FOODGRAINS ECONOMY OF INDIA - A STUDY ON INSTABILITY AND GROWTH : 1970 - 1987

By

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Thesis submitted to Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University)
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(Erstwhile Sri Avinashilingam Home Science College,
Affliated to Bharathiar University)

In partial fulfilment of the requirements for the Degree of Master of arts.

MAY 1989.

ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

The author wishes to express her sincere gratidude and thanks to **Mrs. C. Jaya M.A., M.Phil.(Madurai),** Senior Lecturer, Department of Economics, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University) Coimbatore for the constant guidance, help and encouragement given throughout the period of the study.

The author records her profound thanks to **Dr. (Miss) Saraswathi Bhatji M.A., Ph.D (Madras)** Dean, Faculty of Humanities, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University) Coimbatore, for the help and permission extended to undertake this investigation.

She extends her sincere thanks to **Dr. Rajammal P. Devadas M.A., M.Sc., Ph.D (Ohiostate) D.Sc.(Madras),** Vice-Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women (Deemed University) Coimbatore, for the facilities provided to carry out this research work.

She is grateful to **Dr. N. Krishnamoorthy B.E., M.Sc., P.hd.,** Head, Computer Centre, Governement College of Engineering, Salem for his guidance in the statistical analysis of this work.

She records her thanks to **Sree Andal Computer Services, Coimbatore** for the computerised preparation of the dissertation.

She owes her gratitude to her family members without whose understanding this work would not have been a possibility.

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INTRODUCTION

I. INTRODUCTION

For the past four decades India has been the object and source of alternating attitudes towards economic development. Most notabily the second five year plan developed by Mahalahobis helped to turn alteration away from growth strategies that emphasised labour mobilisation and small scale production. A decade after a renewed search began for means of integrating increased employment and broadened distribution of income. Agriculture performs two key related functions in the new employment oriented strategy of growth. First, because foodgrains make up the bulk of marginal expenditures among the poorer classes, agriculture provides the physical goods to support increased employment and higher wage earnings. In other words, agricultural sector is a crucial source of wage goods, the goods purchased with wages. And it provides much of the increase in employment directly through raising agricultural production indirectly through the stimulas of increased income to the cultivator class and the demand effects of the consequent expenditure. Hence, an accelerated growth of agriculture may be an important condition for a high employment policy. But a high employment policy is an important condition for continued rapid growth rates in the agricultural sector (Mellor, 1976)

Economic regeneration attempted in the successive five year plans has made agriculture a pride of national economy. This sector today provides livelyhood to about 60 percent of the labour force and contributes nearly 37 percent of net national product accounts for a sizable share of total value of exports and provides a major portion of raw materials and market for the industrial sector. The percapita net availability of foodgrains went up to a level of 463 grams per day as compaied to that of 395 grams. In terms of fertilizer consumption India ranks fourth in the world after USA, USSR and China. The growth rate in agricultural production during 1950-1985 was 2.63 percent per annum and during the post green revolution period the growth rate assessed was 2.66 percent. These facts indicate that the agricultural sector and the food grains sector have recorded an impressive growth in terms of production.

Foodgrains domicate the agricultural economy of the state much in the sameway as agriculture dominates the overall economy. As the most essential wage good the availability price of foodgrains determines the level of living and pace of development of the economy. A lagging food grain sector pushes up the price of wage goods which in turn raises the cost of living and price of labour and result in higher costs in the economy. Thus there is a cascading effect when there is a set back to foodgrain prodution. Foodgrains production is specially important for the small

holders as they devote a great proportion of their area to cultivation of foodgrains than medium and large farmers. The proporton of acrages of small holders to total area of operational holdings in the state has increased from 37.6 percent in 1970-71 to 47.1 percent in 1980-81(poduval 1986).

Discussion among economists, administrators, and knowledegable persons have focussed on the theme that agricultural growth in India is either stagnating or decelarating. According to Cohen (1968) most industries subject to short period distrubance but agriculture, perhaps more than most. The farmer cannot to a large extent control the output that the produces and the yields of crops vary from year to year according to weather. The fluctuations in yield since they are unexpected cannot be counter balanced by varying acrages. The annual variations in crop yields occur in cycles of greater or lesser regularity. Thus cycles are unplanned in the sense that they result from circumstances beyond the control of the farmer (Cohen). Hence one of the popular topics for research in India's agriculture is the growth and instability in crop production. According to poduval, instability in agricultural production in general and foodgrains production in particular springs from fwo factors.

1. Weather induced fluctuations and
2. Fluctuations associated with the new technology. The

marked fluctuations in output arising from these factors are not conducive to sustained growth .

It is in this context the study focuses on the assessment and measurement of instability of foodgrains production and analysis the impact of new technology on the output fluctuations. The weather induced factors are not considered for the analysis as they are beyond the control of the farmer. The assessment of instability will help the planners to estimate the supply projection which forms an essential basis for planning long term polices and strategies for meeting the future foodgrains need of the people. It will also indicate the directions in which further efforts should be made to augument the supply of foodgrains and to expand or modernise the existing production system. So far as the demand is concerned it depends on relative prices growth in income and Population level etc. The National commission on Agriculture (1976) did extensive exercise and arrived at a total demand for foodgrains in 2000 AD as 225 million tonnes . Hence the supply side analysis becomes very crucial in view of the growing demand for foodgrains. An examination of instability of foodgrains is of importance for understanding the nature of food security at the national level (Narain pandey and sarup, 1985).

In the opinion of kurien (1973) "It is the task of research in India, today to gather intelligently ordered facts about the Indian economy from all its nooks and corners especially from the most unorganised areas. It is in this area that new research works can make their most effective contribution".

The following are the objectives of the study:

1. To estimate the growth and analyse the trend in production, area under cultivation fertilizer consumption and use of high yielding variety seeds.
2. To analyse the performance of foodgrains sector - cropwise and state wise.
3. To assess the extent of variability in foodgrains production, yield and statewise production.
4. To examine the extent and nature of instability in foodgrains production.
5. To analyse the impact of seed fertilizer technology on foodgrains output and.
6. To find out the causal relationship between the output and factor inputs in terms of area, fertilizer and high yielding variety seed consumption.

The hypotheses tested in the study were

1. The area effect on production was not significant.
2. The seed fertilizer technology (biological technology) has no relation with the foodgrains output.

REVIEW OF LITERATURE

II REVIEW OF LITERATURE

The Literature pertaining to the study on the "Foodgrains Economy of India - Instability and Growth; 1970-1987" is reviewed under the following heads:

1. The role of agriculture in India's economic development;
2. Agriculture and Five Year Plan;
3. Related Studies.
   i. Studies on growth
   ii. Studies on Instability and
   iii. Studies on Foodgrains economy of States.

ROLE OF AGRICULTURE AND ECONOMIC DEVELOPMENT

IMPORTANCE OF AGRICULTURE IN THE ECONOMIC DEVELOPMENT OF INDIA:

In India agriculture is the largest sector pf economic activity. It provides not only food and raw materials but also employment to a very large proportion of the population. Being the domiant sector the improvement or changes in the national output depend on the output in Agriculture. It has to provide the capital required for its own development and make available surpluses for national economic development. In the early stages of economic development, the exports of primary produce earn valuable foreign exchange which can be used to import capital goods for the development of industry

and infrastructure.

The development of agriculture seems to hold the key to the progress of the economy as a whole and should receive due emphasis, the inter-dependence between agriculture and non-agricultural sectors also needs to be recognised. In fact the interaction between agricultural and non-agricultural sector facilities the growth of both. In essence, agriculture has a crucial role to play in the country's economic development.

PLACE OF AGRICULTURE IN THE INDIAN ECONOMY

Agriculture has a dominant role in the Indian economy contributing nearly 36.86 percent of the national income, providing employment to about 70 percent of the working population and accounting for a sizeable share of the country's Foreign exchange earnings. Agriculture provides the foodgrain to feed the large population, 76.1 crores of this country. It is also the supplier of raw mateial to many industries. Thus, the very economic structure of India rests upon agriculture.

The contribution of agricultural sector to national income, foreign exchange and employment can be treated as a measure of its importance in the overall economy of the country. The present position of agriculture in the Indian economy can be explained under the following heads.

CONTRIBUTION TO NATIONAL INCOME:

Agriculture includes animal husbandry, fisheries and forests. The importance of agriculture can be seen from its contribution to the growth of national output. The share of agriculture in national income was placed at 49 percent in 1948-49. The contribution of agriculture has declined in the last fifteen years due to rapid increase in the production of industrial goods and services. The agricultural sector continues to pre-dominate and contributes a large share of the national output. Its contribution to national income was about 36.86 percent in 1984-85.

Agriculture and related sectors are expected to contribute 33 percent of Gross domestic product in 1989-90 and 25.5 percent in 1999-2000. The share of agriculture and related sectors to Gross domestic product is reducing due to the fast pace of industrialisation and infrastructure facilities and services.

The details of contribution of Agriculture to national income is presented in table 2.1.

TABLE 2.1

CONTRIBUTION OF AGRICULTURE TO NATIONAL INCOME

1950 - 51 -- 1989 - 2000

Year	Percentage contribution of agriculture, Forestry, and Fishing to net domestic product
1950 - 51	56.1
1960 - 61	51.2
1970 - 71	50.6
1980 - 81	42.00
1984 - 85	36.86
1989 - 90	32.68
1999 - 2000	25.50

Source : Computed from the data on contribution of Agriculture to national income - From Economic survey

The above analysis reveals that, the increase in the size of the national output is still substantially dependent upon the performance of the agricultural sector has been the major contributor to net domestic product, but its growth rate over the years has been very low. The growth rate of Agriculture has improved, during the sixth plan it was about 4.3 percent in 1984-85.

CONTRIBUTION TO EMPLOYMENT

Agriculture directly or indirectly has continued to be the main source of livelihood for the majority of the population. In India the census indicate that 70 percent of the population is supported by the agriculture. Majority of workers have been engaged in cultivation. Dependence of the working population on the other fields of agriculture like forest, fisheriel etc. is small.

The distribution of Agricultural labour force to total work force is given table 2.2.

TABLE 2.2

DISTRIBUTION OF AGRICULTURAL LABOUR FORCE AS PERCENTAGE OF TOTAL WORK FORCE (1950-51 1984-85)

YEAR	CULTIVATORS	AGRICULTURAL LABOURERS	LIVESTOCK FORESTRY, FISHING, PLANTATION etc.	TOTAL AGRICULTURAL WORK FORCE	NON-AGRICULTUFAL WORK FORCE
1951	50.00	19.7	2.4	72.1	27.9
1961	52.8	16.7	2.3	71.8	28.2
1971	43.4	26.3	2.4	72.1	27.9
1981	43.9	24.8	2.9	71.6	28.4
1984-85	43.0	24.0	3.5	70.5	29.5

SOURCE: Computed from the data on Distribution of agricultural labour force to total work force - Report of the National Commission on Agriculture.

The table reveals that

a) The dependence of workers on agriculture has not significantly changed.

b) The rate and pattern of investment in other economic sectors have not been such as to draw away surplus rural labour and relieve the pressure of population of land.

c) Since the growth of agricultural sector was slow; it failed to create enough opportunities for additional employment.

d) It has resulted in widespread under employment and a rising backlog of unemployed.

CONTRIBUTION TO FOREIGN EXCHNAGE RESOURCES

Agricultural products, primary produce and manufacturers based thereon occupy an important place in the country's export trade.

The table 2.3 shows the share of Agricultural Exports to total exports.

The table reveals that share of agriculture in the total exports was 41 percent in 1950-51. It reduced to 36.8 percent in 1970-71 and to 34 percent in 1980-81. It is estimated to 32 percent in 1984-85 and it is expected to fall down to the level of 28 percent in 1989-90. It is because of the increasing domestic demand or inadequate output growth.

TABLE 2.3

SHARE OF AGRICULTURAL EXPORTS TO TOTAL EXPORTS 1950-51 TO 1989-90

YEAR	PERCENTAGE SHARE OF AGRICULTURAL EXPORTS TO TOTAL EXPORTS
1950-51	41.00
1970-71	36.80
1980-81	34.00
1984-85	32.00
1989-90	28.00

SOURCE: Computed from the data on share of agricultural exports to total exports - Seventh plan projection.

INTER-DEPENDENCE BETWEEN AGRICULTURAL AND INDUSTRY SECTORS:

There is a close interdependence between agricultural and industry. This relates to the supply of raw materials and inputs from agriculture to industry and the supply of basic consumption goods to the agricultural population and the supply of materials for the building up of economic and social overheads in the agricultural sector. The interdependence between agricultural and industry is becoming stronger as the economy is developing. The application of science and technology in agricultural sector induces innovations in respect of industrial products which are used for agricultural production. This results in supply of equipment like farm machinery from industry which facilitates modernisation of agricultural technology out of the total agricultural production. 23 percent is utilitsed by industries. Thus agricultural sector has to depend for its inputs on industry. The demand from agricultural population for various types consumer goods originating from the industrial sector increases with rise in income. This analysis indicates the interdependence between agricultural and industry.

AGRICULTURE AND FIVE YEAR PLANS:

In spite of the fact that 70 percent of our working

population was engaged in cultivation, the country had come to depend very heavily on imports of foodgrains to satisfy the minimum requirements of the people. India got as its share 82 percent of the original population but only 69 percent of land under rice, 65 percent under wheat-that is more people but less land to support them.

OBJECTIVES OF PLANNING FOR THE AGRICULTURAL SECTOR.

a) **Increase agricultural production**

The aim is to bring more land under cultivation raise the per hectare yield through intensive application of such agricultural inputs like irrigation, seeds, fertilisers etc. and thus bring about increased agricultural production.

b) **Increase Employment opportunities:**

The agricultural sector should generate additional employment opportunities and provide scope for increasing the incomes of the poorer sections in our villages.

c) **Reduce the pressure of population on land:**

Agricultural sector should reduce the number of people working on land. The surplus labour on land should be shifted to secondary and tertiary sectors, preferably in rural and semi-urban areas.

d) **Reduce inequality of incomes in rural areas:**

The Government should remove the exploitation of tenants, and should distribute surplus land among small and

marginal farmers in such a way that there would be some degree of equality and justice in rural areas.

AGRICULTURAL PROGRESS UNDER FIVE YEAR PLANS:

The table 2.4 shows the targets and achievements of agricultural production during plan period.

AGRICULTURE IN THE FIRST PLAN:

The planning commission accorded the highest priority to agiculture, as the country was faced with a serious food crisis and acute shortage of essential raw materials. Out of a total actual investment of Rs 1960 crores made in the first plan, Rs 601 crores i.e. 31 percent was alloted to agriculture, Rs. 291 crores for agriculture and community development and the balance of Rs 310 crores for irrigation. As a result of the success in these directions and also because of favourable weather conditions, the production targets fixed by the planning commission were more than fulfilled in certain areas.

TABLE 2.4
TARGETS AND ACHIEVMENTS OF AGRIUCLTURAL PRODUCTION (1950-51 ----- 1989-90)

CROPS	FIRST PLAN 1950-51 - 55-56		SECOND PLAN 1956 - 1961		THIRD PLAN 1961 - 1966		FOURTH PLAN 1969 - 1974		FIFTH PLAN 1974 - 1979		SIXTH PLAN 1979 - 1984		SEVENTH PLAN 1984 - 1989	
	TARGET	ACTUAL PRODUCTION	TARGET	ACTUAL PRODU-CTION	TARGET	ACTUAL PRODU-CTION	TARGET	ACTUAL PRODU-CTION	TARGET	ACTUAL PRODUC-TION	TARGET	ACTUAL PRODUC-TION	TARGET	ACTUAL PRODUCTION
1. FOODGRAINS IN MILLION TONNES	61.6	65.8	80.5	79.7	100.0	72.3	129.0	104.0	125.0	126.0	154.0	152.0	150.0	178-183
2. OILSEEDS IN MILLION TONNES	5.5	5.6	7.6	6.5	9.8	6.4	10.5	8.7	12.0	8.9	11.1	13.1	13.0	18.0
3. SUGARCANE IN MILLION TONNES	6.3	6.0	7.8	10.4	10.0	12.7	15.0	14.0	16.5	16.5	215.0	190.0	180.0	217.0
4. COTTON IN MILLION BALES	4.2	4.0	6.5	5.4	7.0	4.6	8.0	5.8	8.0	7.1	9.2	8.4	7.5	9.5
5. JUTE IN MILLION	5.4	4.2	5.5	4.0	6.2	4.5	7.4	6.2	7.7	7.1	9.1	8.4	7.5	9.5

SOURCE: Computed from the data on Targets and Achievements of Agricultural Production - Economic survey various issues.

The year 1955-56 was not a good year. Foodgrains registered a record production of 69 million tonnes in 1953-54 oilseeds output was maximum at 6.2 million tonnes in 1954-55. The effect of increase in agricultural production was quite favourable. This is evidenced by the fact that the import of foodgrains declined from 4.7 million tonnes in 1951 to 0.7 million tonnes in 1955. The prices index of agricultural commodities came down to 92.8. The increase in agricultural production brought during the plan helped to end inflation and stablise the economy.

AGRICULTURE IN THE SECOND PLAN:

The planning commission wanted the second plan to lay the foundations of industrialization and secure equal opportunities for all. Out of total actual expenditure of Rs 4600 crores during the plan, a sum of Rs 950 crores was spent on agriculture. This accounted for about 20 percent of total outlay. This was due to the shift in favour of heavy and basic industries within the agricultural sector, Rs 530 crores were devoted to agriculture to community development and Rs 420 crores to major and minor irrigation. For instance, against the target of 21 million acres of additional land to be brought under irrigation the actual

investment was about 16 million acres only. There was a shortfall in the production of all groups of commodities except sugarcane in which there are remarkable progress.

AGRICULTURE IN THE THIRD PLAN:

The achievement of self-sufficiency in foodgrains and increased agricultural production to meet the requirements of industry and trade were clearly stated as one of the five basic objectives of the third plan. As against a proposed investment of Rs 1310 crores in the public sector on agriculture, actual expenditure worked out to be Rs 1745 crores. In relative terms, the actual expenditure on agriculture was 20 percent of the total plan expenditure. The third plan expected an increase of 30 percent in agricultural production with the target increase of 30 percent in foodgrains base of 10 percent increase had been realised in the first four years. As a consequence of the shortfall in food production, foodgrains worth Rs 1,100 crores were imported between 1961-62 and 1965-66. This strained the Foreign exchange position still further.

AGRICULTURE UNDER THE ANNUAL PLANS:

Since the fourth plan could not be introduced in April 1966, the Government introduced the Annual plans for three years (1966 to 1969). The actual total outlay was 6,757 crores, and 1,167 crores for agriculture and community

development and balance Rs 457 crores for irrigation. A good year of rainfall coupled with efforts to improve production with a new technology resulted in record foodgrains production of 95.6 million tonnes in 1967-68. The target for 1968-69 was 102 million tonnes. It was not possible to reach the target in view of crop failure production of foodgrains was maintained at the level of 95.6 million tonnes in 1968-69.

AGRICULTURE UNDER THE FOURTH PLAN

The approach of the fourth plan emphasised the necessity to create favourable economic conditions for the promotion of agriculture, a systematic effort to extend the application of science and technology in agriculture. The plan envisaged an expenditure of Rs 3814 crores on agriculture which was 24 percent of the total expenditure of Rs 15,902 crores. but the actual outlay was only 21 percent.

The target for Foodgrains was 129 million tonnes for 1973-74 but the actual production in that year was only 104 millions tonnes. As against the target of 81 million bales of cotton the actual was 5.8 million bales. In jute the target was 7.4 million bales, but actual production was only of 6.2 million bales in 1973-74. The overall rate of growth of agricultural production during the plan was only 2.8 percent per annum as against the targeted 5 percent. The

unsatisfactory performance of the agricultural sector was the root cause of the stagnation of economy and emergence of inflationary pressures since 1972-73.

AGRICULTURE UNDER THE FIFTH PLAN:

The revised fifth plan provided Rs 8,080 crores for agricultural development and irrigation. Agricultural production during 1974-78 has been fluctuating. Production of foodgrains reached a level of 121 million tonnes in 1975-76, but slumped to 112 million tonnes during 1976-77 a bad weather year. The production of oilseeds which touched nearly 10 million 1975-76 declined steeply to 7-8 million tonnes in 1976-77. But in cotton and jute, the yearly variations were considerable. Lack of stability in agricultural production was due to non-availability to assured irrigation. The poor performance of agrilculture during the fifth plan period (1974-78) was due to poor and unreliable weather conditions and partly due to planning failure.

AGRICULTURE IN THE SIXTH PLAN:

In obsolute term the average annual expenditure on agricultural and irrigation was 4940 crores. The sixth plan aimed at bringing additional 13.6 million hectares under irrigation out of which 8 million hectares were to be covered with the help of minor and 5.6 million hectares through major

and medium irrigation. The consumption of fertilizers was to be stepped up from 5.3 million tonnes to 9.7 million tonnes an increase of 83 percent. Foodgrains output was expected to increase at the average annual rate of 3.9 percent. The record foodgrains production of 152 million tonnes in 1983-84 and the output of 146 million tonnes in 1884-85, the last year of the sixth plan has regarded as signal achievement for India. Apart from foodgrains, production targets in other major crops were also achieved.

AGRICULTURE UNDER THE SEVENTH PLAN:

The public sector outlay of Rs.1,80,000 crores during the seventh plan works out to be 22 percent of this total plan outlay. The seventh plan has fixed annual growth rate of 4 percent for the agricultural sector and 3.7 percent per annuum for foodgrains output. The net sown area help to increase the area under short duration high yielding varieties, facilitate multiple cropping and raise cropping intensity from 1.26 in 1984-85 to 1.33 in 1989-90. Thus gross cropped area is expected to go up from 180 million hectares in 1984-85 to 190 million hectares in 1989-90 which implies an annual growth in fertilizer consumption from 8.4 million tonnes in 1984-85 to 13.5-14.0 million tonnes in 1989-90.

RELATED STUDIES

I: STUDIES ON GROWTH OF AGRICULTURAL PRODUCTION

1. TRENDS, VARIABILITY IN AREA, PRODUCTION OF COARSE GRAINS AND PULSES IN HARYANA

The growth in Agricultural production is the result of the growth in Area and productivity of crops. The Haryana state has experienced green revolution mostly in wheat and rice. The area under the crops has increased from 935 thousand hectares in 1966-67 to 1952 thousand hectares in 1980-81. The production of these crops has increased from 1982 thousand tonnes in 1966-67 to 4720 thousand tonnes in 1980-81. Singh and Gangwar (1986) conducted a study on trends and variability in area production and productivity of coarse grains and pulses in the Haryanna.

1) The study shows that the increase in yield, area and prices was due to interaction between prices area and yield.

2) The study indicated under the study period namely 1966-67 to 1980-81 in Haryana state the selected coarse grains and pulses showed a declining trend (jowar, Bajra, Maize and Barley).

3) The coefficient of variation in Area production productivity were estimated to be 22.83, 29.41 and 27.47 for jowar, 4.85, 36.65, 35.49 percent for Bajra, 17.78, 29.24, 16.65 for Maize.

2. THE TRENDS IN AGRICULTURAL PRODUCTION, PRODUCTIVITY IN INDIA 1966-67 - 1981-82.

An attempt was made by sirohi, vasisht and chhotan singh

for analysing the trends in agricultural production and productivity in India between the period 1967-68 to 1981-82. From the analysis it was concluded that:

1) The production of rice, wheat, jowar and cotton showed the significant rise in trend during the peirod 1970-71 to 1981-82. The increase in the production of remaining crops was insignificant.The linear trends for the two periods namely 1970-71 to 1975-76 and 1976-77 to 1981-82 were significant only in the case of wheat and cotton.

2) The trend of production of maize which was near zero during the period upto 1975-76, became positive inthe latter period.

3) The study concluded that the productivity of foodgrains or the productivity of Agricultural commodities per hectare has been stagnant or declined during the recent period only.

3. DECLARATION OF INDIAN AGRICULTURE:

Sawanat (1983) made an investigation of hypothesis of declaration in Indian Agriculture. The analysis was restricted to the major foodgrains and non-foodgrains crops namely rice jowar, bajra, maize, wheat, groundnut, jute and sugarcane and covered inthe major producing states. Thestudy concluded that

1) The decelarating trend in growth of foodgrains production was set by the beginning of the sixties after an impressive performance of growth during the fifties which was mainly due to expansion in area.

2) Decelaration in the growth of foodgrain production was arrested with the onset of the green revolution in Indian Agriculture but reversal of the process of declaration could not be sustained without interruption beyond 1970-71.

3) In terms of overall performance during the entire post-green revolution period, Punjab, Harayana, Gujarat and Karnataka did relatively much better than the remaining states. Among them, however, the performance was consistently good and substantive only for Punjab and Andhra Pradesh.

4) The major contribution to relatively accelerated growth in foodgrains production came from wheat followed by rice - that too mainly from the non-traditional rice growing states and jowar.

5) In general, the growth rates in productivity of many foodgrian and non-foodgrain crops excluding wheat, jowar and cotton were either highest or almost the same in the pre-green revolution. The

situation improved after 1975-76 due to relatively increased growth rates of yield per hectare of rice, jowar, cotton in additon to coarse wheat, crops lagging behind were bajra, maize and jute.

4. AN ANALYSIS OF YIELD GAPS IN FOODGRAINS IN HARYANA

An analysis of attainable yield gaps in important foodgrain in Haryana was undertaken by Panghal, Pandey and Gangwar in the year 1985. For the purpose of the study secondary data concerning the area, production and average yields of important crops, percentage of area under irrigation from 1965-66 to 1980-1981 were collected from various issues of statistical abstracts besides that relevent primary data were also derived from 100 farmers for the same period. The study found that:

1) The average yield per hectare for various foodgrains ranged between 1282 and 2360 kg of wheat 444, and 1082kg of gram, 266 and 939kg of bajra, 1063 and 2680kg of rice and 341 and 721kg of rapeseed and mustard.
2) The average area under wheat, bajra and rice during the period 1976-81, increased by about 72,24 and 102 percent over 1965-70.
3) The coeffecient of variation in area overtime was 21,20,6,31,34.

4) The year to year variability in yield was found to the highest in bajra followed by gram and rice.

5) The variability in area allocated to bajra was low which may be due to increased demand for order and absence of any better alternative crop that would be grown successfully on the land under bajra.

5. GROWTH RATES AND CHANGINNG IN CROPPING PATTERN IN HIMACHALA PRADESH

Sikka and vaidya (1985) made an analysis on "Growth rates and changes in cropping pattern in Himachala Pradesh". The main purpose of the analysis was to examine the performance of agriculture in Himachala Pradesh and to see if there are any noticeable changes during the past one-half decade. The study concluded that

1) Among the foodgrain production of wheat and rice have shown an increase in trend at a growth rate of 2.79 and .66 percent per annum.

2) The aggregate production of cereals, pulses and foodgrain have all been showing the positive growth and the highest rate among these was that of pulses 13.33 percent. The same trend existed in case of area under these crops.

3) The study also concluded that there was positive growth rate in area, production and productivity in case of almost all crops.

4) Ecological and topical factors constituted main constrains for growth in yield and crop output in Himachala Pradesh.

6. CEREAL ECONOMY IN INDIAN AGRICULTURE

An analysis of Cereal Economy of Indian Agriculture, yield rates of rice and wheat was undertaken by chandha in year (1980). He concluded that, some states have been able to achieve very high growth rate inspite of their initial bone. Many other states have not been able to capture the potential advantage of to start from relatively low yield levels. There were many states which experienced extremely low or negligible growth rate for a number of years.

The study also concluded that the increases in yield of rice and wheat have been shared unevenly by different states. The rice yield rate in Assam remained unchanged in contrast to their increasing in yield rate of wheat. There have been more impressive and sustained growth in case of both rice and wheat almost in all states. In the case of the rice producing states such as Bihar, Madhya Pradesh, Andhra Pradesh and wheat producing states which are Bihar and Andhra Pradesh there has been no tendency for inter-district disparities to narrow down.

7. STAGNATION OF PRODUCTION OF PULSES

Ranga Rao and Ray (1985) conducted a study on stagnation in production of pulses of quantitative analysis. They brought out certain conclusion which have policy implication. They are as follows

1) To increase the competitiveness of gram and other pulses with that of wheat and paddy. It would be necessary to develop such new varities of gram and pulses which are not only high yielding but also stable and resistant to pests and diseases attack.

2) Production of pulses is subject to fluctuations from year to year as about 1.5 percent of the total area is irrigated with a view to reducing weather-induced output fluctuations and for facilitating adoption of yield raising improved technology. It is imperative that the irrigation base of pulses should be enlarged.

3) To enlarge irrigated area under pulses, efforts should be made to introduce short-duration pulses varieties in irrigating farming system without disturbing the major crops of the area.

4) Effectiveness of a price support policy very largely depends upon the effeciency of the market structure, lack of adequate economic

infrustructure including regulated markets and storage are major handicaps in the implementation of price policy for pulses.

8. FERTILIZER CONSUMPTION AND AGRICULTURAL PRODUCTION

In the year (1986) Mahajan made an analysis on the pattern of fertilizer consumption in India. The main objectives of the study are

1) To examine variations in rates of consumption of fertilizer in different crops.
2) To estimate the consumption of fertilizers in different crops in various states at all India level.
3) To determine propotion pf fertilizers consumption invarious crops.
4) To suggest more alternative policy implication is optimum allocation of fertilizers.

The study concluded that:

1) Immerse need for increasing the consumption of fertilizer increases where present rates of consumption per unit of area are low but potentials are high during kharif season. Rice is the major crop which accounts for the bulk of fertilizer consumption in that season and if we want to increase fertiliser use and also

productivity of rice priority in regard to allocation of fertiliser should be given to Bihar, Madhya Pradesh and Andhra Pradesh.

2) Bulk of fertilisers are used in foodgrain mostly in paddy and wheat. The rates of consumption of fertilisers in millets and pulses are very low. This might be the reason for slow growth of productivity of millets and pulses.

3) Extention efforts might be directed towards popularising use of fertilisers in these crops in order to increase their production and productivity.

4) In case of sugarcane, rates of consumption of ferilisers in Uttar Pradesh and Bihar was almost one-fifth of that in Maharashtra and Andhra Pradesh.

5) As marginal productivity of fertiliser is higher in area where existing rates of consumption are relatively low, the increased use of fertilisers in those areas would increase overall fertilisers response ratio in the country and helping in reducing disparity in agricultural productivity in different states.

9. A MODEL FOR FOODGRAINS PRODUCTION

Chansarkar has developed a "model for foodgrains production" (1982) using multiple regression in order to analyse the factor affecting the production of foodgrains in India. It was concerned in the model the total production of foodgrain depends on actual plan outlay gross area under foodgrains, fertiliser available, weather condition, net imports and prices.

The multiplicative model fitted to the foodgrains production in India gives the following results

Y = foodgrains production

a = Public sector Actual outlay

b = Availability of total fertilisers

c = Gross area irrigated under foodgrains

d = Gross area unirrigated under foodgrains

e = Net imports of foodgrains

f = Wholesale price index of foodgrains

g = Weather conditions

(i.e)

$$\text{Log } y = 3.025 - \underset{(0.055)}{0.0831}\log a - \underset{(0.035)}{0.008}\log b + \underset{(0.326)}{1.017}\log c + \underset{(0.281)}{1.8501}\log d - \underset{(0.013)}{0.0321}\log e + \underset{(0.076)}{0.044}\log f - \underset{(0.008)}{0.011}g$$

Figures in bracket indicates standard error.

II STUDIES ON INSTABILITY IN AGRICULTURE:

10. CHANGES IN INSTABILITY IN CROP PRODUCTION

In order to examine whether the pattern of growth and instability in crop reduction has recorded only significant change and to test some of the hypothesis relating to it an attempt was made by Ray (1983) in this work on growth rates. He has concluded that

1) Instability in production turned out to be relatively low during 1950's for each of the successive decades followed instability generaly showed a tendency of increase.
2) Instability in production has measured by standard deviation for the year to year changes. In production index it was lower during 1950 for all the crops and crop aggregates except tabacco.
3) Again the author reported that the crop production in India was more sensitive to rainfall, the distribution pattern of rainfall, price ratio's and the impact of the modern inputs.

11. INTER STATE ANALYSIS OF GROWTH AND INSTABILITY:

Mahendradev made an inter-state analysis of growth and instability in food grains production in (1987). This attempt aimed at examing inter-state analysis of foodgrain production taking into account fluctuations weather - adjusted growth rates, the relationship between growth and

instability is of importance, for understanding the nature of food security at the regional level. He reviews trend in instability using a moving period approach and analyses the factors influencing inter-state disparities in growth and instability and the consequenses of these differences on rural poverty. It aimed at

a) Unadjusted and wealth adjusted growth rates

b) Trends in instability

c) Relationship between growth and instability

The growth rates in foodgrains were estimated by using the following log linear functions

$O_t = b_0 + b_1 t$

$O_t = c_0 + c_1 t + c_2 w_t$;

O_t = production t = time

w_t = production rainfall. The coeffecient b_1 gives the weather adjusted trend growth rate, c_2 provides the elasticity of production with respect to rainfall. It indicates that variations in rainfall alone can help to explain in a substantial measure to the variations in foodgrains production in these states. The study concluded that

(1) First we begin with the conclusion of the analysis on growth in foodgrain production for the period 1970-71 to 1984-85. Weather adjusted growth rates were higher insome states and lower in some other

states and the adjusted growth rates. Gujarat registered high growth rate of more than 3 percent per annum . If we take into account the changes in rainfall the growth rate drops to around 2 percent.

(2) The range of instability for the entire period 1960-61 to 1984-85 varied from 7.2 percent in Kerala as high as 32.2 percent in Gujarat. Low rainfall low irrigated states registered relatively higher magnitude of instability than other states.

(3) Trends in instability for crop aggregates show that instability for rice declined in some states and increased in some other states. It declined in most of the states for wheat.

(4) The relationship between growth and instability revealed that there is no basis to believe the hypothesis of high growth causing high instability . The cross-section regressions on the relationship between unadjusted growth rate and levels of instability for three sub-periods donot show any significant associations between trends in instability and unadjusted growth rates for the period 1960-61 to 1984-85 showed a significant negative relationship between growth

and instability in foodgrains production.

(5) It was shown that differences in quantity and quality of irrigation might be the major sector that influenced inter-state variations in growth and instability in foodgrain production.

12. NEW AGRICULRAL STRATEGY IN TAMIL NADU PERFORMANCE STUDY

Benjamin (1986) in his title "New agricultural strategy in Tamil Nadu performance and challenges" discussed the various issues relating to the question whether foodgrain production has increased at a faster rate during the period of new agricultural strategy and also to examine the sources of growth productivity area and to test which factor has contributed to increase the production. It was brought to light in the study that

1) The rate of increase in rice production during the period of new agricultural strategy stands at 4.9 percent which is higher than the past trends.
2) Between food and nonfood crops it is seen that the change in the area has little in favour of food crops. There was only litle evidence to show that increase in foodgrain production was due to changes in cropping pattern in favour of food crops.

III STUDIES ON INNTER-STATE VARIATIONS IN AGRICULTURAL DEVELOPMENT :

13. A CASE STUDY OF INTER-REGIONAL INSTABILITY

Monhanty (1985) conducted a case study in Punjab on the inter-regional price instability in agriculture. The study mainly aimed at examing the instability with respect to prices and weather it has been reduced with passage of time.

From the study it was concluded that

1) Price instabilities of paddy and wheat declined during 1956 and 80 though it could not be statiscally confirmed.
2) Price variation in case of rapeseed and mustard increased but at a decreasing rate which was statistically significant.
3) The index of instability was incresasing for gram under the period of study.
4) Besides the study also examined the explanatory variables in influencing the instability in price namely like minimum support prices, relative production and weather conditions.

14. FERTILIZER CONSUMPTION AND CROPPING INTENSITY:

Ray and Sharma (1985) made a district wise approach to the contribution of fertiliser and cropping intensity to different agricultural growth in Inda. The main objectives

of the study was to find out the various reasons for differential performance of various regions and farms of India with respect to agriculture.

The study conclude that

1) Irrigation chemical fertilisers in combination with other modern inputs played a key role in increasing the cropping intensity.
2) Districts of high growth regions have about 70 percent, area under irrigation districts of low and negative growth regions have even lessthan 10 percent area under irrigation.
3) In respect of fertiliser use the variation ranges from 2.8 kilo per hectare in low growth regions to 44 kilograms per hectare in high growth regions.
4) The change in value, productivity of output per unit area due to the combined effect of fertiliser and cropping intensity was considerably high in high growth regions followed by medium growth regions.

15. STATE WISE VARIATION IN GROWTH OF FOODGRAINS PRODUCTION

An attempt was made by Bhatia (1981) to study state-wise variations in growth of foodgrains production in India. It aimed at

a) Studying the rate of growth of production and productivity of major foodgrains in India intwo periods of time namely 1960-61 to 1978-79 and 1967-68 to 1978-79.

b) The growth rate of production and productivity of major crops in different states.

c) To associate factors which determine the rate and pattern of growth of foodgrain production and productivity.

The study concluded that :

1) Growth rate of foodgrains production during the period imder the study was about 2.56 percent and 2.77 per annum which clearly indicated the modern technology of high yielding varieties and their effect on accelerating rate of growth.

2) The growth rate of production and productivity of rice and wheat were quiet higher as compared to other foodgrain crops.

3) Higher use of fertilisers and high yielding variety seeds,need to be existensively used in backward areas of Assam, Orissa, Madhya Prasdesh for balanced development of agriculture in different states.

4) Intensive research efforts will have to be made for accelerating the growth of productivity of pulses and making the sectoral balance in

foodgrains.

16. FOOD GRAIN ECONOMY OF ANDHRA PRADESH

In the study on "foodgrain economy of Andhra Pradesh", Lakshmana rao (1980) examined the foodgrain economy of Andhra Pradesh with particular focus on inter-district differences. He concluded in his analysis that :

1) In 1980-81 coastal region produced 52.81 percent
2) Foodgrains with 40.18 percent of the total area
3) As far as the inter-regional disparities in yields in coastal regions the west Godavari districts recorded highest yield (2370 kgs) followed by east Godavari.
4) The measure of variations in yield was 47.02 percent in the coastal regions. It was 30.89 percent and 49.69 percent in Rayalaseema and Telengana regions respectively.
5) Among the explanatory factors which account for inter-districts differences, chemical fertiliser variable, gross area irrigated and percentage of gross irrigated area to total cropped area appeared very prominent. Average size of the holding variable negatively impinged on average yield.

17. INSTABILITY IN RAINFALL AND AGRICULTURAL YIELD IN A DROUGHT PRONE DISTRICT OF TUMKUR :-

Nadkarni Gosh(1983) studied the instability in rainfall and agricultural yield in a drought prone district Tumkur for the analysis of variation in crop yield. They have selected four crops namely ragi, jowar, tur and rice. The area under ragi accounted for 35 percent in year 1974-75. But the productivity of ragi declined by 1.4 percent per annum though this decline was not steady and smooth as seen from coeffecient being statistically significant. Area under ragi it seems that fertile area is been progressively from ragi to other crops. The instability in crop yield is lower than the instability in monthly wise rainfall. The instability of crop yields was higher than the annual rainfall.

METHODOLOGY

III METHODOLOGY

The methodology adopted in the current study on "The Food Grains Economy of India-instability and growth: 1970-1987" is described under the following heads:

1. Selection of the Problem.
2. Sources of Data , and
3. Tools of analysis.

1. Selection of the Problem:

Agriculture has a dominant role in the Indian economy contributing nearly 36.86 per cent of the national income, providing employment to 70 per cent of the working population. Being the unorganised sector, it seeks the attention of researchers at different levels. Nationwide dicussions are going on about the crucial issues of agriculture particularly, the growth and instability. An examination of the nature of instability of agricultural production and food grains production is very important to understand the security of food grains. Hence, the focus of the present study is on the nature of instability and its analysis in a very scientific manner. The growth of the sector is also examined indepth. The area effect on production, the impact of seed fertilizer technology on production are also considered for the analysis as it will help to realise the extent of inter relationship between agricultural and non agricultural sectors of the Indian Economy.

2. Sources of data:

The data base of the study is secondary. The data on crop wise production, area under cultivation of various crops, fertilizer consumption, state wise production, area under high yielding variety seeds were collected from the following sources:

1. Pre budget Economic Survey
   Various issues, Ministry of Finance, Government of India.
2. Season and Crop reports published by the Government of Tamilnadu.
3. Tamil nadu -- An Economic Appraisal - various issues.
   Finance Department - Government of Tamil nadu.
4. India - A Reference Manual. Government of India publication 1987.
5. Plan Documents -- Various Plans.

The books, journals and magazines like, Agricultural Situation in India, Indian Journal of Agricultural Economics, Indian Journal of Economics, Economic and Political Weekly and Margin were also referred to.

3. Tools of analysis:

Percentages of cereals and pulses to total foodgrains production, irrigated and unirrigated area to gross area, the crop wise production to total production, Statewise production to total production, area under cultivation of Various crops, were worked out. For the estimation of compound growth rates, the following formula was used.

$$y = y0\ e^{xt}$$

where y = the relevant variable (time series data.)

x = compound growth rate

t = time

This formula is used in the estimation of growth rate as it straight away gives the compund growth rate.

For finding the area effect on production, and seed fertilizer technology impact on production, simple and multiple regressions were used. They are given as

i. $y = a + bx$

y = food grains production

x = area and fertilizer consumption

ii. $y = a + b\ x_1 + c\ x_2$

x_1 = Area under Hyv. seeds

x_2 = Fertilizer consumption

The coefficient of determination "R^2" 't' values, and standard errors of the coefficients were also worked out to find out the goodness of fit and statistical significance of the relations.

For the assessment of variability, the coefficient of variation was used as a variability index. This is given as

$$C.V = \frac{S.D \times 100}{\bar{X}}$$

where

$\bar{x}$ - Mean

S.D. - Standard deviation.

Crop wise production yield variability indices, and statewise production variability indices were also estimated.

For the assessment of in stability the following method was used.

i. For the data on food grains production, first, second, third degree polynomials were fitted.

ii. From the estimated equations, differential equations were formed.

iii. From the roots of the characteristic equations for the three cases as mentioned in (i), the instability was tested. (The method is described and discussed in detail in the chapter Results and Discussions).

RESULTS AND DISCUSSION

IV. RESULTS AND DISCUSSION

The results of the anlaysis carried out on instability, growth, factor response of production and variability of the foodgrain economy of India are discussed and presented as follows:

1. Foodgrains Production
   - i) Cereals and Pulses
   - ii) Cropwise production
   - iii) State wise production
2. Area Under Cultivation
   - i) Cereals and pulses
   - ii) Cropping pattern Irrigated and unirrigated area
   - iii) Cropwise Irrigated area
   - iv) Area under high yielding variety seeds
3. Cropwise Yield
4. Fertilisers Consumption
5. Variability analysis
   - i) State wise variability
   - ii) Cropwise variability
     - a) Production variability
     - b) Yield variability
6. Growth and instability
   - i) Growth analysis
   - ii) Instability analysis
7. Factors response of Production
   - i) Area response

ii) Fertiliser response

iii) The response of production to High Yielding variety area.

iv) The response of production to simultaneous changes in fertiliser consumption and area under cultivation

1.FOODGRAINS PRODUCTION

Agricultural sector had to face seasonal shortcomings of a serious nature. Foodgrains production is particularly sensitive to adverse weather conditions. The production performance of the foodgrains economy of India for a period from (1970-71 to 1986-87) is presented in table 4.1

TABLE 4.1
FOOD GRAINS PRODUCTION IN INDIA
1970-71 -- 1986-87

YEAR	CEREALS	PULSES	TOTAL (IN MILLION)
1970 - 71	96.60 (89.10)	11.82 (10.90)	108.42
1971 - 72	94.08 (89.86)	11.09 (10.54)	105.17
1972 - 73	87.12 (89.79)	9.91 (10.21)	97.03
1973 - 74	94.66 (90.45)	10.00 (9.55)	104.67
1974 - 75	89.80 (89.97)	10.01 (10.03)	99.81
1975 - 76	107.99 (89.23)	13.04 (10.77)	121.03
1976 - 77	99.79 (89.78)	11.36 (10.22)	111.15
1977 - 78	114.43 (90.52)	11.97 (9.47)	126.41
1978 - 79	119.72 (90.77)	12.18 (9.23)	131.90
1979 - 80	101.13 (92.19)	8.57 (7.81)	109.70
1980 - 81	118.96 (91.80)	10.63 (8.20)	129.59
1981 - 82	121.79 (91.37)	11.51 (8.63)	133.30
1982 - 83	117.66 (90.84)	11.86 (9.16)	129.52
1983 - 84	139.48 (91.78)	12.89 (8.46)	152.37
1984 - 85	133.58 (91.78)	11.96 (8.22)	145.54
1985 - 86	137.07 (91.12)	13.36 (8.88)	150.43
1986 - 87	132.33 (91.89)	11.74 (8.15)	144.07

FIGURES IN BRACKETS INDICATE PERCENTAGES TO TOTALS

SOURCE :ECONOMIC SURVEY - VARIOUS ISSUES

The period considered for the study in the post-green revolution period, fluctuations are observed from year to year. It is evident from the table that the fluctuations are comparatively more in cereals production than in the pulses production. In the total foodgrains production, the cereals production accounted for about 90 percent. The momentum of foodgrains growth established during the early eightees leading upto a peak production of 152.37 million tonnes in 1983-84 has been seriously disturbed by adverse weather conditions during the last few years. Two successive years of poor monsoon in many parts of the country, the foodgrains production has been worst affected during 1980-88. In view of the decline in the storage capacity of 47 reservoirs from 75 percent to 52 percent. It is expected that foodgrains production in 1987-88 to be lower than the production of 1986-87.

But the overalll production shows an impressive performance thanks largely to the tremendous contribution of the farmers and agricultural scientists towards achieving higher productivity and the farsighted policy of laying emphasis on growth self reliance and food security pursued by India.

(ii) Cropwise Production of Cereals:

As the share of cereals is comparatively more than the pulses, a cropwise detailed performance of the cereals economy is presented in table 4.2.

TABLE 4.2
CROPWISE PRODUCTIONNOF CEREALS IN INDIA 1970-71 -- 1986-87

YEAR	RICE	WHEAT	JOWAR	MAIZE	BAJRA	OTHER CEREALS	TOTAL IN MILLION TONNES
1970-71	42.23 (43.72)	23.83 (24.67)	8.10 (8.39)	7.49 (7.75)	8.03 (8.31)	6.93 (7.71)	96.60
1971-72	43.07 (45.78)	26.41 (28.07)	7.72 (8.21)	5.10 (5.42)	5.32 (5.65)	6.46 (6.87)	94.08
1972-73	39.25 (46.53)	24.74 (28.40)	6.97 (8.00)	6.39 (7.33)	3.93 (4.51)	5.84 (6.70)	87.12
1973-74	44.05 (46.53)	21.78 (23.01)	9.10 (6.13)	5.80 (7.94)	7.52 (6.77)	6.41 (6.77)	94.66
1974-75	39.58 (44.08)	24.10 (26.84)	10.41 (11.50)	5.56 (6.19)	3.27 (3.64)	6.88 (7.66)	89.81
1975-76	48.74 (45.13)	28.85 (26.72)	9.50 (8.80)	7.26 (6.72)	5.74 (5.32)	7.91 (7.32)	107.99
1976-77	41.92 (42.01)	29.01 (29.07)	10.52 (10.54)	6.36 (6.37)	5.85 (5.86)	6.13 (6.14)	99.79
1977-78	52.67 (46.03)	31.75 (27.75)	12.06 (10.54)	5.97 (5.21)	4.73 (4.13)	7.25 (6.34)	114.43
1978-79	53.77 (44.91)	35.51 (29.66)	11.44 (9.56)	6.20 (5.18)	5.57 (4.65)	7.23 (6.04)	119.72
1979-80	42.83 (41.86)	31.83 (31.47)	11.65 (11.52)	5.60 (5.54)	3.95 (3.91)	5.77 (5.71)	101.13
1980-81	53.63 (45.08)	36.31 (30.52)	10.43 (8.77)	6.96 (5.85)	5.34 (4.49)	6.29 (5.29)	118.96
1981-82	53.25 (43.72)	37.45 (30.75)	12.06 (9.90)	6.90 (5.61)	5.54 (4.55)	6.59 (5.41)	121.79
1982-83	47.12 (40.05)	42.79 (36.37)	10.75 (9.14)	6.55 (5.57)	5.13 (4.36)	5.32 (4.52)	117.66
1983-84	60.10 (43.09)	45.48 (32.61)	11.92 (8.55)	7.92 (5.68)	7.72 (5.53)	6.34 (4.55)	139.48
1984-85	58.34 (43.67)	44.07 (32.99)	11.40 (8.53)	8.44 (6.32)	6.05 (4.53)	5.28 (3.95)	133.58
1985-86	63.82 (46.56)	47.05 (34.33)	10.20 (7.44)	6.64 (4.84)	3.66 (2.67)	5.7 (4.16)	137.07
1986-87	60.42 (45.66)	45.57 (34.44)	8.87 (6.70)	7.46 (5.64)	4.49 (3.39)	5.52 (4.17)	132.33

SOURCE : ECONOMIC SURVEY 1987-88
FIGURES IN BRACKETS REPRESENT PERCENTAGES TO TOTALS

The production of foodgrains has looked up most of the incremental production originated from rice. In the total cereals productin rice alone accounted for about 45 percent followed by wheat. One of the main reason for this significant contribution of rice and wheat is that these are cultivated right through the year and except the eastern region, in all other regions, these are produced under assured irrigation conditions governmental efforts have been directed towards increasing the production of rice and wheat through creating new irrigation sources introducing new technology and high yielding variety seeds . This is an indication of the technological transformation that the foodgrains economy has experienced during the post green revolution period. But coarse cereals cultivation constitutes nearly 30 percent of the total production have not received the attention of the government as it is evident from the consistent decline in the share during the period. The production of coarse cereals being concentrated in particular regions of the country, their development is more of regional form than of a national interest. The declining trend may also be due to the fact that they are grown in low rainfall and dry areas they did not receive that much attention in research and development as the irrigated crops. But it is to be noted that coarse cereals should not be allowed to remain neglected since the conventional high potential areas in the country can not by themselves meet the growing demand

for food.

(iii) Statewise Production of Foodgrains:

There are wide variations in the production of foodgrains among the states, the details of foodgrains production statewise during the period (1975-76 to 1986-87) are presented in table 4.3.

TABLE 4.3

STATEWISE PRODUCTION OF FOOD GRAINS -- 1975-76 - 1986-87

STATE	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	R
1.ANDRAPRADESH	9428.1 (7.79)	7475.8 (6.72)	8984.4 (7.10)	10666.5 (8.09)	9528.9 (5.62)	9991.6 (7.71)	11413.1 (8.56)	11172.3 (8.63)	11881.3 (7.80)	9615.1 (6.61)	10373. (6.90)	9139 (6.34)	6
2.ASSAM	2411.0 (1.99)	2255.4 (2.03)	2452.1 (1.94)	2301.9 (1.75)	2031.7 (1.20)	2705.7 (2.09)	2419.1 (1.81)	2773.3 (2.14)	2708.9 (1.77)	2670.5 (1.83)	3030.5 (2.01)	2588.0 (1.80)	14
3.BIHAR	9177.1 (7.58)	9183.8 (8.26)	9685.6 (3.06)	9977.1 (3.40)	7104.5 (2.36)	9911.2 (3.45)	82439.0 (3.82)	7316.2 3.39)	9874.8 (3.77)	10328. (3.61)	10955.3 (1.82)	10865.3 (2.15)	4
4.GUJARAT	4519.8 (3.73)	4027.8 (3.62)	38373.5 (3.06)	4485.2 (3.40)	4007.5 (2.960)	4475.1 (4.66)	5088.6 (4.53)	4396.2 (5.13)	5743.6 (4.32)	5257.0 (4.62)	736.0 (5.41)	3100.6 5.30)	13
5.HARYANA	5040.0 (4.16)	5250.9 (4.72)	5340.4 (4.22)	6333.3 (4.80)	5027.8 (2.96)	6044.7 (4.66)	6040.2 (4.53)	6649.7 (5.13)	6585.5 (4.32)	6729.5 (4.62)	8140.9 (5.41)	7635.4 (5.30)	7
6.HIMACHAL PRADESH	1128.6 (0.93)	932.6 (0.84)	1063.7 (0.84)	1058.3 (0.80)	882.5 (0.52)	1183.5 (0.91)	1054.0 (0.79)	972.6 (0.75)	1050.7 (0.69)	1007.5 (0.80)	1200.9 (0.84)	1214.1 (0·84)	16
7.JAMMU & KASMIR	1007.6 (0.83)	933.8 (0.84)	1121.0 (0.81)	1214.8 (0.92)	1111.6 (0.66)	1307.3 (1.01)	1272.6 (0.95)	1260.7 (0.97)	1113.3 (0.73)	1244.6 (0.86)	1403.6 (0.92)	1431.2 (0.99)	15
8.KARNATAKA	7083.3 (5.85)	4705.7 (4.23)	7286.9 (5.76)	7457.3 (5.65)	7370.9 (4.34)	5879.6 (4.54)	7380.3 (5.48)	6021.4 (4.65)	7251.8 (4.76)	6725.0 (4.62)	5861.8 (3.90)	6909.2 (4.80)	10
9.KERALA	1386.3 (1.15)	1276.8 (1.15)	1314.1 (1.04)	1285.9 (0.97)	1311.5 (0.77)	1297.9 (1.0)	1362.1 (1.02)	1329.9 (1.03)	1231.8 (0.81)	1279.8 (0.88)	1202.5 (0.80)	1162.0 (0.81)	17
10.MADHYAPRADESH	12000.8 (9.92)	9575.7 (8.61)	12341.5 (9.76)	11727.5 (8.89)	7535.1 (4.44)	12411.9 (9.58)	12824.2 (9.62)	12615.2 (9.74)	15704.4 (10.31)	13295.0 (9.14)	15293.2 (10.17	13199.2 (9.16)	3
11. MAHARASTRA	9103.0 (7.52)	9696.5 (8.72)	10456.0 (8.27)	10016.7 (7.5)	10362. (6.11)	9757.8 (7.55)	10571.4 (7.93)	9215.6 (7.12)	10951.8 (7.19)	9735.8 (6.99)	8784.0 (5.84)	7144.1 (4.86)	9
12. MEGHALAYA	135.3 (0.11)	142.5 (0.13)	148.5 (0.12)	150.0 (0.11)	140.7 (0.08)	154.9 (0.12)	154.7 (0.12)	153.6 (0.19)	163.3 (0.11)	159.9 (0.11)	166.7 (0.11)	166.7 (0.12)	19
13. NAGALAND	88.6 (0.07)	93.5 (0.08)	85.3 (0.07)	88.0 (0.07)	64.8 (0.04)	105.5 (0.08)	113.3 (0.08)	122.6 (0.09)	109.6 (0.07)	123.8 (0.09)	117.8 (0.08)	99.4 (0.07)	20
14. ORISSA	5566.5 (4.60)	4075.4 (3.67)	5560.9 (4.40)	5765.0 (4.37)	3871.7 (2.28)	5977.0 (4.61)	5437.2 (4.08)	4562.9 (3.52)	7016.5 (4.60)	5618.7 (3.86)	6883.1 (4.58)	6445.2 (4.47)	12
15. PUNJAB	8827.4 (7.29)	9197.6 (8.27)	10369.7 (8.20)	11673.9 (8.89)	11929.4 (7.03)	11902.7 (9.18)	13325.8 (10.00)	14145.5 (10.92)	1470.7 (9.07)	16091.3 (11.06)	17189.0 (11.43)	1784.6 (12.48)	2
16. RAJASTAN	7735.3 (6.39)	7490.3 (6.74)	7158.4 (5.66)	7822.2 (5.93)	5245.0 (3.09)	6496.9 (5.01)	7163.1 (5.37)	8323.3 (6.43)	10075.6 (6.61)	6792.0 (7.67)	7928.1 (5.26)	6722.6 (4.66)	11
17. TAMILNADU	7183.2 (5.93)	6336.3 (5.70)	7750.8 (6.13)	7603.2 (5.76)	7661.6 (4.51)	5486.8 (4.23)	7400.4 (5.55)	4832.8 (3.73)	6184.4 (4.05)	6895.0 (4.74)	7135.5 (4.77)	7291.1 (4.06)	8
18. TIRIPURA	373.1 0.31	352.8 0.32	374.9 0.30	378.1 0.29	312.0 0.18	402.6 0.31	360.0 0.27	428.1 0.33	386.7 0.25	378.9 0.26	373.8 0.25	390.1 0.27	18
19. UTTARAPRADESH	19477.1 16.09	199085.5 17.91	21232.9 16.80	23079.2 17.50	16427.1 6.14	24945.4 19.25	24288.9 18.22	26483.4 20.45	29182.5 19.15	29887.8 20.54	31424.1 20.89	29988.0 20.82	1
20. WEST BENGAL	8592.7 7.10	7453.8 6.71	8970.2 7.10	8044.5 6.10	7062.1 4.16	8281.0 6.39	6549.7 4.91	5852.2 4.52	9170.0 6.02	9223.1 6.34	9127.8 6.07	9661.2 0.67	5
21. SIKIM	--	- -	---	--	--	---	---	62.9	75.9	90.9	90.8	92.8	21
22. MIZORAM	---	---	---	----	---	---	---	0.04 34.6	0.05 30.7	0.06 47.0	0.06 49.9	52.8	22
23. ALL INDIA	121034.3	111166.8	126406.8	131902.0	169700.	129588.5	133294. 8	0.03 129518.7	0.02 152374. 0	0.03 145538. 7	0.03 150440. 0	0.04 144068. 0	--

SOURCE : ECONOMIC SURVEY 1987-88

FIGURES IN BRACKETS REPRESENT THE PERCENTAGES TO TOTALS

The table shows that Punjab, Madhya Pradesh and Uttar Pradesh constitute nearly 30 percent of the total foodgrains production. Uttar Pradesh ranks first in its contribution to total foodgrains production followed by Madhya Pradesh, Tamil Nadu is the eigth state in terms of its contribution to the total production. One of the important reasons for the good performance of foodgrain sector in these states, Madhya Pradesh, Uttar Pradesh and Punjab may be the success of green revolution particularly in wheat production. The Southern region of Karnataka, Tamil Nadu, Andhra Pradesh and Kerala constitutes nearly 20 percent of the total foodgrains production. The Eastern region is normally affected by floods hence its contribution is very meagre in the total production. The extension work done by Agricultural development and Agricultural universities with established research centres had led to the spread of knowledge among farmers and the success of Green revolution is mainly due to the extension work and research and training of the universities.

2. AREA UNDER CULTIVATION:

The cropping pattern of an economy is determined by factors like rainfall, irrigation conditions, size of holdings, prices of crops, ground water availability etc. The cropping pattern of foodgrains economy shows a stable trend unlike foodgrains production indicating that the increase is more due to a step up in yield rate of all crops.

The details of the area under cultivation of cereals and pulses, irrigated and unirrigated, cropwise irrigated and unirrigated areas are presented in the following tables.

TABLE 4.1

AREA UNDER FOOD GRAINS PRODUCTION IN INDIA 1970-71 -- 1986-87

YEAR	CEREALS	PULSES	TOTAL
1970 - 71	101.78 (81.88)	22.53 (18.22)	124.31
1971 - 72	100.47 (81.94)	22.15 (18.06)	122.62
1972 - 73	98.36 (82.46)	20.92 (17.54)	119.28
1973 - 74	103.11 (81.48)	23.43 (18.52)	126.54
1974 - 75	99.05 (81.81)	22.02 (18.19)	121.07
1975 - 76	103.73 (80.93)	24.45 (19.07)	128.18
1976 - 77	101.37 (81.52)	22.98 (18.43)	124.35
1977 - 78	104.00 (81.57)	23.50 (18.43)	127.52
1978 - 79	105.35 (81.66)	23.66 (18.34)	129.01
1979 - 80	102.95 (82.27)	22.26 (17.78)	125.21
1980 - 81	104.21 (82.27)	22.46 (17.73)	126.67
1981 - 82	105.30 (81.54)	23.84 (18.46)	129.14
1982 - 83	102.26 (81.75)	22.83 (18.25)	125.09
1983 - 84	107.62 (82.05)	23.54 (17.95)	131.16
1984 - 85	103.93 (82.05)	22.74 (17.95)	126.67
1985 - 86	103.61 (80.93)	24.42 (19.07)	128.03
1986 - 87	103.08 (81.70)	23.09 (18.30)	126.17

SOURCE : ECONOMIC SURVEY VARIOUS ISSUES
FIGURES IN BRACKETS REPRESENT PERCENTAGES TO TOTALS

It is clear from the table that the whole area under cultivation remains stable. The impressive growth trend observed in foodgrains production are discussed in the previous section is mainly due to the increase in yield rate due to change in technology, and the input support provided by the government which is wide ranging. The areas of intervention during irrigation are high yielding variety coverage, seed production and distribution, and fertiliser distribution etc. The table indicates that nearly 82 percent of the wheat cropped area is under cereals and this is the reason for the major share of cereals production in the total foodgrains production.

Table 4.5 presents the cropping pattern of the foodgrains economy.

TABLE 4.5
CROPWISE AREA UNDER CULTIVATION (Million Hectares)

YEARS	RICE	JOWAR	BAJRA	MAIZE	WHEAT	TOTAL CEREALS	TOTAL PULSES	TOTAL GROSS AREA
1970-71	37.59 (30.24)	17.37 (13.97)	12.91 (10.38)	5.85 (4.71)	18.24 (14.67)	101.78 (81.87)	22.53 (18.12)	124.32
1971-72	37.36 (30.79)	16.78 (13.68)	11.77 (9.60)	5.67 (4.62)	19.14 (15.61)	100.47 (81.94)	22.15 (18.06)	122.62
1972-73	36.69 (30.76)	15.51 (13)	11.82 (9.91)	5.84 (4.76)	19.46 (14.68)	98.36 (81.48)	20.92 (18.52)	119.28
1973-74	38.29 (30.26)	16.72 (13.21)	13.93 (11.01)	6.02 (4.76)	18.58 (14.68)	103.11 (81.48)	23.42 (18.52)	126.54
1974-75	37.89 (31.29)	16.19 (13.37)	11.29 (9.32)	5.86 (4.84)	18.01 (14.87)	99.05 (81.81)	22.02 (18.19)	121.08
1975-76	39.48 (30.8)	16.09 (12.55)	11.57 (9.02)	6.03 (4.7)	20.45 (15.95)	103.73 (80.93)	24.45 (19.07)	128.18
1976-77	38.51 (30.92)	15.77 (12.68)	10.75 (8.64)	6 (4.82)	20.92 (16.82)	101.37 (81.51)	22.98 (18.48)	124.36
1977-78	40.28 (31.59)	16.32 (12.8)	11.1 (8.7)	5.8 (4.45)	21.46 (16.83)	104.02 (81.57)	23.5 (18.43)	127.52
1978-79	40.48 (31.37)	16.15 (12.52)	11.39 (8.83)	5.76 (4.46)	22.64 (17.55)	105.35 (81.66)	23.06 (18.34)	129.01
1979-80	39.41 (31.48)	16.67 (13.31)	10.58 (8.55)	5.72 (4.57)	22.17 (17.71)	102.95 (82.22)	22.26 (17.78)	125.21
1980-81	40.15 (31.7)	15.81 (12.48)	11.66 (9.21)	6.01 (4.74)	22.28 (17.59)	104.21 (82.27)	22.46 (17.73)	126.67
1981-82	40.71 (31.52)	16.6 (12.85)	11.78 (9.12)	5.94 (4.6)	22.14 (17.14)	105.3 (8.54)	23.84 (18.46)	129.14
1982-83	38.26 (30.59)	16.37 (8.75)	10.94 (4.57)	5.72 (18.84)	23.57 (81.75)	102.26 (18.25)	22.83 (18.25)	125.09
1983-84	41.24 (31.44)	16.43 (12.53)	11.83 (9.02)	5.86 (4.47)	24.67 (18.81)	107.62 (82.05)	23.54 (17.95)	131.16
1984-85	41.16 (32.49)	15.44 (12.19)	10.62 (8.38)	5.8 (4.58)	23.56 (18.6)	103.93 (82.05)	22.74 (17.95)	126.67

Figures in brackets represent percentages to totals
Source: Economic Survey Various Issues

The table reveals that the cropping intensity had ranged over a period of time. For rice the percentage of area increased from 32 to 34 percent. For coarse cereals the area under cultivation shows a declining trend. For wheat the percentage of area increased from 14.67 to 18.6. The area under cultivation of pulses declined from 18.1 percent to 17.95 percent. The change in the cropping pattern in favour of rice and wheat indicates that the government policy and intervention programmes are being concentrated for rice and wheat.

The details of irrigated area under different crops are given in tables (4.6) and (4.7).

TABLE 4.6
IRRIGATED AREA UNDER FOODGRAINS IN INDIA 1970-1985
(in Million Hectares)

YEAR	GROSS	IRRIGATED AREA	PERCENTAGE OF IRRIGATED AREA	PERCENTAGE OF UNIRRIGATED AREA
1970-71	124.32	30.12	24.23	75.77
1971-72	122.62	30.08	24.53	75.47
1972-73	119.28	30.76	25.79	74.21
1973-74	126.54	31.17	24.63	75.37
1974-75	121.08	32.30	26.68	73.32
1975-76	128.18	34.09	26.60	73.40
1976-77	124.36	34.22	27.52	72.48
1977-78	127.52	35.20	27.60	72.40
1978-79	129.01	37.21	28.84	71.16
1979-80	125.21	37.79	30.18	69.82
1980-81	126.67	37.61	29.69	70.31
1981-82	129.14	38.32	29.67	70.33
1982-83	125.09	38.45	30.74	69.26
1983-84	131.16	40.21	30.66	69.34
1984-85	126.67	39.95	31.54	68.46

Source: Economic Survey Various Issues

TABLE 4.7
IRRIGATED AREA UNDER DIFFERENT CROPS (MILLION HECTARES)

CROPS	1970-71			1971-72			1972-73			1973-74		
	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA
RICE	37.59	14.34 (38.15)	23.25 (61.85)	37.76	14.08 (37.29)	23.68 (62.71)	36.69	14.42 (39.30)	22.27 (60.70)	38.29	14.67 (38.31)	23.62 (61.69)
JOWAR	17.37	0.61 (3.51)	16.76 (96.49)	16.78	0.73 (4.35)	16.05 (95.65)	15.51	0.55 (3.55)	14.96 (96.45)	16.72	0.68 (4.07)	16.04 (95.93)
BAJRA	12.91	0.53 (4.11)	12.38 (95.89)	11.77	0.44 (3.74)	11.33 (96.26)	11.82	0.56 (4.74)	11.26 (95.26)	13.93	0.59 (4.24)	13.34 (95.76)
MAIZE	5.85	0.93 (15.96)	4.92 (84.10)	5.67	0.80 (14.11)	4.87 (85.89)	5.84	1.09 (18.66)	4.75 (81.34)	6.02	0.88 (14.62)	5.14 (85.38)
WHEAT	18.24	9.92 (54.39)	8.32 (45.61)	19.14	10.40 (54.34)	8.74 (45.66)	19.46	10.77 (55.34)	8.69 (44.66)	18.58	10.76 (57.91)	7.82 (42.09)
TOTAL CEREALS	101.78	28.09 (27.60)	73.69 (72.40)	100.47	28.11 (27.98)	72.36 (72.02)	98.36	29.00 (29.48)	69.36 (70.52)	103.11	29.30 (28.42)	73.81 (71.58)
TOTAL PULSES	22.53	2.02 (8.97)	20.51 (91.03)	22.15	1.97 (8.89)	20.18 (91.11	20.9	1.76 (8.41)	19.16 (91.59)	23.43	1.87 (7.98)	21.56 (92.02)

Contd...

TABLE 4.7
IRRIGATED AREA UNDER DIFFERENT CROPS (MILLION HECTARES)

CROPS	1974-75			1975-76			1976-77			1977-78		
	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA
RICE	37.89	14.67 (38.72)	23.22 (61.28)	39.48	15.22 (38.55)	24.26 (61.45)	38.51	14.77 (38.35)	23.74 (61.65)	40.28	16.20 (40.22)	24.08 (59.78)
JOWAR	16.19	0.75 (4.63)	15.44 (95.37)	16.09	0.79 (4.91)	15.30 (95.09)	15.77	0.80 (5.07)	14.97 (94.93)	16.32	0.66 (4.09)	15.66 (95.96)
BAJRA	11.29	0.64 (5.67)	10.65 (94.33)	11.57	0.59 (5.10)	10.98 (94.90)	10.75	0.53 (4.93)	10.22 (95.07)	11.10	0.47 (4.23)	10.63 (95.77)
MAIZE	5.86	1.22 (20.82)	4.64 (79.18)	6.03	0.96 (15.92)	5.07 (84.08)	6.00	1.06 (17.67)	4.94 (82.33)	5.68	0.91 (16.02)	4.77 (83.98)
WHEAT	18.01	11.08 (61.52)	6.93 (38.48)	20.45	12.56 (61.42)	7.89 (38.58)	20.92	13.59 (64.96)	7.33 (35.02)	21.46	13.72 (63.93)	7.74 (36.07)
TOTAL CEREALS	99.05	30.48 (30.77)	68.57 (69.23)	103.73	32.14 (30.98)	71.59 (69.02)	101.37	32.45 (32.01)	69.92 (67.99)	104.02	33.50 (32.21)	70.52 (67.79)
TOTAL PULSES	22.02	1.82 (8.27)	20.20 (91.73)	24.45	1.95 (7.98)	22.50 (92.02)	22.98	1.77 (7.70)	21.21 (92.30)	23.50	1.70 (7.23)	21.80 (92.77)

TABLE 4.7
IRRIGATED AREA UNDER DIFFERENT CROPS (MILLION HECTARES)

CROPS	1978-79			1979-80			1980-81			1981-82		
	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGAED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA
RICE	40.48	16.86 (41.65)	23.62 (58.35)	39.41	16.91 (42.91)	22.50 (57.09)	40.15	16.34 (40.70)	23.81 (59.30)	40.71	17.11 (42.03)	23.60 (57.97)
JOWAR	16.15	0.77 (4.77)	15.38 (95.23)	16.67	0.63 (3.78)	16.04 (96.22)	15.81	0.63 (3.98)	15.18 (96.02)	16.60	0.63 (3.80)	15.97 (96.20)
BAJRA	11.39	0.50 (4.39)	10.89 (95.61)	10.58	0.63 (5.95)	9.95 (94.05)	11.66	0.64 (5.49)	11.02 (94.51)	11.78	0.70 (5.94)	11.08 (94.06)
MAIZE	5.76	0.95 (16.49)	4.81 (83.51)	5.72	1.36 (23.78)	4.36 (76.22)	6.01	1.20 (17.97)	4.81 (80.03)	5.94	1.15 (19.36)	4.79 (80.64)
WHEAT	22.64	14.87 (65.68)	7.77 (34.32)	22.17	15.03 (67.79)	7.14 (32.21)	22.28	15.52 (69.66)	6.76 (30.34)	22.14	15.47 (69.87)	6.67 (30.13)
TOTAL CEREALS	105.35	35.32 (33.53)	70.03 (66.47)	102.95	35.84 (34.81)	67.11 (65.19)	104.21	35.59 (34.15)	68.62 (65.85)	105.30	36.24 (34.42)	69.06 (65.58)
TOTAL PULSES	23.66	1.89 (7.99)	21.77 (92.01)	22.26	1.95 (8.76)	20.31 (91.24)	22.46	2.02 (8.99)	20.44 (91.01)	23.84	2.08 (8.72)	21.76 (91.28)

TABLE 4.7
IRRIGATED AREA UNDER DIFFERENT CROPS (MILLION HECTARES)

CROPS	1982-83			1983-84			1984-85		
	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGATED AREA	GROSS AREA	IRRIGATED AREA	UN-IRRIGAED AREA
RICE	38.26	16.05 (41.95)	22.21 (58.05)	41.24	17.43 (42.26)	23.81 (57.74)	41.16	17.65 (42.88)	23.51 (57.12)
JOWAR	16.37	0.62 (3.79)	15.75 (96.21)	16.43	0.65 (3.96)	15.78 (96.04)	15.44	0.66 (4.27)	14.78 (95.73)
BAJRA	10.94	0.65	10.29	11.83	0.56	11.27	10.62	0.55	10.07
MAIZE	5.72	1.22 (21.33)	4.50 (78.67)	5.86	0.98 (16.72)	4.88 (83.28)	5.80	0.95 (16.38)	4.85 (83.62)
WHEAT	23.57	17.05 (72.34)	6.52 (27.66)	24.67	17.89 (72.52)	6.78 (27.48)	23.56	17.44 (74.02)	6.12 (23.98)
TOTAL CEREALS	102.26	36.62 (35.81)	65.64 (64.19)	107.62	38.49 (35.76)	69.13 (64.24)	103.93	38.21 (36.77)	65.72 (63.23)
TOTAL PULSES	22.83	1.83 (8.02)	21.00 (91.98)	23.54	1.72 (7.31)	21.82 (92.69)	22.74	1.74 (7.65)	21.00 (92.35)

FIGURES IN BRACKETS REPRESENT THE PERCENTAGE OF IRRIGATED AREA AND UNIRRIGATED AREA TO TOTAL AREA UNDER EACH CROP.

SOURCE: ECONOMIC SURVEY - VARIOUS ISSUES.

The anlaysis of Tables (4.6) and (4.7) reveals the following facts.

1) In the total area under cultivation, the share of irrigated area ranges between 24 percent to 32 percent.

2) It shows that the irrigation sector is performing well continuously. More area is brought under irrigation and the irrigation potentials created were effectively utilised.

3) The percentage of unirrigated area had declined from 76 percent to 68 percent during 1970-1985. It also indicates that the cropping intensity was in conformity with the irrigation intensity. It is also reflected in the increasing expenditures on irrigation, in the overall budget expenditure.

4) With regard to cropping pattern the ratio of irriagated to unirrigated area for rice is transformed from 38:62 in 1970-71 to 43:57 in 1981-82. But for wheat a different trend is observed. The irrigated area percentage for wheat had increased from 54 to 70 percent and wheat accounted for about 70 percent of the total irrigated area.

Area Under High Yielding variety seeds:

A major element in this strategy for increased production is to increase the area under High Yielding varieties of seeds.

TABLE (4.8)

AREA-HIGH YIELDING VARIETIES SEEDS IN INDIA

Year	Total Hyv(Million Hectares)
1970-71	15.38
1971-72	18.17
1972-73	22.09
1973-74	26.00
1974-75	27.30
1975-76	31.89
1976-77	33.60
1977-78	38.93
1978-79	40.13
1979-80	38.38
1980-81	43.07
1981-82	46.69
1982-83	47.48
1983-84	53.74
1984-85	54.14
1985-86	55.42
1986-87	54.14
1987-88	62.42

SOURCE: ECONOMIC SURVEY - VARIOUS ISSUES.

The table clearly shows that the area under High yielding variety had increased significantly from 15 million hectares to 62 million hectares during the period 1970-1988 unlike total area under cultivation. The increase in yield rate of all crops is mainly due to this programme. Thanks to the government of India for the adequate production of certified quality seeds and its distribution. This also shows that the conventional inputs like land and labour have not significantly contributed to the impressive growth in food production when compared to non-conventional high pay off inputs like fertilisers and High Yielding variety seeds.

3.CROPWISE YIELD:

Considerable increase in the use of fertilizers and the area under High Yielding variety seeds is reflected in the increase of yield rate of food crops. Yield per hectare of main crops is presented in table (4.9)

TABLE 4.9

CROP WISE YIELD/HECTARE 1970-71 -- 1986-67

Year	Rice	Wheat	Jowar	Maize	Bagra	Gram
1970-71	1123	1307	466	1279	622	663
1971-72	1141	1380	460	900	452	642
1972 73	1070	1271	449	1094	333	651
1973-74	1151	1172	544	965	540	528
1974-75	1045	1338	643	948	290	570
1975-76	1235	1410	591	1203	496	707
1976-77	1088	1387	667	1060	544	680
1977-78	1308	1480	739	1051	426	678
1978-79	1328	1568	708	1076	489	745
1979-80	1074	1436	699	979	373	481
1980-81	1336	1630	660	1159	458	657
1981-82	1308	1691	727	1162	470	590
1982-83	1231	1816	657	1145	469	715
1983-84	1457	1843	725	1352	653	663
1984-85	1417	1870	715	1456	569	661
1985-86	1552	2046	633	1146	344	742
1986-87	1482	1998	567	1270	401	658

SOURCE : ECONOMIC SURVEY 1987-88.

It is clear from the table that the growth in yield is comparatively higher in the case of wheat than in other cereals and pulses. In the case of rice, the changes are more in eightees when compared to the seventees. As far as the coarse cereals are concerned there is no much variation and in bajra the yield had declined. The extent of cropwise variability is assessed separately.

4. FERTILIZER CONSUMPTION:

Along with the adoption of High yielding variety seeds the consumption of chemical fetilizers has also risen impressively with more than 9 percent (Discussed under the section growth anlaysis).

The fertilisers consumption for the period 1970-71 to 1987-88 is given in the table 4.10

Table 4.10

FERTILIZER CONSUMPTION (Million tonnes)

1970 -71 to 1987-88

Year	Total NPK (Nitrogenous, phosphate, potassium)
1970-71	2.18
1971-72	2.66
1972-73	2.77
1973-74	2.84
1974-75	2.58
1975-76	2.89
1976-77	3.43
1977-78	4.29
1978-79	5.12
1979-80	5.26
1980-81	5.52
1981-82	6.06
1982-83	6.39
1983-84	7.71
1984-85	8.21
1985-86	8.74
1986-87	8.74
1987-88	9.11

SOURCE : ECONOMIC SURVEY 1987-88.

The table shows that the Indian fertilizer scene however is still characterised by geographical and cropwise concentration. The impressive growth in the use of fertilizers is mainly due to efforts of the government fertilizers promotion, machinery and the pressure from the supply side.

5.VARIABILITY ANALYSIS:

a. Statewise Variability:

The performance of foodgrains sector is very much sensitive to weather conditions and hence homogenity in production in different areas states is not present. The variations and variability may be due to variations in the fertilities of the soil, availability of technology, rainfed conditions, the prices of agricultural inputs etc. Hence economic variability, technical variability and grographic variability are the common features of the foodgrain sector. The variability in this sector is quantatively assessed by using the index of coefficient of variation (c.v)

$$C.V. = \frac{S.D \times 100}{Mean}$$

Where S.D - standard deviation. The indices computed are presented in terms of crop production yield and regions. Table 4.11 presents the indices of variability statewise.

TABLE (4.11)

VARIABLITY INDICES STATE WISE PRODUCTION

(1975-76 TO 1986-87)

S.NO	NAME OF THE STATE	VARIABLITY INDEX	RANK
1.	Andra Pradesh	31.33	22
2.	Assam	30.72	21
3.	Bihar	12.82	10
4.	Gujarat	34.94	23
5.	Hariyana	15.26	15
6.	Himachalpradesh	9.48	4
7.	Jammu & Kashmir	11.85	7
8.	Karnataka	12.29	9
9.	Kerala	4.76	1
10.	Madya Pradesh	17.01	17
11.	Maharashtra	10.09	5
12.	Megalaya	6.35	2
13.	Nagaland	16.78	16
14.	Orisa	17.16	18
15.	Punjab	21.93	20
16.	Rajastan	15.08	14
17.	Tamilnadu	12.07	8
18.	Tiripura	7.14	3
19.	Uttar Pradesh	14.07	13
20.	West Bengal	14.07	12
21.	Sikkim	14.05	11
22.	Mizoram	20.31	19
23.	All India	11.13	6

JRCE: Computed from the data on Statewise Production of food grains - Economic Surveys - Various Issues.

The table clearly shows that the extent of variability is less in states like Kerala, Tripura, Meghalaya and Himachal Pradesh. In Gujarat, Assam and Andhra Pradesh the variability is comparatively more than in other states. In other states the extent of variability is more or less same. The eastern region and the rice belt areas in middle regions are generally affected by floods and the standing crops are mostly destroyed by regions. In the regions with assured water conditions the extent of variability is less.

Crop-Wise Variability:

a. Production Variability and Yield Variability

There are production and yield variability among the crops. The details of variability among the crops during the period 1970-71 to 1986-87 is presented in table 4.12

TABLE (4.12)

VARIABILITY INDICES CROP WISE - PRODUCTION AND YIELD

S.NO	CROPS	PRODUCTION	YIELD
1	RICE	15.50	12.30
2	WHEAT	24.65	16.56
3	JOWAR	15.03	15.13
4	MAIZE	13.14	12.79
5	BAJRA	25.00	20.88
6	GRAMS	10.69	10.62

SOURCE: Computed from the data on production and yield - Foodgrains - Economic Survey - Various Issues.

The table clearly shows that the extent of variability is same in the case of pulses both in production and yield. The variability is relatively more in the case of wheat and bajra in production and yield. The extent of variability is less in the case of rice both in production and yield.

6.GROWTH AND INSTABILITY:

i.Growth Analysis:

The foodgrains economy of India had shown an impressive growth in the post green revolution period from 1970 to 1987. The growth is quantitatively assessed by using exponential growth equations for the data on production of foodgrains, rice, wheat, area under High yielding variety, fertilizer consumption . As the production of wheat and rice contitutes the major share in the total foodgrains production, they are separately considered for the growth anlysis. The area under cultivation of High Yielding variety seeds and the fertilizer consumption are also considered for the growth analysis as they reflect the technological transformation experienced by the foodgrains sector in India. The growth equations obtained are presented as follows.

$$\text{Foodgrains} \quad Y = 122.287\, e^{.0259\, t}$$

$$\text{Rice} \quad = 49.172\, e^{.265\, t}$$

$$\text{Wheat} \quad = 32.881\, e^{.0487\, t}$$

Area under High yielding variety seeds $= 38.638\ e^{.0676\ t}$

Fertilizer consumption $= 4.921\ e^{.096\ t}$

The estimated compound growth rate as given below

Foodgrains = 2.59 percent

Rice = 2.65 percent

Wheat = 4.87 percent

Area under High yielding variety seeds = 6.76 percent

Fertilizer consumption = 9.06 percent.

It is evident from the growth rates that wheat production had increased at a higher rate of 4.87 percent when compared to rice production and the total foodgrains production. It is a well established fact that green revolution for a major part remained as wheat revolution, and the growth recorded in wheat production is quiet impressive. Another point is the sizable step up in the fertilizer consumption with a compound growth rate of 9.6 percent and the area under High yielding variety seeds with 6.76 percent. These rates reflect the improvement in agricultural practices of farmers, the extent of diffusion of technology in the sector and the linkages of the agricultural sector with the non - agricultural sectors of the economy . The estimated growth rates are significant except rice production. The statistical significance of the growth rates with the error estimates and the values of R2 the coefficient of determination, are given in (Table 4.13)

TABLE 4.13

GROWTH RATE EQUATIONS

Item	Initial Coefficient	Compound growth rate	Standard error of the coefficient	R^2	't' values
Poodgrains	122.287	2.59	.0118	.084	2.19 * * *
Rice	49.172	2.65	.0314	.738	.084 *
Wheat	32.881	4.87	.014	.931	3.30 * *
HYV	38.638	6.76	.0096	.933	6.99 * *
Fertilizer	4.92	9.06	.0396	.961	2.28 * * *

Hyv = High yielding variety seeds.

* = Insignificant.

* * = Highly significant.

* * * = Significant at 5 percent level.

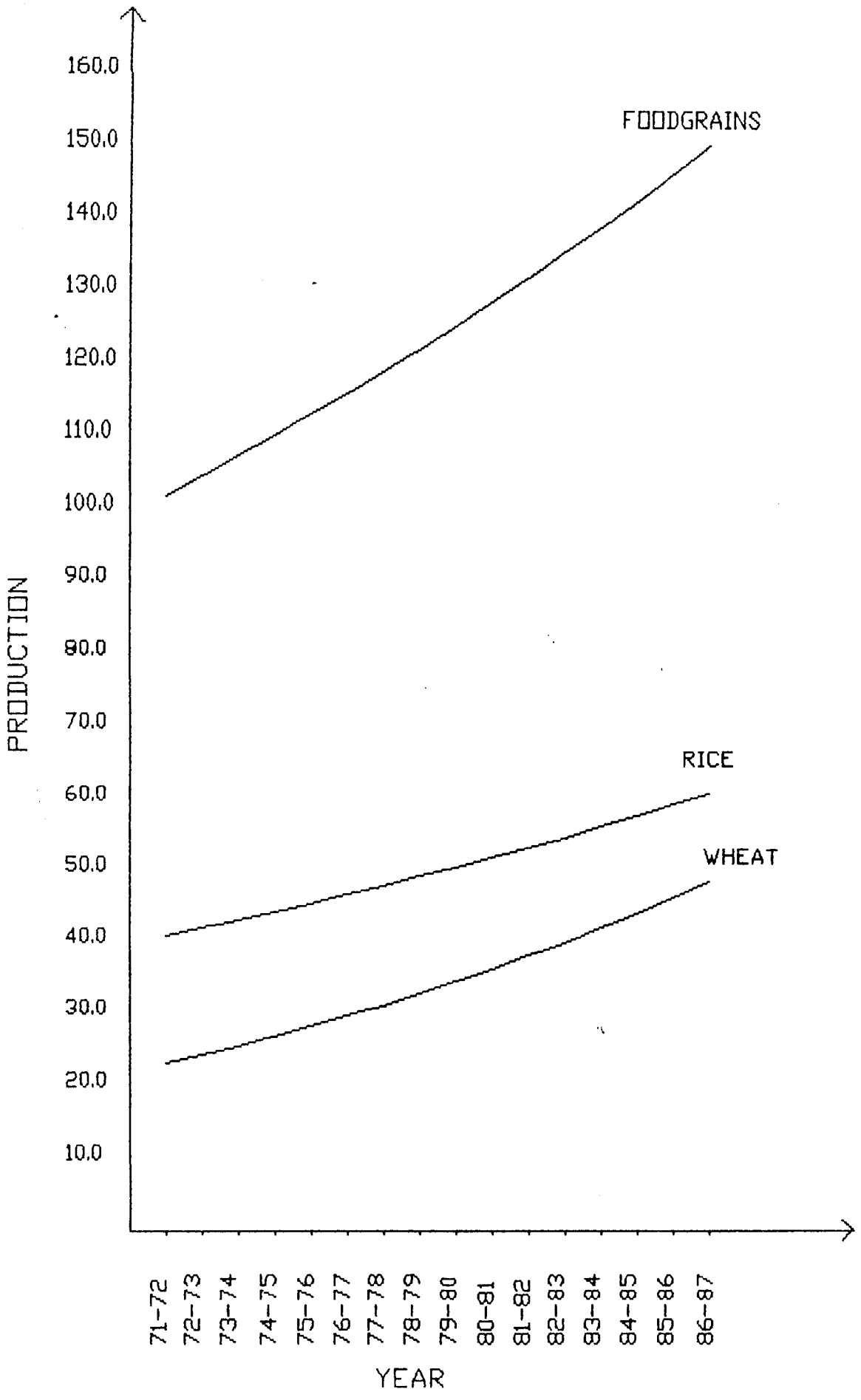


FIG.1 : ESTIMATED PRODUCTION

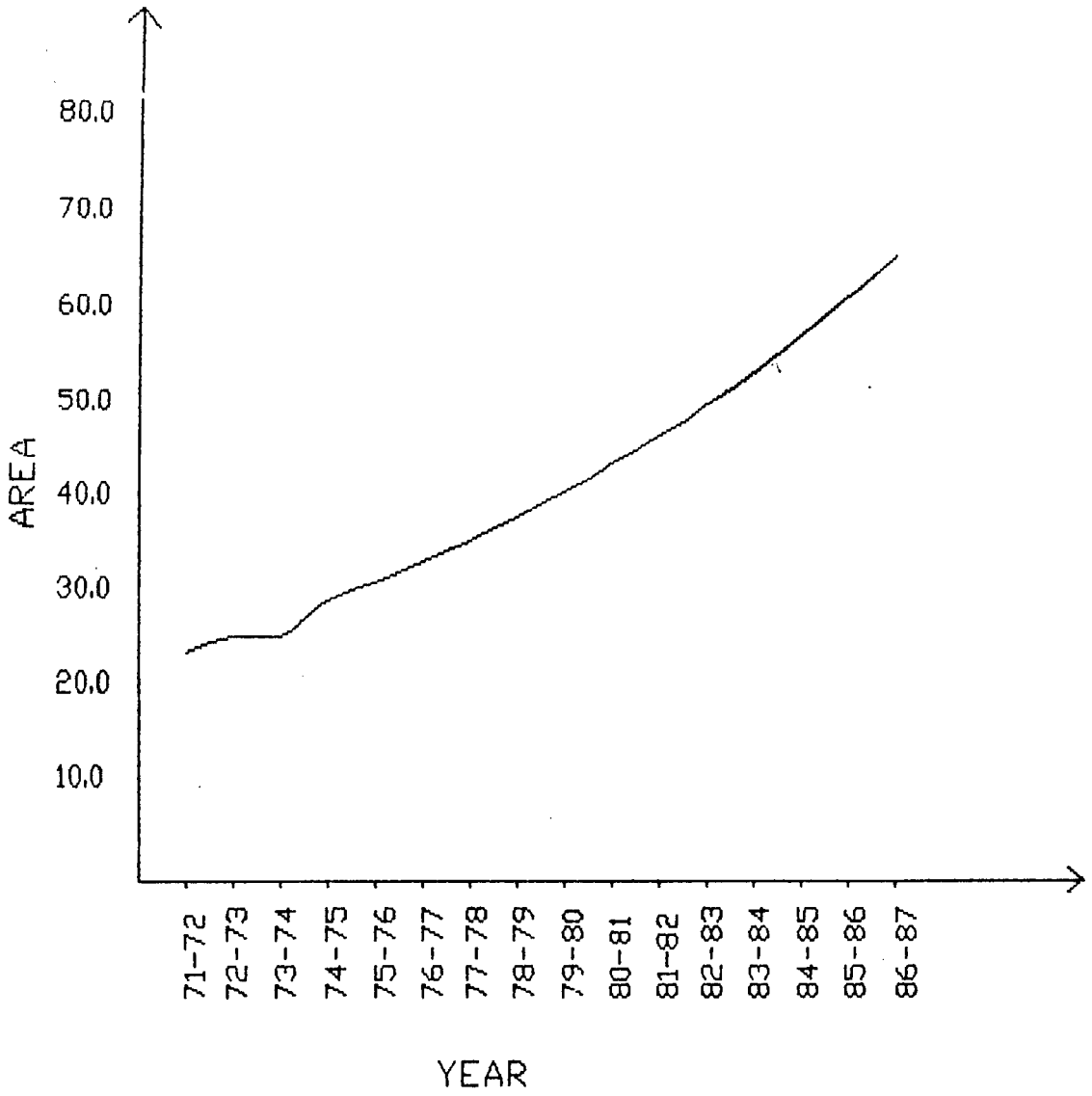


FIG.2 Estimated Area Under HyV seeds

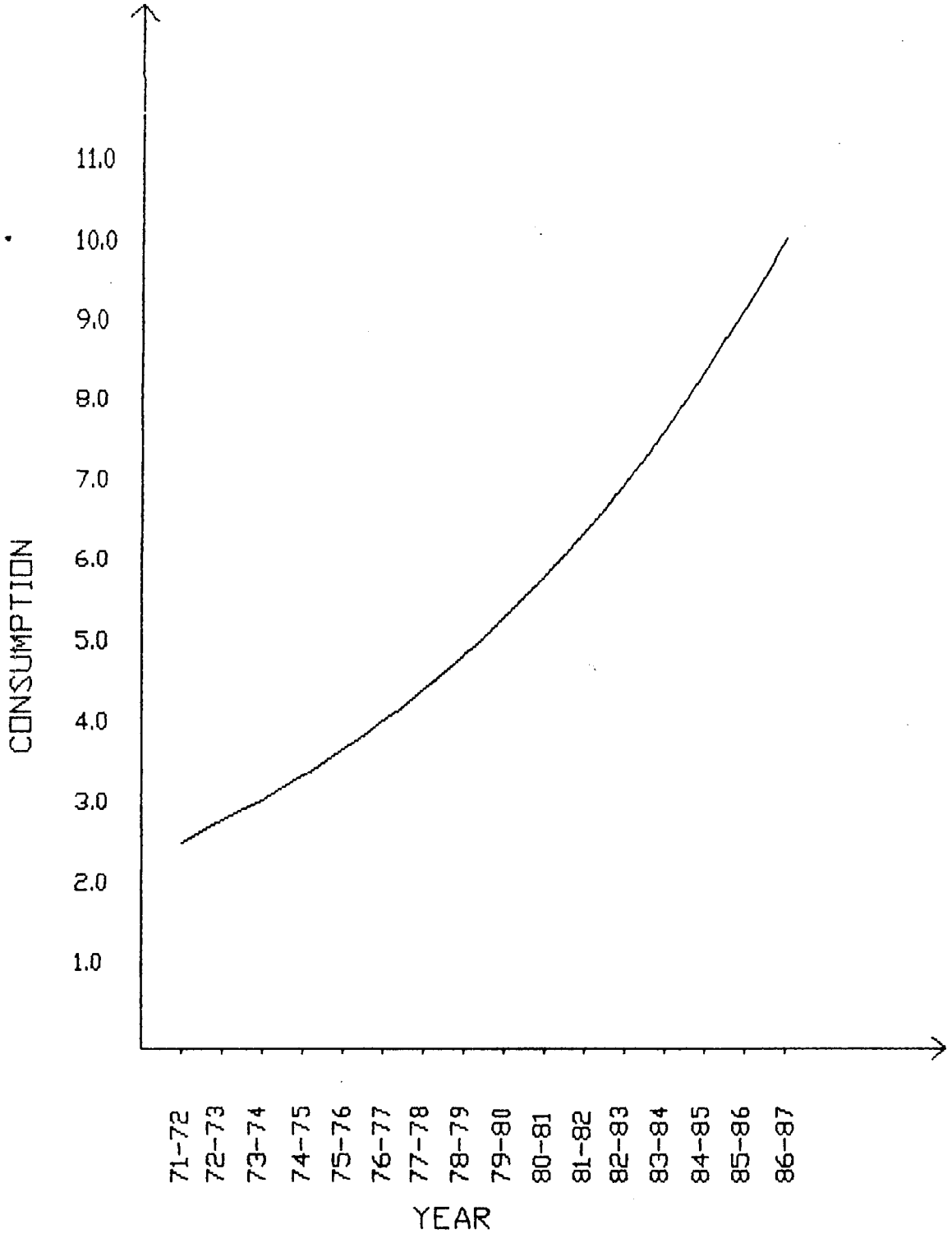


FIG 3: FERTILIZER CONSUMPTION

The estimated production of foodgrains, wheat, rice, area under High Yielding variety seeds and fertilizer consumption are illustrated in figures I,II and III.

INSTABILITY ANALYSIS:

Instability is an important problem faced by the foodgrains economy in India. An examination of instabity and its nature is a necessary condition to understand the security of foodgrains. To assess the instability nature of foodgrains production, the variation of food grains production with respect to time is obtained as different polynomials of various degrees. From these polynomials the corresponding differential equations with respect to time are formed. From the characteristic equations of the above differential equations, roots of the characteristic equations are obtained. The nature of the roots of characteristic equations, determines the instability of foodgrains.

CASE I:

The linear equation of production is obtained as

$$Y = 123.56 + 3.2\ t$$

Corresponding differrential equation will be

$$dy/dt - 3.2 = 0$$

The characteristic equation using Laplace transform is given as $s - 3.2 = 0$

Where $S = dy/dt$. The roots of the above equations is $R1 = 3.2$. For a stable system, the root must lie in the

lefthand side of the complex plain (i.e) the root must be negative. In this case the root is positive and hence the system is unstable.

CASE II:

If the production is represented as a second degree polynomial as given by

$$Y = a + bt + bt^2$$

i.e $Y = 121.7 + 3.2 + .079t^2$ the differential equation is

$$d^2y/dt^2 - .158 = 0$$

The characteristic equation is S2-158 =0 The roots of the characteristic equations are

R1 = + .397 R2 = - .397

In this case one root is in the lefthand side of the complex plain and the other root is on the righthand side. Hence the system is unstable.

CASE III

The third degree polynomial obtained for production is given as: $Y = 121.7 + 4.32\ t + .079\ t^2 - .026\ t^3$

The corresponding differential equation

$$d^3y/dt^3 + 0.162 = 0$$

The characteristic equation is

$$(S + 0.545)\ (S2 - .5455 + .297)$$

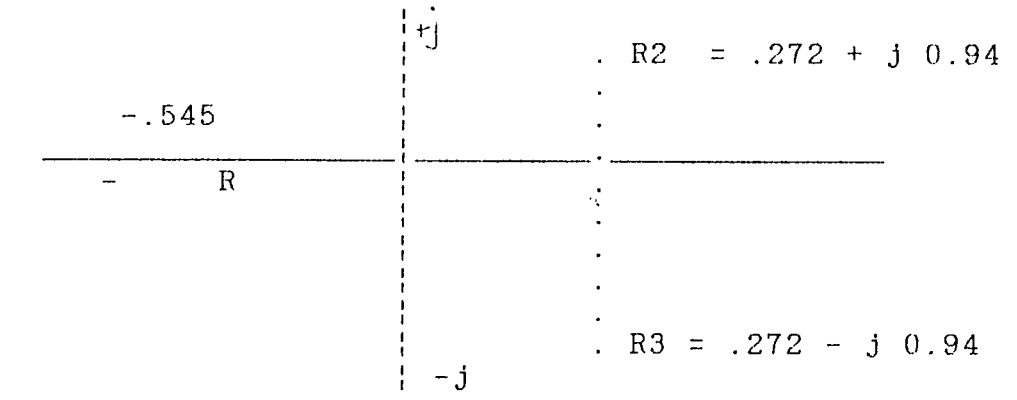
The roots are R1 = - .545

R2 = + .272 + j 0.94

R3 = + .272 - j 0.94

While R is in the left hand side of the complex plain, the

roots R1 R2 form a complex pair with real part of the .272. Hence the roots R1, R2 are on the right hand side of the complex plain. The plot of the roots of the characterristic equation complex plain is given below.



7.FACTORS RESPONSES:

In the sixtees, the increase in production was mainly due to the increase in the area under cultivation of major crops, In seventees, the green revolution had its impact on the progress of foodgrain sector. In the late seventees and eightees the transfer of technology had its impact on foodgrains production, particularly the biological technology in terms of high quantity and high yielding variety seeds and the fertilizer use. Hence to analyse the response of production to variations in areas under cultivation, fertilizer use and the use of hihg yielding variety seeds, a simple equation of the form

$Y = a + b x$ was fitted to the relevant data and the estimated equations are as follows:

1. Production $y = - 460.9 + 4.64 x$ ----(1)

x - Area

Production Y = 88.28 + 6.99 x -------(2)
x = fertilizer

The equation (1) explains that one unit change is the area under cultivation will lead to a change in the foodgrains production by 4.64 units

The second equation relating production and fertilizer consumption explains that an increase of one unit of fertilizer is expected to increase the foodgrains production by 6.99 units. The estimated equations clearly reveal that the little of change of production with respect to fertilizer consumption is relatively greater than the area under cultivation.

To analyse this relationship between production and the effect of simultaneous change in fertilizer use and area under High yielding seeds, a multiple regression of the form

Y = a + B1 x + B2 z was fitted to the data where

x = fertilizer use, z - area under cultivation of High yielding variety seeds. The estimated equation is given as

Y = 80.02 + 3.12 X + .73 z

The equation explains that a simultaneous change in fertilizer and area high yielding variety seeds is expected to increase the foodgrains production by 3.12 units, and .73 units respectively. It is also evident that the production response to fertilizer is comparatively greater than the area under High Yielding variety seeds. The production response to factors is statistically significant as it is evident from the calculated "t" values and R2 values.

TABLE - 4.14

REGRESSION EQUATIONS - FACTOR RESPONSES

Item	Initial Coefficient	B1	B2	R^2	t
Fertilizers vs production	83.28	6.99	—	.826	8.44 *
Area vs production	-460.9	4.64	—	.601	4.75 *
Production Area under High yielding variety and fertilizer	80.02	3.12	.73	.85	t_1 = 1.22 ** t_2 = 1.59 **

* = Highly significant

* * = Significant at 10 percent level.

SUMMARY AND CONCLUSION

V. SUMMARY AND CONCLUSION:

The data on production of foodgrains, area under cultivation, fertiliser consumption, area under high yielding variety seeds, and statewise production was analysed by using correlation, regression, exponential growth equation, difference equation and coefficient of variation. The summary of the analysis is as follows:

I. FOODGRAINS PRODUCTION:

1. The cereals production accounted for 90 percent of the total production and pulses production was only 10 percent. The foodgrain production increased at a compound rate of 2.59 percent.
2. In the total cereal production rice production had a share of 45 percent, followed by wheat, it had increased at a compound rate of 2.65 percent followed by 4.87 percent growth rate in wheat production.
3. There was a declining trend in the production of pulses.
4. Uttar Pradesh and Punjab had contributed 20.82 and 12.48 percent to the total foodgrains production.

II AREA UNDER CULTIVATION:

5. Total area under cultivation remained stable during the period of study, but the cropping pattern had changed in favour of wheat.

6. In the total area under cultivation, the share of irrigated area ranged between 24 and 32 percent during the period.

7. The percentage of unirrigated area declined from ~~the~~ 76 percent to 68 percent.

8. The ratio of irrigated to unirrigated area for rice transformed from 38:62 in 1970-71 into 43:57 into 1981-82.

9. The irrigated area percentage for wheat had increased from 54 to 70 percent and wheat accounted for about 70 percent of total irrigataed area.

10. The extent of area under cultivation of pulses was 92 percent unirrigated.

11. The area under high yielding variety seeds had increased significantly by 6.76 percent.

12. The consumption of fertilizer had also increased significantly by 9.06 percent.

13. The growth in yield was comparatively more in the case of wheat than in other cereals and pulses.

14. The yield had declined in the producton of Bajra.

III. VARIABILITY ANALYSIS :

15. The extent of variability was less in states like Kerala, Tripura, Meghalaya and Himachal Pradesh.

16. In Gujarat, Assam and Andhra Pradesh, the variability in production was comparatively more.

17. The extent of variability was more or less same in

other states (from the indices of variability, the coefficient of variation).

18. Extent of variability ranged between 10 and 25 in the case of production of foodgrains and between 10 and 20 in the case of crop yield.

19. Bajra had a high variability indices in both production and yield followed by wheat.

20. The variability in rice was comparatively less in both production and yield.

IV GROWTH ANALYSIS:

21. The total foodgrains had significantly increased by 2.59 percent.

22. Rice production had increased at a compound rate of 2.65 percent but the growth rate was not satistically significant (from the computed 't' values)

23. Wheat production had recorded a compound growth rate of 4.87 percent.

24. The area under High yielding variety seeds had increased by a compound rate of 6.76 percent.

25. The consumption of fertilzer had shown an impressive growth rate with 9.06 percent.

V INSTABILITY ANALYSIS:

26. First, second and three degree polynomials fitted to the data on foodgrains production where differenated with respect to time and the differential equation obtained was dy/dx 3.2 = 0, and the characteristic equation was S-3.2=0. The root of the equation R was 3.2 which is positive for the

other degrees also, the roots had positive signs indicated the existence of instability.

VI FACTORS RENPONSES:

27. The estimated regression equation relating to foodgrains production and area under cultivation was

$y = -460.9 + 4.64$ x one unit change of area under cultivation had increased the foodgrains production by 4.64 units.

28. The estimated equation relating foodgrains production fertilizer consumption was $y = 88.28 + 6.99$ x one unit change in fertilizer consumption had increased the foodgrains production by 6.99 units.

29. The estimated equation relating foodgrains production, area under high yielding variety seeds and fertilizer consumption was $y = 80.62 + 3.12x + .73$ z one unit increase in fertilizer consumption had increased the production by 3.12 units and it was only .73 units for area under High yielding variety seeds.

30.The technological transformation in terms of fertilizer use, and use of High yielding variety seeds had significant impact on foodgrains production of India.

In the light of the above discussion one can conclude ~~unable~~ that appropriate measures are to be taken by ~~this~~ the government to stabilise the foodgrains production which require a long term strategy. The most important element of the ~~shategy~~ strategy is to maximise the area under assured irrigation, ~~two~~ Another ~~their~~ dimension of this strategy is the ~~continuatin~~ consideration of regional factors in agricultural planning. In order ~~of~~ to increase yields per hectare a major thrust is required to

argument the flow of agricultural inputs particularly chemical and Bio-Chemical fertilisers. The government has how decided to give priority to these strategic tasks in order to stabilise agricultural growth along a higher path.

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