and 43.26% respectively. It was again Samastipur (7.88%) in the north-west; and Begusarai (14.50%) and Saharsa (9.26%) in the east plains which occupied relatively high area under maize.

IV.2.10 Decline in area under maize during 1977-91 was uniform across different agro-climatic zones in the state. However, there were variations in the magnitude of the rate of decline. The south-west alluvial plains showed the highest rate of decline at (-)6.84% per annum, followed by plateau districts at (-)3.73% per annum. North-west alluvial plains showed decline at (-)2.51% and east alluvial plains at (-)1.47%. Analysing the trend of growth in the two sub-periods, it is observed that it continued to decline even in the second sub-period in all the four agro-climatic zones. The south-west alluvial plains registered higher rate of decline at (-)7.40% per annum, followed by the plateau districts at (-)3.62% per annum, the north-west alluvial plains at (-)2.12% and the east alluvial plains at (-)0.75% per annum. Among the major maize growing districts area under the crop was observed to increase only in Purnea and Saharsa, Begusarai with dominance in maize production showed shrinkage in area even during the second sub-period.
ii) Yield of Maize

IV.2.11 The yield of maize in the state showed significant increase over the years, off-setting the resultant impact of decline in area on output levels of maize. The yield of maize was 1120 kg/ha. in 1970-71 which increased to 1830 kg/ha. in 1992-93 registering compound annual rate of growth at 3.50% during 1971-93. Much of the yield increase was recorded during the second sub-period with growth rate of 5.15% as against 2.25% in the first sub-period. The yield level of maize in the state compared well with the national average of 1530 kg/ha. but less in comparison to states like Karnataka (2960 kg/ha.), West Bengal (2260 kg/ha.) and Punjab (2020 kg/ha.).

Regional pattern

IV.2.12 Across different zones average yield of maize was much higher in the north-west (1.88 t/ha.), followed by the east plains (1.64 t/ha.). In the south-west, although area under maize was relatively much less, but yield was fairly high at 1.42 t/ha. The plateau districts lagged far behind with yield of maize at 0.97 t/ha. only. Across districts it was highest at 2.47 t/ha. in Samastipur. In Begusarai and Saharsa, although production of maize as also its area was relatively high, but they lagged far behind other districts of the north-west in terms of yield. It was 1.98 t/ha. in Begusarai and 1.87 t/ha. in Saharsa as against 2.34 t/ha. in Darbhanga, 2.27 t/ha. in Madhubani, 2.13 t/ha. in East Champaran and 2.12 t/ha. in Muzaffarpur.

IV.2.13 Analysis of trend growth in yield showed that the north-west alluvial plains registered the highest growth rate of 4.36% per annum during 1977-91. It was followed by the east alluvial plains with growth rate at 3.80% and the South-west alluvial plains at 2.43%. The plateau districts showed a growth in yield at 1.94% during this period. Increase in yield showed to accelerate in all the zones during the second sub-period, however, more in respect of the east alluvial plains (6.37%). Rate of growth in yield was relatively high in major maize growing districts such as Begusarai (8.03%) and Saharsa (10.58%) during the second sub-period.

Conclusions

IV.2.14 The following broad conclusions may thus be arrived at:

i) Production of maize in Bihar remained stagnant till 1987-88 with marginal year to year fluctuation. The subsequent period, however, witnessed acceleration in maize production in the State. It was only next to Uttar Pradesh in the volume of maize production. In terms of rate of growth, however, it lagged behind states like Karnataka, Madhya Pradesh and Uttar Pradesh.
ii) Maize production was region specific with the east plains and north-west plains leading in production. Among the districts, Begusarai, followed by Samastipur and Saharsa dominated in maize production. In terms of growth rate while the east and north-west plains showed increasing trend, reverse was the case in the south-west and plateau zones.

iii) Much of the increase in maize production emanated from increase in the yield level, as area under maize showed declining trend.

iv) The declining trend in area was noticeable even in the east and the north-west plains, the dominant maize growing zones.

v) The increase in yield of maize was observed in all the agro-climatic zones. However, it was impressively high in respect of the east and the south-west plains. The districts to witness impressive increase in maize yield included Madhubani, Muzaffarpur, Siwan, Vaishali, Begusarai, Katihar, Saharsa, Gaya, Nawadah and Ranchi.

| Table IV.2.1 |
| Area, production and yield of maize as also trend growth rate in Bihar |
| YEAR | AREA (000 ha) | PRODN (000 tns) | YIELD (tns/ha) | INDEX NUMBERS OF Area | Prodn. | Yield |
| 1970-71 | 990.80 | 1113.20 | 1.12 | 100 | 100 | 100 |
| 1980-81 | 882.50 | 869.50 | 0.99 | 89 | 78 | 88 |
| 1990-91 | 654.80 | 1037.50 | 1.56 | 67 | 93 | 139 |
| 1991-92 | 653.60 | 1223.80 | 1.84 | 67 | 110 | 164 |
| 1992-93 | 724.70 | 1326.10 | 1.83 | 73 | 119 | 163 |

| Table IV.2.2 |
| Compound Annual Rate of Growth |
| Period | Area | CARG | Prodn. | Yield |
| 1970-71 TO | -1.83 | 1.56 | 3.50 |
| 1992-93 | (0) | (0) | (0) |
| 1970-71 TO | -0.71 | 1.29 | 2.25 |
| 1982-83 | (0.005) | (0.216) | (0.029) |
| 1983-84 TO | -1.42 | 3.80 | 5.15 |
| 1992-93 | (0.003) | (0) | (0) |

Figures in parentheses indicate the level of significance
IV.3 WHEAT

Wheat is the second most important cereal food crop for the State, next only to paddy, occupying 21.7% of the GCA and 33.4% of foodgrains output in 1990-93. The trends of growth in production, area and yield of wheat across different zones/districts is analysed in the following paragraphs.

i) Production

IV.3.2 Wheat production in the State was 4.12 lakh tones during the triennium 1958-61. Over the years it increased to 12.39 lakh tones in 1968-71, 22.31 lakh tones in 1978-81 and 35.36 lakh tones in 1990-93. Wheat production in the state over three decades thus recorded a compound annual rate of growth of 6.90%. Rate of increase in wheat production during the recent period i.e. 1983-93 was more impressive (4.34%) as compared to the national average of 3.70% per annum. It compares well with major wheat growing states of Haryana, Uttar Pradesh and Punjab where the annual compound growth rate of production during the same period was recorded at 5.68%, 3.56% and 3.79% respectively.

IV.3.3 Analysing the wheat production from 1970-71 to 1992-93, it is observed that wheat production in the State remained by and large stagnant, hovering around 24 lakh tonnes up to 1982-83. The year 1983-84 was a landmark for wheat production when it exceeded 29 lakh tonnes. It continued to rise since, touching 35.60 lakh tones in 1990-91. The trend rate of growth was 3.28% per annum for the period 1971-93. Between the two sub-periods, it was relatively high (3.50%) for the second sub-period and low (2.72%) for the first sub-period.

Regional Pattern

IV.3.4 Across different zones, the north-west plains (40.93%), followed by the south-west plains (35.41%) dominated in wheat production. The east plains had a share of 21.61% in total wheat production of the State. It was almost absent in the plateau zone with a share of 2.05% only. District-wise analysis suggests that production of wheat was by and large evenly spread among the districts of the north-west. However, in districts such as East Champaran (5.65%), Gopalganj (5.65%), Saran (5.44%), Siwan (5.27%) and West Champaran (4.00%) cultivation of wheat was relatively more dominant. Among the districts of the east plains, Begusarai (5.95%), Purnea (4.28%) and Saharsa (4.40%) emerged prominently in wheat production. Among the districts of the south-west plains wheat cultivation was more widespread with relatively high share in State's total wheat production. However, Rohtas followed by Bhojpur was found to be the main wheat granary of the State with a share at 9.92% and 7.43% respectively.
IV.3.5 Analysing the trend rate of growth, it is observed that the zones of the north-west alluvial plains and the south-west alluvial plains experienced relatively high rate of increase in wheat production at 3.68% and 4.16% per annum respectively during 1977-91. It was relatively low for the east alluvial plains at 2.66% per annum. The plateau zone offered disappointing picture with trend rate of growth showing decline at (-)2.77% during this period. However, scenario changed for the better during 1984-91 with rate of growth speeding up in all the agro-climatic zones. It was more impressive in the north-west alluvial plains and the south-west alluvial plains with rates of growth exceeding 6.0%. The case of plateau region was still more impressive, as it reversed from declining trend in the first sub-period to impressive level of increasing trend at 2.67% in the second sub-period. The rate of growth was relatively less in the east alluvial plains at 4.31% only.

IV.3.6 Relatively high rate of growth in wheat production during 1977-91 was observed in the case of districts with lower share in state wheat production. They included Begusarai (4.90%), Gaya (4.49%) and Nalanda (5.45%). Rate of growth was equally high in East Champaran (5.17%) and Hazaribagh (4.20%).

Instability in wheat production

IV.3.7 The wheat production in the State showed to grow with fair degree of stability, as the co-efficient of variation in its growth rate was low at 8.81% only. Across different agro-climatic zones it was relatively more stable in the north-west plains and the south-west plains with co-efficient of variation in trend growth rates at 8.34% and 9.35% respectively. However, the co-efficient of variation was relatively more in the plateau zone (16.28%) suggesting higher instability in wheat production in the zone. Analysis at the district level showed that growth in wheat production was relatively more stable in districts such as Saran, Siwan and West Champaran with co-efficient of variation in trend growth rate of wheat at less than 12.00%. Districts with high instability in the growth of wheat production included Gopalganj (21.51%), Samastipur (21.54%), Sitamarhi (22.44%) in the north-west plains; Katihar (20.34%), Munger (21.41%) and Begusarai (20.34%) in the east plains; and Dhanbad (56.24%), Singhbhum (26.57%), Hazaribagh (27.21%) and Palamu (31.94%) in the plateau region.

Analysis of acceleration/deceleration

IV.3.8 Analysing the rate of acceleration/deceleration in the trend rates of growth in wheat production across different zones/districts, it is significant to observe that the growth in wheat production in the State was increasing at accelerated rate at 0.26%. Across different agro-climatic zones as well the
increasing trend in wheat production was found to accelerate, although at varying levels. It was fairly high in respect of the north-west (0.39%), the south-west (0.17%) and the plateau districts (0.44%). In the east plains, however, rate of acceleration in the increasing growth rate of wheat production was low at 0.09% only.

IV.3.9 Analysing the rates of acceleration/deceleration at district levels, it is observed that in the north-west plains all districts, except Vaishali, showed acceleration in the increasing trend rate of growth of wheat production, ranging between 0.86% as in Gopalganj and 0.03% as in Siwan. Vaishali was the lone district to show deceleration in the increasing trend. Among the districts of the east plains incidence of districts showing deceleration in their trend growth rates of wheat production was more. Such districts of the zone were Begusarai (-0.26%), Bhagalpur (-0.14%) and Katihar (-0.10%). Only Saharsa and Purnea showed acceleration in the increasing trend rate of growth of wheat production at 0.37% and 0.24% respectively. In Munger the declining trend rate of growth in wheat production was found to accelerate at 0.27%. Districts of the south-west plains presented a relatively more homogenous picture with most of them showing acceleration in the growth rates of wheat production. It was impressively high at 0.69% in Nawadah and 0.62% in Patna. Aurangabad was the lone district of the zone to show deceleration (-0.43%) in the increasing trend rate of growth of wheat production. In the plateau region, all the districts showing declining trend rate of growth had acceleration in wheat production ranging between 0.95% as in Dhanbad and 0.19% as in Hazaribagh. Only the district of Hazaribagh had increasing trend that showed acceleration.

ii) Area under wheat

IV.3.10 Area under wheat expanded several fold in Bihar over the last three decades. It was just 6.39 lakh hectares in 1960-61 which increased to 19.96 lakh hectares in 1992-93, showing compound annual rate of growth at 3.59%. The area expansion for wheat reached, however, plateau level of 19.45 lakh ha. by 1976-77. As a result, the pace of further expansion of area under wheat slowed down in subsequent period. The trend rate of growth in area under wheat during 1971-93 was observed to be 1.49 % per annum. It, however, increased faster at 2.22% during the first sub-period and slowed down at 1.34% during the second sub-period. Comparing the trend rate of growth in wheat area with those of major states it is observed that while some of the major states experienced declining trend in area under wheat during the eighties, Bihar continued to show expansion. For example, in Bihar it grew annually at 1.45% during 1983-93, it declined at 2.75% in Assam, 1.43% in Gujarat and 3.85% in Maharashtra. In fact, area expansion of wheat in Bihar compares better
with the national average of 0.56%. It compares well with Uttar Pradesh (0.78%), Punjab (1.10%) and Haryana (1.66%) also.

Regional pattern

IV.3.11 Across different zones/districts, the north-west (39.25%), followed by the south-west (34.16%) showed relatively high area under wheat. Rohtas (9.99%), followed by Bhojpur (7.11%) and Gaya (4.79%) in the south-west; Purnea (5.26%), followed by Saharsa (5.22%) and Begusarai (5.04%) in the east; and East Champaran (5.05%), followed by Gopalganj (4.80%), Saran (4.70%) and Siwan (4.71%) in the north-west were the districts where area under wheat formed relatively high proportion of the total wheat area in the State.

IV.3.12 Analysing the trend in two sub-periods, it is observed that during the first sub-period all agro-climatic zones of Bihar, except the south-west plains, showed declining trend in area under wheat. It was as high as (-)6.30% in the plateau zones. In the north-west and the east plains the rate of decline was similar at (-)1.60% and (-)1.30%. In the south-west plains, however, it showed increasing trend at 1.90% per annum. The process took a significant turn in the second sub-period with area under wheat showing increasing trend at accelerated rate in all the zones. It was as high as 3.39% in the east plains, followed by 2.45% in the north-west and 2.28% in the south-west plains. Plateau zone as well showed increasing trend, albeit marginally, at 0.07%. The fact that the plateau zone showed reversal from high declining rate to increasing trend in area under wheat itself is a significant development. Across different districts rate of growth in wheat area was relatively high in districts that were less dominant in wheat production. Such districts included Begusarai (5.80%), Purnea (6.43%), Darbhanga (4.38%), Sitamarhi (4.85%), Nalanda (5.37%) and Hazaribagh (5.56%).

iii) Yield of wheat

IV.3.13 Part of the increase in wheat production in the State could be attributed to impressive increase in the yield level. It increased from 644 kg/ha. in 1958-61 to 1790 kg/ha. in 1990-93, recording compound annual rate of growth at 3.2%. Further, the first sub-period showed increasing yield but with wide year to year fluctuation. The yield hovered around 1250 kg/ha. during this period. The second sub-period showed a more stable and consistent increase in yield in upward direction, touching the level at 1820 kg/ha. in 1991-92. The trend rate of growth in yield of wheat for the period 1971-93 was 1.77% per annum. The pace of increase in yield became faster at 2.19% per annum during the second sub-period as against 0.46% per annum during the first sub-period.
IV.3.14 Despite the accelerated rate of growth, the yield of wheat in Bihar at 1790 kg/ha. in 1990-93 was below the national average of 2330 kg/ha. It was much less than the yield level in Haryana (3570 kg/ha.) and Punjab (3760 kg/ha.). Even the pace of increase in yield level lagged behind in Bihar. While it increased at 3.14% per annum at the national level, it was 2.80% for Bihar during 1983-93. In Haryana the pace of increase in yield was still faster at 4.0% per annum during the same period.

Regional pattern

IV.3.15 Across different zones/districts, the average yield of wheat was the same in the north-west and the south-west plains at 1.79 t/ha. and 1.78 t/ha. respectively. Districts such as Patna (2.22 t/ha.) and Nalanda (2.14 t/ha.) in the south-west; Samastipur (2.10 t/ha.) and Gopalganj (2.02 t/ha.) in the north-west; and Begusarai (2.02 t/ha.) in the east plains showed relatively high yield level of wheat. Districts with yield of wheat higher than the State average (1.71 t/ha) included East Champaran (1.92 t/ha.), Saran (1.98 t/ha.) and Siwan (1.92 t/ha.) in the north-west; and Bhojpur (1.79 t/ha.) and Nawadah (1.76 t/ha.) in the south-west plains.

IV.3.16 Increase in yield of wheat was experienced in all agro-climatic zones, however, at varying rates. It was as high as 2.73% per annum in respect of the north-west alluvial plains, followed by 2.51% in the south-west alluvial plains during 1977-91. The rate of yield increase was relatively less for the east alluvial plains (1.33%) during this period. The plateau region had trend growth rate, although positive, but low at 0.13% only.

IV.3.17 The scenario took a rapid turn from mid-eighties with even plateau districts experiencing impressive increase in yield level. It reversed from a declining trend rate of (-)3.90% in the first sub-period to increasing trend at 2.60% per annum during second sub-period. Rate of increase in yield was still more impressive in the case of other agro-climatic zones, more so in the south-west alluvial plains (4.15%) and the north-west alluvial plains (3.62%) during the second sub-period. The east alluvial plains, however, continued to lag behind with trend growth rate at 0.92% only during the second sub-period. Across different districts rate of growth in yield of wheat was relatively high in less dominant wheat growing districts. Such districts included Munger (4.72%), Nawadah (6.51%), Patna (5.27%) and Hazaribagh (6.46%).

Conclusions

IV.3.18 The following broad conclusions are thus arrived at:
(i) Production of wheat showed impressive acceleration in the State, especially during the second sub-period. Much of the increase in wheat production emanated from yield increase. Nevertheless, significance of area expansion in contributing to wheat production was no less, especially when seen in the context of wheat area increasing while most of other crops showing shrinkage in area. Despite acceleration, the State is yet to match other major wheat growing States both in terms of the volume of wheat production and yield per hectare.

(ii) Across different zones, it was the north-west (40.93%), followed by the south-west (35.41%) which had a large share in the wheat production of the State. Districts to figure prominently in wheat production included Rohtas (9.92%), Bhojpur (7.43%), Begusarai (5.95%), East Champaran (5.65%), Gopalganj (5.65%), Saran (5.44%) and Siwan (5.27%).

(iii) In terms of growth rates in wheat production both the north-west and the south-west plains showed impressive performance. In districts such as West Champaran, Begusarai and Nalanda the rate of growth in wheat production was comparable to the national average and even those achieved by major wheat growing States. Districts showing relatively high production of wheat recorded generally modest rate of increase in the range of 3.50% and 4.50%.

(iv) Rate of growth in wheat production was still more impressive during the second sub-period in districts such as East Champaran, Sitamarhi, Nalanda, Nawadah, Hazaribagh and Palamu at exceeding 8.0%.

(v) In districts such as Darbhanga, Sitamarhi, Begusarai and Purina much of the increase in wheat production was due to area expansion exceeding 5.0% per annum. On the other hand in districts such as East Champaran, Sitamarhi, Gaya, Nawadah, Patna, Hazaribagh and Palamu increase in wheat production was largely due to increase in yield level exceeding 5.0% per annum.

(vi) There were quite a few districts such as Gopalganj, Samastipur, Begusarai, Nalanda and Patna in whose case the average yield of wheat was close to the national average. But in none of the districts it was near to the yield level as in Haryana and Punjab.
Table IV.3.1  
Area, production and yield of wheat as also trend growth rates thereof in Bihar during 1971 to 93

<table>
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<th>PRODN (000 tns)</th>
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Table IV.3.2  
Compound Annual Rate of Growth

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<td>1982-93</td>
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<td>1983-84 TO</td>
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<td>(0)</td>
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</table>

Figures in parentheses indicate the level of significance.
IV.4. ARHAR

A wide range of pulses are produced in Bihar. They include gram, arhar, khesari, moong, masoor, etc. Of them, arhar is the most important in terms of both area and production. As much as 146.9 thousand ha. were under this crop in the state producing 135.37 thousand tonnes of output in 1990-93. The question of how this crop has grown over the years across different agro-climatic zones/districts assumes significance in the context of policy thrust to maximise pulses output. The following paragraphs attempt to highlight the growth trend and pattern of arhar in Bihar during the period 1971 to 1993.

i) Production of Arhar

IV.4.2 Production of arhar was 134.6 thousand tonnes in 1970-71, but continued to decline ever after with production dipping low at 73.7 thousand tonnes in 1992-93. Year to year fluctuation in arhar production was high with lowest production at 55.6 thousand tonnes in 1978-79 and highest production at 134.6 thousand tonnes in 1970-71. The production of arhar declined at (-)0.61% per annum during this period. Although it declined in both the sub-periods, however, the rate of decline was more sharp (-4.07%) in the first sub-period than in the second sub-period (-2.21%). The declining trend in arhar production in Bihar assumes significance and remains cause of concern, especially when seen in the context of rising trend of arhar production at all-India level at 1.69% per annum. When it is compared with major arhar producing states, it becomes all the more alarming. For example, it increased annually at 6.08% in Gujarat, 6.49% in Orissa and 21.65% in Haryana during 1983-93, whereas it declined by (-)0.96% in Bihar during this period.

Regional Pattern

IV.4.3 Across different zones/districts, the north-west plains was the major arhar producing zone, contributing almost two-fifths (41.18%) of the State's arhar production. It was followed by the plateau districts (28.69%) and the south-west plains (20.44%). Arhar production was almost absent in the east plains with only 9.68% share in the State. Across different districts share of arhar production was relatively high in Palamu (12.61%) and Ranchi (6.85%) in the plateau zone; Rohtas (7.36%), Bhojpur (4.10%) and Gaya (4.17%) in the south-west; Begusarai (3.05%) in the east; and Siwan (8.95%), Saran (5.37%), Samastipur (4.99%), West Champaran (4.65%) and Gopalganj (4.06%) in the north-west plains.
IV.4.4 Analysing the growth pattern across various agro-climatic zones, it is observed that while the east alluvial plains registered a decline at (-2.70%) per annum during 1977-91, other zones showed increasing trend at varying rates. Both the south-west alluvial plains and plateau zone showed relatively high rate of increase at 4.57% and 4.78% per annum respectively during this period. It was relatively much less at 1.25% per annum for the north-west alluvial plains. Analysis of growth trends separately for the two sub-periods, however, suggests that while the plateau zone continued to experience increasing trend in arhar production even during the second sub-period, the south-west alluvial plain got reversal from declining trend (-0.97%) in the first sub-period to increasing trend (2.68%) in the second sub-period. The east alluvial plains and the north-west alluvial plains presented a picture of reversal from increasing trend (6.13% and 5.59 % respectively) in the first sub-period to declining trend (-12.30% and -6.0% respectively) in the second sub-period.

IV.4.5 Across different districts the rate of growth in arhar production was high in districts with high share in state production during 1977-91. Prominent among them included Palamu (5.10%), Ranchi (6.30%), Rohtas (8.39%), West Champaran (6.83%) and Samastipur (4.49%).

Instability in arhar production

IV.4.6 Arhar production in the State increased during 1977-91 with less of instability, as co-efficient of variation was low at 11.78% only. Among the zones the north-west plains showed stable growth, as co-efficient of variation in growth was only 12.35%. On the other hand, in the south-west and plateau zones, although it was increasing relatively at high rate but with high instability with co-efficient of variation at 24.12% and 22.76% respectively. Co-efficient of variation in arhar production at district level varied widely. Districts such as Muzaffarpur, Samastipur, Siwan and West Champaran recorded growth in arhar production with greater stability with co-efficient of variation at less than 20.0%.

Analysis of acceleration/deceleration

IV.4.7 At the State level the increasing trend in arhar production showed accelerating (0.15%) trend. At the zone level, however, the rate of acceleration/deceleration was observed to vary widely. While in respect of both the north-west and the plateau districts increasing trends were decelerating at (-0.05%) and (-0.07%) respectively, it was increasing at accelerated rate at 0.43% in respect of the south-west plains. Districts with high share in arhar production of the State showed acceleration in their increasing rate, excepting West Champaran, Saran and Gopalganj.
Area under Arhar

IV.4.8 Area under arhar showed shrinkage over the years in Bihar. It was 150.3 thousand hectares in 1970-71, declined thereafter to a low of 63.3 thousand hectares in 1992-93. Trend growth rate thus came to be negative at (-)3.40% per annum for the period 1971-93. It declined more sharply at (-)4.78% in the first sub-period. The second sub-period, however, witnessed slackening in the declining rate at (-)3.21%. The declining trend in area under arhar in Bihar assumes seriousness if seen in the context of increasing area under arhar for India as a whole (2.15% per annum) during 1983-93 as also in major arhar growing states like Gujarat (5.95%), Haryana (20.48%) and Orissa (5.07%) during the same period.

Regional Pattern

IV.4.9 While in production of arhar the north-west plains was leading, in terms of area the zone of plateau districts was ahead (39.80%), followed by the south-west plains (33.46%). The two districts of the plateau viz. Ranchi and Palamu alone covered almost one-third of arhar area of the State. Other districts with high area under arhar included Rohtas, Gaya and Bhojpur in the south-west; Begusarai in the east; and West Champaran, Siwan, Saran and Gopalganj in the north-west plains.

IV.4.10 Decline in area under arhar was observed in all the agro-climatic zones, although the rate of decline varied widely across different zones. Rate of decline was as high as (-)5.19% per annum in the east alluvial plains and (-)3.09% per annum in the south-west alluvial plains during 1977-91. It was relatively less in the south-west alluvial plains (-0.80%) and the plateau zone (-1.47%). Analysing the trend growth rates for two sub-periods, it is observed that the pace of decline speeded up in the north-west alluvial plains from (-)2.09% in the first sub-period to (-)4.92% in the second sub-period. In the east alluvial plains as well it speeded up from (-)1.38% in the first sub-period to (-)10.56% in the second sub-period. The south-west alluvial plains, however, experienced reversal from declining trend at (-)7.71% in first sub-period to increasing trend at 2.44% in the second sub-period. The plateau zone offered the same picture of reversal from declining trend at (-)3.17% in the first sub-period to increasing trend at 0.89% in the second sub-period. Districts to record positive growth in arhar area during the second sub-period included Rohtas (9.12%), Patna (3.51%), Gaya (2.29%), Hazaribagh (4.28%) and Ranchi (2.65%). Districts such as Bhojpur, Palamu, Begusarai, Siwan, Saran and Gopalganj with dominant arhar production recorded shrinkage in its area in the range of (-)0.50% and (-)12.84%.
iii) Yield of arhar

IV.4.11 There was impressive increase in the yield level of arhar in Bihar. Yield per hectare was 960 kg in 1970-71 which declined till 1978-79, but started moving in upward direction since then reaching the peak level at 1380 kg/ha. in 1991-92. Trend growth rate in arhar production was observed to be 2.87% per annum during 1971-93. Analysis of the trend rates of growth in two sub-periods suggests that while it showed increasing trend in both the sub-periods, it was marginally high at 1.00% in the second sub-period as against 0.90% in the first sub-period. Comparing the yield level of arhar in Bihar with that of the national average and those of major states, it was found to be impressive for the State. For example, it was 640 kg/ha. as all-India average, 1110 kg/ha. for Uttar Pradesh, 450 kg/ha. for Maharashtra, 870 kg/ha. for Madhya Pradesh and 1260 kg/ha for Bihar in 1990-93. Moreover, while it declined annually by (-)0.48% for India as a whole, (-)1.41% in Uttar Pradesh and (-)1.37% in Maharashtra, it increased by 1.93% annually in Bihar during 1983-93.

Regional Pattern

IV.4.12 Analysis of the regional pattern in Arhar yield revealed that zones/districts with high level of arhar production and area did not necessarily have high yield. It was relatively high in the north-west (1.32 t/ha.) and the south-west (1.31 t/ha.) plains. The zone of plateau districts on the other hand showed relatively low level of arhar yield (0.77 t/ha.). Districts showing high yield of arhar included Siwan (1.65 t/ha.), Darbhanga (1.47 t/ha.), West Champaran (1.46 t/ha.) and Madhubani (1.39 t/ha.) in the north-west; Katihar (1.42 t/ha.), Purnea (1.38 t/ha.) and Saharsa (1.34 t/ha.) in the east; and Nalanda (1.46 t/ha.) and Patna (1.44 t/ha.) in the south-west; and Santhal Parganas (1.39 t/ha.) in the plateau zone.

IV.4.13 Trend rates of growth in the yield of arhar was impressive in all agro-climatic zones during 1977-91. It was relatively high in the south-west alluvial plains (5.36%), plateau districts (6.25%) and north-west alluvial plains (4.34%). East alluvial plains experienced relatively low rate of yield increase at 2.49%. Analysing the trend growth rates for two sub-periods separately, it is observed that it was uniformly high in all the agro-climatic zones in the first sub-period ranging between 7.68% and 6.74%. The second sub-period, however, experienced a reversal to declining trend in respect of the north-west alluvial plains (-1.08%) and the east alluvial plains (-1.74%). The south-west alluvial plains and the plateau zone continued to show increasing trend even in the second sub-period but at reduced rate at 0.24% and 3.02% respectively. Across different districts rate of growth in yield of arhar was relatively high in less dominant arhar growing districts such as
Madhubani (15.60%), Patna (5.21%), Santhal Parganas (9.82%) and Singhbhum (4.72%).

Conclusions

IV.4.14 On the basis of the foregoing discussions the following conclusions emerge:

(i) Production of arhar witnessed significant reversal in Bihar. Rate of reversal, however, slackened in the second sub-period.

(ii) Much of the decline in arhar production in the State was due to area shrinkage.

(iii) The yield of arhar was relatively high in Bihar as compared to other states and all-India average.

(iv) Production of arhar was region specific largely in the north-west plains with districts of Siwan, Saran and Gopalganj contributing major share. Palamu and Ranchi in the plateau zone as well showed higher share in arhar production.

(v) All these districts showed declining trend in arhar production, especially in the second sub-period. With prices of arhar increasing fast and production of arhar showing increasing trend at all-India level, the reversal in Bihar becomes a matter of concern.

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Table IV.4.2

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<td>1992-93</td>
<td>(0)</td>
<td>(0.001)</td>
<td>(0.01)</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate the level of significance.
IV.5 GRAM

Gram is one of the important pulses crop in Bihar. The present section analyses the trend and pattern of its growth in production, area and yield over the years across different agro-climatic zones/districts of the State.

i) Production

IV.5.2 The production of gram has been consistently declining in the state over the years. It was as high as 174.20 thousand tonnes in 1970-71 which declined to 123.90 thousand tonnes in 1981-82. It, however, recorded upward movement in subsequent years, but never to reach the base level of 1970-71. During the eighties the annual production of gram hovered around 140 to 160 thousand tonnes. The index number came down to its lowest at 56 in 1992-93. Trend rate of growth for the period 1971-93 showed declining trend at (-)0.25%. It showed declining trend in both the sub-periods. It was more sharp at (-)2.09% per annum during the first sub-period. The declining trend narrowed in the second sub-period at (-)1.05% per annum, due to wider application of HYV seeds/pesticides technology in particular. Bihar occupied sixth position in its production (135.7 thousand tonnes in 1990-93) with states such as Madhya Pradesh (1778.13 thousand tonnes), Uttar Pradesh (994.77 thousand tonnes) and Rajasthan (827.90 thousand tonnes) way ahead of Bihar. Declining trend in the production of gram was the general pattern across major gram growing states, except Maharashtra, Madhya Pradesh, Karnataka and Andhra Pradesh. In these states it showed increasing trend ranging between 6.18% and 1.18% during 1983-93. Among the major gram growing states, the rate of decline was relatively high in Haryana (-1.28%), Uttar Pradesh (-2.24%) and Rajasthan (-3.17%) during the same period.

Regional Pattern

IV.5.3 Across different zones, the south-west plains alone produced three-fifth (61.09%) of gram in the State. The share of other zones was much less at 18.76% for the east plains, 11.07% for the plateau districts and 9.08% for the north-west plains. Among the districts, Patna (14.77%), Bhojpur (14.21%) and Rohtas (13.37%) were the major gram growing centres in the State, producing two-fifths of the State gram production. Other districts with relatively high share of gram production included Palamu (5.02%) in the plateau; Nalanda (6.28%) and Gaya (6.03%) in the south-west plains; Munger (9.59%) and Bhagalpur (5.37%) in the east; and Darbhanga (2.27%) and Siwan (1.70%) in the north-west plains.
IV.5.4  Analysis of trend growth rates in the production of gram for the period 1977-91 revealed that the south-west alluvial plains had increasing trend in gram production (2.03%) during 1977-91. In other zones viz. north-west alluvial plains, east alluvial plains and plateau regions it showed declining trend at (-)2.26%, (-)1.08% and (-)0.90% respectively. The declining trend became sharp in respect of the north-west alluvial plains from (-)0.10% in the first sub-period to (-)4.21% in the second sub-period. Declining trend continued to be sharp at (-)2.96% during the second sub-period as against (-)2.82% during the first sub-period in respect of the east plains. In the case of the south-west plains it reversed to declining trend at (-)0.56% in the second sub-period from increasing trend at 0.49% during the first sub-period. The growth rate further decelerated from (-)0.90% in the first sub-period to (-)2.12% in the second sub-period in the plateau zone. Across different districts the rate of growth in gram production was relatively high in Darbhanga (2.69%), Aurangabad (4.39%) and Nawadah (4.59%). Major gram growing districts such as Palamu, Santhal paraganas and Rohtas showed reversal in the growth rate of gram output.

Instability Analysis

IV.5.5  The production of gram in the State was observed to decline with co-efficient of variation at 9.87% only. Across different zones the south-west plains alone showed stable increase in gram production with co-efficient of variation at 12.95% only. However, in respect of the plateau districts, the declining trend in gram production showed high fluctuation, as the co-efficient of variation was at 25.99%. On the other hand, the declining trend in respect of the north-west and the east plains was more stable with co-efficient of variation at 15.66% and 12.55% respectively. Across major gram growing districts, the increasing trend was more stable in Patna with co-efficient of variation at 13.96% only. But it was relatively more unstable in case of Bhojpur (24.17%) and Rohtas (20.59%). In Palamu and Darbhanga the rate of increase was not stable, as co-efficient of variation was high at 42.40% and 37.24% respectively. Bhagalpur too was a major gram growing district. In its case, however, the production of gram showed declining trend (-1.19%) with low fluctuation as co-efficient of variation was 12.80% only.

Analysis of acceleration/deceleration

IV.5.6  The declining trend in gram production of the State was observed to be decelerating (-0.06%). The increasing trend in the south-west plains was found to decelerate (-0.03%). The declining trend in respect of the north-west (-0.22%), east plains (-0.08%) and plateau districts (-0.05%) as well were decelerating. Among the major gram growing districts the increas-
ing trend was found to be accelerating only in respect of Patna (0.65%), Palamu (0.92%) and Darbhanga (0.51%). In case of Bhojpur (-0.23%) and Rohtas (-0.25%) the increasing trend was observed to be decelerating. In Bhagalpur the declining trend was found to be decelerating (-0.24%).

II) Area under gram

IV.5.7 Area under gram showed a sharp shrinkage in the state. It was as high as 244,40 thousand hectares in 1970-71 which increased initially to 266,60 thousand hectares in 1972-73, but continued to decline thereafter reaching the lowest level at 124,30 thousand hectares in 1992-93, with index number at 51 points only. The trend growth rate was observed to be declining at (-)2.40% per annum during 1971-93. The rate of decline was almost uniform in both the sub-periods. It was (-)2.59% in the first sub-period and (-)2.40% in the second sub-period.

IV.5.8 Inter-state comparison of area under gram suggests that Bihar was way behind other states, holding seventh position in the country. While it occupied 2333.43 thousand ha. in Madhya Pradesh and 1376.80 thousand ha. in Rajasthan, it was a mere 146.90 thousand ha. in Bihar during 1990-93. It formed only 2.25% of the gram area of the country. Comparing the trend rates of growth with major gram growing states, it is observed that the rate of decline in area was relatively low in Bihar. For example, Madhya Pradesh, Maharashtra and Karnataka, the major gram growing states, showed expansion in gram area at 1.18%, 2.50% and 4.01% per annum during 1983-93. Uttar Pradesh, Rajasthan and Haryana on the other hand showed shrinkage in gram area at (-)2.89%, (-)1.73% and (-)5.22% per annum respectively as against (-)2.37% in Bihar during the same period.

Regional pattern

IV.5.9 In terms of area as well the south-west plains dominated with a share of 54.17% in the State gram area. Districts to occupy relatively high area under gram included Bhojpur (11.79%), Patna (10.23%) and Rohtas (13.35%) in the south-west; Palamu (7.39%) and Santhal Parganas (3.14%) in the plateau; Munger (9.59%) and Bhagalpur (6.60%) in the east and Darbhanga (2.36%), Saran (1.60%) and Siwan (1.45%) in the north-west plains.

IV.5.10 Further, shrinkage in area under gram was observed in all the four agro-climatic zones, however, varying from a high rate of decline at (-)4.40% in the north-west alluvial plains to a low of (-)1.51% in the south-west alluvial plains. The zone of plateau districts showed equally high level
of shrinkage at (-)3.91% during this period. East alluvial plains on the other hand showed modest rate of shrinkage at (-)2.43%. Between the two sub-periods, the second sub-period witnessed slackened rate of decline in the north-west and plateau zone. In the case of the east plains the rate of decline accelerated in the second sub-period to (-)10.53%. The south-west plains, however, experienced reversal from declining trend in the first sub-period to increasing trend in the second sub-period. Across different districts rate of growth in gram area was positive in select districts only viz; Nalanda (0.10%), Nawadah (1.17%), and Giridih (0.65%). They were the districts with less dominance in its production. Districts with dominant gram production showed shrinkage in their area.

iii) Yield of gram

IV.5.11 There has been definite increase in the yield of gram over these years in Bihar. It was 0.71 thousand tonnes/ha. in 1970-71 which declined initially to reach the lowest level at 0.44 thousand tonnes/ha. in 1973-74, but showed increasing trend thereafter reaching the maximum level of 1.02 tonnes/ha. in 1991-92 with index number reaching at 143 point. Trend rate of growth during 1971-93 thus showed to be increasing at 2.14% per annum. Analysis of the trend rates of growth in two sub-periods suggests that although it showed increasing trend in both the periods, the rate of increase, however, was higher during the second sub-period (1.35%) than the first sub-period (0.48%).

IV.5.12 Comparing the yield level across major gram growing states, it is encouraging to observe that Bihar figured at the top with yield level at 0.91 tonnes/ha. during 1990-93 as against 0.87 tonnes/ha. in Uttar Pradesh, 0.61 tonnes/ha. in Rajasthan, 0.50 tonnes/ha. in Maharashtra, 0.76 tonnes/ha. in Madhya Pradesh and 0.68 thousand tonnes/ha. in Haryana. In terms of growth as well it showed encouraging picture for Bihar. It grew annually at 2.22% in Bihar, 1.57% in Madhya Pradesh and 0.59% in Uttar Pradesh during 1983-93. In Rajasthan it showed a declining trend at (-)1.36%. However, Maharashtra and Haryana showed better performance with yield level growing annually at around 3.30% during the same period.

IV.5.13 Across different zones, the south-west plains with high production of gram also showed high yield level of gram at 0.98 t/ha. The zone of plateau districts had the least of yield at 0.83 t/ha. Further, districts showing high level of gram production also showed high level of yield of gram. They included Patna (1.25 t/ha.) and Bhojpur (1.04 t/ha.) in the south-west; Siwan (1.02 t/ha.) in the north-west; Begusarai (0.95 t/ha.) in the east; and Santhal Parganas (0.77 t/ha.) and Palamu (0.74 t/ha.) in the plateau zone.
### Regional pattern

IV.5.14 All the four agro-climatic zones showed increasing trend in yield of gram during 1977-91. The districts of south-west alluvial plains and plateau districts showed better performance in yield increase at 3.54% and 3.02% per annum respectively. East alluvial plains lagged behind with trend rate of growth at 1.39% only. North-west alluvial plains on the other hand showed modest performance at 2.14% per annum during the same period. Analysis of the growth rates in two sub-periods suggests that in the case of east alluvial plains and the plateau districts it showed reversal from increasing trend at 0.03% and 6.54% respectively in the first sub-period to declining trend at (-)1.06% and (-)0.45% respectively in the second sub-period. Increasing trend slackened considerably from 6.21% in the first sub-period to 1.18% in the second sub-period in respect of the north-west alluvial plains. South-west alluvial plains maintained the increasing trend even in the second sub-period. Across different districts rate of growth in yield of gram was relatively high in less dominant gram growing districts such as Samastipur (8.28%), Aurangabad (5.84%) and Dhanbad (4.54%). Among the dominant gram growing districts Palamu alone showed relatively high rate of growth in yield (4.72%) of gram.

### Conclusions

IV.5.15 On the basis of the observations thus arrived at, the following broad conclusions are suggested:

i) Production of gram in Bihar was much less as compared to other major gram growing states. While most of the states showed increasing trend in gram production, in respect of Bihar it showed significant decline, particularly in the second sub-period.

ii) The decline in gram production was on account of both area shrinkage and reversal in yield.

iii) Production of gram in Bihar was region specific with the south-west plains producing around two-thirds of gram output in the State. Districts to figure prominence in gram production included Bhojpur, Rohtas, Patna, Gaya, Palamu, Bhagalpur and Munger.

iv) Reversal in gram production was seen in zones/districts with low area under gram. The zone of south-west plains with dominant share in gram production showed impressive growth performance. Although area as well showed increasing trend in this zone, the increase in the yield of gram was still more impressive.
### Table IV.5.1
Area, production and yield as also trend growth rates of gram in Bihar during 1971-93

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AREA (000 ha)</th>
<th>PRODN (000 tns)</th>
<th>YIELD (tns/ha)</th>
<th>INDEX NUMBERS OF Area</th>
<th>PRODN</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>244.40</td>
<td>174.20</td>
<td>0.71</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1980-81</td>
<td>195.60</td>
<td>140.60</td>
<td>0.72</td>
<td>80</td>
<td>81</td>
<td>101</td>
</tr>
<tr>
<td>1990-91</td>
<td>167.70</td>
<td>157.80</td>
<td>0.94</td>
<td>69</td>
<td>91</td>
<td>132</td>
</tr>
<tr>
<td>1991-92</td>
<td>148.70</td>
<td>151.20</td>
<td>1.02</td>
<td>61</td>
<td>87</td>
<td>143</td>
</tr>
<tr>
<td>1992-93</td>
<td>124.30</td>
<td>87.10</td>
<td>0.78</td>
<td>51</td>
<td>56</td>
<td>110</td>
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</tbody>
</table>

### Table IV.5.2
Compound Annual Rate of Growth

<table>
<thead>
<tr>
<th>Period</th>
<th>Area</th>
<th>CARG</th>
<th>Prodn</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71 TO</td>
<td>-2.40</td>
<td>-0.25</td>
<td>2.14</td>
<td></td>
</tr>
<tr>
<td>1982-93</td>
<td>(0)</td>
<td>(0.342)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1970-71 TO</td>
<td>-2.59</td>
<td>-2.09</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>1982-93</td>
<td>(0)</td>
<td>(0)</td>
<td>(0.545)</td>
<td></td>
</tr>
<tr>
<td>1983-84 TO</td>
<td>-2.40</td>
<td>-1.05</td>
<td>1.35</td>
<td></td>
</tr>
<tr>
<td>1992-93</td>
<td>(0)</td>
<td>(0.067)</td>
<td>(0.013)</td>
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</tr>
</tbody>
</table>

Figures in parentheses indicate the level of significance.
IV.6 RAPESEED/MUSTARD

Rapeseed/mustard are the most important crops among oilseeds in terms of both area (105.43 thousand ha.) and production (88.77 thousand tonnes) in Bihar. It formed 51.5% of the oilseeds area and 65.3% of oilseeds production in 1990-93 in the state. The analysis of the growth pattern in area, production and yield of rapeseed/mustard crops during 1971-93 at State level and 1977-91 at zone/district level is presented below.

i) Production of rapeseed/mustard

IV.6.2 Production of rapeseed/mustard increased significantly during 1971-93 in the State. It was 49.0 thousand tonnes in 1970-71 which increased to a maximum of 109.0 thousand tonnes with index number touching 222 in 1991-92. But there was wide year to year fluctuation with minimum and maximum production at 34.9 and 109.0 thousand tonnes respectively. While the first sub-period experienced stagnation with production hovering around 40.0 to 50.0 thousand tonnes, the second sub-period witnessed phenomenal increase in output. Trend rate of growth was negative at (-)0.76% per annum for the first sub-period and positive at 5.26% per annum for the second sub-period.

IV.6.3 Bihar was not a major rapeseed/mustard growing state, as it ranked ninth among the states in its production. Rapeseed/mustard production was as high as 1924.93 thousand tonnes in Rajasthan, followed by 1034.77 thousand tonnes in Uttar Pradesh whereas it was only 88.77 thousand tonnes in Bihar in 1990-93. Increase in rapeseed/mustard production in Bihar as well does not compare well with the national average as also other major states. For example, during 1983-93, while production of rapeseed/mustard grew annually at 7.34% in Bihar, it was 8.76% at all-India level, 15.97% in Haryana, 14.44% in Gujarat, 12.97% in Madhya Pradesh, 17.50% in Rajasthan and 13.43% in West Bengal.

Regional Pattern

IV.6.4 The zone of east plains was the major producer of rapeseed/mustard, contributing 43.30% to the State production. It was no less in the case of the north-west plains, contributing 37.62% of the State production. The share of other zones was relatively much less at 18.02% for the south-west and 9.64% for the plateau districts. Among the districts Begusarai (16.81%) and Purnea (14.00%) figured prominently in its production. Other districts with relatively high share in rapeseed/mustard production included Santhal Parganas (4.26%) and Palamu (3.14%) in the plateau; Bhojpur (3.50%), Patna (4.46%) and Rohtas (4.64%) in the south-west.
plains; Saharsa (5.99%) and Katihar (2.59%) in the east plains; and Samastipur (8.49%), Siwan (5.89%) and West Champaran (4.71%) in the north-west plains.

IV.6.5 Analysing the trend growth rates across different agro-climatic zones, it is observed that while in the first sub-period all agro-climatic zones as well as the State experienced declining trend in production, the trend reversed in the second sub-period at the State level and for two major zones. The decline was as high as (-)11.07% in the plateau districts and as low as (-)0.21% in the south-west alluvial plains. The second sub-period brought reversal in positive direction in all zones, except the north-west alluvial plains which continued to experience declining trend at an accelerated rate even during this period. Rate of decline in this zone was (-)0.21% in the first sub-period, but increased to (-)2.10% in the second sub-period. In other zones rate of increase in production of rapeseed/mustard was impressive. For example, in the north-west alluvial plains it reversed from declining trend at (-)6.07% in the first sub-period to increasing trend at 8.03% in the second sub-period in the Plateau region from high rate of decline at (-)11.09% in the first sub-period, to a low rate of decline at (-)0.13% in the second sub-period and in the east alluvial plains from declining trend at (-)0.47% in the first sub-period to increasing trend at 4.05% in the second sub-period.

IV.6.6 A large number of districts showed relatively high rate of growth in rapeseed/mustard production during 1977-91. They included Darbhanga (7.36%), Samastipur (8.31%), Siwan (10.20%), Vaishali (5.96%), Begusarai (15.85%), Bhagalpur (4.92%), Aurangabad (6.34%), Patna (7.66%) and Rohtas (11.88%).

**Instability in rapeseed/mustard production**

IV.6.7 Rapeseed/mustard production during 1977-91 in the State showed stable increase, as co-efficient of variation was low at 15.14% only. Across different zones, the increasing trend rate of growth was more stable in the north-west plains with co-efficient of variation at 19.79% only. On the other hand, the increasing trend in respect of the east plains, the major rapeseed/mustard growing zone, was relatively more unstable, as co-efficient of variation was high at 25.71%. In the case of the south-west plains (31.72%) and plateau districts (22.48%) as well the increasing trend rate of growth was unstable. Districts with higher growth rate in rapeseed/mustard production showed higher level of instability. For example, Begusarai, Purnea and Saharsa with high trend rates of growth showed high co-efficient of variation, ranging between 57.34% and 95.12%. Similar was the pattern in respect of other districts showing high rate of growth in rapeseed/mustard production.
Analysis of acceleration/deceleration

IV.6.8 The increasing rate of growth in rapeseed/mustard production at state level showed to be accelerating (0.40%). Across different zones, there was deceleration in the increasing trend rates of growth in respect of the south-west plains (-0.15%). In all other zones the increasing trend showed to be accelerating with rates of acceleration ranging between 0.80% and 0.32%. Among the major rapeseed/mustard growing districts the increasing trend rate of growth showed to decelerate in respect of Saharsa and Bhojpur with rate of deceleration at (-)0.54% and (-)1.64% respectively. In all other districts the increasing trend rates of growth showed to be accelerating in the range of 1.65% and 0.12%.

ii) Area under rapeseed/mustard

IV.6.9 Area under this crop remained stagnant till 1988-89, but started upward movement from 1989-90 onwards. It was 84.7 thousand ha. in 1970-71 and crossed 105.20 thousand ha. in 1992-93. Trend rates of growth in area under this crop during 1971-93 showed to be increasing annually at 0.42%. Between the two sub-periods while the first sub-period witnessed slow growth in area annually at 9.14% the second sub-period showed area expansion annually at 2.25%.

IV.6.10 Inter-state comparison of area under this crop suggests that Bihar was nowhere near Rajasthan and Uttar Pradesh. Area under these crops was at 2258.60 thousand ha. in Rajasthan and 1196.00 thousand ha. in Uttar Pradesh as against just 109.10 thousand ha. in Bihar in 1990-93. Bihar ranked ninth position among the rapeseed/mustard growing states. In terms of area expansion of rapeseed/mustard as well the State did not compare well with major states. For example, while in Bihar it grew annually at 2.50% during 1983-93, rate of increase was as high as 10.04% for Gujarat, 9.61% for Haryana, 15.38% for Rajasthan and 10.23% for West Bengal. It was even less than the national average of 4.21% during this period in Bihar.

Regional pattern

IV.6.11 The zones of the north-west and the east plains occupied almost four-fifth of the area under this crop. Cultivation of rapeseed/mustard in the south-west and plateau districts was less widespread with their respective share at 18.31% and 15.17% only in the State total. Analysis at the district level suggests that districts showing high production of rapeseed/mustard are also the districts showing high area under this crop. They included Begusarai (11.06%), Purnea (16.35%), Saharsa (6.44%) and Katihar (4.86%)
in the east plains; Santhal Parganas (6.10%) and Palamu (5.24%) in the plateau zone; Rohtas (4.76%) and Bhojpur (4.75%) in the south-west plains; and Samastipur (6.16%), Siwan (5.15%) and West Champaran (5.00%) in the north-west plains.

IV.6.12 Analysis of trend rates of growth in area under rapeseed/mustard during 1977-91 as also for for two sub-periods shows that the second sub-period witnessed reversal to increasing trend in the north-west and the east alluvial plains from (-)2.45% to 2.73% in the former and from (-)1.50% to 1.40% in the latter zone. The south-west alluvial plains experienced on the contrary marginal acceleration in area expansion from 0.26% in the first sub-period to 0.95% in the second sub-period. The plateau region was alone to witness continued declining trend, albeit at reduced rate from (-)9.05% in the first sub-period to (-)3.30% in the second sub-period. Across different districts area under rapeseeds/mustard showed increasing trend, largely in districts dominant in its production, particularly during the second sub-period. In some of the districts growth of rapeseed/mustard cultivation was still faster, particularly during the second sub-period. They included Darbhanga (7.35%), Muzaffarpur (3.88%), Gopalganj (2.15%), Vaishali (2.05%), and Bhojpur (3.72%)

iii) Yield of Rapeseed/Mustard

IV.6.13 Much of the increase in output of rapeseed/mustard in Bihar could be attributed to yield increase alone in the State. It was just 580 kg/ha. in 1970-71 which touched the highest level of 1070 kg/ha in 1991-92. Year to year fluctuations in the yield level was wide. Further, it maintained one level of yield upto 1982-83 in the range of 450 to 600 kg/ha. From 1983-84 onward there was a sudden jump in yield reaching the level at 1070 kg/ha in 1991-92. The rate of growth in yield during 1971-93 was 2.58% per annum. For the first sub-period rate of growth was negative at (-)0.83% per annum. In the second sub-period it got reversed to increasing trend at 3.07% per annum. The yield of rapeseed/mustard in Bihar compared well with other States. While for Bihar it was 0.84 t/ha., it was 0.87 t/ha. in Uttar Pradesh, 0.85 t/ha. in Rajasthan and 0.85 t/ha. as all-india average in 1990-93. Gujarat (1.09 t/ha.) and Haryana (1.10 t/ha.) showed higher yield than Bihar. In terms of growth rate in yield it was faster only in Uttar Pradesh (5.70%) than in Bihar (4.71%).

Regional Pattern

IV.6.14 The level of yield was almost uniform in the north-west (0.85 t/ha.), the east plains (0.82 t/ha.) and the north-west plains (0.81 t/ha.) and relatively much less in the plateau zone (0.52 t/ha.). Districts with high yield
were not necessarily districts with high production of rapeseed/mustard. Districts with high yield level included Patna (1.39 t/ha.) and Begusarai (1.25 t/ha.). Other districts with equally high yield level were Darbhanga (1.04 t/ha.), Madhubani (1.01 t/ha.), Samastipur (1.13 t/ha.) and Vaishali (1.10 t/ha.) in the north-west plains.

IV.6.15 The trend rates of growth in yield of rapeseed/mustard varied widely across different agro-climatic zones. It was as high as 5.03% per annum in the case of the north-west alluvial plains, followed by 3.17% per annum in the plateau districts during the second sub-period. East alluvial plains showed relatively low rate of growth at 2.65% per annum. On the other hand, the south-west alluvial plains showed declining trend at (-)3.05% per annum during this period. Comparing the rate of growth separately for two sub-periods, it was observed that the north-west alluvial plains showed reversal from high rate of declining trend at (-)3.62% in the first sub-period to high rate of increasing trend at 5.03% in the second sub-period. South-west alluvial plains on the other hand showed further acceleration in the declining trend from (-)0.47% in the first sub-period to (-)3.05% in the second sub-period. Plateau region showed increasing trend in both the sub-periods, 2.02% in the first sub-period and 3.17% in the second sub-period. Across different districts rate of growth in yield of rapeseeds/mustard was relatively high in districts being less dominant in its production. They included East Champaran (9.60%), Madhubani (5.75%), Vaishali (7.83%), West Champaran (9.69%), Hazaribagh (5.45%) and Palamu (5.46%). The districts dominant in rapeseed/mustard production showed declining trend in its yield, particularly during the second sub-period.

Conclusions

IV.6.16 The following broad conclusions may thus be arrived at:

(i) The State showed impressive increase in rapeseed/mustard production, especially during the second sub-period. The increase in rapeseed/mustard production emanated from both area expansion and yield increase. Despite this, the State of Bihar was way behind other states in terms of yield as also volume of rapeseed/mustard production.

(ii) Production of rapeseed/mustard was region specific with the east and north-west plains taking the lead. Purnea, Begusarai, Muzaffarpur, Siwan and West Champaran showed dominant share in rapeseed/mustard production. All these districts showed increasing trend in rapeseed/mustard production due to both area expansion and yield increase.
Table IV.6.1
Area, production and yield of rapeseed/mustard in Bihar during 1971-93

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AREA (000 ha)</th>
<th>PRODN (000 tns)</th>
<th>YIELD (tns/ha)</th>
<th>INDEX NUMBERS OF Area</th>
<th>Prodn</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
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<td>109.00</td>
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Table IV.6.2
Compound Annual Rate of Growth

<table>
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<tr>
<th>Period</th>
<th>Area</th>
<th>CARG Area</th>
<th>CARG Prodn.</th>
<th>CARG Yield</th>
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<td>1970-71 TO</td>
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<td>1982-83</td>
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<td>1983-84 TO</td>
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<td>1992-93</td>
<td>(0.91)</td>
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</table>

Figures in parentheses indicate the level of significance.
IV.7 SUGARCANE

Bihar is the sixth largest state to grow sugarcane in the country with 142,17 thousand ha. under its cultivation, forming 4.5% of the country’s sugarcane area. However, it formed only 2.9% of the country’s sugarcane production. Within the State it assumed greater importance among non-foodgrain crops covering 18.0% of their area. The following paragraphs discuss the trend and pattern of its growth over a period of time during 1971-93 at the State level and 1977-91 at zone/district level.

i) Production

IV.7.2 Production of sugarcane in the state continued to decline till late eighties but made impressive reversal to increasing trend thereafter. For example, it was 6209.4 thousand tonnes in 1970-71 and continued to decline thereafter till 1988-89. It, however, showed upward movement in 1989-90 with production at 6694.1 thousand tonnes. In 1990-91 it further increased to an impressive level at 7805.30 thousand tonnes. Trend rate of growth per annum during 1971-93 was much low at 0.27%. Analysis of the trend rates of growth separately for two sub-periods suggests that it showed declining trend at (-)3.79% during the first sub-period, but reversed to high rate of increasing trend at 7.65% in the second sub-period.

IV.7.3 Comparing the level of sugarcane production in Bihar with those of major sugarcane growing states, it was found to lag far behind. For example, while the production was 105867.27 thousand tonnes in Uttar Pradesh and 35152.10 thousand tonnes in Maharashtra, it was just 6971.17 thousand tonnes in Bihar in 1990-93. In terms of growth rate, however, Bihar compared well with these states. While production of sugarcane grew annually at 2.33% in Maharashtra and 3.64% in Uttar Pradesh it was 3.32% in Bihar during 1983-93. This may be taken to imply that there was revival in the production of sugarcane in Bihar.

Regional Pattern

IV.7.4 Across different zones, the north-west plains alone was the major sugarcane growing belt, producing almost nine-tenth (89.39%) of the State production. In all other zones, production of sugarcane was insignificant with a share ranging between 5.24% and 1.84% only. In the north-west zone cultivation of sugarcane was region/area specific, as three-fourth of the zone production was from three districts alone. They included West Champaran, Gopalganj and East Champaran. West Champaran was the major producer of sugarcane with a share of 45.61% in the zone’s total. The share of Gopalganj and East Champaran was 21.07% and 11.81% respectively.
IV.7.5 Analysis of zone-wise trend rates of growth in production of sugar-cane during 1977-91 suggested that while the north-west alluvial plains showed increasing trend at 2.16% per annum during 1977-91, it was declining in other zones, viz. east alluvial plains (-2.37%), south-west alluvial plains (-0.38%) and Plateau districts (-6.94%). Analysis of the trend rates of growth in two sub-periods suggested that it speeded up significantly in the north-west alluvial plains in the second sub-period at 7.88%. East alluvial plains also showed impressive performance with trend growth rate reversing from declining rate (-3.58%) in the first sub-period to increasing rate (2.85%) in the second sub-period. Plateau region, however, continued to experience declining trend even in the second sub-period.

IV.7.6 Across different districts the dominant sugarcane growing districts in the north-west plains viz. East Champaran (1.52%), West Champaran (2.80%) and Gopalganj (4.56%) showed impressive rate of growth in its production during 1977-91. Rate of growth in sugarcane production was equally impressive in districts such as Samastipur (4.74%), Begusarai (2.84%), Bhagalpur (2.84%) and Bhojpur (3.53%) during the same period.

Instability in production

IV.7.7 Although the production was increasing in the major sugarcane growing zone of the north-west plains, it did not show stability, as the coefficient of variation therein was relatively high at 22.98%. Other zones also showed wide fluctuations, as coefficient of variation exceeded 20.0%. District-wise analysis suggested higher instability in production of sugarcane was high in districts with relatively high increasing or high decreasing rates of growth. With specific reference to major sugarcane growing districts, it was observed that Gopalganj and West Champaran both showing high increasing growth rates (4.46% and 2.80% respectively) had relatively high instability, as coefficient of variations were 43.77% and 31.38%, respectively. East Champaran, the other district where sugarcane production was large, showed relatively more stability with coefficient of variation at 19.39% only.

Analysis of acceleration/deceleration in production

IV.7.8 Analysis of acceleration/deceleration in the growth of sugarcane production in different zones/districts indicated that there was acceleration in the increasing growth rate in sugarcane production (0.84%) in the north-west plains. The declining trend in the production of sugarcane in other zones viz. the east, south-west and plateau districts showed to accentuate with rate of acceleration at 0.50%, 0.44% and 0.05% in respective zones. Analysing the pattern across districts of the north-west where pro-
Production of sugarcane was relatively more, it is significant to observe that in all the three major sugarcane growing districts of the zone, viz. West Champaran, East Champaran and Gopalganj there was acceleration in the increasing trend rate of growth. There was acceleration in the increasing growth rate in respect of Sitamarhi and Siwan as well. Samastipur was the only disitrict of the zone which showed deceleration in its increasing growth rate. The declining growth rates in respect of Vaishali (-6.52%), Saran (-0.80%), Madhubani (-0.71%) and Darbhanga (-2.57%) showed to accelerate.

ii) Area under sugarcane

IV.7.9 Area under sugarcane was as high as 161.90 thousand ha. in 1970-71 which fell to 111.80 thousand ha. in 1984-85. During 1971-87 it continued to decline with mild year to year fluctuation and from 1987-88 showed upward movement reaching the level at 148.0 thousand ha. in 1990-91. During 1971-93 it showed declining trend growth rate at (-)0.77% per annum. The declining trend rate of growth was more steep during the first sub-period at (-)2.29% per annum. The second sub-period, however, showed increasing trend growth rate at 1.60% per annum. Inter-state comparison of area under sugarcane showed that Bihar ranked sixth among the major sugarcane growing states. With area only at 142.17 thousand ha. as compared to that of 1881.80 thousand ha in 1990-93 in Uttar Pradesh one does not get solace with the sixth position of the state in area under sugarcane. Rate of increase in sugarcane area in Bihar, although positive at 1.57% during 1983-93, was also less as compared to Maharashtra (3.99%), Karnataka (4.56%) and Gujarat (3.70%) during the same period.

Regional Pattern

IV.7.10 The north-west plains had the largest share of area under sugarcane (85.90%) in the State total. Other zones had a negligible share in sugarcane area. Districts with high sugarcane production also had high sugarcane area. They included West Champaran (38.77%), followed by Gopalganj (16.04%) and East Champaran (10.05%).

IV.7.11 In terms of growth in area the north-west alluvial plains showed reversal from declining trend (-2.68%) in the first sub-period to increasing trend (1.78%) in the second sub-period. The plateau districts and the south-west alluvial plains, on the other hand, showed continued declining trend even in the second sub-period. In the east alluvial plains the process of change was in opposite direction, i.e. from increasing trend (0.97%) in the first sub-period to declining trend (-7.21%) in the second sub-period.
Among the major sugarcane growing districts, while West Champaran and Gopalganj showed relatively high area expansion (4.00% and 4.60% respectively), it showed declining trend in East Champaran at (-)1.77% during the second sub-period. In districts such as Madhubani, Muzaffarpur, Saran, Munger and Bhojpur area under sugarcane expanded during this period.

### iii) Yield level of sugarcane

**IV.7.12** The yield of sugarcane increased over the years in the state. It was 38.35 t/ha. in 1970-71, but declined thereafter to a level of 27.29 t/ha. in 1978-79. It maintained static condition till 1986-87, but showed sharp increase in 1987-88 with yield level at 38.01 t/ha. and further reaching a maximum of 53.72 t/ha. in 1989-90, but declined again to 45.39 t/ha. in 1992-93. The trend rate of growth was increasing annually at 1.04% only during 1971-93. Between the two sub-periods, it showed declining trend at (-)1.48% in the first sub-period and increasing trend at 6.02% in the second sub-period.

**IV.7.13** Yield of sugarcane in Bihar was dismally low (45.10 t/ha. in 1990-93) as compared to the national average (65.09 t/ha.) as also states like Maharashtra (80.92 t/ha.), Tamil Nadu (103.13 t/ha.), Gujarat (86.75 t/ha.), Karnataka (82.51 t/ha.) and Uttar Pradesh (56.24 t/ha.).

### Regional Pattern

**IV.7.14** Across different zones, it was relatively high in the north-west plains (52.54 t/ha.) and low in the plateau districts (26.51 t/ha.). In the east and the south-west zones it was almost similar at 41.66 t/ha. and 40.30 t/ha. respectively. Districts with high production of sugarcane were found to have high yield of sugarcane. They included East Champaran (53.04 t/ha.), Gopalganj (59.26 t/ha.) and West Champaran (53.10 t/ha.). In Siwan and Vaishali, although production of sugarcane was much less, its yield was fairly high at 53.92 t/ha. and 52.83 t/ha. respectively. Among the districts of other zones, yield of sugarcane was found to be fairly high in Saharsa (52.95 t/ha.), Nawadah (46.76 t/ha.), Gaya (45.03 t/ha.), Singhbhum (51.14 t/ha.) and Santhal Parganas (46.14 t/ha.).

**IV.7.15** Analysing the trend rates of growth in yield of sugarcane for various agro-climatic zones and districts during 1977-91 it is observed that zones of north-west alluvial plains, east alluvial plains and south-west alluvial plains showed increasing trend in the yield at 2.01%, 1.08%, and 2.98% respectively. Plateau region, however, showed declining trend at (-)2.02%. Analysis of trend rates of growth in two sub-periods suggests that
the north-west alluvial plains gained significantly in yield by reversing the declining trend (-0.93%) in the first sub-period to increasing trend (6.10%) in the second sub-period. Similar was the trend in the east alluvial plains and the south-west alluvial plains with reversal to increasing trend at 10.07% and 4.90% respectively in the second sub-period. The plateau region continued to show declining trend (-2.28%) even in the second sub-period. The major sugarcane growing districts such as West Champaran, East Champaran and Gopalganj showed high growth rates in the yield of sugarcane during the second sub-period. In some of the less dominant sugarcane growing districts, however, the rate of growth in the yield of sugarcane was still more impressive. Such districts included Bhagalpur (17.98%), Munger (14.60%), and Saharsa (10.50%).

Conclusions

IV.7.16 The following are the broad conclusions with regard to the trend and pattern of growth of sugarcane in Bihar:

(i) Bihar was one of the major sugarcane growing states in the country. However, this status slipped from the State in the early eighties. It was nowhere near Uttar Pradesh, Maharashtra and Tamil Nadu in terms of area as well as yield of sugarcane. The second sub-period witnessed revival in sugarcane production in upward direction. It emanated from both area expansion and yield increase. The rate of increase in yield was more impressive.

(ii) Sugarcane production as well was region specific in Bihar with the north-west plains contributing almost four-fifth of the State production. Among the districts of the zone, West Champaran, East Champaran and Gopalganj, all forming a geographical cluster, excelled in sugarcane production.

(iii) All these districts showed significant increase in sugarcane production, especially during the second sub-period due largely to yield increase.

(iv) The resurrection in sugarcane production is also seen in other districts of the zone such as Madhubani, Muzaffarpur, Siwan and Samastipur which were traditionally sugarcane growing districts.
Table IV.7.1
Area, production and yield as also trend growth rates of sugarcane in Bihar during 1971-93

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AREA (000 ha)</th>
<th>PRODN (000 tns)</th>
<th>YIELD (tns/ha)</th>
<th>INDEX NUMBERS OF</th>
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<td></td>
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<td></td>
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Table IV.7.2
Compound Annual Rate Of Growth

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<th>CARG Area</th>
<th>CARG Prodn</th>
<th>Yield</th>
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<td>(0.039)</td>
<td>(0)</td>
<td>(0)</td>
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Figures in parentheses indicate the level of significance
Jute is one of the major fibre crops in Bihar. The state is only next to West Bengal in the country in terms of area (17.61%) as well as production (13.37%). Moreover, it occupied almost one-fifth (18%) of the area under non-food crops in Bihar. The following paragraphs discusses the trend and pattern of growth in jute production in the state.

I) Production

IV.8.2 Over the years since 1970-71 jute production in Bihar has increased. It was 773.40 thousand tonnes in 1970-71 which increased to 1107.40 thousand tonnes in 1992-93, growing annually at 3.06% over these years. The minimum production was recorded at 469.9 thousand tonnes in 1971-72 and maximum at 1674.6 thousand tonnes in 1985-86. Variation between the minimum and maximum production was at 256.40%. The jute production during the first sub-period was low ranging between 500-900 thousand tonnes. The second sub-period witnessed rapid strides in jute production in the range of 1000-1200 thousand tonnes. The trend rate of growth in the first sub-period was 2.42% as against 1.29% in the second sub-period. Growth trend in West Bengal, the state growing more jute, was no better. The level of production was, however, five times higher at 5738.73 thousand tonnes in West Bengal as against 1101.0 thousand tonnes in Bihar in 1990-93. In terms of growth rate it was 3.81%, in Bihar and 3.09% in West Bengal during 1983-93.

Regional Pattern

IV.8.3 Jute was a region specific crop in Bihar. It was cultivated mainly in districts falling in the east alluvial plains. In other agro-climatic zones cultivation of jute was virtually absent. Of the total jute production in the State, as much as 98.83% was produced in the east plains alone. Among the districts of the east plains, Purnea, Saharsa and Katihar had shares at 57.59%, 21.31% and 19.87% respectively. Production of jute increased annually at 2.15% in this zone during 1977-91. Among the major jute growing districts of the zone, it grew in the range of 2.89% and 2.02%. Bhagalpur and Begusarai on the other hand showed declining trend at (-)4.53 and (-)4.86% respectively. Jute production increased impressively among the districts of this zone, except Purnea, during the second sub-period. While Begusarai and Bhagalpur picked up in jute production during this period with trend growth rate at 16.80% and 3.53% respectively, it showed declining trend in Purnea at (-)5.98% as against the increasing trend at 3.70% in the first sub-period. Saharsa and Katihar maintained steady trend in the growth rate at 4.47% and 1.10% respectively during the second sub-period.
Instability in jute production

IV.8.4 The growth in jute production in Bihar was not stable, as co-efficient of variation in its growth during 1977-91 was as high as 30.03%. Similar was the case in the east plains with co-efficient of variation in the growth of jute production at 30.46%. Across major jute growing districts, the co-efficient of variation in the growth of jute production was equally high. It was as high as 43.05% in Saharsa.

Analysis of acceleration/deceleration

IV.8.5 There was deceleration in the increasing trend rate of growth of jute production at (-)0.73% for the State. Similar pattern was observed in the increasing trend growth rates of the east and north-west plains with rate of deceleration at (-)4.20% and (-)0.15% respectively. Across major Jute districts, the growth rate in production was found to accelerate only in respect of Bhagalpur (0.49%), West Champaran (1.57%) and Madhubani (2.36%). In all other districts it showed deceleration in their increasing trend growth rates.

ii) Area under Jute

IV.8.6 Area under jute in Bihar has remained almost stagnant during 1971-93. It was 141.80 thousand ha. in 1970-71, which increased marginally to 144.70 thousand ha. in 1992-93, recording around 2.0% expansion in 23 years. The minimum area cultivated under jute was 99.30 thousand ha. in 1975-76. It was maximum at 212.90 thousand ha. in 1985-86 with index number touching 150 points. Year to year fluctuation in area, however, does not seem to be wide over these years. Trend rate of growth in jute area for 1971-93 was 0.52% per annum. Analysing the trend growth rate separately for two sub-periods, it was observed to be increasing at 1.32% per annum in the first sub-period, but declining at (-)0.32% per annum in the second sub-period.

IV.8.7 Compared to jute area in West Bengal it was much less in Bihar. For example, while in West Bengal jute was cultivated in 522.30 thousand ha., it was only 142.03 thousand ha. in Bihar in 1990-93. Area expansion under jute during 1983-93 was insignificant in both the State. It was at the rate 0.08% in West Bengal and 0.25% in Bihar during 1983-93.
Regional Pattern

IV.8.8 Area expansion was not impressive in major jute growing zone of the east plains, as it grew annually at 0.79% only during 1977-91. Across different districts, it was found to be declining in Begusarai and Bhagalpur at (-)4.35% and (-)8.92% respectively. Districts of Katihar, Purnea and Saharsa, on the other hand, showed increasing trend rates of growth, although at varying levels. Rate of increase was low in Katihar and Purnea at 0.23% and 0.66% respectively. Saharsa showed relatively more impressive increase at 2.08% per annum. The declining trend intensified in the second sub-period at (-)11.20% in Begusarai. In Purnea it reversed from increasing trend at 3.90% in the first sub-period to declining trend at (-)0.86% in the second sub-period. Bhagalpur, however, showed increasing trend in both the sub-periods. Saharsa maintained steady trend at 2.21% even in the second sub-period. In case of Katihar rate of increase in jute area slackened from 3.70% in the first sub-period to 1.29% in the second sub-period.

iii) Yield of jute

IV.8.9 Much of the increase in jute production emanated from yield increase only, as area showed negligible expansion over this period. Yield of jute in the State was 0.545 t/ha. in 1970-71, which increased to 0.765 t/ha. in 1992-93. The minimum yield level was 0.451 t/ha. in 1980-81 and maximum was 0.822 t/ha. in 1991-92. The trend rate of growth in yield level was 2.54% during 1971-93. Analysing the trend rate of growth separately for two sub-periods, it was observed to be increasing in both the sub-periods. It was growing at 1.24% per annum in the first sub-period and 1.65% per annum in the second sub-period. Compared to West Bengal, the yield level was relatively much less for Bihar. While it was 1.98 t/ha. for West Bengal, it was 0.77 t/ha. in Bihar in 1990-93. The yield level was higher in West Bengal by almost 157%. Rate of increase in yield was also way ahead at 3.42% in West Bengal as against 2.95% in Bihar during 1983-93.

Regional Pattern

IV.8.10 Yield level of jute was much higher in non-traditional jute growing areas. It was as high as 0.888 t/ha. in the north-west plains, followed by 0.783 t/ha. in the plateau districts as against 0.593 t/ha. in the traditional jute growing districts of the east plains. Analysis at the district level as well suggests similar pattern. The non-traditional jute growing districts showed higher yield level than traditional jute growing districts. It was as high as 0.944 t/ha. in West Champaran, 0.922 t/ha. in Valshali and 0.902 t/ha. in
Darbhanga of the north-west plains as against 0.525 t/ha. in Purnea, 0.764 t/ha. in Saharsa and 0.685 t/ha. in Katihar of the east plains. Even the districts of the plateau zone displayed higher yield level of jute in the range of 0.748-0.800 t/ha.

IV.8.11 Trend rate of growth in the yield of jute in the east alluvial plains was low at 1.36% per annum as against 5.57% in the north-west plains during 1977-91. Across different districts, while it showed declining trend at (-)0.19% in Begusarai, it showed increasing trend in all other districts of the east plains. It was as high as 4.06% in Bhagalpur, followed by 1.86% in Katihar and 1.36% in Purnea. Saharsa had relatively low trend rate of growth at 0.81% only. However, the pattern took a turn in these districts in the second sub-period, with Begusarai showing phenomenal increase in yield at 28.0% per annum. Purnea on the other hand reversed to declining trend at (-)5.12% per annum during this period. In Saharsa yield level speeded up during the second sub-period at 2.26% per annum. Katihar, however, experienced slackening growth in yield from 4.46% in the first sub-period to 0.19% per annum during the second sub-period.

Conclusions

IV.8.12 The following broad conclusions are thus arrived at:

(i) Bihar has been the traditional grower of jute. However, it lagged far behind West Bengal in terms of area coverage as also yield of jute. The production of jute recorded significant increase in the State. Rate of increase in jute production was more in the first sub-period, as it slackened to lower rate in the second sub-period.

(ii) Increase in jute production was more due to yield increase as area under jute showed static level.

(iii) Production of jute in the State was region specific with the east plains showing dominant share. Among the districts of this zone it was produced largely in Purnea, Katihar and Saharsa. In all these districts it showed significant increase in jute production due to both area expansion and yield increase.
Table IV.8.1
Area, production and yield of jute crop in Bihar during 1971-93

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<tr>
<th>YEAR</th>
<th>AREA (000 ha)</th>
<th>PRODN (000 tns)</th>
<th>YIELD (tns/ha)</th>
<th>INDEX NUMBERS OF Area</th>
<th>Prodn</th>
<th>Yield</th>
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Table IV.8.2
Compound Annual Rate of Growth (%)

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<tr>
<th>Period</th>
<th>Area</th>
<th>CARG Prodn.</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71 TO 1992-93</td>
<td>0.52</td>
<td>3.06</td>
<td>2.54</td>
</tr>
<tr>
<td>1992-93</td>
<td>(0.115)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>1970-71 TO 1982-83</td>
<td>1.32</td>
<td>2.42</td>
<td>1.24</td>
</tr>
<tr>
<td>1982-83</td>
<td>(0.093)</td>
<td>(0)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>1983-84 TO 1992-93</td>
<td>-0.32</td>
<td>1.29</td>
<td>1.66</td>
</tr>
<tr>
<td>1992-93</td>
<td>(0.792)</td>
<td>(0.391)</td>
<td>(0)</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate the level of significance.
IV.9 POTATO

Bihar was the third largest State in the country in production of potato, only next to Uttar Pradesh and West Bengal. Potato occupied place of importance within the State as well, forming 21.17% of the non-food crop area. The growth in production of potato over the years in Bihar and its regional pattern are given in the following paragraphs.

I) Production

IV.9.2 The production of Potato in the state showed declining trend in the initial years, but recovered to reach 1383.0 thousand tonnes in 1975-76. In subsequent years upto 1985-86 it remained stagnant with production hovering around 1250-1350 thousand tonnes. Production jumped at exceeding 1523.0 thousand tonnes in 1986-87. Since then it remained stagnant with output level hardly reaching 1557.6 thousand tonnes. In terms of growth rate it increased annually at 2.28% per annum during 1971-93. Making the analysis separately for two sub-periods, it is observed that it grew at similar rates in both the sub-periods. It was 2.03% per annum in the first sub-period and 2.28% in the second sub-period. Compared to the growth rate as observed at national level or in the major potato growing states, the scenario was disappointing for Bihar. For example, while annual rate of growth in the production of potato was 2.65% in Bihar during 1983-93, it was as high as 4.82% at national level. It was still more impressive for West Bengal with production of Potato growing annually at 8.51% during this period. Uttar Pradesh had modest rate of increase at 3.75% per annum.

Regional Pattern

IV.9.3 The north-west plains emerged as the major potato growing zone with almost two-fifth (37.64%) of the State production. In other zones the level of potato production was similar with their share in the State production ranging between 22.90% and 17.68%. Among the districts, the major producers of potato included Samastipur (5.98%), East Champaran (4.73%), Madhubani (4.26%) and Saran (4.16%) in the north-west plains; Begusarai (4.30%) and Saharsa (4.18%) in the east plains; Gaya (4.83%), Nalanda (5.70%) and Rohtas (4.42%) in the south-west plains; and Hazaribagh (5.44%) and Ranchi (4.21%) in the plateau zone.

IV.9.4 The trend rates of growth in potato production varied widely across different agro-climatic zones during 1977-91. While it showed declining trend in the south-west alluvial plains (-0.35%), it showed increasing trend in the north-west alluvial plains (1.36%), east alluvial plains (4.64%)
and plateau districts (3.96%) during this period. The rate of decline was relatively more sharp in the plateau districts. Rate of increase on the other hand was high in the east alluvial plains. Analysis of the trend rates of growth in two sub-periods suggests that the north-west alluvial plains resur­rected from declining trend (-0.79%) in the first sub-period to increasing trend (3.02%) in the second sub-period. East alluvial plains on the contrary experienced slackening in growth rate from 5.29% in the first sub-period to 4.50% in the second sub-period. Performance of the south-west alluvial plains could be described as significant despite continued declining trend, as the rate of decline fell sharply from (-)6.91% in the first sub-period to just (-)0.79% in the second sub-period. Plateau districts made marginal improvement with trend rate of growth increasing from 2.56% in the first sub-period to 3.10% in the second sub-period.

IV.9.5 Across different districts the rate of growth in potato production during 1977-91 was relatively high in districts with high share in state potato production. They included East Champaran (5.29%), Madhubani (9.60%), Samastipur (5.15%), Begusarai (11.40%), Purnea (9.67%), Saharsa (4.88%), Rohtas (5.71%), Hazaribagh (5.48%) and Ranchi (3.19%).

Instability in potato production

IV.9.6 At the state level the increasing growth rate was fairly stable with co-efficient of variation at 7.41% only. Across different zones, it was stable in the north-west plains with co-efficient of variation at 7.67% only. On the other hand it was less stable in the plateau and the east zones with co-effi­cient of variation at 15.81% and 13.72% respectively. In the case of the south-west plains the declining trend in potato production was also less stable with co-efficient of variation at 16.10%. Analysing the co-efficient of variation across different districts, it is observed that except Purnea and Samastipur increasing trend in potato production was highly unstable with co-efficient of variation exceeding 25.0% in most of such districts. In Purnea and Samastipur, however, the growth in potato production was relatively more stable with co-efficient of variation at 16.32% and 14.58% only. On the other hand districts with declining trend in potato production showed relatively more stability in their declining trend with co-efficient of variation less than 20.0%. Such districts included Saran, Sitamarhi, Vaishali and Katihar.

Analysis of acceleration/deceleration

IV.9.7 There was acceleration in the increasing trend rate of growth in potato production (0.25%) at State level. The increasing trend in growth rates of potato production in different zones as well showed acceleration.
The declining trend in the growth rate of potato production in the south-west was accelerating. Across the major potato growing districts while it showed acceleration in the increasing trend growth rates in respect of Samastipur (0.55%), Begusarai (0.69%), Saharsa (0.25%), Gaya (1.08%), Nalanda (0.77%), Rohtas (0.13%) and Ranchi (1.11%), it showed deceleration in respect of Hazaribagh (-0.31%) and East Champaran (-0.70%). Saran and Nalanda on the other hand showed acceleration in their declining trend.

ii) Area under potato

IV.9.8 Much of the increase in potato output in Bihar could be seen in expanding area under potato. Area under potato was 1.00 lakh hectares in 1970-71 which continued to increase in subsequent years with mild fluctuations, touching 1.47 lakh ha. in 1976-77. The subsequent period up to 1986-87 witnessed virtual stagnation with area under potato hovering around 1.35 lakh ha. only. The year 1987-88 was the landmark with area increasing to reach 1.71 lakh ha. in 1992-93. The trend rate of growth was recorded at 1.85% during 1971-93. The rate of growth in area was almost similar during both the sub-periods. It was 3.03% in the first sub-period and 2.49% during the second sub-period. The growth rate in area under potato was low in Bihar as compared to major potato growing states. For example, while it grew annually at 2.79% in Uttar Pradesh and 6.23% in West Bengal, it was only 2.39% in Bihar during 1983-93. It was still less as compared to the national average of 5.60% during the same period.

Regional Pattern

IV.9.9 Across different zones, the north-west plains showed relatively high share in area under potato. Districts with high share in area under potato included East Champaran (4.64%), Samastipur (4.62%) and Saran (4.20%) in the north-west plains; Purnea (6.49%) and Saharsa (4.42%) in the east plains; Gaya (4.68%) in the south-west plains; and Hazaribagh (6.93%) and Ranchi (5.45%) in the plateau zone.

IV.9.10 Analysis further revealed that the trend rates of growth in area varied widely across different agro-climatic zones. It showed increasing trend during 1977-91 in the north-west alluvial plains (0.80%) and the east alluvial plains (2.20%). The plateau region (-7.93%) and the south-west alluvial plains (-1.93%) recorded declining trend. Analysing the trend rates of growth across two sub-periods, it is observed that the while south-west alluvial plains witnessed reversal from declining trend in the first sub-period (-5.30%) to increasing trend in the second sub-period (0.22%), the plateau region experienced slow down in the increasing trend rate of growth from...
2.41% to 1.77%. The north-west alluvial plains and the east alluvial plains as well recorded acceleration in area increase during the second sub-period. Across different districts area under potato showed relatively higher growth rates in less dominant potato growing districts. Such districts included Darbhanga (5.68%), West Champaran (6.43%), Katihar (6.10%) and Palamu (4.52%). Among the major potato growing districts while districts such as Madhubani (3.27%), Begusarai (10.47%), Purnea (3.08%) and Saharsa (3.00%) showed expansion of area, in the case of Saran, Nalanda and Nawadah area under potato showed a shrinking trend.

iii) Yield of Potato

IV.9.11 Yield of potato was declining in Bihar. It was 11.11 tonnes/ha. in 1970-71, but declined thereafter with yield level hovering around 8-10 tonnes/ha. till 1992-93. Trend rate of growth in yield during 1971-93 worked out at 0.43% per annum. However, it was observed to be negative when separately analysed for the two sub-periods. Rate of decline was (-)1.01% in the first sub-period and (-)0.20% in the second sub-period. When compared with the national average as also those in the major potato growing states, it was disappointingly low at 9.15 tonnes/ha. in Bihar, as against 24.98 tonnes/ha in Gujarat, 22.09 tonnes/ha. in West Bengal and 17.17 tonnes/ha. in Uttar Pradesh in 1990-93. The national average was 13.51 tonnes/ha. in 1990-93.

Regional Pattern

IV.9.12 Although both production and area under potato was high in the north-west plains, in terms of yield the south-west plains (11.53 t/ha.) far exceeded the other zones. In the north-west and the east plains it was almost similar at 9.91 t/ha. and 9.15 t/ha. respectively. The plateau zone showed relatively low level of potato yield at 7.87 t/ha. Across different districts it was significantly high at 18.03 t/ha. in Nalanda, followed by 13.33 t/ha. in Begusarai and 13.39 t/ha. in Rohtas. It was impressively high in such districts as Darbhanga (12.70 t/ha.), Gopalganj (12.61 t/ha.), Madhubani (12.77 t/ha.), and Samastipur (12.47 t/ha.) in the north-west plains; and Patna (12.39 t/ha.), Aurangabad (10.44 t/ha.) and Nawadah (10.59 t/ha.) in the south-west plains. Yield of potato did not vary much among the districts of plateau zone with yield ranging between 9.31 t/ha. as in Santhal Parganas and 7.39 t/ha. as in Giridih.

IV.9.13 The second sub-period brought reversal in the north-west alluvial plains from declining (-2.10%) to increasing trend (1.10%) in the rate of growth in yield. East alluvial plains showed slackening in the increasing
trend rate of growth from 3.58% in the first sub-period to 0.92% in the second sub-period. South-west alluvial plains continued to have declining trend (-1.01%) even in the second sub-period. Plateau districts recorded increasing trend in both the sub-periods. Across different districts rate of growth in yield of potato was relatively high in districts dominant in its production. They included Samastipur (6.63%), Begusarai (7.65%) and Nalanda (4.82%). Some of the districts less dominant in potato production as well showed relatively high rate of growth in its yield. They included Darbhanga (8.75%), Giridih (3.90%) and Palamu (6.22%).

Conclusions

IV.9.14 The foregoing discussion thus suggests the following broad conclusions on the trend and pattern of growth in potato cultivation in Bihar:

(i) Potato production in the State was only next to West Bengal and Uttar Pradesh in the country. It showed increasing trend in Bihar but at lower rate than in West Bengal and Uttar Pradesh.

(ii) Much of the increase in potato production was due to area expansion, as yield showed declining trend.

(iii) Production of potato was not region specific in the State, as it was being cultivated in significant measure in most of the districts in different agro-climatic zones of the state.

(iv) Districts growing potato dominantly showed relatively more impressive performance in potato production, especially in the second sub-period.

(v) While in most of the districts both area and yield of potato showed to increase, the districts of the south-west plains showed reversal in potato output due largely to decline in the yield rate.

(vi) Districts of the south-west plains were dominant in potato production but it showed reversal in yield.
### Table IV.9.1
Area, production and yield of potato in Bihar during 1971-93

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AREA (000 ha)</th>
<th>PRODN (000 tns)</th>
<th>YIELD (tns/ha)</th>
<th>INDEX NUMBERS OF AREA</th>
<th>INDEX NUMBERS OF PRODN</th>
<th>INDEX NUMBERS OF YIELD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>100.90</td>
<td>1121.20</td>
<td>11.11</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<tr>
<td>1980-81</td>
<td>132.30</td>
<td>1062.90</td>
<td>8.03</td>
<td>131</td>
<td>95</td>
<td>72</td>
</tr>
<tr>
<td>1990-91</td>
<td>160.60</td>
<td>1494.70</td>
<td>9.31</td>
<td>159</td>
<td>133</td>
<td>84</td>
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<td>1991-92</td>
<td>189.90</td>
<td>1535.90</td>
<td>9.04</td>
<td>168</td>
<td>137</td>
<td>81</td>
</tr>
<tr>
<td>1992-93</td>
<td>171.19</td>
<td>1557.80</td>
<td>9.10</td>
<td>170</td>
<td>139</td>
<td>82</td>
</tr>
</tbody>
</table>

### Table IV.9.2
Compound Annual Rate of Growth (%)

<table>
<thead>
<tr>
<th>Period</th>
<th>Area</th>
<th>Prodn.</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71 TO</td>
<td>1.85</td>
<td>2.28</td>
<td>0.43</td>
</tr>
<tr>
<td>1992-93</td>
<td>(0)</td>
<td>(0)</td>
<td>(0.068)</td>
</tr>
<tr>
<td>1970-71 TO</td>
<td>3.03</td>
<td>2.03</td>
<td>-1.01</td>
</tr>
<tr>
<td>1982-83</td>
<td>(0)</td>
<td>(0.033)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>1983-84 TO</td>
<td>2.49</td>
<td>2.28</td>
<td>-0.20</td>
</tr>
<tr>
<td>1992-93</td>
<td>(0)</td>
<td>(0)</td>
<td>(0.561)</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate the level of significance.
The crop group of spices and condiments grown in Bihar largely include turmeric, coriander, chillies, ginger and garlic. Chillies constituted a major share in terms of both area and production among these crops in Bihar. As much as 46.8% of the spices area and 47.8% of its production were under chilli crop in the State in 1990-93. The following paragraphs examine the trend and pattern of growth in its production as also area and yield thereof over the years across different agro-climatic zones and districts in the State.

Production

There was a sharp decline in chilli production in the state over these years. It was as high as 16.50 thousand tonnes in 1970-71 which reached its peak of 24.40 thousand tonnes in 1972-73, but started a nosedive thereafter with lowest level of production at 4.0 thousand tonnes in 1987-88. It, however, took upward movement to reach at 13.00 thousand tonnes in 1992-93. Trend rate of growth recorded decline at (-)5.12% per annum during 1971-93. The rate of decline was at (-)11.99% per annum in the second sub-period as compared to (-)0.18% per annum in the first sub-period. Performance of the state in chilli production was all the more poor as compared to the major chilli growing states. For example, while Andhra Pradesh had production of chilli at 320.67 thousand tonnes, it was only 7.90 thousand tonnes in Bihar in 1990-93. States like Karnataka, Maharashtra, Orissa and Tamil Nadu were similarly much ahead of Bihar in chilli production. In terms of growth rate as well it lagged far behind. In Andhra Pradesh, Orissa and West Bengal chilli production increased annually at 6.65%, 3.87% and 8.92% respectively but in Bihar it declined annually at (-)5.31% during 1983-93.

Regional Pattern

Across different zones, it was the east and the north-west plains which excelled in chilli production in the state. While the east plains had a share of 41.11% in the State chilli production, it was 34.46% for the north-west plains. Across different districts Begusarai in the east plains and Rohtas in the south-west plains dominated in chilli production with the share at 32.35% and 21.84% respectively. The other districts to produce chilli significantly included East Champaran (2.64%), Muzaffarpur (2.65%), Samastipur (6.75%) and Vaishali (3.05%) in the north-west plains; Munger (1.04%) and Puria (6.05%) in the east plains; Gaya (2.52%) and Patna (8.70%) in the south-west plains; and Palamu (2.87%) in the plateau zone.
IV.10.4 The declining trend in chilli production was recorded in all the four agro-climatic zones. However, the zones falling in the north Gangetic plains i.e. north-west alluvial plains and east alluvial plains displayed higher rate of decline at (-)10.35% and (-)11.33% respectively than those in the south of the Ganges. It was (-)5.29% for the south-west alluvial plains and (-)6.32% for the plateau regions. During the first sub-period, the rate of decline was almost uniform across different zones. It, however, became quite sharp in the second sub-period in respect of the north-west alluvial plains (-22.69%), east alluvial plains (-25.43%) and plateau districts (-19.72%). The south-west alluvial plains maintained almost similar rate of decline (-5.0%) even in the second sub-period. The case of the east alluvial plains was more alarming, as it experienced reversal from increasing trend (0.81%) in the first sub-period to high rate of decline (-25.43%) in the second sub-period.

IV.10.5 Admister general declining trend in chilli production there were districts to show increase in it during 1977-91. Such districts were those having less share in state chilli production. They included East Champaran (5.13%), Muzaffarpur (5.01%), Saran (5.33%) and West Champaran (3.54%). Among the dominant chilli growing districts only Vaishali (5.85%) showed increasing trend. Samastipur and Begusarai, the other dominant chilli growing districts, recorded sharp declining trend during the same period.

Instability in chilli production

IV.10.6 The rate of decline in chilli production was highly unstable with coefficient of variation high at 31.60%. Across different agro-climatic zones, the rate of decline was relatively more stable in the south-west plains with coefficient of variation at 24.98% as against 35.00% in the north-west plains, 41.50% in the east plains and 34.32% in the plateau districts. Analysing the pattern across major chilli growing districts, it is observed that production of chilli in respect of Madhubani, Begusarai and Patna was unstable, as coefficient of variation exceeded 50.0% in all such cases. The increasing trend in respect of Rohtas and Purnea as well showed instability with high coefficient of variation.

Analysis of acceleration/deceleration

IV.10.7 The declining trend in the growth rate of chilli production in the State showed deceleration (-1.62%). Across different zones, however, while the north-west (-1.21%), the east (-1.78%) and the plateau zone (-1.16%) showed deceleration, the south-west plains showed acceleration (0.31%) in the declining trend rates of growth. Analysis at the district level suggests that in Purnea and West Champaran there was acceleration in
the increasing growth rates at 0.77% and 0.25% respectively. Districts namely, Muzaffarpur, Saran, Sitamarhi, Vaishali, Rohtas, etc. showed deceleration in their increasing growth rates. The declining trend rates of growth in most of the districts were on the other hand found to accelerate.

ii) Area under chilli

IV.10.8 The shrinkage in area under chilli was significantly large in the State. Area under chilli in the state was as high as 20.90 thousand hectares in 1970-71 which fell down to 10.00 thousand hectares in 1980-81. It further slipped down to just 4.00 thousand hectares in 1987-88 and continued to hover around the same till 1991-92. In 1992-93, however, it picked up to reach 12.00 thousand hectares, but remained still far below the 1970-71 level. The trend rate of growth showed decline at (-)5.51% per annum during 1971-93. The rate of decline became more sharp (-9.49%) in the second sub-period as compared to the first sub-period (-3.21%). Compared to major chilli growing states, area under chilli was significantly low in Bihar. It was as high as 224.50 thousand hectares in Andhra Pradesh, 137.93 thousand hectares in Karnataka, 128.80 thousand hectares in Maharashtra and 93.13 thousand hectares in Orissa, whereas it was just 7.37 thousand hectares in Bihar in 1990-92. Again, while it showed expansion in Andhra Pradesh (3.01%) and Orissa (3.35%) during 1983-93, it showed declining trend in Karnataka (-1.14%) and Maharashtra (-1.40%). The rate of decline was high in Bihar (-4.27%) during the same period.

Regional Pattern

IV.10.9 Zones/districts with high chilli production had also high area under it. For example, the east plains with maximum production of chilli (41.11%) had maximum area under chilli as well (48.39%). It was followed by the north-west plains (22.11%) and the south-west plains (20.10%). It was relatively much less in the plateau zone (9.40%). Across different districts area under chilli was maximum (40.49%) in Begusarai, followed by Samastipur (9.77%) and Rohtas (7.25%). Other districts with relatively high area under chilli included East Champaran (2.74%), Muzaffarpur (2.51%) and Vaishali (3.45%) in the north-west plains; Purnea (4.16%) in the east plains; Gaya (4.23%) and Patna (5.24%) in the south-west plains; and Palamu (5.53%) and Ranchi (1.86%) in the plateau zone. It is also observed that Rohtas with a share in chilli production at 21.84% had only 7.25% share in State’s chilli area. This was largely due to high yield level in this district.

IV.10.10 Shrinkage in area under chilli was observed in all the agro-climatic zones during 1977-91. However, it was relatively high (-11.82%) in the north-west alluvial plains, followed by the east alluvial plains (-6.18%).
Rate of decline was slightly less in respect of the south-west alluvial plains and plateau districts at (-)2.84% and (-)4.37% respectively during this period. Shrinkage in area was more prominent during the second sub-period in respect of the north-west alluvial plains (-18.91%) and east alluvial plains (-14.42%). In the case of the east alluvial plains it was a case of reversal from increasing trend in the first sub-period (0.74%) to declining trend (-14.42%) in the second sub-period. The south-west alluvial plains and plateau districts showed declining trend in both the sub-periods. Across different districts area under chilli was recorded to expand in districts being less dominant in chilli cultivation. They included West Champaran (8.07%), Saran (1.76%), Nawadah (2.43%), Rohtas (3.70%), Hazaribagh (9.12%) and Ranchi (1.00%). Districts dominant in chilli cultivation such as Begusarai, Samastipur, Rohtas, Patna and Purnea showed declining trend in its area in the range of (-)0.70% and (-)27.34%.

iii) Yield of chilli

IV.10.11 Unlike production and area, the yield of chilli showed increasing trend in the state, albeit marginally. It was 0.79 tonnes/ha. in 1970-71 which showed upward movement reaching its peak at 1.24 tonnes/ha. in 1981-82. The yield, however, started declining from 1984-85, touching the minimum of 0.80 tonnes/ha. in 1988-89. The trend rate of growth in the yield of chilli was found to be increasing (0.54%) during 1971-93. However, it showed declining trend at (-)2.50% per annum in the second sub-period as against increasing trend of 3.29% per annum in the first sub-period. Comparing the yield level with other major chilli growing states, it was found to be relatively high at 1.02 tonnes/ha. in 1990-93 for Bihar. It was only next to Andhra Pradesh (1.43 tonnes/ha.). In other states it was much less at 0.29 tonnes/ha. in Karnataka, 0.50 tonnes/ha. in Maharashtra and 0.81 tonnes/ha. in Orissa. In terms of growth rate, however, while it showed increase in yield at 2.50% per annum at all-India level, 3.53% for Andhra Pradesh and 0.50% for Orissa, it was declining at (-)1.52% in Bihar during 1983-93.

Regional Pattern

IV.10.12 Across different zones, the east plains excelled in chilli production as also in area. However, in terms of yield it was impressively high at 1.4 t/ha. in the south-west plains as against a low of 0.69 t/ha. in the east plains, 0.69 t/ha. in the north-west plains and 0.50 t/ha. in the plateau zone. Across different districts, Rohtas emerged at the top with almost twice the yield level (0.25 t/ha.). Other districts to show relatively high yield included Bhojpur (0.15 t/ha.) and Patna (0.12 t/ha.) in the south-west plains; and Katihar (0.14 t/ha.) and Purnea (0.12 t/ha.) in the east plains. In
Begusarai, the largest chilli growing district, the yield was much less at 0.65 t/ha. only. Among the districts of the north-west plains, the non-traditional chilli growing districts showed higher yield than those in traditional chilli growing districts. For example, it was high at 0.95 t/ha. in non-traditional chilli growing district of Gopalganj but low at 0.56 t/ha. in traditional chilli growing district of Samastipur.

IV.10.13 Zonewise analysis of the trend rates of growth in the yield of chilli clearly demonstrated that only the north-west alluvial plains (1.47%) had increasing trend in yield during 1977-91. All other agro-climatic zones showed declining trend. The rate of decline was as high as (-)5.15% per annum in the case of the east alluvial plains and (-)2.45% in the south-west alluvial plains. In the plateau districts it declined annually at (-)1.94%. Between the two sub-periods, it showed increasing trend in the first sub-period at 2.90% in the north-west alluvial plains, 0.07% in the east alluvial plains and 4.22% in the plateau districts. However, the trend reversed to declining rate in the second sub-period in all these zones at (-)3.78%, (-)11.00% and (-)14.82% respectively. The south-west alluvial plains showed declining trend in both the sub-periods at (-)1.90% and (-)2.30% respectively.

IV.10.14 Across different districts while rate of growth in yield of Chilli was negative in most cases, there were districts to show high rate of growth during 1977-91. Such districts included East Champaran (6.20%), Gopalganj (5.71%), Saran (6.04%), Siwan (6.21%), Vaishali (10.21%), West Champaran (6.10%), Katihar (5.92%), Purnea (5.19%) and Saharsa (4.63%). However, none of these districts were dominant in chilli production.

Conclusions

IV.10.15 The analysis thus suggests the following broad conclusions in respect of trends and patterns of growth in chilli production in Bihar:

(i) Bihar once excelled in chilli production with high area as well as yield level. However, it was relegated to the bottom by the turn of Eighties with states like Andhra Pradesh forging much ahead. The decline in chilli production was observed during the second sub-period when production of other crops started picking up.

(ii) Much of the decline in chilli production emanated from sharp decline in area.

(iii) Production of chilli in the State was region specific with the east and the south-west plains much ahead of other zones. In these two zones production of chilli was specific to Begusarai and Rohtas. Samastipur has been relegated to the background in chilli production.
(iv) Of the two major chilli growing districts while Begusarai showed declining trend, Rohtas showed only marginal increase in chilli production in the second sub-period. In Begusarai both area and yield of chilli showed shrinkage. In Rohtas, however, while area showed shrinkage, yield of chilli showed increasing trend.

Table IV.10.1
Area, production and yield of chillies in Bihar during 1971-93

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AREA (000 ha)</th>
<th>PRODN (000 tns)</th>
<th>YIELD (tns/ha)</th>
<th>INDEX NUMBERS OF Area</th>
<th>Prodn</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>20.90</td>
<td>16.50</td>
<td>0.79</td>
<td>100</td>
<td>100</td>
<td>100</td>
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<tr>
<td>1980-81</td>
<td>10.00</td>
<td>11.40</td>
<td>1.14</td>
<td>48</td>
<td>69</td>
<td>144</td>
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<tr>
<td>1990-91</td>
<td>5.00</td>
<td>4.90</td>
<td>0.96</td>
<td>24</td>
<td>30</td>
<td>124</td>
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<tr>
<td>1991-92</td>
<td>5.10</td>
<td>6.80</td>
<td>1.14</td>
<td>24</td>
<td>35</td>
<td>144</td>
</tr>
<tr>
<td>1992-93</td>
<td>12.00</td>
<td>13.00</td>
<td>1.08</td>
<td>57</td>
<td>79</td>
<td>137</td>
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</table>

Table IV.10.2
Compound Annual rate of Growth (%)

<table>
<thead>
<tr>
<th></th>
<th>Area</th>
<th>CARG</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71 TO</td>
<td>-5.51</td>
<td>-5.12</td>
<td>0.54</td>
</tr>
<tr>
<td>1992-93</td>
<td>(0)</td>
<td>(0)</td>
<td>(0.193)</td>
</tr>
<tr>
<td>1970-71 TO</td>
<td>-3.21</td>
<td>-0.18</td>
<td>3.29</td>
</tr>
<tr>
<td>1982-83</td>
<td>(0)</td>
<td>(0.824)</td>
<td>(0)</td>
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<tr>
<td>1983-84 TO</td>
<td>-9.49</td>
<td>-11.99</td>
<td>-2.50</td>
</tr>
<tr>
<td>1992-93</td>
<td>(0)</td>
<td>(0)</td>
<td>(0.036)</td>
</tr>
</tbody>
</table>

Figures in parentheses indicate the level of significance.
IV.11 TOBACCO

The crop group of narcotics and beverages occupied a very small area in Bihar agriculture. Among them only tobacco was grown prominently in the state. The following paragraphs discuss the growth performance of tobacco in terms of production, area and yield over a period of time during 1971-93 at the State level and 1977-91 at different agro-climatic zones and districts levels.

i) Production

IV.11.2 The state recorded a production of 12000 tonnes of tobacco during 1970-71 which increased to 19000 tonnes in 1987-88, but declined to 9300 tonnes in 1992-93. The compound annual rate of growth in tobacco production during 1971-93 worked out to 2.35%. The first sub-period registered a positive growth rate at 0.97% per annum while the second sub-period showed negative growth rate at (-)1.61% per annum. The decline in production was more prominent in 1991-92 when it touched the lowest level of production at 8600 tonnes. The growth rate for Bihar was much less as compared to the growth rates in major tobacco growing states. For example, during 1983-93 the growth rate in tobacco production was 0.84% at all-India level, 0.65% in Andhra Pradesh, 2.40% in Karnataka and 1.24% in Uttar Pradesh, as against the declining trend of (-)1.31% in Bihar.

Regional Pattern

IV.11.3 Tobacco was produced largely in the north-west plains with its share in State total tobacco production at 93.59%. It was also produced, although in small measure, in the east plains with its share at 5.83%. In the south-west plains and plateau districts production of tobacco was almost absent. Across different districts it was Samastipur and Vaishali which figured prominently in tobacco production with share at 36.93% and 44.67% respectively. These two districts alone produced four-fifth (81.6%) of the State's tobacco production. Other districts to grow tobacco relatively more included Muzaffarpur (7.90%), Gopalganj (1.09%) and Sitamarhi (1.01%) in the north-west plains; and Purba (3.67%) and Begusarai (1.46%) in the east plains.

V.11.4 Across different zones, the north-west plains recorded increase in tobacco production annually at 5.46% during 1977-91. The east plains showed significant reversal with production declining annually at (-)4.61%. While the north-west zone maintained its increasing trend, although at reduced rate, even in the second sub-period (4.11% and 2.58% in respective sub-periods), the east plains showed reversal from increasing trend (3.56%)
in the first sub-period to declining trend (-5.37%) in the second sub-period. Across different districts rate of growth in production of tobacco during 1977-91 was relatively high in districts dominant in its production. They included Begusarai (8.10%), Vaishali (6.70%), Samastipur (4.37%) and Muzaffarpur (7.11%). Rate of growth in tobacco production was equally impressive in Darbhanga (4.22%), Gopalganj (3.88%) and Sitamarhi (9.04%).

Instability in tobacco production

IV.11.5 At the State level the increasing trend rate of growth was observed to be fairly stable, as co-efficient of variation was low at 13.85% only. Between the two tobacco growing zones, the growth rate was relatively more stable in the north-west plains as compared to the east plains. Across different districts it was relatively more stable with low co-efficient of variation in East Champaran and Vaishali. On the contrary Begusarai (82.87%) and Sitamarhi (45.61%) showed instability with high co-efficient of variation. The declining rate of growth was relatively more stable in Purnea with co-efficient of variation at 25.49% and unstable in Saran with co-efficient of variation at 56.16%.

Analysis of acceleration/deceleration

IV.11.6 At the State level the increasing trend rate of growth showed deceleration (-0.08%) during 1977-91. Between the two tobacco growing zones, while the increasing trend rate of growth in the north-west plains showed acceleration (1.56%), the declining trend rate of growth in the east plains showed deceleration (-0.27%). Analysis across different districts suggests that the increasing trend growth rate in Samastipur showed to accelerate (0.59%), but the declining trend in Vaishali showed to decelerate (-0.24%). Most of the districts of these zones showed deceleration in their increasing trend growth rates. Districts with declining trend also showed deceleration in their declining growth rates, except Saran where it was found to accelerate (0.24%).

ii) Area under tobacco.

IV.11.7 Area under tobacco showed upward movement from 1986-87 and continued rising up to 1992-93. In the preceeding period i.e. 1971-86 it showed complete stagnation with area under tobacco hovering around 12-13 thousand ha. The trend rate of growth during 1971-93 was observed to be positive at 0.98% per annum. It speeded up to 1.37% in the second sub-period as against the declining trend at (-)0.36% per annum in the first sub-period. Trend growth rate in area was impressive for Bihar when com-
pared with the declining trend at (-1.0%) all-India level, (-)1.05% in Andhra Pradesh and (-)1.38% in Gujarat during 1983-93.

Regional Pattern

IV.11.8 Zones/districts with high production of tobacco had also high area under this crop. The north-west plains with overwhelming share in tobacco production had the highest area under this crop, forming 92.78% of the State's total area under tobacco. Similar was the pattern across different districts. Samastipur and Vaishali, showing maximum tobacco production, had overwhelming share in tobacco area in the State. It was 47.97% for Vaishali and 32.42% for Samastipur. The other districts with relatively high share in tobacco area included Muzaffarpur (8.38%), Gopalganj (1.09%) and Siwan in the north-west plains; and Purnea (4.51%) and Begusarai (1.21%) in the east plains.

IV.11.9 Among the two traditional tobacco growing zones, the trend rate of growth was positive at 2.42% in the north-west alluvial plains and negative at (-)3.18% in the east alluvial plains during 1977-91. Increasing trend got accelerated in the north-west zone from 1.54% in the first sub-period to 2.01% in the second sub-period. However, in the east alluvial plains declining trend accelerated from (-)0.69% in the first sub-period to (-5.80%) in the second sub-period.

IV.11.10 Among the districts, area under tobacco showed increasing trend in such cases as Darbhanga, Muzaffarpur, Samastipur, Sitamarhi, Begusarai and Vaishali ranging between 1.84% and 4.99%. The districts to show decline in area included Saran, Madhubani, East Champaran, Siwan, Munger, Bhagalpur, and Saharsa ranging between (-)0.71% to (-)30.08%. Both the dominant tobacco growing districts viz; Vaishali and Samastipur showed expansion in its area. Districts such as Begusarai, Siwan and Sitamarhi which were less dominant in its production recorded expansion in its area.

III) Yield of Tobacco

IV.11.11 Performance in yield of tobacco was not encouraging in the state. It was 890 kg/ha in 1970-71 which showed ups and downs in the ensuing years. The maximum yield was 1270 kg/ha in 1987-88. The yield started declining afterwards to reach a level of only 570 kg/ha in 1992-93. The rate of growth in yield was positive at 1.30% per annum during 1971-93. It showed increasing trend (1.23%) in the first sub-period and declining trend (-2.98%) in the second sub-period. The yield of tobacco in Bihar was lower as compared to all-India level as well as those in major tobacco producing
states. It was 1370 kg/ha at all-India level, 1220 kg/ha in Andhra Pradesh, 1730 kg/ha in Gujarat and 3640 kg/ha in Uttar Pradesh in 1990-93 as against 650 kg/ha in Bihar. Again, the growth rate had been positive at all-India level as well as in those states during the eighties while it was negative in Bihar.

Regional Pattern

IV.11.12 Zone-wise/district-wise analysis of yield of tobacco as triennial average in 1988-91 showed that it was relatively more in zones/districts with high tobacco production. For example, it was the highest at 1.02 t/ha. in the north-west plains, the dominant tobacco growing zone and 0.9 t/ha in the east plains. Across different districts yield was not necessarily high in districts growing more of tobacco. For example, it was only 0.95 t/ha. in Vaishali, the major tobacco growing district, but 1.3 t/ha. in Madhubani, the lesser producer of tobacco. Other districts to show high yield of tobacco included Darbhanga (1.19 t/ha.), Gopalganj (1.0 t/ha.), Samastipur (11.55 q/ha.), and West Champaran (1.0 t/ha.).

IV.11.13 Analysis of the trend rate of growth in tobacco yield across different zones suggests that while the north-west alluvial plains showed increasing trend (3.04%), it was declining (-1.43%) in the east alluvial plains during 1971-91. Yield recorded increasing trend in both the zones in both the sub-periods. However, the rate of growth increased from 1.09% in the first sub-period to 2.09% in the second sub-period in respect of the north-west plains, where it showed accelerated growth rate from 2.58% in the first sub-period to 4.11% in the second sub-period in the east plains.

IV.11.14 The trend rate of growth was positive across different districts of the north-west alluvial plains during 1977-91 in the range of 2.13% and 6.23%. All these districts continued to show increasing trend in yield even during the second sub-period. In some districts it even accelerated to higher growth levels. Such districts included Madhubani (9.65%) and Darbhanga (6.25%). In case of Samastipur it reversed from high rate of declining trend (-5.07%) in the first sub-period to increasing trend (5.02%) in the second sub-period.

IV.11.15 Districts of the east alluvial plains on the other hand presented a picture in contrast, where most of them showed declining trend rate of growth in yield of tobacco during 1977-91 in the range of (-)1.99% and (-)2.53%. Amidst such a scenario, however, there were districts showing increase in yield. They included Begusarai (1.78%), Bhagalpur (0.57%) and Munger (1.84%). Begusarai and Bhagalpur showed reversal from declining trend in the first sub-period to increasing trend in the second sub-period.
On the other hand districts such as Saharsa, Purnea, and Katihar showed reversal from increasing trend in the first sub-period to declining trend in the second sub-period. Munger continued to show declining trend in both the sub-periods.

Conclusions

IV.11.16 Analysis thus suggests the following broad conclusions in respect of trend and pattern of growth in tobacco production in the State:

(i) Bihar was one of the major tobacco growing States till early Seventies. However, this status for Bihar was relegated to the background by the turn of early nineties. While most of the major tobacco growing states recorded impressive increase in tobacco production, Bihar showed declining trend during the Eighties.

(ii) The decline in tobacco production was largely due to sharp decline in yield of tobacco, as area under tobacco recorded increasing trend.

(iii) Production of tobacco in the State was region specific with the north-west plains being the major producer, of which Vaishali and Samastipur districts produced the lion's share.

(iv) While most of the districts showed lower yield of tobacco, there were districts which compared well with the national average in tobacco yield. It was, however, much less as compared to Gujarat and Uttar Pradesh.

(v) Both Samastipur and Vaishali, the major tobacco growing districts showed increasing trend in tobacco production with both area and yield showing increasing trend.

(vi) Seen in the context of the state being traditional in tobacco production, its declining trend in tobacco production is a serious cause of concern.
### Table IV.11.1
Area, production and yield of tobacco in Bihar during 1971-93

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AREA (000 ha)</th>
<th>PRODN (000 tns)</th>
<th>YIELD (tns/ha)</th>
<th>INDEX NUMBERS OF (000)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area</td>
<td>Prodn</td>
<td>Yield</td>
<td>Area</td>
</tr>
<tr>
<td>1970-71</td>
<td>13.50</td>
<td>12.00</td>
<td>0.89</td>
<td>100</td>
</tr>
<tr>
<td>1980-81</td>
<td>12.50</td>
<td>9.70</td>
<td>0.78</td>
<td>93</td>
</tr>
<tr>
<td>1990-91</td>
<td>15.30</td>
<td>12.70</td>
<td>0.83</td>
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</tr>
<tr>
<td>1991-92</td>
<td>15.20</td>
<td>8.60</td>
<td>0.57</td>
<td>113</td>
</tr>
<tr>
<td>1992-93</td>
<td>16.40</td>
<td>9.30</td>
<td>0.57</td>
<td>121</td>
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</table>

### Table IV.11.2
Compound Annual rate of Growth (%)

<table>
<thead>
<tr>
<th></th>
<th>Area</th>
<th>CARG Area</th>
<th>CARG Prodn</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71 TO</td>
<td>0.96</td>
<td>2.35</td>
<td>1.30</td>
<td></td>
</tr>
<tr>
<td>1992-93</td>
<td>(0)</td>
<td>(0)</td>
<td>(0.038)</td>
<td></td>
</tr>
<tr>
<td>1970-71 TO</td>
<td>-0.36</td>
<td>0.97</td>
<td>1.23</td>
<td></td>
</tr>
<tr>
<td>1982-83</td>
<td>(0.471)</td>
<td>(0.531)</td>
<td>(0.318)</td>
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<tr>
<td>1983-84 TO</td>
<td>1.37</td>
<td>-1.61</td>
<td>-2.98</td>
<td></td>
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<tr>
<td>1992-93</td>
<td>(0)</td>
<td>(0.439)</td>
<td>(0.187)</td>
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Figures in parentheses indicate the level of significance.
CHAPTER V
CROPPING PATTERN AND AREA SHIFTS ACROSS DIFFERENT DISTRICTS

The question of which crop dominates in area coverage and what has been the trend and pattern of area shifts across different crops over a period of time in Bihar assumes significance, particularly in the context of growing emphasis on crop diversification and commercialisation. The following paragraphs address to these questions. Analysis of cropping pattern across different zones/districts has been made using the data on area under different crops/crop groups over a period of time. Percentage share of different crops/crop groups in total cropped area is taken to reflect the cropping pattern. Analysis of area shift across different crops/crop groups has been made at the state level considering the period from 1970-71 to 1992-93. Trend rate of growth in per cent share of different crops/crop groups during the period under reference is taken to reflect the direction and rate of shift in area across different crops/crop groups.

Cropping Pattern

V.2 Analysis of area under different crops/crop groups as also per cent share thereof in the state in 1988-91 indicated that food crops dominated the agriculture of the state with its share in total cropped area at 91.77%. Non-food crops formed a low share at 8.23% only. Among the food crops, the cereals constituted as high as 80.50% and pulses 11.27% to total cropped area. Among the cereals, crops such as paddy (50.58%), followed by wheat (20.57%) and maize (7.13%) were the most important. Among pulses, gram constituted 1.53%, arhar 0.68% and other pulses 9.06%. Among non-food crops a wide range of crops were produced in the state. However, the most important ones were rapeseed/mustard (1.10%), linseed (0.72%), jute (1.53%), potato (1.74%) and sugarcane (1.48%). Besides, cash crops such as tobacco (0.16%), chillies (0.07%), turmeric (0.03%) and coriander (0.02%) were also important in a few pockets of the state.

V.3 Analysis of cropping pattern across different zones/districts suggests that while in the plateau zone paddy crop (66.38%) alone was dominant among the cereal crops, in the case of other zones viz. the north-west, the south-west and the east plains wheat was also an important cereal crop with its share at 24.7%, 27.27% and 19.03% respectively in the respective ones. In addition, maize formed significant proportion in the north-west (7.57%) and the east alluvial plains (11.81%). It is further observed that while paddy and wheat was cultivated in almost equal measure in all the districts of the plains, cultivation of maize was specific to select districts
such as Samastipur, Saran, Vaishali, Begusarai, Bhagalpur, Saharsa and Palamu.

V.4 Analysis of area under pulses across different zones/districts suggests that while it was cultivated in all zones/districts, some zones/districts figured prominently in their cultivation. The zones of south-west (16.43%) and the east alluvial plains (11.98%) were relatively more dominant in pulse cultivation. Districts to figure prominently in pulse area included Darbhanga (12.60%), Muzaffarpur (13.67%) and Vaishali (12.29%) in the north-west; Bhagalpur (13.94%), Munger (16.12%) and Saharsa (18.23%) in the east plains; Aurangabad (18.12%), Nalanda (17.51%) and Patna (29.66%) in the south-west plains and Palamu (20.33%) in the plateau zone.

V.5 Among the non-food crops rapeseed/mustard, sugarcane, potato, tobacco, chilli and jute were the major crops. Analysis of the data suggests that cultivation of these crops were area/region specific. In the case of rapeseed/mustard the east plains (1.48%) and the north-west plains (0.97%) figured more prominently. In the case of sugarcane it was the north-west (3.51%) which dominated in its cultivation. Area under potato was almost uniformly spread across different zones. Tobacco was restricted to the north-west plains. Jute on the other hand was the speciality of the east plains.

Area shifts across different crops

V.6 It is significant to observe that there was a shift of area in favour of cereal crops, fruits and vegetables and fibre crops in the State with trend rates of growth per annum in per cent area of these crops positive at 0.22%, 1.65%, and 0.37% respectively during 1971-93. On the other hand crop groups such as pulses, oilseeds, spices and miscellaneous crops were losing area to other crops, with trend rates of growth declining annually at (-)1.35%, (-)0.27%, (-)4.80% and (-)0.26% per annum respectively during the same period.

i) Cereals

V.7 Between the two sub-periods area expansion was higher in the second sub-period in comparison to the area expansion experienced during the first sub-period. Analysis of the trend rates of growth separately for superior and coarse cereals suggests that while superior cereals gained in area with trend rate of growth at 0.63%, the coarse cereals showed shrinkage in area with trend rate of growth at (-)2.13% during this period.

V.8 Area expansion of superior cereals slackened in the second sub-period with trend rate of growth at 0.23% per annum, whereas it was
0.43% per annum in the first sub-period. The coarse cereals on the other hand showed opposite trend. The second sub-period recovered in the declining trend. While it declined annually at (-)1.22% in the first sub-period, the declining trend slackened to (-)0.08% in the second sub-period.

(ii) Fruits and Vegetables

V.9 Fruits and vegetable showed high rate of area expansion at 11.15% per annum during the first sub-period. The second sub-period showed reversal to declining trend, albeit marginally at (-)1.0% per annum. It may be pointed out that production of fruit (mainly banana) and vegetables (mainly potato and onion) picked up fast in Bihar during the late seventies. This continued up to mid eighties.

(iii) Pulses

V.10 Area under pulses showed shrinkage consistently since 1970-71. However, the rate of decline was higher at (-)2.02% per annum in the first sub-period and it was low at (-)1.20% per annum in the second sub-period. Deceleration in the declining trend rate of growth in the second sub-period could largely be on account of the fact that it reached the minimum level below which further decline could not be possible to ensure minimum supply of pulses at the farm level.

(iv) Oilseeds

V.11 In the case of oilseed crops the first sub-period witnessed significant area expansion growing annually at 3.16%. The second sub-period, however, experienced stagnant situation with trend rate of growth although declining but low at (-)0.10%.

(v) Spices

V.12 Spices too showed declining trend in area. It had a share of 0.27% in the gross cropped area in 1970-71 which continued to decline reaching the lowest level of 0.08% in 1990-91. The rate of decline in the per cent share has been steep in both the sub-periods, (-)6.35% in the first sub-period and (-)6.00% in the second sub-period. Prominent spice crops produced in Bihar include chilli, turmeric, coriander and garlic. They are mostly cultivated for the market. Prices of spices have been increasing in recent years. In this context shrinkage in area under spices remain a puzzle and needs further investigation.
Area shifts of individual cereal crops

V.13 Significantly, both the superior cereals such as paddy and wheat showed area expansion during 1971-93. However, gains of area expansion for wheat (1.50% per annum) was much higher as compared to paddy (0.10% per annum). Further, while wheat showed area expansion almost uniformly in both the sub-periods at 1.52% and 1.26% respectively, paddy showed shrinkage in area at (-)0.48% per annum in the second sub-period. Thus, while paddy formed 63.83% of total cereals area in 1970-71, it reduced to 57.64% in 1992-93. In the case of wheat while it formed 15.92% in 1970-71, it increased to 26.25% in 1992-93. For jowar and bajra the shrinkage in area became more prominent and sharp at (-)4.19% and (-)4.39% per annum respectively in the second sub-period. Percentage share of these crops in total cereals area reduced to 0.05% and 0.10% respectively in 1992-93.

V.14 Maize was once a prominent coarse cereal in Bihar. It occupied around 12.0% of the total cereals area in 1970-71. Area under maize remained stagnant hovering around 10.0% upto 1981-82. It declined thereafter forming around 8.0% to 9.0% of the total cereals area. While the first sub-period witnessed decline at (-)0.54% per annum, it showed marginal improvement in the second sub-period with rate of growth reversing to increasing trend at 0.07% per annum. Loss of area under coarse cereal emanated largely from maize to go in favour of superior cereals, mainly wheat. Maize is sown in both the seasons - Kharif and Rabi. With relative economics of wheat being more favourable largely due to high relative prices, farmers seemed to substitute wheat for maize. Moreover, it was also a substitution of coarse cereals to superior cereals. Ragi was another important coarse cereal to loose its area significantly to superior cereals in the second sub-period with trend rate of growth at (-)5.01% per annum.

V.15 Analysis of area shifts among pulses was more revealing. Pulse's shares in gross cropped area showed significant decline, suggesting loss of pulse area to other crops, mainly superior cereals. It formed 14.90% of gross cropped area in 1970-71 which reduced to 10.23% in 1992-93. Among pulses crop also there was shifting of area taking place. While both arhar and gram continued to show declining trend at (-)1.14% and (-)0.80% respectively, other pulses showed increasing trend at 0.26% during 1971-93. Analysing the trend of area shifts across two sub-periods it is observed that while arhar and gram experienced area shifts in both the sub-periods, in the case of other pulses it showed to gain in area in both the sub-periods. Other pulse crops include mainly masoor, urad, khesari, etc. With increase in irrigation and other crops having less favourable economics of cultivation in the context of spurt in arhar prices it becomes a puzzle to observe
arhar area showing significant shrinkage and need to be examined in
greater detail. Loss of gram area could largely be attributed to vagaries of
nature, as it is cultivated under rainfed condition. Pulses like masoor and
urad as well are cultivated under rainfed condition. But they have greater
resistance to withstand the dry spell. Farmers cultivate more of other
pulses, substituting gram or arhar largely to ensure minimum pulse produc-
tion for self consumption.

V.16 Oilseeds showed shrinkage in area in both the sub-periods with
almost equal intensity loosing to other crops, mainly cereals. However, when
the trend and pattern of area shifts across oilseed crops themselves are
examined it is significant to observe that while rapeseed/mustard showed
encouraging gains in area, linseed and nigerseed showed loss of area. In-
creasing area under rapeseed/mustard began in early eighties. It showed
expansion of area from 1981-82 with a share at 35.57% in total oilseeds
area to as high as 55.57% in 1992-93. Shifts in area in their favour was
observed to be at 3.22% per annum during the second sub-period as
against the declining trend at (-)0.16% during the first sub-period. In the
case of linseed, reversal in area started in the second sub-period with
trend rate of growth at (-)2.98% as against the increasing trend rate of
growth at 1.73% in the first sub-period. Nigerseed was the worst looser
with its share at 25.0% in 1970-71, but reducing to 13.68% in 1992-93.
Rate of decline was equally high in its case in both the sub-periods at
(-)2.90% and (-)2.57% respectively.

V.17 Among the three major fibre crops, namely jute, mesta and
sunhemp, jute gained in its relative share in area. It formed 76.55% of the
area under fibre crops in 1970-71 which increased to 81.45% in 1992-93,
recording annual rate of growth at 0.38% during this period. Shift in area
was more prominent during the second sub-period with trend rate of growth
at 0.29% as against 0.15% in the first sub-period. Sunhemp on the other
hand showed reversal in its relative share in the second sub-period with
declining rate of growth at (-)2.68%, as during the first sub-period it showed
increasing rate of growth at 2.55% per annum. Mesta, only next to jute
among the fibre crops, showed declining trend rate of growth during both
the sub-periods. It was (-)1.34% in the first sub-period and (-)0.82% in the
second sub-period.

V.18 Turmeric and chillies were the two major spices crops being cultivated
in Bihar. Relative share of the spice crops showed declining trend during
both the sub-periods, implying loss of their area to other crops. However,
analysis of the relative share of chilli and turmeric throws significant light.
Chilli gained in area during the first sub-period with trend growth rate in-
creasing annually at 0.81%; but reversed to declining trend in the second
sub-period at (-)1.96% per annum. On the contrary, turmeric showed loss in area during the first sub-period at (-)1.66% per annum, but reversed to increasing trend at 4.19% per annum in the second sub-period.

V.19 Relative share of sugarcane and tobacco is analysed in terms of their share in gross cropped area. Sugarcane gained in its share impressively during the second sub-period at 2.85% as against the declining trend in the first sub-period at (-)1.38% per annum. Tobacco on the other hand showed gains in area during both the sub-periods, however, relatively high at 2.27% in the second sub-period than in the first sub-period at 0.82%.

Conclusions

V.20 The following broad conclusions may thus be arrived at on the basis of foregoing discussions with regard to trend and pattern of area shifts across various crops and crop groups.

i. Bihar agriculture continues to be dominant in foodgrains production with its area at 91.77% in 1990-93. Among the food crops it was essentially cereals (80.50%) which was prominent, as pulses area covered 11.27% only. Paddy, wheat and maize were the major cereal crops.

ii. Non-food crops constituted merely 8.23% of the gross cropped area in the state. Among the non-food crops rapeseed/mustard, linseed, jute, mesta, potato and sugarcane had a dominant share. Chilli, turmeric, coriander and tobacco were also grown in the state, but in specific regions only.

iii. Over the years there was a clear shift of area in favour of cereals, fruits and vegetables and fibre crops. On the other hand crop groups such as pulses, oilseeds, spices and miscellaneous crops showed loss of area.

iv. Among the cereals while superior cereals gained in area, coarse cereals recorded loss of area. In the case of pulses while arhar and gram recorded loss of area, other pulses showed gains in area.

v. While oilseeds in general showed loss of area, rapeseed/mustard recorded impressive gains in area. Linseed and nigerseed showed loss of area.

vi. Among the fibre crops jute alone showed to gain in area, whereas mesta and sunhemp recorded loss of area. Turmeric and chillies, among the spices crops as well showed significant loss of area. Sugarcane recorded impressive gains in area.
CHAPTER VI
YIELD INCREASE - CROP-WISE COMPARATIVE ANALYSIS

The question of which crop has gained in yield expansion over these years becomes important to understand the relative position of a crop vis-a-vis other crops in yield gains to facilitate policy decisions. The present chapter seeks to address to this question at the State level. For this purpose major crops alone were considered. The period under consideration is 1970-71 to 1992-93. For each of these years yield per hectare is arrived at from the area and production data. For each of these crops trend growth rates were worked out in their yield levels to reflect the rate of change as well as direction of change for the period during 1970-71 to 1992-93. Trend rates of growth in the yield of these crops were worked out separately for two sub-periods as well.

a) Cereal crops

VI.2 Across various cereal crops, the yield of maize was increasing annually at 3.49% per annum during 1971-93. Ragi and small millets followed with trend rate of growth at 2.67% per annum for both the crops. Jowar and barley recorded growth in yield at 2.24% and 2.07% respectively. Wheat recorded growth rate in its yield at 1.77% which was much less than that of maize or for that matter even ragi and small millets. Rice and bajra showed the lowest rate of yield increase at 1.30% and 1.18% per annum respectively.

VI.3 Analysis of trend rates of growth in the yield of these crops in two sub-periods was more revealing. In the case of crops like rice, maize, ragi, small millets, wheat and barely increase in yield speeded up in the second sub-period. It was as high as 5.14% for maize and 4.27% for small millets. Wheat, ragi and rice experienced similar rate of yield increase during this period at 2.19%, 2.46% and 2.28% respectively. The case of ragi was more impressive, as the trend reversed from declining rate at (-)0.76% in the first sub-period to increasing rate, that too at high level at 4.27% in the second sub-period. Bajra on the other hand showed a picture in contrast. While it showed increasing trend in yield at 2.50% in the first sub-period, it reversed to declining trend at (-)6.47% in the second sub-period. Among the food crops bajra and jowar alone showed reversal in the growth of yield, particularly during the second sub-period.
b) Pulses

VI.4 Among the pulses arhar showed higher rate of yield increase at 2.87% as compared to gram at 2.13% and other pulses at 1.63% during 1971-93. Growth rates in the yield were higher in the second sub-period for all the pulses, more so for other pulses at 2.23%. The case of other pulses was still more impressive in the second sub-period in the context of declining trend at (-)0.57% in the first sub-period. Higher growth response in the yield of pulses including those of miscellaneous types during the second sub-period could be attributed largely to the emergence of HYV seeds for most of them and their wider and extensive application, even under unirrigated conditions.

c) Oilseeds

VI.5 Rapeseed/mustard, linseed and nigerseed are the major oilseeds cultivated in Bihar. Among these crops, rapeseed/mustard showed impressive growth in their yield. It increased at 2.58% during 1971-93. Nigerseed as well had relatively better growth response at 1.81% during this period. Linseed on the other hand showed more or less stagnant picture with yield increasing marginally at 0.60% per annum.

VI.6 Rapeseed/mustard on the contrary gained momentum in yield more significantly during the second sub-period with annual growth rate in yield at 3.07%. More important, it showed reversal from declining trend at (-)0.83% in the first sub-period to increasing trend at 3.07% in the second sub-period. In the case of nigerseed, however, the second sub-period witnessed slackening in the growth rate of yield at 1.74% as against annual growth rate of 2.30% in the first sub-period. For linseed the growth rate in yield was negligible in the second sub-period.

d) Other crops

VI.7 Other crops included jute, chilli, potato, sugarcane and tobacco. Among these crops, jute showed relatively more impressive performance in yield increase at 2.53% per annum during 1971-93. It was followed by tobacco (1.29%) and sugarcane (1.04%). In the case of chilli, yield took a reversal from increasing trend (3.29%) in the first sub-period to declining trend (-2.50%) in the second sub-period. Potato on the other hand maintained declining trend in the yield in both the sub-periods. It was (-)1.0% in the first sub-period and (-)0.19% in the second sub-period. Jute showed marginal improvement in the yield level from 1.24% in the first sub-period to 1.65% in the second sub-period. Tobacco showed reversal from increasing trend (1.23%) in the first sub-period to declining trend (-2.98%) in the
second sub-period. Sugarcane on the other hand showed more impressive turn around from declining trend (-1.47%) in the first sub-period to increasing trend (6.02%) in the second sub-period.

Conclusions

VI.8 Increase in yield of foodgrains recorded better performance, especially during the second sub-period. Rate of growth in the yield of maize and small millets was relatively more. Wheat and rice showed relatively low increase in yield. Among the non-food crops it was rapeseed/mustard and sugarcane which recorded impressive growth rates in yield. Crops such as chilli and tobacco recorded reversal in their yield from increasing trend in the first sub-period to declining trend in the second sub-period.
CHAPTER VII
TREND AND PATTERN OF LAND USE -
ZONE-WISE/DISTRICT-WISE ANALYSIS

The present chapter seeks to address the question of how the land use pattern has been changing over the years and how does it vary across different agro-climatic zones/districts in Bihar. These questions assume significance in the context of output maximisation objective on the one hand and constraints in adaptation of modern technology on the other. This calls for adoption of a land policy to ensure optimum use of land.

a) Land Use Pattern - An Aggregate Analysis

VII.2 Despite vast geographical spread, the availability of agricultural land was relatively low in Bihar. It was 62.5% in the state as against 86.0% in Haryana, 86.7% in Punjab, 68.1% in Uttar Pradesh and 66.5% in West Bengal. It was largely because of high forest area (17.0%) on the one hand and large non-agricultural land (18.1%) on the other. Net sown area was still low in Bihar at 45.40% as compared to states such as Haryana, Punjab, West Bengal and Uttar Pradesh where it formed as high as 81.7%, 83.8%, 60.3% and 58.1% respectively. In terms of per capita availability the net sown area was low at 0.09 ha. for Bihar as against 0.22 ha. for Haryana, 0.21 ha. for Punjab and 0.12 ha. for Uttar Pradesh. Again, share of net sown area to total reporting area was found to be declining in Bihar over these years. It formed 49.38% in 1950-51, declined to 47.98% in 1980-81 and 45.40% in 1990-91. Rate of decline was (-)0.93% per annum during 1977-91. Part of the low net sown area could be seen in relatively high fallow land (10.42%), culturable waste (16.29%) and barren land (5.6%) in the state. At all-India level it was only 7.36% as fallow land, 4.95% as culturable waste and 5.93% as barren land. In Punjab and Haryana share of fallow, and waste and barren land was relatively low at 4.50% and 6.60% respectively.

VII.3 Barren land and cultivable waste land declined annually at (-)1.64% each in the state. However, fallow land, both permanent and current, showed increasing trend at 0.74% and 0.80% respectively, ultimately leading to shrinkage in net sown area in the State.

VII.4 Comparing land use pattern in Bihar with that at all-India level, it is observed that area under forest showed increasing trend in both Bihar (0.34%) and at all-India level (0.20%). Land under non-agricultural use also increased, however, more at all-India level (1.50%) than in Bihar (0.47%). In the case of miscellaneous trees while Bihar showed increasing trend
(1.70%), it was declining at all-India level (-0.80%). Fallow land, both permanent and current, increased in Bihar as well as at all-India level. However, the rate of increase in permanent fallow was more for Bihar (0.74%) than at all-India level (0.58%). Rate of increase in current fallow was more at all-India level (1.19%) than in Bihar (0.80%). Net sown area declined both in Bihar and at all-India level. However, the rate of decline was significantly high in Bihar at (-)0.77% as against (-)0.05% at all-India level.

b) Land Use Pattern - Regional Analysis

VII.5 Across different zones the net sown area constituted around half of the reporting area in the northern plain areas. However, in the plateau region net sown area constituted only one-fourth (25.21%) of the reporting area, while around one-third of the area (29.46%) was under forest. In all the four agro-climatic zones the net sown area showed declining trend. Rate of decline was as high as (-)1.54% in the plateau region and as low as (-)0.47% in the south-west alluvial plains. Part of the decline in net sown area was due to expanding area under miscellaneous trees and other waste land, particularly in the north-west alluvial plains and the east alluvial plains. In the plateau region increasing current fallow and barren land contributed more to the declining net sown area. In the south-west alluvial plains part of the decline in net sown area was caused by expanding other waste land and barren land.

c) Intensity of Land Use for Crop Culture

VII.6 The land available for cultivation cannot be expanded in the short run, given the physical constraints on the one hand and limitations of resources for investments on the other. In such a situation the other alternative to maximise the crop output is to raise more crops in different crop seasons on the same piece of land. In other words, it implies raising crop intensity of the land. In the context of declining net sown areas, raising crop intensity assumes more importance. Implicitly, crop intensity is influenced largely by favourable monsoon on the one hand and availability of modern technology, mainly irrigation on the other. Over these years there has been rapid strides in the expansion of improved technologies in Bihar agriculture as well. Before the question of what are the determinants of crop intensity and whether it has kept pace with increasing use of modern technologies is addressed to, it is more pertinent to examine as to how does it vary across different agro-climatic zones/districts and what has been the trend in its growth over a period of time.
VII.7 Crop intensity for Bihar was 136.1% in 1990-91. Over the years it showed marginal improvement in crop intensity from 129.0% in 1971-72 to 135.2% in 1981-82 and 136.1% in 1990-91. As compared to all-India average of 130.4%, Bihar presents better picture in crop intensity. However, in comparison to cropping intensity in states like Punjab (177.7%) and Haryana (165.4%) it is much less in Bihar. States such as West Bengal, Uttar Pradesh and Orissa as well were ahead of Bihar with crop intensity at 162.5%, 147.3% and 152.2% respectively. All these states gained in crop intensity in the range of 27.5% as in Orissa to 10.8% as in Uttar Pradesh, whereas in Bihar it improved by 5.5% only over the same period.

VII.8 Across different agro-climatic zones/districts, the plateau districts showed relatively low crop intensity at 109% only. Among the alluvial plains it was relatively high in the north-west zone (149%), followed by the east zone (143%). The south-west zone showed crop intensity at 140%. Analysing crop intensity across different districts, it is observed that districts such as Darbhanga, Gopalganj and Siwan in the north-west plains showed high crop intensity at 171%, 184% and 165% respectively. Districts such as Muzaffarpur, Saran and Vaishali had moderately high crop intensity ranging between 150% and 155%. It was, however, much less in Madhubani (134%) and East Champaran (128%).

VII.9 Among the districts of the east alluvial plains, only Begusarai, Katihar and Saharsa showed relatively high crop intensity at 155%, 161% and 154% respectively. Bhagalpur and Munger on the contrary showed relatively low crop intensity at 122% and 123% respectively. Among the districts of the south-west alluvial plains Rohtas alone showed crop intensity (150%) comparable to districts in the north-west and east alluvial plains. In other districts it was modest in the range of 137% as in Patna and 144% as in Nalanda. Crop intensity among the districts of the plateau zone was dismal low in the range of 114% as in Hazaribagh and 103% as in Singhbhum.

d) Area sown more than once

VII.10 Area sown more than once showed increasing trend in most of the agro-climatic zones. It was increasing at 0.42% per annum in the north-west alluvial plains, 0.38% per annum in the east alluvial plains and 1.09% per annum in the south-west alluvial plains. The plateau districts on the contrary showed declining trend at (-)1.49% per annum. Amidst general scenario of expanding area sown more than once, most of the districts in the north-west alluvial plains showed declining trend. Such districts included Madhubani, Samastipur, Saran, Sitamarhi, Vaishali and West Champaran. Rate of decline was as high as (-)1.90% in West Champaran and as low
as (-)0.06% in Samastipur. Districts showing expansion in area sown more than once included Muzaffarpur (4.22%), Gopalganj (2.72%), Darbhanga (1.35%), East Champaran (0.81%) and Siwan (1.21%).

VII.11 In the east alluvial plains only Munger and Purnea showed declining trend at (-)5.08% and (-)0.36% respectively. In all other districts it showed expansion in the range of 4.12% per annum as in Begusarai and 0.44% as in Bhagalpur. Districts of the south-west alluvial plains on the contrary showed uniformity in the expansion of area sown more than once, increasing in the range of 1.89% as in Nalanda and 1.29% as in Gaya. Scenario among the districts of the plateau zone was different with some of the districts showing high rate of decline. Rate of decline was as high as (-)9.22% in Santhal Parganas and (-)2.03% in Dhanbad. Districts such as Singhbhum, Hazaribagh, Palamu and Ranchi, however, showed increasing trend in area sown more than once at 6.21%, 1.90% and 1.61% respectively.

(e) Gross cropped area

VII.12 In the context of expanding area sown more than once, gross cropped area showed shrinkage in most of the agro-climatic zones and districts. All the zones of the north-west alluvial plains, south-west alluvial plains, east alluvial plains and plateau districts showed declining trend in gross cropped area at (-)0.62%, (-)0.45%, (-)0.15% and (-)2.31% respectively. Declining trend was far and wide among the districts of the north-west, in the range of (-)1.83% as in Sitamarhi and (-)0.03% as in Siwan. Amidst such a scenario Gopalganj and Muzaffarpur showed expansion in gross cropped area at 0.51% and 1.65% respectively.

VII.13 Shrinkage in gross cropped area was more wide spread among the districts of the east alluvial plains with Munger showing high rate of decline at (-)3.99% per annum. Bhagalpur on the other hand showed minimal shrinkage in gross cropped area at (-)0.09% per annum. Begusarai and Saharsa showed expansion in gross cropped area at 3.50% and 0.49% per annum respectively. Districts of the south-west alluvial plains also showed decline in gross cropped area, although at modest rates ranging between (-)0.74% as in Aurangabad and 0.16% as in Patna. Nalanda was the lone district in this zone to show expansion in gross cropped area at 0.11% per annum. In contrast to the districts of the south-west alluvial plains, the districts of the plateau region showed declining trend uniformly with the only exception of Dhanbad. It ranged between (-)5.53% as in Ranchi and (-)0.48% as in Hazaribagh.
(f) Crop Intensity

VII.14 Examining the trend rates of growth in crop intensity across different agro-climatic zones, it showed increasing trend in the north-west alluvial plains, east alluvial plains and south-west alluvial plains at 0.28%, 0.71% and 0.29% respectively. It may be taken to imply that in all these zones the land is being increasingly used more intensively for cultivation purposes. However, the zone of the plateau showed declining trend at (-)1.02% per annum, implying thereby that intensive use of land is on the wane in this zone.

VII.15 Crop intensity across different districts showed increasing trend uniformly among the districts of the north-west alluvial plains. Rate of increase was as high as 1.50% in Muzaffarpur and as low as 0.08% in Saran. Amidst such a pattern, however, Madhubani and West Champaran showed declining trend in crop intensity at (-)0.05% and (-)0.56% respectively. Pattern across the districts in the east alluvial plains was almost similar with most of the districts showing increasing trend in crop intensity ranging between 0.93% as in Katihar and 0.06% as in Purnea. Munger was the only district in this zone to show declining trend in crop intensity at (-)0.69% per annum. Pattern among the districts of the south-west alluvial plains was no different, as most of the districts showed increasing trend of crop intensity in the range of 0.63% as in Aurangabad and 0.05% as in Patna. Districts of the plateau region, however, presented a picture in contrast with most of the districts showing declining trend. Rate of decline ranged between (-)0.61% as in Santhal Parganas and (-)0.05% as in Hazaribagh. In contrast Ranchi and Singhbhum showed increasing trend in crop intensity at 3.80% and 0.09% respectively.

Conclusions

VII.16 The following broad conclusions thus emerge on the basis of foregoing discussions with regard to trend and pattern of growth in the land use in Bihar:

(i) Availability of land for cultivation was relatively low in Bihar. In few districts, particularly the plateau districts it was disproportionately low. Presence of high current fallow and other waste land suggests potential for bringing additional areas for cultivation in the state. The problem warrants immediate action in the context of net sown area showing declining trend. It was precipitated largely due to increase in other waste land and current fallow on the one hand and shift of land to miscellaneous trees as also for non-agricultural use on the other.
(ii) Shrinkage in net sown area was uniform across all agro-climatic zones. However, the rate of shrinkage was more prominent and sharp in the plateau zone, followed by the east alluvial plains and the north-west alluvial plains. The south-west alluvial plains showed relatively low shrinkage.

(iii) Area sown more than once showed increasing trend in all the agro-climatic zones in the plain land, but declined in the plateau region. This implied that in the context of declining net sown area the tendency to make more intensive use of land for cultivation was on the increase. But, much of the gains on this account was lost in view of decline in net sown area, resulting in a trend of declining gross cropped area uniformly across all the agro-climatic zones.
CHAPTER VIII

GROWTH IN FERTILIZER CONSUMPTION - TEMPORAL AND SPATIAL PATTERN

Discussions in the preceding chapters brought out the fact that Bihar agriculture is on the growth path with production of foodgrains as also major non-foodgrain crops like oilseeds and sugarcane showing upswing, specially since the mid-eighties. However, despite acceleration in agricultural production in the state, it is yet to catch momentum, given the richness of soil and climate in lines similar to other agriculturally developed states like Punjab, Haryana, etc. With similar area under rice as in Bihar, states like West Bengal and Uttar Pradesh produced almost double of its rice output. Similarly, with half the area under wheat as in Bihar Haryana produced almost similar level of wheat. The case of sugarcane and oilseeds and a few other crops is no better. Such wide differentials in the production of agricultural crops in Bihar with those of other major states emanated largely because of wide differentials in the yield levels. Within the State as well a wide variation was observed in the yield level across different agro-climatic zones and districts.

VIII.2 The yield of crops basically depends on input use and farm management practices. In order to attain the objective of output maximisation, efforts have been made to promote increased as well as balanced use of the modern inputs such as fertilizers, irrigation and HYV seeds, with increased facility of institutional credit. The trend and pattern of fertilizer use which is the major component of modern input package, is attempted in the following paragraphs.

a) Consumption of Fertilizer

VIII.3 Studies have found adequate evidence to suggest significant influence of chemical fertilizer on yield and output level of crops, depending upon irrigated and unirrigated conditions as also nature of crop under cultivation. Mention may be made of studies such as Desai (1982), Mukhopadhyaya (1976), Nagarj (1980), NCAER (1978), Parikh and Trivedi (1982), etc. Increase in fertilizer consumption, however, did not match the pace of increase in foodgrains production. The growth in output is not commensurate with the increased fertilizer use is also observed at all-India level, as is reflected in the study by Parikh and Srinivasan (1974). Significantly, agriculture of Bihar has been responsive to increased use of chemical fertilizers and its resultant impact on enhanced crop yield. Fertilizer consumption in Bihar was a mere 9.06 kg/ha. in 1970-71 which increased to 21.01 kg/ha in 1982-83 and to a high of 57.20 kg/ha. in 1992-93, record-
ing a compound annual growth rate of 8.73% during 1971-93. Despite such an impressive jump in the use of chemical fertilizers, the State was not nearer to the level of fertilizer consumption in states like Punjab (162.2 kg/ha.), Haryana (107.8 kg/ha.), Uttar Pradesh (86.0 kg/ha.), Tamil Nadu (117.1 kg/ha.), as also the all-India average (67.1 kg/ha.) in 1992-93.

Regional Analysis

VIII.4 Fertilizer consumption was increasing in different agro-climatic zones/districts as well. However, there was wide variation in the level of its use across different zones/districts. It was as high as 87.36 kg/ha. in the south-west plains, followed by 55.04 kg/ha. in the north-west and 50.11 kg/ha. in the east plains during 1990-91. On the other hand it was much less at 25.66 kg/ha. in the plateau zone. Across different districts, the fertilizer consumption was as high as 135.86 kg/ha. in Nalanda and 103.62 kg/ha. in Begusarai. The levels of fertilizer consumption in these districts were almost similar to that of Punjab, Haryana and other agriculturally developed states. Among the districts of the north-west plains, the fertilizer consumption was relatively high in Saran (81.80 kg/ha.), Muzaffarpur (79.35 kg/ha.), Vaishali (73.43 kg/ha.) and Samastipur (68.92 kg/ha.). On the other hand, districts such as Madhubani (18.85 kg/ha.) and Darbhanga (33.93 kg/ha.) showed relatively low consumption of fertilizers.

VIII.5 The districts in the east plains did not present encouraging picture in the use of fertilizers. Among these districts, however, Purnea (59.68 kg/ha.) and Katihar (59.74 kg/ha.) showed relatively high level of fertilizer consumption. Bhagalpur (30.66 kg/ha.) and Saharsa (34.25 kg/ha.) lagged far behind. Increase in the consumption of fertilizer was relatively more in Purnea and Katihar, growing annually at 20.96% and 23.87% respectively during 1977-91. Bhagalpur and Munger on the other hand showed stagnation in the consumption of fertilizer, specially during the second sub-period.

VIII.6 Fertilizer consumption in the districts of the plateau zone was less than 25 kg/ha. Dhanbad (4.86 kg/ha.) and Palamu (10.24 kg/ha.) showed the least consumption of fertilizers. With the exception of Dhanbad, the districts of this zone, however showed increasing trend in its consumption during 1977-91.

Composition of Fertilizer Consumption

VIII.7 The composition of chemical fertilizer is important, as it adversely affects the soil fertility, if used disproportionately. It is important, therefore, to use fertilizers in required doses as well as in optimum composition. In
Bihar, fertilizer was used largely for paddy and wheat. Comparing the recommended dose of chemical fertilizer for these crops with that of the actual consumption, it is observed that the use of fertilizer nutrients was not balanced in the state. As against recommended share of 56.0% for nitrogen it was 74.0% in 1970-71. Although, over the years, the share of nitrogen declined from 80.0% in 1975-76 to 67.5% in 1992-93, still it remained excess than the recommended level. The consumption of phosphorous on the other hand was deficient despite its increasing share over the years from 16.0% in 1970-71 to 22.5% in 1982-93 as against the recommended composition of 30%. The use of potash as well was deficient and remained at around 10.0% only as against the recommended composition of 14%. Thus, while nitrogen was over-used, the use of potash and phosphorous was deficient in the state.

VIII.8 Analysis of the composition of NPK at two points of time across different agro-climatic zones/districts showed that zones where the consumption of fertilizer was high had greater imbalance in the use of fertilizer. For example, the south-west plains which showed the maximum fertilizer consumption (87.36 kg/ha.) in 1990-91 showed a composition of nitrogen at 68.63%. In other zones the composition of nitrogen was nearer to the recommended dose (around 56%) in 1990-91. The share of nitrogen showed declining trend during 1977-91. However, the rate of decline was high at (-)1.90% in the east plains and (-)1.83% in the south-west plains. The share of phosphorous was nearer to the recommended composition in the north-west, the east and the plateau zone in the range of 25-29%. In the case of the south-west plains, consumption of phosphorous was deficient with a share at 21.83% only, despite consumption of phosphorous showing increasing trend at around 3.7% in all the agro-climatic zones. Consumption of potash was deficient in the north-west, south-west and plateau zones with its share at around 9% only in each zone. In the case of the east plains, composition of potash was relatively high at 12.3% but less than the recommended dose.

l) North-west plains

VIII.9 Consumption of nitrogen was excessive in most of the districts of the north-west zone, as its share exceeded 60% in most cases. There were, however, a few districts showing balanced consumption of nitrogen. Such districts included Saran, East and West Champaran, forming a geographical cluster. Excessive consumption of nitrogen was on the decline in these districts. For example, it was as high as 85.00% in 1976-77 but reduced to 65.37% in 1990-91 in Muzaffarpur. Similar trend was observed in respect of other districts of the zone. The rate of decline in consumption of nitrogen was negative in all the districts ranging between (-)7.89% and
(-)0.79%. Sitamarhi was the only district to show increasing trend in the consumption of nitrogen, however, marginally at 0.02%.

VIII.10 Consumption of phosphorus on the other hand was deficient in most of these districts with a share less than recommended level of 30%. In districts like Darbhanga, Vaishali and Gopalganj, the share of phosphorus consumption was low at around 25%. Admit such a scenario, however, there were districts to show balanced consumption of phosphorus. They included West Champaran, Saran and East Champaran, all forming one geographical cluster. The use of balanced proportion of phosphorus in these districts was the development of recent years, as it was found to be deficient in all these districts in 1976-77. The rate of growth in the share of phosphorus was observed to be increasing in the range of 10.51% as in Vaishali and 1.46% as in Sitamarhi. The analysis of potash consumption across different districts of this zone suggests that most of the districts continued to be deficient in potash consumption. Amidst such a scenario, East Champaran and Samastipur were found to be close to balanced consumption of potash. Further, while most of the districts showed increasing trend in the share of potash, there were districts to show declining trend. Such districts included Siwan, Sitamarhi, Madhubani and West Champaran.

ii) East Plains

VIII.11 Consumption of nitrogen was more balanced in the districts of the east plains. In Munger and Bhagalpur the share of nitrogen continued to be high at around 70.0% in 1990-91. There was, however, a declining trend in over-consumption of nitrogen in these districts. Begusarai and Purnea showed relatively high rate of decline, exceeding 2.0% per annum. In respect of phosphorus, the districts of this zone showed to be deficient. In Munger, the share of phosphorus was low at only 19.66%. The share of phosphorus increased in all these districts in the range of 7.65% and 1.48%. In the consumption of potash, the districts of this zone presented a more favourable picture, except Bhagalpur and Munger. In these two districts, the share of potash continued to be low at 8.91% and 6.61% respectively in 1990-91. In all other districts of the zone, the share of potash showed an increasing trend.

iii) South-west Plains

VIII.12 The districts of the south-west plains showed over-consumption of nitrogen in 1990-91. Rohtas was the only district to show balanced consumption of nitrogen at around 60.0%. In all other districts, the share of nitrogen exceeded 65.0%. It was as high as 75.53% in Patna. The share of
nitrogen declined in all these districts during the period. In respect of phosphorous, the districts of this zone showed under-consumption with its share at around 20% in most of the districts. Rohtas, however, offered a picture in contrast with a more balanced consumption of phosphorous as well. Over the years, the share of phosphorous consumption showed increasing trend in all the districts. The share of phosphorous in 1976-77 was less than 10.0% which increased to around 20.0% in 1990-91, showing annual compound growth rate in the range of 9.32% and 4.95% in these districts. Unlike the districts of the east plains, the districts of the south-west plains showed under-consumption of potash in 1990-91. It did not exceed 12.0% in any of the districts as against the recommended dose of 14.0%. It was as low as 7.26% in Patna. Over the years, however, the share of potash has been increasing. For example, while it was 4.52% in 1976-77 but increased to 12.28% in 1990-91 in Nawadah. Similar trend could be discerned in other districts with annual rate of growth in the share of potash ranging between 8.11% and 5.90%.

iv) Plateau Zone

With the exception of Santhal Parganas, Singhbhum and Ranchi, consumption of nitrogen among the districts of this zone exceeded 65.0% in 1990-91. Over the years, however, there was a declining trend in its share. The rate of decline ranged between (-)1.58% and (-)0.05%. In respect of phosphorous consumption, districts of this zone was largely closer to the recommended dose. Its share was found to be 31.18% in Ranchi and 24.24% in Giridih. All these districts showed increasing trend in the share of phosphorous consumption over the years. The rate of increase ranged between 6.15% and 1.02%. In respect of potash consumption, however, the districts of this zone showed unfavourable picture with its share below 12.0% in all the districts. It was as low as 4.56% in Palamu district and 6.93% in Hazaribagh in 1990-91. Some of the districts showed further deterioration in the share of potash consumption. Such districts included Dhanbad (-3.19%), Giridih (-3.85%), Hazaribagh (-0.73%) and Palamu (-1.56%).

Measure of fertilizer nutrient imbalance

In order to comprehend the imbalance in the use of different fertilizer nutrients such as nitrogen, phosphorous and potash, the index of nutrient ratio was worked out for different agro-climatic zones as also districts in Bihar with recommended ratio as the base.

It is striking to observe that the ratio of N/P and N/K are much higher than the base (225.0%) in both the cases at State level. This im-
plies that use of phosphorus and potash in relation to nitrogen was highly
deficient in the state. A similar scenario was observed in respect of differ­
ent agro-climatic zones. The imbalances in the use of nutrients seemed to
be large in the case of the south-west plain. It was as high as 318.0% for
N/P and 347.0% for N/K. The imbalances in the use of nutrients was ob­
served in all other zones. Analysing the index of nutrient ratio across differ­
ent districts of the north-west plains, it is observed that the imbalances in
their use was quite large in respect of Sitamarhi and East Champaran with
ratio exceeding 250.0%. Samastipur and Gopalganj on the other hand of­
fered relatively less of imbalances in the use of nutrients. Among the dis­
tricts of the east plains, Munger and Bhagalpur figured prominently in terms
of imbalances in the use of nutrients. Saharsa and Katihar on the other
hand showed lesser deviation in the use of nutrients from the recom­
mended dose. The case of districts in the south-west plains was highly
unfavourable. In all these districts the index of nutrient ratio (N/K and N/P)
exceeded 250.0%. In the case of Patna, it was as high as 440.0% for
N/P and 506.0% for N/K. Deviation in the use of nutrients in respect of
districts in the plateau zone was less unfavourable. In districts such as
Singhbhum and Ranchi, the deviation was low at 112.0% and 124.0% re­
spectively for N/P and N/K. However, it was unfavourable in terms of the
ratio for N/K in Ranchi (255%). The districts showing relatively more unbal­
anced use of nutrients included Dhanbad, Hazaribagh and Palamu. The
ratio of N/K was more unfavourable than the ratio of N/P among these
districts.

Impact of Imbalance in Nutrient Use on Yield Level

VIII.16 The question of whether the unbalanced use of nutrients influences
the yield level of foodgrains was also examined by regressing index of
nutrient ratio and foodgrains yield across different zones/districts. The elas­
ticity was negative at (-)0.35 for N/P and (-)0.42 for N/K at the State level.
This signifies that unbalanced use of nutrients adversely affects the yield
level of foodgrains. Similar relationship was observed in respect of different
agro-climatic zones and districts for both the ratios.

Relationship between Fertilizer Consumption, Foodgrains Production,
Irrigation and Rainfall

VIII.17 Relating the fertilizer consumption with yield of foodgrains over
1977-91, positive elasticity of 0.23 is observed for the State. Across differ­
ent agro-climatic zones, the elasticity was positive at 0.30 in the south-west
zone, followed by 0.27 for the north-west zone. It was 0.16 each in the
east plains and the plateau region. It was significant in all the agro-climatic
zones. Analysing the elasticity across different districts, it is observed that
all the districts showed positive elasticity of fertilizer consumption on foodgrains production. It may be taken to suggest that one per cent increase in fertilizer consumption leads to increase in the yield of foodgrains by 0.23% in the state. With the yield at 1040 kg/ha. and consumption of fertilizer at 57.20 kg/ha. it appears that increase in fertilizer consumption by 0.57 kg. leads to an increase of foodgrains yield by 2.40 kg.

VIII.18 The influence of irrigation on fertilizer consumption was significantly large with elasticity at 6.14% in the State. Across different agro-climatic zones, elasticity was significant and high at 9.76% in the south-west plains. In the north-west and the east plains as well the elasticity was positive at 4.76% and 5.03% respectively. For the plateau zone, the elasticity was low and insignificant at 3.13%. Across different districts the relationship between fertilizer consumption and irrigation was found to be significant in most cases.

Conclusions

VIII.19 On the basis of the foregoing discussions the following broad conclusions on the trend and pattern of fertilizer consumption in Bihar could be arrived at:

(i) Consumption of fertilizer recorded rapid increase, particularly during the eighties from 21.01 kg/ha in 1982-83 to 57.20 kg/ha in 1992-93. Despite such an impressive jump, the level of fertilizer consumption in Bihar was less than Punjab (162.20 kg/ha), Haryana (107.8 kg/ha), and all-India average (67.12 kg/ha) in 1992-93.

(ii) Across different regions, consumption of fertilizer was relatively high in regions with higher irrigation network as in the south-west alluvial plains where the foodgrains production was also higher.

(iii) In districts such as Patna (135.86 kg/ha) and Begusarai (103.62 kg/ha) the level of fertilizer consumption compared well with the averages in agriculturally more prosperous states.

(iv) The use of fertilizer was not in recommended combination in the state. The use was in excess in the case of nitrogen and deficient in phosphorus and potash. It was more disproportionate in regions with high irrigation network and foodgrains production. Over the years, however, over-use of nitrogen was on the decline in the state. Proportionate share of phosphorus and potash was increasing on the other hand.

(v) Unbalanced use of different fertilizer nutrients showed negative influence on yield of foodgrains at the state level as also at different agro-climatic zones/districts.
(vi) Influence of fertilizer consumption on yield of foodgrains was significant, as elasticity of fertilizer consumption was observed to be positive. For every increase of 0.57 kg of fertilizer, increase in yield was observed to be 2.40 kg of foodgrains.

(vii) Irrigation was found to significantly influence the consumption of fertilizer in the state, as elasticity was positive across different zones/districts.
CHAPTER IX
GROWTH IN IRRIGATION -
TEMPORAL AND SPATIAL ANALYSIS

The expansion and improvement in irrigation network occupies a central role in agricultural development strategy, as it augments the land productivity on the one hand and brings stability in agricultural output on the other. Bihar has been endowed with vast irrigation potential. The ultimate irrigation potential for the State is estimated at 6.50 million hectare metres for major/medium irrigation. However, potential created was only 43.0% in respect of major/medium irrigation by 1990-91. The case of minor irrigation was no better. According to the Ground Water Irrigation Commission, the State has 2.67 million hectare metres of ground water as utilizable for irrigation. As against this the net draft i.e. level of ground water development was only 25.46% in the State. This leaves enough scope for expansion of minor irrigation potentials in the State. In this context one is led to ask a number of policy questions. How has the irrigation expanded across different agro-climatic zones/districts over these years? What has been the efficiency of irrigation? To what extent has it facilitated increased use of bio-chemical technology? How has it influenced the yield and hence agricultural output in different regions? Why irrigation is not expanding despite vast potentials? What are the major constraints for investments in irrigation in the State? The following paragraphs address to these questions on the basis of data on irrigation as available from secondary sources.

(i) Expansion of Irrigation

IX.2 The net irrigated area in the state increased only marginally from 28.74 lakh ha. in 1976-77 to 33.05 lakh ha. in 1990-91, an expansion of 11.50% only in 15 years. The net irrigated area formed only 42.85% of net sown area in 1990-91 as against 93.5% in Punjab, 76.05% in Haryana and 60.92% in Uttar Pradesh.

IX.3 Of the several sources of irrigation it was tubewell (42.0%), followed by canal (33.0%) which dominated the irrigation network in the State. Irrigation through wells and ponds formed insignificant proportion. Analysis of the growth in different sources of irrigation suggests that while tubewell showed expansion (2.37% p.a.), all other sources, including canal showed shrinkage with their share in total irrigation showing declining trend.

IX.4 Analysing the availability as also expansion of irrigation across different agro-climatic zones it was observed that the south-west plains was highly irrigated (81.14%), quite comparable to the States of Punjab and
Haryana. Districts of this zone, except Patna showed relatively high irrigation level, exceeding 80.0%. Patna had irrigated area at 60.94% only. Net irrigated area showed increasing trend (0.66%) during 1977-91 in this zone. Rate of increase was high in Rohtas (2.32%). Patna, Nawadah and Gaya on the other hand showed declining trend in net irrigated area.

IX.5 The level of irrigation was almost similar in the north-west and east plains at 45.19% and 41.73% respectively in 1990-91. Among the districts of these zones Begusarai (70.55%), followed by Siwan (70.37%) and Saran (68.68%) had relatively high level of irrigation. However, districts such as Purnea (23.87%) and Katihar (29.54%) of the east plains; and Madhubani (21.15%) and Sitamarhi (23.69%) in the north-west plains had the least coverage of irrigation. In terms of growth in irrigated area districts such as Purnea (6.02%), Katihar (6.9%), Vaishali (5.75%) and Darbhanga (5.96%) showed impressive performance.

IX.6 The plateau districts on the contrary showed low irrigated area at 7.19% only in 1990-91. Of the districts falling under this zone, Palamu showed relatively high level of irrigation (21.75%). In all other districts it was less than 10.07% of the net sown area. The level of irrigation showed shrinkage in all the districts ranging between (-)12.15% as in Dhanbad and (-)0.77% as in Ranchi during 1977-91.

Canal

IX.7 Canal irrigation showed increasing trend only in respect of the east plains (2.12%) and the south-west plains (1.35%). Rate of increase in canal irrigation was impressive, especially in Aurangabad (4.52%), Saharsa (3.05%), Munger (2.89%) and Bhagalpur (2.08%). All these districts showed relatively high level of irrigation from canal. There were a few other districts as well with high canal irrigation network, but showing shrinkage therein. They included East Champaran (-1.13%), Gopalganj (-3.71%) and West Champaran (-4.86%). Districts of the plateau zone as well showed decline in canal irrigation, prominently in Santhal Parganas (-9.35%). By implication there was a decline of 1.04 lakh hectares in canal irrigation in the State over these years which formed 9.50% of canal irrigation in 1990-91*. This means, irrigation potentials on these lands were created, but irrigation could not be provided because of choking of canal or absence of proper distribution or land falling at the tail-end unable to receive irrigation. Improvement in terms of disiltation of canal, repair of bunds and creation of additional distributories may enable irrigation on these lands as well.

* This refers to aggregate of decline in respect of districts showing decline in canal irrigation or any other sources of irrigation.
Tubewells

IX.8 Tubewell irrigation, the other major source of irrigation, showed expansion in respect of the north-west (3.10%), the east (3.52%) and the south-west plains (0.98%). The plateau districts on the other hand showed shrinkage (-0.13%) in tubewell irrigation. The districts to show impressive expansion in tubewell irrigation included Darbhanga (4.35%), Madhubani (4.59%), Vaishali (5.28%) and West Champaran (6.35%) in the north-west plains; Begusarai (6.33%) and Purnea (6.95%) in the east plains; Nawadah (3.73%) in the south-west plains; and Hazaribagh (8.61%) in the plateau. Districts such as Muzaffarpur, Munger, Aurangabad and Rohtas where tubewell irrigation was prominent, however, showed shrinkage in tubewell irrigation. The aggregate decline in tubewell irrigation area in the State came to 0.49 lakh hectares. The major reason for decline in tubewell irrigation could be attributed to non-functioning of the state owned deep tubewells. Besides, some of the private investment in shallow tubewells have become infrastructuous.

Other Wells

IX.9 Irrigation through other wells was not a major source at the aggregate level. However, in some of the districts, especially in the plateau zone it was an important source with larger share in total irrigation. Such districts included Gopalganj, Saran and Siwan in the north-west; Bhagalpur and Munger in the east; Gaya and Nalanda in the south-west; and Santhal Parganas, Giridih, Hazaribagh, Palamu and Ranchi in the plateau zone. In all these districts, except Bhagalpur, irrigation through other wells showed decline. Rate of decline was significantly high in respect of Saran, Siwan, Nalanda and Nawadah. Aggregate decline in irrigation through other wells in 1990-91 over 1976-77 worked out to 1.62 lakh hectares which formed 124.53% of the irrigation through other wells in 1990-91. Irrigation potential through other wells created once, but were lying unutilised for reasons of energisation, incomplete channel work, etc.

Ponds/Tanks

IX.10 Irrigation through ponds/tanks, though in small magnitude, is uniformly spread in different agro-climatic zones of the State and showed almost stagnant area under their irrigation at state level. Across different districts, however, while it showed impressive increase in respect of districts such as Darbhanga, Madhubani, West Champaran, Munger, Gaya, Nalanda and Hazaribagh, a few other districts registered sharp decline in area under pond/tank irrigation. They included Samastipur, Siwan, Santhal Parganas, Giridih and Palamu. Aggregate decline in irrigation through ponds/tanks
worked out to 0.38 lakh hectares which formed 33.10% of ponds/tanks irrigated area in 1990-91 in the state.

(ii) Irrigation Intensity

IX.11 Irrigation intensity, measured as ratio of gross irrigated area to net irrigated area, provides one measure to examine the extent of irrigation utilisation. Analysis of the data suggests that it was quite low at 124.0% for the State in 1991-92 as against 180.0% in Punjab, 163.0% in Haryana, 140.0% in Uttar Pradesh and 131.0% at all-India level. More important, over the years since 1976-77 it appears to be stagnant, with trend rate of growth registering an increase, albeit marginally, at 0.15% per annum only.

IX.12 Across different agro-climatic zones it was relatively high at 134.0% in the south-west plains, followed by 131.0% in the east plains and 128% in the Plateau districts. Irrigation intensity was much less in the north-west (114%). Over the years it has not recorded increase in any of the zones. Across different districts irrigation intensity was impressively high at 170.0% in Gopalganj, 178.0% in Katihar, 161.0% in Purnea, 140.0% in Saharsa, 145.0% in Patna, 157.0% in Rohtas and 149.0% in Hazaribagh. Districts to show low irrigation intensity included Saran (93%), Sitamarhi (106%), Vaishali (107%) and Begusarai (107%). Districts of the south-west plains with relatively high irrigated area showed low irrigation intensity. While plausible explanations for such a pattern call for a more in-depth study, on a-priori understanding, relatively high level of irrigation intensity in respect of Gopalganj, Katihar, Purnea and a few other districts could be attributed to dominance of canal and tubewell irrigation in these districts. Moreover, the canal irrigation from Kosi, Gandak and Sone has of late become more stable in these districts. Extensive tubewell irrigation brought further stability in the availability of irrigation in these districts. More important, cultivation of cash crops in these districts are relatively more which calls for application of more irrigation. Low irrigation intensity, especially in districts such as Saran, Siwan, Begusarai, etc. could be attributed to mono-crop culture, vast low lying areas inundated mostly with flood water and inefficient management of irrigation. Districts of the south-west plains with relatively high irrigated area but low irrigation intensity offer greater cause of concern. They fall largely under the Sone command areas with irrigation mostly from canal and tubewells. The canal irrigation has become inefficient due to siltation, choking of distributories, inadequate maintenance of channels, untimely supply of water in the canal, etc. Even the tubewell irrigation has not provided the fillip, because of the presence of diesel operated pumpsets in the absence of sufficient rural electrification. Cost of irrigation, using diesel pumpsets is also high which dissuades farmers from use of irrigation. Ab-
sence of cultivation of cash crops in these areas also discourage farmers to use more of irrigation at higher cost.

(III) Use of irrigation by crops

IX.13 It may be expected that a rational farmer would use irrigation essentially for crops yielding more gains. However, in the absence of wide crop diversification there is only few options in the use of irrigation. Given the situation, with wide inter-regional variations in cropping pattern it becomes important to understand the question as to which crops get irrigation and what is the coverage of irrigation to such crops in the State. In order to better comprehend these questions, the percentage share of major crops in gross irrigated area across different agro-climatic zones/districts and compound annual growth in their area over the period 1977-91 was examined. Coverage of irrigation available to these crops was analysed in terms of percentage of irrigated area of a crop to area under that crop.

IX.14 Analysing the share of irrigation by different crops shows that 93.07% of the irrigation was used for foodgrain crops in the State in 1990-91, thus leaving only 6.93% of irrigation for non-food crops. It is further observed that among the foodgrains it was essentially cereals taking the dominant share (92.89%) of irrigation. Of the cereal crops it was paddy (45.55%), followed by wheat (40.08%) and maize (6.84%) where most of the irrigation was used. Over the years while the distribution of irrigation has remained by and large the same between food and non-food crops, among the food crops there was a shifting pattern in favour of wheat and maize with paddy losing its share in irrigated area. Use of irrigation for non-food crops is dismal in Bihar.

IX.15 Across different zones/districts while the use of irrigation for food crops remained dominant in all the agro-climatic zones, in the plateau zone, however, other crops constituting miscellaneous ones had a fairly high share (29.20%) in irrigated area. Across different districts of this zone share of other crops in total irrigation was as high as 70.09% in Dhanbad. In districts such as Ranchi, Hazaribagh and Ghidih its share was equally high in the range of 52.0% and 57.0%. Further, while in the north-west plains wheat showed a higher share in irrigation (59.13%), in the south-west plains paddy (64.94%) had dominant share in irrigation. Districts to show high share of Irrigation for wheat included Gopalganj (83.82%), Saran (75.91%) and Siwan (71.12%), all forming one geographical cluster. These districts had high share in total wheat area in the state.
Accessibility of irrigation by crops/crop groups

IX.16 Irrigation is an important determinant of the yield level of a crop. Data suggests that the coverage of irrigation can be widened and intensified for a larger number of crops in the State. To what extent different crops have the accessibility to irrigation in different agro-climatic zones/districts? Percentage of irrigated area under different crops provides a measure of their irrigation accessibility level. Analysis suggests that wheat had the highest level of irrigation (85.52% in 1990-91) and the same showed to be increasing over the year. On the other hand, level of irrigation in respect of all other crops except, tobacco was low, as in none of the cases irrigated area exceeded even 50.0%. For paddy it was low at 35.43% in 1990-91 and showed to be stagnant at around the same level since 1976-77. In the case of maize, although per cent of irrigated area increased from a low of 17.55% in 1976-77 to 43.15% in 1990-91, but it was yet to cross 50.0% mark. Rapeseed/Mustard, tobacco and other crops showed increased accessibility of irrigation over the years. For tobacco it reached the level of 65.76% in 1990-91.

IX.17 Analysis further shows that in the north-west plains wheat (84.52%), followed by tobacco (69.45%) and maize (60.83%) showed high level of irrigation. Paddy (34.53%) and other crops (39.19%) showed medium coverage of irrigation. All other crops, including cash crops like rapeseed/mustard (25.09%) and sugarcane (4.02%) showed low level of irrigation. In the east plains, it was essentially wheat which showed high accessibility level of irrigation (80.94%). Paddy (46.04%) and maize (45.26%) were next in importance. The south-west plains, however, offered a picture in contrast with most of the crops showing higher level of irrigation. It was as high as 98.65% for paddy, 90.28% for wheat, 40.66% for maize, 61.67% for rapeseed/mustard, 99.10% for sugarcane and 69.80% for other crops. It was evidently high because availability of irrigation in terms of per cent net irrigated area was significantly large in this zone. In the plateau zone on the other hand wheat alone seemed to be cultivated largely under irrigated conditions with 85.52% of irrigated area under this crop.

IX.18 Analysis of the pattern across different districts is more revealing. Higher the area under the crop, higher was the level of irrigation. For example, districts such as Gopalganj, Saran, Siwan, Saharsa, Bhojpur, Rohtas, etc. with high area under wheat also showed high accessibility of irrigation for this crop. Similarly districts such as Aurangabad, Rohtas, etc. with high area under paddy also showed high level irrigation for the crop. It is better explained in respect of cash crops like rapeseed/mustard, tobacco and sugarcane. Districts such as Gopalganj, Saran, Siwan and those in the south-west plains having relatively high area under rapeseed/mustard also showed higher level of irrigation for this crop.
Relationship between Irrigation and a set of independent variables

(i) Irrigation and yield of foodgrains

IX.19 Irrigation is an important determinant to augment the land productivity. Examining the relationship between yield of foodgrains and irrigated area under foodgrains at state level as also zones/districts of the State using log linear function on data from 1976-77 to 1990-91, the elasticity is observed to be 1.54 ($R^2$ 0.88) for the State. This implies positive influence of irrigation on yield of foodgrains in the State. Across different zones/districts as well, the relationship of irrigation with yield of foodgrains was positive with high $R^2$ values. Amidst such a pattern, however, there were districts showing weak relationship between irrigation and yield. Such districts fall largely in the north-west, south-west and plateau zones. These districts showed either high or low net irrigated area. Districts with high irrigated area and weak relationship included Aurangabad, Nalanda, Nawadah and Patna in the south-west plains. Weak relationship of irrigation with yield in these districts with higher level of irrigation could be attributed to the inefficiency of the irrigation system in providing adequate and timely irrigation. Districts showing low net irrigated area and weak relationship between irrigation and yield included Muzaffarpur, Sitamarhi, West Champaran, Dhanbad, Santhal Parganas, Singhbhum, Giridih, Hazaribagh and Ranchi. Weak relationship of irrigation with yield of foodgrains in such districts could be attributed to low irrigation network, such that its presence does not influence yield in significant manner.

(ii) Irrigation and fertilizer consumption

IX.20 Use of chemical fertilizers under irrigated condition further supplants the land productivity. Enhancing the use of fertilizers, therefore, would maximise the farm output. The positive relationship between irrigation and fertilizer is strongly reflected in Bihar across different zones/districts. The elasticity of irrigation on fertilizer use was 6.14 with $R^2$ at 0.88. Across different zones it was relatively high at 9.76 with $R^2$ at 0.72 in the south-west plains and relatively low at 3.13 with $R^2$ at 0.17 in the plateau zone. The elasticity varied widely across different districts. It was high at 6.66 in Siwan, 3.93 in Katihar, 9.01 in Bhojpur and 5.64 in Palamu. Districts such as Santhal Parganas, Singhbhum and Giridih showed negative elasticities of irrigation on fertilizer. There are thus two important observations: first, there is a wide inter-district variations in the elasticity of irrigation on fertilizer, and second, some districts of the plateau zone showed negative elasticities. It may be pointed out that irrigation as such is not sufficient to determine the demand for fertilizer. Associated factors such as efficiency of irrigation network, coupled with cropping pattern, farm management practices, etc. are
also important to influence the level of fertilizer consumption. Observation of negative relationship in respect of a few plateau districts cannot be taken to imply adverse influence of irrigation on fertilizer use, as the relationship itself is not significant. Moreover, the level of irrigation in these districts was so low that it hardly could be expected to influence the fertilizer consumption.

Irrigation and crop intensity

IX.21 Relatively low level of agricultural output in Bihar is attributed, among others, to low crop intensity as well. Cropping intensity is influenced largely by the irrigation network. Given the inelastic supply of land, the objective of output maximisation could be achieved either by increased use of land augmenting inputs and/or by utilising the same piece of land for more number of times, subject to constraints of resources and technologies. In view of this one may expect expanding irrigation to step up crop intensity in the state. Relating the net as well as gross irrigated area with crop intensity at State level as also zone/district level, using log linear function on data from 1976-77 to 1990-91, the elasticity of crop intensity with respect to net irrigated area is observed to be 0.10 with $R^2$ at 0.49. The elasticity of crop intensity with gross irrigated area for the State was observed to be 0.10 with $R^2$ at 0.28. Across different zones, the elasticity of crop intensity with net irrigated area was found to be significant in respect of the north-west and south-west plains alone. Similar picture is discerned across different districts, testifying weak relationship between irrigation and crop intensity. It may, however, not be appropriate to conclude that irrigation does not influence crop intensity in these districts. The weak relationship is emerging perhaps because of inefficient irrigation network on the one hand and low level of irrigated area on the other.

Irrigation and crop diversification

IX.22 Creation of irrigation potential involves private and/or public investment. As a natural corollary, a farmer would not only make optimal use of irrigation, but also use it in a crop which maximises farm income. With higher relative prices of cash crops farmers would be prompted to allocate more of land towards cultivation of such crops, allocating minimum area for food grain crops just to ensure food security. With area under non-food grain crops at bare minimum of around 7.0% in Bihar, the scope to further expand cash crops seems plausible. Creation of additional irrigation potential, coupled with adequate prices may encourage cultivation of more cash crops in the state.

IX.23 Considering increase in per cent area under non-food grain crops as a proxy measure for crop diversification towards commercialisation and
relating it with per cent of gross irrigated area it is significant to observe
negative relationship between the two with elasticity at (-)0.44 at the State
level. Similar relationship could be seen in most of the districts. Districts
showing positive relationship are very few, that too, mostly with low elastici-
ties. At the face of it one may conclude that irrigation influences crop diver-
sification negatively which is contrary to the expectation. It may be pointed
out that cultivation of cash crops is region specific. For example, it is jute
in Purnea, Katihar and Saharsa in the east plains; tobacco and chillies in
Vaishali, Muzaffarpur, Samastipur and Begusarai in the north-west; sugar-
cane in Gopalganj, West Champaran and East Champaran in the north-
west; and fruits and vegetables in Vaishali and Muzaffarpur in the north-
west; and Purnea and Katihar in the east plains. Instability in the produc-
tion of cash crops, as suggested by high fluctuation in their area, could be
seen in a number of factors with market, including inadequacy of prices as
the most significant. Case of sugarcane is worth highlighting. More than
80.0% of sugarcane are sold to sugar mills at prices which is the lowest in
the country. With high cost of cultivation, mostly due to irrigation through
diesel pumpsets and relatively low price of the product, the economics of
sugarcane cultivation becomes unfavourable in the state. More important,
the payment by the sugar mills is not timely. In some cases, payments to
farmers are due for three years, providing as a further disincentive for cul-
tivation of this crop. Transportation of sugarcane and long waiting time to
dispose of the same further dampens the spirit of the farmers. The case of
tobacco, jute, chillies, fruits and vegetables is no better and need to be
studied in detail.

Conclusions

IX.24 The following broad conclusions on the trends and pattern of growth
in irrigation may thus be arrived at on the basis of the foregoing discussions:

i. Despite vast potentials, the availability of irrigation was low in Bihar at 42.85%
of the net sown area in 1990-91 as against 93.32% in Punjab and 76.05% in
Haryana and 60.92% in Uttar Pradesh. Potential created was only 43.07% in
respect of major/medium irrigation and 25.46% for ground water.

ii. Increase in net irrigated area from 28.78 lakh ha. in 1976-77 to 33.05 lakh
ha. in 1990-91 was not substantial, as it was an increase by 11.50% only in
15 years.

iii. Dominant source of irrigation was tubewells (42.0%), followed by canal
(33.0%). Tubewell irrigation alone showed expansion, while all other sources,
including canal irrigation recorded shrinkage.

iv. Across different agro-climatic zones, the south-west plains (81.14%) was rela-
tively more irrigated. It compared well with those of more prosperous states.
The north-west and east plains lagged far behind with net irrigated area around 45.05% only. It was negligible (7.19%) in the plateau zone. The south-west plains registered growth in irrigated area while all other zones showed declining trend.

v. Analysis of the growth by different sources of irrigation suggested that canal irrigation was increasing only in the west and south-west Plains. Prominent districts to show increase in canal irrigation included Aurangabad, Saharsa, Munger and Bhagalpur. At the same time there were districts which showed decline in canal irrigation. They included East Champaran, West Champaran and Gopalganj. Aggregate decline in canal irrigation worked out at 1.04 lakh hectares over 1977-91. This formed 9.53% of canal irrigation in 1990-91.

vi. Tubewell irrigation was prominent in the north-west plains and showed increasing trend in all zones, except the plateau. Districts to record impressive increase in tubewell irrigation included Dharbhanga, Madhubani, Vaishali, West Champaran, Begusarai, Purnea and Nawadah. At the same time there were districts, mainly in the plateau to record decline in tubewell irrigation. Aggregate decline worked out to 0.49 lakh ha. which formed 3.53% of tubewell irrigation in 1990-91.

vii. Irrigation through other wells was prominent in the plateau region. It showed declining trend. Aggregate decline was 1.62 lakh ha., forming 124.5% of its irrigated area in 1990-91. Irrigation through ponds/tanks as well declined. Aggregate of its decline was 0.38 lakh ha. in 1990-91.

viii. Irrigation intensity was low at 124.0% in Bihar as against 180.0% in Punjab, 163.0% in Haryana, and 131.0% at all-India level. Across different zones it did not vary widely. However, the south-west plains showed relatively high irrigation intensity at 134.0%. Across different districts it was relatively high in Gopalganj (190%), Katihar (178%) and Rohtas (157%).

ix. Irrigation was used mostly for foodgrain crops with their share at 93.07% in total irrigation. Among them, it was mostly cereals (92.89%) which occupied a lion’s share in irrigation. Crops such as paddy, wheat and maize had the largest share in irrigation.

x. Analysis of irrigated area for major crops suggests that wheat had the highest irrigation coverage at 85.52% in 1990-91. For paddy and maize, it was low at 35.43% and 43.15% respectively. Among the non-foodgrains, tobacco showed higher coverage of irrigation at 60.76% in 1990-91.

xi. Irrigation was observed to influence the consumption of fertilizer as also crop intensity significantly in the state.

xii. Irrigation was observed to influence crop diversification as well. Relationship between irrigation and area under non-food crop was, however, negative.
CHAPTER X

EXPANSION IN THE USE OF HYV SEEDS -
TEMPORAL AND SPATIAL ANALYSIS

Studies* have shown that approximately 45.0% of the increase in crop output is attributable to pure yield increase. Given the soil-moisture environment the bio-chemical technology has been found to be crucial in determining the crop yield per unit area.** HYV seed is one major component of bio-chemical technology. Field data have shown that HYVs can absorb a much larger quantum of nutrients and give a higher yield per unit of nutrient than traditional varieties*. Irrigation and fertilizer alone cannot have the full impact on yield increase until and unless it is accompanied by the use of HYVs at the same time. Given the objective of output maximisation this calls for spread of HYV seeds covering larger number of crops and greater crop area. Needless to say, under the plan effort the HYV seeds have expanded in coverage, although in varying degrees across different states. With the passage of time it was observed to have spread across all classes of farmers. While the use of HYV seeds in Punjab and Haryana became widespread, states of the eastern region were found to lag behind in this respect. Moreover, HYV technology was available only for a few crops and that too under irrigated conditions.

X.2 As discussed in Chapter III, foodgrains production in Bihar has recorded impressive performance. Further, while irrigation remained stagnant, use of fertilizer recorded significant increase in the State. Has the other component of bio-chemical technology i.e. HYV seeds recorded similar increase, as in fertilizer, in Bihar? Which zones/districts have responded more favourably in the use of HYV seeds? How has the use of HYV seeds influenced the use of related inputs as also the crop output in Bihar? The present chapter makes an attempt to understand these broad questions by using time series data on area under HYV seeds for major crops like paddy, maize and wheat for which HYV technology is used more widely in the state. The data was obtained from Directorate of Economics and Statistics, Government of Bihar. Time series have been built up from the year from 1979-80 to 1990-91 both at the State and district level, as only in respect of these years that the data were available. Analysis of the spread

* Mention may be made of studies by Minhas and Vaidyanathan (1965), Ray (1983), Bhalla and Alagh (1977), etc.

** Studies such as NCAER (1978), Nagaraj (1980), etc. have prominently brought out such evidence.


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of HYV seeds is restricted for crops such as paddy, wheat and maize alone, as the required data were available only for these crops. The spread in the use of HYV seeds - both temporal and regional is examined in terms of percentage change in HYV area over these years. Compound annual rate of growth in both physical area and percentage area under HYV seeds is also worked out to assess the trends of their growth. Finally, the relationship of HYV seeds with crop output, irrigation and fertilizer consumption is also analysed using simple regression technique.

a) Paddy

X.3 Analysis suggests an increasing coverage of paddy HYV area in recent years in the State. It formed only 20.31% of paddy area in 1979-80 which increased to 33.86% in 1990-91. The coverage of HYV paddy area thus recorded an increase with compound annual rate of growth at 4.05% during this period. In terms of physical area as well the HYV seeds of paddy showed expansion from 10.36 lakh hectares in 1979-80 to 16.67 lakh hectares in 1990-91, recording an increase of 60.90% in eleven years. The compound annual rate of growth in HYV area of paddy was thus 4.02% during this period. However, compared to other major states, coverage of HYV for paddy was much less in Bihar. While it was 94.17% in Punjab, 87.04% in Uttar Pradesh, 56.03% in West Bengal, 95.03% in Tamil Nadu, 90.04% in Andhra Pradesh and 64.31% at all-India level, for Bihar it was only 33.86% in 1990-91.

X.4 Across different zones/districts the coverage of HYV area in respect of paddy was wide in the south-west alluvial plains at 65.89%. Among the districts of this zone it was relatively more in Rohtas (86.64%) and Bhojpur (81.95%). Districts of Gaya (41.32%) and Nawadah (35.95%) of this zone, on the contrary, showed lower coverage of HYV. The rate of increase in the physical HYV area as well as increase in percent coverage thereof during 1980-91 was all the more impressive in most of these districts. Rate of increase per annum in physical area was as high as 8.92% in Nalanda and 7.34% in Gaya.

X.5 Coverage of HYV seeds in the north-west zones as well as the east plains was relatively low for paddy at 25.72% and 39.07% respectively. In the plateau districts it was almost negligible at 8.33% only. Analysing the rate of expansion of HYV seeds across these agro-climatic zones, it was found to be making impressive dent only in the eastern plains with both the north-west plains and plateau districts showing low pace of increase in HYV coverage. Across different districts of these zones there was not much variation in the coverage of HYV seeds. The coverage of HYV seeds was seen relatively more in respect of Siwan (47.63%), Saran (41.52%) and
West Champaran (37.73%) of the north-west plains; Purnea (77.41%) in the east plains; and Santhal Parganas (11.63%) in the plateau districts.

b) Maize

X.6 Analysis of maize presents a picture in contrast with HYV area showing shrinkage from 3.99 lakh hectares in 1979-80 to 3.82 lakh hectares in 1990-91, thus recording a decline at (-)0.60% per annum during this period. Coverage of HYV maize area, however, was increasing from 48.12% in 1979-80 to 57.48% in 1990-91, recording compound annual rate of growth at 1.94%. In the context of stagnant or decline in maize HYV area, the increasing share in percentage terms gives hardly any solace, as maize area itself recorded a significant shrinkage during this period. Compared to other major maize growing states the coverage of HYV in Bihar was not encouraging. While it was as high as 75.47% in Andhra Pradesh, 100% in Maharashtra, 94.15% in Punjab and 76.92% in West Bengal, Bihar had only 58.52% of maize area under HYV.

X.7 It may be recalled from the discussion in Chapter IV.2 that cultivation of maize in Bihar was region specific in the north-west and the east plains. Coverage of maize HYV was relatively large in these zones, more so in the north-west plains (75.38%). In other zones where cultivation of maize was low, spread of HYV area was also low. The plateau districts showed virtual absence of HYVs with its spread at 9.96% only. It is, however, significant to observe that HYV area for maize was shrinking in all the zones, except the east plains. The north-west plains, the bastion in maize production registered a decline in HYV area at (-)1.85% per annum during 1980-91. Rate of decline was still high at (-)4.47% for the plateau districts and (-)4.25% for the south-west plains. The east plain registered an increasing trend at 1.53% per annum.

X.8 It may be recalled that Begusarai, Saharsa, Purnea and Samastipur were the major maize producing districts. All these districts, except Samastipur, showed increasing trend in maize HYV area. Begusarai which produced almost one-third of the state maize production recorded impressive growth rate (6.99% per annum) in HYV area. Samastipur showed shrinkage in HYV area under maize at (-)1.14% per annum. East Champaran, Gopalganj, Muzaffarpur and Saran were other major maize growing districts and all these districts showed decline in HYV area.

c) Wheat

X.9 Coverage of HYV in respect of wheat was relatively high. It formed 74.50% of wheat area in 1990-91. Over a decade its coverage has, how-
ever, not increased impressively. For example, while HYV wheat area formed 70.44% in 1979-80 it increased marginally to 74.50% in 1990-91. It recorded compound annual rate of growth at 0.56% only. In terms of physical area, however, the increase in HYV for wheat was more impressive. It was 1.20 lakh hectares in 1979-80 which increased to 1.46 lakh hectares in 1990-91, showing compound annual rate of growth at 2.51% during this period. Spread of HYV seeds for wheat was low, largely because of neutralising effects of increasing wheat area itself. While area under wheat increased from 1.70 lakh hectares in 1979-80 to 1.96 lakh hectares in 1990-91, recording an increase of 15.30% in eleven years, the area under HYV seeds for wheat increased from 1.20 lakh hectares in 1979-80 to 1.46 lakh hectares in 1990-91, recording an increase of 21.7% during this period. Compared to other major states, however, the coverage of HYV for wheat in Bihar was low. It was as high as 96.33% in Punjab, 94.54% in Haryana, 93.40% in Uttar Pradesh, 100% in West Bengal and 84.14% at all-India level. As against this it was only 75.06% in Bihar.

X.10 The coverage of HYV area under wheat was high in zones/districts with high wheat production. For example, the north-west plains with relatively high wheat production (40.93%) showed relatively high coverage of HYV (78.80%). The south-west plains with wheat production (35.41%) only next to the north-west plains also showed relatively high HYV area (73.51%). The plateau districts with least of wheat production (2.05%) showed least of HYV coverage (35.72%).

X.11 At district level as well similar pattern was observed. For example, districts such as Siwan, Saran, East Champaran and Gopalganj of the north-west; Begusarai of the east; and Bhojpur and Rohtas of the south-west plains with relatively high wheat production showed high coverage of HYV in the range of 93.72% and 70.32%. There were a few districts which showed high coverage of HYV despite being low producer of wheat. They included Muzaffarpur (81.62%) and Samastipur (81.88%) in the north-west; Katihar (88.25%) and Saharsa (83.18%) in the east; and Dhanbad (92.42%) in the plateau zone.

X.12 Analysing the increase in physical area of wheat HYV it is observed that all the zones of the plains showed expansion in HYV area almost at uniform rate during 1980-91. It increased at compound annual rate of growth at 2.74% in the north-west, 2.72% in the south-west and 2.57% in the east plains. Further, expansion in HYV wheat area was uniform across districts of these zones irrespective of the level of wheat production in the district. For example, Katihar and Darbhanga with relatively low share in wheat production showed impressive expansion in the HYV area at exceeding 3.0% per annum. Similarly, districts like Bhojpur, Begusarai, and
Gopalganj with high wheat production as well showed impressive expansion in HYV area at exceeding 3.05% per annum.

X.13 The case of the plateau region offered a picture in contrast with HYV area showing shrinkage at (-)5.99% per annum during 1980-91. The trend of decline was uniform across different districts of this zone, except Hazaribagh. The rate of decline in HYV area was as high as (-)21.50% per annum in Singhbhum and (-)16.52% in Dhanbad. Hazaribagh was the lone district to show increasing trend in the HYV area at 1.05% per annum.

Relationship of HYV area with irrigation and fertilizer

a) Irrigation

X.14 Baker and Herdt* observed inadequacy of irrigation and water control as the major constraint in the wider diffusion of rice HYV seeds. Ramasamy* observed irrigation as an important determinant of adoption of HYV seeds in respect of rice cultivation in Tamil Nadu. Examining the influence of irrigation on adoption of HYV seeds in respect of paddy, maize and wheat in Bihar by fitting double log regression equation on district-wise time series data on HYV area and irrigated area of the crop it is observed that irrigation has positive influence on the adoption of HYV area in Bihar as well. The elasticity of HYV on irrigation at State level was 1.51 for paddy, 0.75 for wheat and 0.23 for maize.

X.15 Comparing the elasticity of irrigation on HYV area for paddy across different zones/districts with that of trend rate of growth in HYV area and net and gross irrigated area, it is observed that zones/districts with high net/gross irrigated area had higher trend rate of growth in HYV area and vice versa. For example, the plateau districts showed consistent decline in irrigation availability as also shrinkage in HYV area for wheat and paddy. The districts of the plain land on the other hand showed increase in irrigation availability as also that in HYV paddy and wheat area. The elasticity of irrigation on HYV coverage of paddy and maize, however, is found to be positive and significant in districts of the plateau region as well which showed HYV area coverage of these crops even with less availability of irrigation. This could be interpreted to indicate farmers choosing to use the available scarce irrigation resource mostly for these crops, particularly in the plateau districts.


X.16 Maize on the other hand offered a picture in contrast with its HYV area showing declining trend even in zones/districts having increasing irrigation network. Still, the elasticity of irrigation of HYV maize area was positive and significant in most of the districts, including those in the plateau zone. The sharp decline in maize HYV area across different zones/districts could be seen largely in abandoning of maize cultivation itself. The positive elasticity of irrigation in this case is indicative of the use of irrigation for maize cultivation largely under HYV seeds.

X.17 The expansion in HYV area, especially for paddy and wheat in zones/districts with declining irrigation network could be taken to suggest that farmers of Bihar, given the yield augmenting effect of the HYVs, have not waited for irrigation to widen its use.

b) Fertilizer

X.18 Fertilizer is a sine-qua-non for farmers to benefit from modern variety of seeds* as nutrient using efficiency of modern varieties of seeds was observed to be far more than traditional varieties. Observations in respect of India for crops such as rice, wheat, maize, etc. further testify the higher nutrient using efficiency of modern varieties of seeds. This induced farmers for increased application of fertilizers, especially under irrigated condition for crops under modern HYV seeds across different regions of the country. In Bihar as well, there was vertical increase in the fertilizer consumption, particularly after the mid-eighties. Examining the impact of HYVs on fertilizer consumption in the State as also zones/districts using time series data on fertilizer consumption and area under HYV seeds of paddy, wheat and maize and using double log regression equation, it was observed that with the increase in HYV area, the consumption of fertilizers also increased. The elasticity at the State level was 4.49. Analysing the elasticity across different zones/districts, it was observed that while zones/districts in the plain alluvial land showed uniformly positive elasticities, in the case of districts of the plateau the elasticity was negative, excepting Hazaribagh. It may be recalled (Chapter IX) that districts of the plateau, except Hazaribagh showed sharp decline in both net and gross irrigated area. With the elasticity of fertilizer use to irrigation being weak and often negative in the districts of the plateau, the induced effect of HYV on fertilizer consumption may thus not be expected to be positive, especially when HYVs are not drought resistant for the arid districts of the plateau zone.

Conclusions

X.19 The following broad conclusions on the trends and pattern of growth in HYV seed area in Bihar could thus be arrived at from the foregoing discussions:

i) Coverage of HYV area has been on the increase in respect of major crops such as paddy, wheat and maize in the State. Pace of increase in the HYV coverage was relatively more for paddy. Compared to agriculturally developed states, the coverage of HYV was, however, low in Bihar. It was much less for paddy at 33.86% in Bihar as against 94.17% in Punjab and 87.04% in Uttar Pradesh.

ii) In terms of physical area while maize HYV showed declining trend, for paddy and wheat it was increasing.

iii) Across different agro-climatic zones, while the coverage of HYV showed increasing trend in the plain land, the plateau zone showed shrinkage in respect of all the three major crops such as paddy, wheat and maize.

iv) Expansion in HYV area for paddy and wheat was region specific to districts with high production of the crop.

v) Amidst general declining trend in maize HYV area, districts, namely Begusarai, Saharsa and Purnea having high maize production showed expansion in HYV area.

vi) Districts with relatively high irrigation network also showed high HYV coverage. Further, crops with high irrigation also showed higher coverage of HYV. Similarly, association between fertilizer consumption and coverage of HYV was found to be strong with positive elasticity.

vii) Given the high yield augmentation effect of HYV, farmers of Bihar does not seem to have waited for irrigation for its use, as HYV area was observed to show positive elasticity even in districts with low irrigation network, particularly the plateau zone.
Credit is important for achieving higher productivity and output of agricultural crops, particularly in resource deficient regions with low investible surpluses, as it facilitates increased use of modern inputs at lower costs. It was largely towards achieving the goal of enhanced flow of institutional credit that formal credit agencies was expanded in Bihar as well, particularly in the post bank nationalisation period. The branch network of scheduled commercial banks (CBs) in the state increased to 3,001 and that of Regional Rural Banks (RRBs) to 1,892 in 1993. In addition, there were 34 District Central Co-operative Banks (DCCBs) with 494 branches and 6,967 Primary Agricultural Credit Societies (PACS) all over the State in 1992. Besides, there were 187 branches of Bihar State Land Development Bank (BSLDB) to cover financing of investment credit in the State. To what extent these financial institutions have succeeded to serve the credit needs of agriculture in the State? The present chapter makes an attempt to examine and analyse the flow of institutional credit in Bihar.

i) Assessment of credit requirement in the State

XI.2 The Sen Committee in 1982 estimated credit requirement - both short-term production credit and long term investment credit for Bihar agriculture at Rs. 1,505 crores for the VIIth Plan period and Rs. 1,870 crores for VIIIth Plan period. Converting the estimate at current prices* of respective plan period, it worked out at Rs. 2,172 crores for VIIth Plan and Rs. 4,039 crores for VIIIth Plan period. On per year basis it was Rs. 434 crores for VIIth Plan and Rs. 607 crores for VIIIth Plan period. The Potential Linked Credit Plan (PLPs) in 1989-90 estimated the credit requirement for the rural and agriculture sector of the State at Rs. 601 crores for 1992-93. The Task Force on Bihar similarly put the credit requirement of the State at Rs. 720 crores for 1993-94.

ii) Credit flow in the State

XI.3 Comparing the various estimates of credit requirement with the actual flow of credit in the State it is observed to be quite inadequate in the State. While the Sen Committee estimated the credit requirement for VIIth Plan period at Rs. 2,172 crores (with price adjustment for the Plan period), the actual flow of aggregate credit in the State during this period was Rs. 1068.7 crore in the agriculture and allied sector. This was hardly one-

* The average wholesale prices of all commodities in respective plan period was considered to convert the estimate of credit requirement at the prices of respective plan period.
half (49.2%) of the estimated credit requirement. The flow of institutional credit in the initial years of VIIth Plan was still much less. It was Rs. 214.3 crore in 1991-92 and Rs. 195.7 crore in 1992-93 for the agriculture sector. Compared to the Sen Committee estimates the actual flow of credit was only around one-fourth for agriculture sector in the State. The estimates of credit requirement under the Potential Linked Credit Plans (PLPs) as also that of Task Force had a larger gamut in as much as it covered, in addition to agriculture and allied sector, the small scale industries and tertiary sectors as well. Comparing the two estimates with the aggregate credit flows it was observed to form only around 35.03% of the PLP estimate in 1991-92 and around 27.03% of the Task Force estimates in 1992-93.

XI.4 Data show further downward trend in the credit flows in the State, more so in the agriculture and allied sector. While the aggregate credit flows in 1986¹ was Rs. 298.5 crores which increased to Rs. 524.0 crore in 1988-89, but slipped thereafter reaching the low level at Rs. 289.5 crore in 1992-93. The flow of credit in agriculture and allied sector maintained similar trend with Rs. 152.0 crore in 1986, increasing to Rs. 308.0 crore in 1988-89 but had a continued decline thereafter reaching the level at Rs. 195.7 crores in 1992-93.

XI.5 The agriculture and allied sector continued to dominate in terms of share in the total credit flow in the State. However, its share remained almost unchanged at around 50-58% upto 1990-91. From 1991-92 onwards, its share started increasing to touch 67.63% in 1992-93.

XI.6 Flow of credit in Bihar was much less at Rs. 312 per gross cropped hectare as compared to other major states. It was as high as Rs. 5,961 per gross cropped hectare in Kerala, followed by Rs. 2,155 in Tamil Nadu, Rs. 1,189 in Punjab and Rs. 1,101 in Andhra Pradesh. The flow of credit in Bihar was even less than all-India average of Rs. 708 per gross cropped hectare. Further, in all these states the flow of credit was mostly from the PACS for short-term purposes. However, it seemed to lag far behind in Bihar with share of PACS in total credit flow at 28.30% only as against 68.31% in Kerala and 59.72% in Punjab and 42.48% at all-India level. It is further observed that share of production credit was disproportionately low in Bihar at 36.50% as against 85.30% in Kerala, 67.25% in Punjab, 84.41% in Tamil Nadu, 73.17% in Andhra Pradesh, 63.22% in Haryana and 60.32% at all-India level.

XI.7 Analysis of agency-wise and sector-wise target and disbursement of institutional credit in the State for the preceeding few years shows that

¹ It refers to the period April-December 1986.
achievement of target was low at 38.07% in 1992-93. Over the years the achievement level was on the decline from 60.03% in 1989-90 to 38.05% in 1992-93. While the decline in the achievement level of credit disbursement was uniform for all agencies, it was more steep in the case of co-operatives. Involvement of RRBs in the credit disbursement had been no better with their achievement level varying in the range of 50.06% to 27.08% in recent years.

XI.8 With co-operatives and RRBs becoming weak, the expectation from the Commercial Banks to fill the void increased, especially when there was sufficient gap in the C:D ratio in their cases, implying comfortable availability of resources for local deployment in the State. Analysis further suggests that while the deployment of funds by Commercial Banks in the State increased significantly from a mere Rs. 51.0 crore in 1969 to Rs. 3,830.0 crore in 1993, it, however, did not increase in the same proportion as in the case of deposits. Deposits increased from Rs. 186.0 crore in 1969 to Rs. 10,260.0 crore in 1993. As a result, the average C:D ratio has remained stagnant at around 38.03% in the State as against the stipulated norm of 60.0%. Compared to all-India C:D ratio of around 60.0% as well it has been low in the State. Analysis further suggests that while advances to priority sector by commercial banks has been close to the stipulated norm (around 60.0%), the share of advances in the agriculture sector has been dismally low at around 25.05% only in the State.

iii) Regional disparity in credit flow

XI.9 Zone-wise/district-wise Analysis of credit flow in the state during 1992-93 suggests that much of the credit has gone in the agriculturally developed zone of the south-west plains (29.86%), followed by the north-west plains (24.79%). The flow of credit in the zone of plateau districts was relatively low (22.91%). Across different districts the proportionate flow of credit was high in Ranchi (7.03%), Santhal Parganas (4.64%) and East Singhbhum (4.75%) of the plateau districts; Gaya (5.60%), Nalanda (5.22%), Patna (5.23%) and Rohtas (5.25%) of the south-west plains; Begusarai (5.79%) and Purnea (4.83%) of the east plains; and West Champaran (3.82%), East Champaran (3.02%) and Muzaffarpur (3.52%) of the north-west plains. Districts to show relatively low share in the proportion of credit flows included Hazaribagh (0.92%) and Giridih (1.19%) of the plateau zone; and Vaishali (1.21%), Madhubani (1.42%) and Gopalganj (1.33%) of the north-west plains.

XI.10 In terms of credit flow per hectare of gross cropped area, while the south-west plains maintained its lead (Rs. 340.2), the relative position of other zones changed. The zone of plateau districts with per hectare credit
flow at Rs. 303.8 was ahead of the north-west and the east plains with per hectare credit flow at Rs. 218.1 and Rs. 248.8 respectively. Across different districts, the flow of credit per hectare was relatively high in Dhanbad (Rs. 921.0) of the plateau zone; Nalanda (Rs. 546.8) and Patna (Rs. 519.2) of the south-west plains; and Begusarai (Rs. 521.4) of the east plains. Districts of the north-west and the east plains showed low level of credit flow per hectare. Prominent among them included Gopalganj (Rs. 132.6), Madhubani (Rs. 129.3), Sitamarhi (Rs. 178.3), Vaishali (Rs. 177.5), Saharsa (Rs. 165.9), Purnea (182.4) and Bhagalpur (Rs. 189.9). Among the districts of the plateau zone Hazaribagh alone showed, relatively low level of credit flow per hectare (Rs. 124.5).

XI.11 Relatively high level of credit flow per hectare among the districts of the plateau zone was on account of higher share in credit to non-agricultural sector, as the share of agriculture in the total credit flow was only 55.21%. Contrary to this, in all other zones the share of agriculture in total credit flow was significantly large in the range of 68.0% to 73.0%. Districts to show relatively high share of credit to agriculture included West Champaran (86.28%) and East Champaran (78.23%) of the north-west plains; Begusarai (87.09%), Katihar (75.47%) and Purnea (76.86%) of the east plains; Nawadah (89.57%), Nalanda (85.88%) and Aurangabad (85.62%) of the south-west plains; and Santhal Parganas (79.28%) of the plateau zone.

iv) Recovery Performance

XI.12 The problem of high overdues of institutional credit has been all the more serious in Bihar. In the case of PACS the recovery performance was 42.95% in 1985-86 which improved in the ensuing years reaching at 55.62% in 1988-89, but slipped to almost negligible level at 1.65% in 1989-90. It was no better in subsequent years. The case of SLDB was no different. The recovery performance was 85.25% in 1986-87, but fell sharply to 17.36% in 1987-88 and 19.42% in 1988-89. It showed increase in recovery performance at 53.81% in 1990-91 largely due to the benefits under loan waiver scheme. In the subsequent years, it fell down considerably reaching the level at 16.22% in 1992-93. The commercial banks offered relatively better picture in terms of recovery performance, as they showed higher percentage of recovery hovering between 33.85% as in 1992-93 and 59.76% as in 1991-92 during the period from 1985-86 to 1992-93.

Conclusions

XI.13 On the basis of the analysis thus made on the trend and pattern of growth of institutional credit in Bihar the following broad conclusions may be arrived at:

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i) The gap between the credit requirement, as estimated by the Sen Committee/Task Force/Potential Linked Plan and the actual flow, has been wide in Bihar such that not even half of the estimated credit requirement is met. With downward trend in the flow of institutional credit in the State, the gap between the credit requirement and actual flow is further widening.

ii) As compared to other major states the flow of credit in Bihar has been more disappointing. While it was as high as Rs. 5,961 per hectare in Kerala, Rs. 2,155 in Tamil Nadu and Rs. 1,189 in Punjab, it was just Rs. 312 in Bihar in 1991-92.

iii) The share of agriculture in the total credit was high in the State, but it fluctuated significantly from year to year.

iv) Co-operative credit has been declining in the state with their share in total credit flow almost negligible in recent years.

v) The Commercial Banks alone seemed to be active in the disbursement of credit in the State. But, their involvement was short of expectation, as their performance in mobilising deposits was not matching their performance in advances.

vi) District-wise analysis of credit flow in the State was more revealing. Agriculturally more prosperous zones/districts showed to receive relatively more of credit and vice versa. This was evident from the fact that the share of these zones/districts in total credit flow of the State was relatively high and vice versa. Credit per hectare of gross cropped area was also relatively high in zones/districts with high level of foodgrains production.

vii) Zonal/regional biases in the flow of credit was not reflected in the State. The plateau zone too had almost similar level of share in total credit flow as in other zones. In terms of per hectare it was in fact ahead of the north-west and the east plains.

viii) Mounting overdues seemed to be endemic in the State with recovery level coming to a low of less than 5.0% for PACS and less than 20.0% for BSLDB in recent years. The commercial banks, although showed relatively better recovery performance as compared to co-operatives and RRBs, their position was not that encouraging.
CHAPTER XII
OPERATIONAL HOLDINGS AND TENANCY STATUS

The present chapter attempts to understand broad features of operational holdings as also tenancy status in the State. It also attempts to examine the adverse influence of these on the status of agriculture in the State. Analysis is based on the secondary data as available from census of agriculture and other published sources.

I) Operational holdings

XII.2 Analysis of the distribution of operational holdings by size class of farmers at different points of time shows that the marginal and small farmers with their combined share at 86.75% in 1980-81 dominated in the State. The numerical presence of such categories of farmers was much more in Bihar as compared to the national average of 76.23%. Moreover, while the numerical strength of marginal farmers was increasing fast from 48.74 lakh in 1970-71 to 85.12 lakh in 1980-81, the increase in case of small farmers and semi-medium farmers was marginal. The medium and large farmers on the other hand showed sharp decline in their numerical strength. When compared to the national average, the process of increase in the numerical strength of marginal farmers and decline of medium and large farmers seemed to be much more sharp in Bihar.

XII.3 There were 117.1 lakh operational holdings with area at 102.4 lakh hectares in the State in 1985-86. The average size of operational holding was 0.87 ha. only. With relatively large number of operational holdings, given the low area under cultivation, the average size of operational holding (0.87 ha.) was much less for Bihar when compared with states such as Haryana (2.75 ha.), Punjab (3.76 ha.), Andhra Pradesh (1.72 ha.) and Orissa (1.47 ha.). The average size of operational holding at all-India level at 1.57 ha. was much higher than in Bihar. Further it is significant to observe that the number of operational holdings was fast increasing in the State. While there were 75.8 lakh operational holdings in 1970-71, it increased to 117.1 lakh in 1985-86, recording thus an increase by 54.56% in one and half decade. The increase was much higher in Bihar than at the national level (48.24%) during this period. Across different states the increase in the number of operational holdings in Bihar was only next to Andhra Pradesh (71.22%). The matter becomes still more serious when the trend in the growth of size of operational holding is examined. While most of the states, including Punjab, Haryana, West Bengal and Andhra Pradesh showed increase in the size of operational holding, albeit marginally, in respect of Bihar, Orissa and Uttar Pradesh it showed declining trend. The level of decline (-10.85%) was, however, much more in respect of Bihar.
during this period. The decline in the size of operational holding in the State could be seen largely in the declining net sown area on the one hand and increasing current fallow and barren land on the other. As the area of operational holdings of marginal farmers showed to increase from 18.38 lakh ha, in 1970-71 to 25.79 lakh ha. in 1976-77 and 29.56 lakh ha. in 1980-81, the increased number of marginal farmers in the State over these years could be attributed to growing sub-division and marginalisation process with semi-marginal and small farmers turning increasingly into marginal farmers. Again the sharp decline in the number of large farmers could partly be seen in implementation of land ceiling laws in the state.

XII.4 The average size of operational holdings for marginal farmers in Bihar at 0.35 ha. was relatively less as compared to the national average at 0.39 ha. in 1980-81. Over the years, however, the average size of operational holdings for such category of farmers does not seem to have reduced significantly. The fact that 75.81% of the farmers had a mere 0.35 ha. as average holding size gives cause for concern, more on account of viability question. This seems to have given rise to the phenomena of reverse leasing where marginal farmers lease out land to bigger size farmers.*

ii) Regional Pattern in Operational Holdings

XII.5 Analysis of the number of operational holdings across different zones/districts suggests that there was large skewness in the distribution of land in districts such as Purnea, Muzaffarpur and Gaya. It was relatively much less in districts such as Katihar and Nawadah. The number of operational holdings did not seem to be related with density of population as also number of households. Analysis further suggests that the number of operational holdings increased significantly in most of the districts. Rate of increase in the number of operational holdings over the decade 1971-81 was as high as 154.05% in Muzaffarpur, 86.42% in Purnea, 140.07% in Gopalganj, 84.08% in Sitamarhi and 71.45% in Palamu. Amidst such an increasing number of operational holdings, however, Nawadah ((-4.45%) showed a decline in the number of operational holdings during the same period. In the case of Aurangabad, Singhbhum, Samastipur, Munger, Saharsa, Katihar and Ranchi the increase in the number of operational holdings was relatively much less. This could be attributed largely to partial implementation of land consolidation in these districts.

XII.6 In most of the districts operated area showed a shrinkage. The shrinkage in operated area was as high as (-)35.71% in Nawadah,

(-)20.67% in Madhubani, (-)21.24% in Samastipur, (-)28.43% in Munger and (-)39.85% in Saharsa. In the case of districts showing increase in operated area the increase was observed to be marginal. Decline in operated area along with increasing number of operational holdings resulted in declining average size of holding in all the districts.

iii) Surplus land

XII.7 The problem of land concentration has been acute in the State with as much as 11.63% of the area being owned and operated by just 0.64% large farmers. It warranted imposition of land ceiling and distribution of the surplus land among the potential beneficiaries. As a result of the stringent land ceiling laws, a total of 197.9 thousand hectares of land have been declared surplus in the State, of which 168.0 thousand hectares were taken possession and 119.4 thousand hectares were distributed as on January 1995. As compared to other major states, however, the land possession rate as well as land distribution rate has been relatively low at 84.87% and 71.08% in Bihar. While the land ceiling laws as such have been found to be adequate*, serious doubts have been expressed on their implementation. The surplus land declared by the Government was observed to be grossly understated. According to Bharati**, while the surplus land declared by the Government was 158.9 thousand hectares, the estimated surplus land was observed to be around 731.0 thousand hectares. Thus, the gap between the estimated surplus land and declared surplus was almost 4.5 times. Against the estimated surplus land only 21.67% was found to have been acquired and 14.77% were distributed.

iv) Fragmentation of land - Need for consolidation

XII.8 The problem of fragmented land holding is no less in Bihar. According to field investigations, conducted by AERC, Shantiniketan, the average number of fragment per holding varied between 17 and 20 plots in Bihar in 1980-81. Over these years the fragmentation of holding might have further increased mostly as a result of sub-divisions. Iyer# makes similar observation to convey that "lack of consolidation in Bihar has resulted in extreme scattering of land holdings. Often a land holding of five acres may be scattered over 10-15 plots and could be spread in different parts of the village. This creates problem of manageability, forcing them to lease out land on share cropping basis".

** Bharati, Indu 'Potential of Surplus Land in Bihar and the Ground Realities' in B.N. Yugandhar (edt) 'Land Reforms in India' 1993.
# Opp. Cited
Such a large fragmented holdings create a number of other adverse impact as well, especially on the diffusion of modern technology. It restricts application of mechanical mode. Kind of irrigation technologies, being propagated and widely used in Bihar, were also not appropriate in such a situation, because of their non-divisibility. This hinders accessibility of irrigation on such plots of land, despite immense ground water irrigation potential. It also limits the use of chemical fertilizers and pesticides. If the gains of modern technology are to be reaped in optimum and taken to the doors of cultivators, the consolidation of fragmented holdings would have to be accorded due importance. Although the programme of consolidation was taken up in a number of districts, mainly in the north-west and the east plains, the programme seems to have fizzled out, more on account of lack of political will on the one hand and absence of missionary zeal on the other.

v) Concealed Tenancy

Going by the success of operation Barga in West Bengal which facilitated tenancy reforms with a package of on-farm development programme, ushering in widespread gains of development the need for tenancy reforms in Bihar with similar background of Permanent Settlement Act cannot be understated, especially when there is skewed distribution of land and such owners of land do not cultivate land for themselves. Recognising the need, the tenancy cultivation has already been prohibited in Bihar in as much as the Bihar Tenancy Act confers the right of ownership to all such cultivators who cultivate land on lease. However, in the absence of effective implementation of the said act, the oral tenancy practices is all pervasive with regressive character assuming different forms and shapes in the state. In the words of Iyer$, "the tenancy cultivation, besides being exploitative in character, provides sense of insecurity to the cultivator. It also makes them obligeful to the owner of the land which has larger social ramifications". For Rao$$$ it restricts flow of investment in agriculture thereby choking its growth path.

According to Agricultural census, the leased-in area formed 0.43% to total operated area in Bihar in 1981. However, it continued to be grossly underestimated, as it does not capture informal or oral tenancy. The NSS data estimated leased-in area at 10.72% in 1981-82 as against 14.50% in 1970-71 for the State, thus showing a declining trend in leased-in area. This is also not acceptable to the academicians and policy makers alike when seen in the context of ground level realities. According to one estimate by the A.N. Sinha Institute, Patna the percentage of households

$ Opp cited.
$$ Rao, Hanumantha as quoted in Iyer, opp. cited.
leasing-in land was as high as 59.04% in 1981-82. Hanumantha Rao, based on his perceptive understanding, puts the incidence of concealed tenancy at 50.0 to 60.0% in Bihar.

vi) Forms of tenancy

XII.12 Study by Iyer reveals that only one-third of the tenants were pure tenants, while two-thirds were owner-cum-tenants. Pure tenants were overwhelmingly drawn from scheduled caste or OBCs whereas owner-cum-tenants had a larger proportion of OBCs and upper castes. Leasing-out of land was largely caste based, especially when it was a case of larger lease of land. Only fragmented and small piece of land would be given to SCs and OBCs on lease, mainly to circumvent the provision of the tenancy law. It was all oral tenancy only to escape the dragnet of tenancy law. The dominant form of tenancy was share cropping (97%) with fixed kind produce whereas the fixed cash system was almost absent in the state.

XII.13 The share of cropping arrangements were found to be exploitative. While the tenancy act provides for payment to the land owner only 25.0% of the gross produce, in actuality the sharing is 50:50. With the spread of modern technology, however, there was noticeable change in the system with sharing in the cost of such inputs by both the parties. The extent of sharing in the cost of inputs varied in the State from crop to crop across different regions. However, it was yet to become all pervasive, as around one-fifth (21.62%) of such share croppers were not found to share in the input costs with owner cultivators. The analysis of the cost of production and net returns, argues Iyer, suggests an unequal relationship between the share cropper and the land owner. After deduction of input cost, interest on loan and depreciation of bullocks and ploughs, the share cropper was left with a net return of 15.0% only. The return to the land owner after deducting cost of land revenue and input cost works out to 35.0%.

XII.14 More important, despite sharing in the input costs the use of input was observed to be much less in the case of share croppers than owner cultivators, resulting thus into lower productivity level in respect of the former. This was observed to be largely on account of insecurity attached to tenancy cultivation, as also inaccessibility of such farms to institutional credit. Indifference of the land owner to farm income was also one such reasons, as most of them were absentee landlords and had some alternate sources of income. Land owners were observed to lease-out land, largely because they generally belonged to upper strata of the society for whom social stigma was attached to manual labour. Most of them have sources

* opp. cited
$ opp. cited

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of income, mainly in the tertiary and/or service sectors as well. They were happy to get whatever comes to them as rent. Scattered land holdings were also partly responsible for these land owners to lease-out land. Prasad$, based on sample survey, made an important observation that "most of the large farmers have residence outside the village of the farm, belonging essentially to upper caste group. Most of them lease out the land to local villagers on share cropping basis. They come only to collect rent in the harvest period."

vii) Absentee cultivation

XII.15 Dominant form of tenancy (97.0%) in Bihar was share cropping. With 60.0% of the operational area being leased-in, as estimated by the A.N. Sinha Institute as also Rao* the aggregate cultivated area under lease could be put at 66.42 lakh hectares out of 110.70 lakh hectares in the state. Admitting that with the introduction of modernisation, new inputs, new crops and new irrigation devices fresh cost-sharing arrangements have emerged in the state. Iyer* observed, "big landlords do not lease-out irrigated land to the share croppers, because of the fear of losing class one land at the hands of the share croppers who have become aware of the tenancy act". Despite this, considering a liberal assumption that 20.0% of the leased-in land are irrigated, the unirrigated portion of leased-in land available in the land lease market could be estimated at 53.14 lakh hectares in the state.

XII.16 The problem gets compounded if the menace of absentee cultivation is also analysed. It defines to include such share croppers who cultivate land on lease from such landlords who do not reside in the village and were either working in the tertiary/service sector or are landlords residing in other villages. Absentee cultivation was considered to be the worst kind of share cropping, as it discourages all types of entrepreneurial and innovative approach to farming. They also discourage all types of investment on the farm and accept whatever rent they get under share cropping arrangements. Extent of absentee cultivation in Bihar is widely disputed. While for Prasad** it forms nearly 35.0% of share cropping, for Iyer it constitutes nearly 25.0%. Even if we consider the conservative estimate i.e. 25%, the extent of absentee cultivation could be put at 16.60 lakh hectares which forms 15.0% of the total area under operational holding in the state.

XII.17 The tenants cultivating these lands may not be generating enough surplus to facilitate them acquire new farm assets. Moreover, such farmers

$$ Opp. cited.
* Opp. cited.
** Opp. cited.
have no accessibility to institutional credit support due to the prevailing security norms and rigidities of the bankers. They fall out of the gamut of bank loan for acquisition of land based farm assets. This means, nearly one-half of the area under operational holdings do not have the accessibility of credit for creation of farm assets. Under the circumstances it may not be expected to cut much ice on this front in the short run until and unless the tenancy act is put to implementation in toto, as in the case of West Bengal and tenant cultivators are provided the security of cultivation. There would also be a need for amending security norms for bank loan to suit the new condition. Alternatively, in the absence of tenancy reform one can think of changing the security norms to cover such farmers as well under the gamut of bank credit for acquisition of productive assets, including irrigation equipments.

Conclusions

XII.18 Analysis of operational holdings and tenancy status in the State thus suggests the following broad conclusions:

i) Number of operational holdings was fast increasing in the State, thereby rendering the operational holdings of a large number of marginal farmers as non-viable.

ii) The area under operational holdings showed declining trend largely because of declining net sown area on the one hand and increasing current fallow/barren land on the other.

iii) Across different districts, the number of operational holdings was much larger in the north-west and the east plains. Districts where the land consolidation was implemented even partially showed lower increase in the number of operational holdings.

iv) Over and above the land ceiling the state had a large estimated surplus land of around 731.0 thousand hectares.

v) The high fragmentation of land holdings, often 15-20 parcels, posed a bigger problem for the state in dissemination of technology and called for urgent land consolidation.

vi) Land lease market was all pervasive in the State, forming nearly 50-60% of the total operational holdings.

vii) The dominant form of lease was oral tenancy (97%), mostly with crop sharing arrangement.

viii) Menace of absentee cultivation was still more sharp, forming around 15.0% of the operational holdings. This chunk of land remained out of the gamut of farm investment as a result of indifferent attitude of the land owner and inability of the lessee to raise funds for investments.
BIBLIOGRAPHY


Laxminarayan, H. and S.S.Tyagi (1982), 'Changes in Agrarian Structure in India,' AERC, University of Delhi, New Delhi.


Reserve Bank of India (1984), 'Report of the Committee on Agricultural Productivity in Eastern India' (Chairman Dr.S.R.Sen).


