Growth and Variability in Pulses (Gram and Tur) Production : District-Wise Study of Haryana, Madhya Pradesh and Rajasthan (1960-61 to 1984-85)

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CERTIFICATE

Certified that the dissertation entitled,"GROWTH AND VARIABILITY IN PULSES (GRAM AND TUR) PRODUCTION: DISTRICT-WISE STUDY OF HARYANA,MADHYA PRADESH AND RAJASTHAN (1960-61 to 1984-85)" being submitted by Buta Ram in partial fulfilment for the award of the Degree of MASTER OF PHILOSOPHY (M.Phil.) in Jawaharlal Nehru University is to the best of my knowledge, a record of the student's own work,carried out by him under my supervision and guidance. It is hereby certified that this work has not been presented for the award of any other degree or diploma.

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CHAPTER-I

INTRODUCTION

Agriculture is the most important sector of the Indian Economy employing 66.68 per cent of total workers during 1981 and contributory 33.8 per cent (at 1981 prices) of national income during 1985-86. It has also been playing an important role in foreign exchange earnings. The value of export of selected agricultural commodities has been showing a steady upward trend rising from Rs. 335 crores in period 1965-66 to Rs.2269 crores in period 1979-80 recording an average annual compound growth rate of 1.6 per cent per annum. However, its share in total export earnings had declined marginally from 41.6 per cent in 1965-66 to 37 per cent in 1979-80. Share of agricultural commotidies in total imports has also declined from 38.4 per cent in 1965-66 to 14.4 in 1979-80 mainly because of the increase in foodgrains production due to the adoption of new technology. Soon after independence, there was a food shortage and substantial amount of foodgrains were imported upto 1965-66 under PL 480 scheme from the united states. The special efforts were made in the five year plans to raise agricultural output so as to achieve self sufficiency and the better nutritional standards.

Although, foodgrains production has increased from 80.97 million tonnes in 1960-61 to 146 million tonnes in 1984-85 showing grwoth rate of 2.38 per cent per annum. However, this gain has been neutralised by the rapid growth of 2.16 per cent per annum in population during 1951 to 1981. As a result growth in per capita terms is around 0.22 per cent per annum. This impressive growth of output of foodgrains is due to the substantial growth in wheat and rice crops because of green revolution in the mid sixties. The production of wheat and rice have shown growth rate of 5.71 and 2.16 per cent per annum during 1960-61 to 1984-85. As a result, production of cereals has shown growth rate of 2.72 per cent per annum during the period. However, the other component of foodgrains that is pulses has shown a growth rate of -0.25 per cent per annum in production which is less than the population growth and as a result daily per capita availability of pulses has declined from 69 gms to 38.1 gms during 1960-61 to 1984-85 (Table 1.1). If one compares international daily total nutritional supply availability (Table1.2), it can be observed that India is at the bottom and continues to be even behind the neighbouring countries of Pakistan and China what to talk about USA and Canada in terms of calories, proteins and fat contents.

The average Indian diet is not only insufficient in calories but also unbalanced in its composition. Large

section of our population suffer from protein malnutrition partly caused by an insufficient intakes of calories. Average per capita availability of protein in India was 50 gms in 1960 which has been declined to 38.1 gms due to shrinkage in area and almost stagnation of yields with rising population. In India, pulses are the only source of proteins for poor section of population. The daily per capita requirement of pulses has been calculated by Prof. Sukhatame[1] as 90 gms to 104 gms. The prevalence of proteins malnutrition appears to be widespread in the economically poor sections of the population. The availability of proteins under nutrition is particularly severe among children and pregnant and nursing mothers.[2]

Pulses have enriched the diet of the poor as well as the rich, as supplementary food. They provide the base to make curries or side-dishes to go with rice and cereal rotis. They are also the base for breakfast food and snacks. Being rich in proteins, they have played an important role in providing a balanced diet particularly to those who find fish and eggs too costly. But even those who eat meat continued to consume pulses also. Pulses not only play a role of cheap protein supplier in the absence of animal proteins for majority of the population in India but also carry out a much important task of fertility maintance

by supplying nitrogen to the soil through symbiosis in a cropping sequence. In relative dry land or the area where irrigation is very low along with uncertain rainfall, the pulses is the only crop which can assure some yield because high yielding varieties of foodgrains are not appropriate in dry regions. Only the pulse crop helps to tap moisture from the sub-soil layer in the initial stages for seed germination and after germination the plant can survive under relatively drier conditions.[3]. For example, the plant of khesari can grow vigorously under extreme drought conditions because of its hardiness and ability to give yield under poor conditions of farming and low fertility. Tur can prosper on residual moisture left in the field after harvesting the crop. It has been proved that crop mixed with pulses raise the production of crop. Such mixtures not only cover the risk in the case of uncertain rainfall but also the yield of both the crops under mixture shows increase. In the pulse growing states, some crop mixtures are well known like gram and wheat is important in unirrigated area, tur and jowar, tur and bajra, tur and cotton and urad and maize are important mixtures in both irrigated and unirrigated areas.

Pulses legumes produce organic matter which becomes more useful as a green manure crop because their seed rots

more easily and hence gets thoroughly incorporated in the soil. But, now with the increase in irrigation and adoption of new technology one finds that the mixed crops are disappearing because of decline in the risk factor.

1.1 EXISTING TRENDS IN THE PRODUCTION OF PULSES:

Pulses being an important crop in India, but over the period 1960-61 to 1984-85 total area under pulses and their yields per hectare have declined as a consequence the production of pulses has declined during the period. This decline in pulses production coupled with high rate of population lead to decline in daily per Capita availability of pulses (Table 1.1)

If one examine percentage annual growth rate in area, production and yield per hectare of pulses from 1960-61 to 1984-85, production has shown negative growth rate of -0.259 per cent per annum due to negative growth rate in area as well as negative growth rate in yield per hectare which are -0.088 and -0.156 per cent per annum respectively. It has also been found that during 1960-61 to 1966-67 total production of pulses has shown negative growth due to negative growth in area and yield per hectare (Table 1.3). However, production of pulses during 1966-67 to 1984-85 has shown positive growth rate of 1.91 per cent per annum mainly

because of increase in yields per hectare. In this period, growth in area was only 0.14 per cent per annum as compared to yields growth rate of 1.76 per cent per annum.

The decline in production of pulses during 1960-61 to 1984-85 is accounted for by the fact that pulses are grown under adverse condition and their lower responsiveness to the favourable condition of higher rainfall or irrigation facilities at least under available technology. On the other hand, the new HYV technology increased the responsiveness of rice and wheat to irrigation and fertilizer much more. Whenever irrigation was introduced to a region, it generally had the effect of reducing the area under pulses and increasing the area under superior cereals and cash crops. The pulses has thus continued to suffer due to a residual status (Table 1.4). The status of pulses has been changed both in absolute terms and relative terms (in comparison with foodgrains) Relatively, the area under pulses has declined along with decline in absolute terms, i.e.21per cent of area under foodgrains has been under pulses around 1960-61 and that of 18 per cent in 1984-85. Production of pulses has also been declining throughout in absolute terms. In relative terms, it contributed 15 per cent to the total production of foodgrains in 1960-61and only 8 per cent in 1984-85. On the other hand, area under

wheat and rice have increased in absolute terms and relative terms as well during the same period. Also the production of wheat and rice has increased in absolute terms. There has been increase in the poroduction of wheat in relative terms but relatively the production of rice has gone down marginally during the period (Table 1.4). It has been observed that pulses has lost their area mainly in favour of wheat and rice. Pulses are being low productive, therefore, with the decline of area under pulses, production of pulses has declined during the period.

There are significant regional variations in area under pulses and yield rates giving rise to differential pattern of production. States like U.P., M.P., Maharashtra, Bihar, A.P. and Karnataka together contributes around 78 per cent of all India's area and production of total pulses during 1984-85. The contribution of Punjab and Haryana is low in relative terms, but the study of these states becomes important from the viewpoint that area under pulses has been declining consistently since 1960-61, as has also happened in U.P. and Bihar.

As is implied by an earliere statement, pulse cultivation has suffered wherever irrigation and the new seed fertilizer technology have become prevalent. It is well

known that this technology has flourished best in wheat cultivating areas. Pulses areas in Punjab, Haryana, U.P. and Bihar have not only declined as a share in all India's pulses area, but the share of pulses in the total croping pattern when seen as a percentage to gross cropped area of the state has also declined over time (Table 1.5).

There are three states namely Rajasthan, Madhya Pradesh and Maharashtra which grow wheat to some extent but here the irrigation levels are so low that increases in the acreages of wheat has not affected the acreage under pulses. In the three states, a positive change is noticed between 1960-61 to 1983-84 in the states share of area under pulses in all India's pulse area and the proportionate area allocated to pulses in the cropping pattern has also increased in three states over time (Table 1.5).

As all three components are increasing in three states, one can easily infer that pulses in Rajasthan and Madhya Pradesh have gained in both seasons, despite the fact that the proportion of area irrigated has risen concurrently. This should be kept in mind that the adverse effects of irrigation in pulse cultivation are felt only after the irrigation level attains 30 per cent to gross cropped area.[4]

The remaining two states namely A.P. and Karnataka have managed to maintain their proportional contribution to all India area under pulses. In A.P. and Karnataka, the proportional area under pulses when compared to India's area under total pulses, declines somewhat over the years. In fact, the ratio of pulses to the respective gross cropped areas of these two states shows a relatively greater decline (Table 1.5). The irrigation level in A.P. is comparatively high and rising, the relative position of pulses in the cropping pattern has consistently declined though the decline is not as sharp as it has been in Punjab, Haryana, U.P. and Bihar. The reason possibly lies in the fact that irrigation in this state is highly localised and is mostly concentrated in the rice growing deltaic areas. In short, whenever proportion of area under irrigation has increased sharply, area under pulses has declined.

If one looks at the growth rate in production of pulses in nine pulse growing states, it has been found that pulses production has declined in four states which have shown high irrigsation level and sharp decline in area under pulses during 1960-61 to 1983-84. These states are Punjab, Haryana, U.P. and Bihar. It has been observed that where there is marked increase in irrigation and adoption of new technology in wheat and rice also there is an increase in

the irrigated area is above 30 per cent. Because of the adoption of new technology the better area has shifted towards wheat and rice crops, hence only the marginal lands are under the pulses which have witnessed negative growth rates. Except Punjab and Haryana, which have shown negative growth in yield, other states have shown positive growth in yield of pulses but the contribution of yield to the production of pulses is very low if one caompares with contribution of area during 1971-73 tp 1983 to 85 (Table 1.6).

1.2 SURVEY OF LITERATURE

A few studies have been undertaken to look into the uses and problems of production of pulses in India. Pulses were used as inter-crops in traditional cultivation also because they improved soil fertilikty in the process, implanting nitrogen from the air into the soil. Even if the first crop following the monsoon was devoted to pure cereal crops, pulses were cultivated in the following rabi season which restored fertility to the soil. In spite of this pulses are assuming secondary status in the farmer's decision calculas. It has been observed that the bulk of demand for pulses comes from lower and middle income groups and the income elasticity of demand for the lower and middle

income groups is more than unity.[5]. This suggests a rising pressure of demand from these groups with a rise in income.

The efforts to develop scientific agriculture in India have helped much to increase foodgrains production in the country but the increase in productivity had so far been confined to cereals, mainly in wheat and rice. On the other hand, the production of pulses has declined since 1967-68. As some scholars have observed that this decline in the production of pulses over a period of time has been mainly due to the decline in area under pulses which has been especially marked in the regions which have witnessed the introduction of new agricultural technology comprising growth promoting inputs like the high yielding varieties of seeds, use of chemical fertilizers and better farming practices despite the fact that prices of pulses have risen significantly.

However, according to some studies, the states which are important for kharif pulses are showing an upward trend in pulse production as well as a rise in area under pulses though the yield per hectare of kharif pulses has declined.[7]. The share of kharif pulses in total pulse production has increased but the production and area under rabi pulses have declined whereas the yield per hectarte of rabi pulses has almost remained constant. It has been

pointed out that the rabi pulses have faced tough competition from wheat and comparative yield per hectare of wheat is much larger than rabi pulses like gram, peas and kesari. This trend has been observed in Punjab, Haryana, U.P. and Bihar because these states has witnessed comparatively higher irrigation. On the other hand, in the states like M.P. and Rajasthan, there have been an increase in the area and production of rabi pulses due to increase in cropping intensity, yield per hectare of pulses, prices and rainfall during the sowing month of rabi pulses. The other reasons for the increase in area under rabi pulses in M.P. and Rajasthan are increase in gross cropped area and there is an absence of competing crops like wheat because this is a dry region.

Some others have observed that although the prices of pulses have become high however, it does not allure the farmers to put more area under pulses as they are still not as profitable as the foodgrains are. Because the pulses are grown mainly for home consumption and the concentration of areas under pulses is found mainly in small and marginal holdings.

There are several factors which adversely affect the area under pulses such as introduction of HYV of wheat and other commercial crops, disappearance of pulses mixed with

cereal, negative effect of irrigation after it reaches 30 per cent to gross cropped area and price and yield risk of pulses.

There are some factors which are responsible for low productivity of pulses. These are low rainfall and the primitive farm management practices of the average pulse grower. The former gives secondary importance to the pulses crop. The irrigation facilities are less in Maharashtra, Rajasthan, M.P. and Bihar, which are the main grower of pulses, therefore, the production of pulses in these states depends heavily in the amount of rainfall. Thus, the poor performance of pulses in these states may be attributed to the drought conditions. Kharif pulses are mainly rainfed crops and rabi pulses are generally grown in areas where moisture is conserved during the monsoon. Low rainfall not only affects productivity during kharif seasons, it also affects the subsequent rabi pulses such as gram and urad.

1.3 CROSS-CLASSIFICATION OF YIELD LEVELS AND GROWTH RATES:

In order to obtain joint frequency distribution of yield levels and growth rates, states have been cross classified according to their yield levels and growth rates. Two cross-classified tables have been prepared one each for 1971-73 and for 1983-85 (Table 1.7 and 1.8).

Three fold classification for each has been made for yield levels and growth rates of states. Those states which had yield levels 600 kgm. per hectare or more are defined as high yield levels states, those which had yield levels ranging between 400 to 600 kgm. per hectare are designated as medium yielding states and those which had productivity less than 400 kgm per hectare are called low yielding states. In terms of growth rates, the following three fold classification has been adopted.

(i) Annual growth rate ranging between 1.5 to 4.5 per cent -high growth states.

(ii) Ranging between 0 to 1.5 per cent- low growth states.

(iii) Negative growth rate- Decelerating states.

Table 1.7 shows that in 1971-73 both Punjab and Haryana which had high yield level showed negative growth rate during 1971-73 to 1983-85. Because of the adoption of new technology the better area has shifted towards wheat and rice crops, hence only the marginal lands are under the pulses which have shown negative growth rate over the period. Three states namely Bihar, M.P. and U.P. which had medium yield level, two of them M.P. and U.P. showed low growth rate and Bihar showed high growth rate during the

period. Four states, namely, A.P., Maharashtra, Rajasthan, and Karnataka come under low yield level category and among these four states, two of them A.P. and Maharashtra showed high growth rate and the remaining two of them i.e. Rajasthan and Karnataka showed low growth rate.

Table 1.8 shows that in 1983-85, three states (Bihar, U.P. and Punjab) had high yield level but one of them namely (Bihar) showed high growth rate, U.P. showed low and Punjab showed negative growth rate during 1971-73 to 1983-85. M.P., Rajasthan, and Haryana had medium yield level but M.P. and Rajasthan showed low and Haryana showed negative growth rate. A.P., Maharashtra and Karnataka come under low yielding category but two of them, namely, A.P. and Maharashtra showed high whereas Karnataka showed low growth rate during the period.

On comparison, it is observed that there has been increase in production during the period and two states (Bihar and U.P.) have crossed over from medium to higher category and Rajasthan has shifted from low to medium yielding category but, on the other hand, Haryana has shifted from high to medium yield level category during the period.

1.4. OBJECTIVE OF STUDY:

The present study intends to

1. Study the growth pattern of area, production and yield of different districts and analysis the interdistrict variations in growth of area, production and yield of gram and tur pulses.

2. Study the interdistrict variations in acceleration and deceleration in growth rate of area, production and yield per hectare of gram and tur pulses.

3. Decompose the growth of production into growth of yield and area of selected pulses.

1.5 COVERAGE OF STUDY:

(a) Choice of years: The present study covers a time series data of 25 years from 1960-61 to 1984-85. After taking triennium averages, the analysis has been carried out for 23 observations.

(b) District Covered: The coverage in terms of districts is as wide as allowed by the availablility of data. Out of 83 districts of three states namely M.P., Rajasthan and Haryana, study of 73 districts have been

undertaken for gram and 55 districts for tur pulse. A few districts in Haryana had to be combined in order to make them comparable temporaly. The twelve districts of Haryana have been clubbed to form seven composite and comparable districts. Faridabad and Gurgaon have been clubbed to form old Gurgaon district, three districts namely, Sirsa, Bhiwani and Hissar have been clubbed to form old Hissar district, two districts namely Kurukshetra and Karnal have been clubbed into one unit of Karnal and districts of Sonepat and Rohtak have been clubbed to form old Rohtak district. Those districts which have shown negligible area and production of gram or tur for most of the years have not been considered in this study.

1.6 DATA BASE:

The entire study is based on the data published by various states and central government statistical agencies. Thus, the data used in this study is from secondary sources only. The variables used are of area, production and yield of gram and tur pulses. Also districtwise data of net sown area, gross cropped area, net irrigated area, gross irrigated area and irrigated area under pulses have been used. The data for the study have been collected from following sources:-

(i) Season and crop reports of the selected states.(various issues)

(2) Statistical abstract of the selected states (various issues)

(3) Indian Agricultural statistics (various issues).

(4) Agricultural situation in India (various issues).

(5) Years of agriculture statistics Rajasthan 1956-57 to 1974-75.

(6) Bulletin on food statistics for different years.

(7) Estimates of area and Production (various issues)

(8) Economic survey for different years.

1.7 METHODOLOGY:

(a) Percentage annual compound growth rates have been calculated by fitting semi log function as:-

$$\log y = a+bt$$

where a is intercept, b is regression coefficient and t is time.

y is a dependent variable such as area, production and yield per hectare.

(b) Quadratic function has been fitterd to see the acceleration and deceleration in growth rate of area, production and yield such as:-

$$\log y = a+bt+ct^2$$

where b and c are coefficient of t and t^2, b shows growth (positive and negative) and c shows acceleration and deceleration in growth rates in the specified periods.

(c) Decomposition of the variability in Annual Output Growth Rates.

Annual Growth Rates have been calculated by

$$\log \frac{Yt+1}{Yt}$$

Thus, we get

$$Got = Gat+Gyt$$

where Got, Gat and Gyt are the annual growth rates in output, area and yield of the crop in year 't'.

The variability in annual output growth rates over a specified period of length T can be decomposed as

$$V(Go) = V(Ga) + V(Gy) + 2\,Cov\,(Ga, Gy).$$

NOTES:

1. Chopra, Kusum, and Swami, Gurushri, "Pulse - analysis of demand and supply in India", p. 8.

2. Chopra, Kusum and Swami, Gurushri, Ibid.

3. Indian Council of Agricultural Research, Ministry of Food and Agriculture, Agricultural Research in India - Achievement and outlook, New Delhi, April 1972, p.11.

4. Chopra, Kusum, "Pulse Production in India- a state-wise analysis". IJAE, Vol. 37-1982.

5. Kumar, B.L., "Declining Trend in Production of Pulses and Factor Effecting it" Economic and Political Weekly, 8th July, 1978, p.1112.

6. Kumar, B.L., Ibid.

7. Chopra, Kusum, "Pulse Production in India- a statewise analysis", IJAE, Vol.37-1982.

8. Rao, V.G., and Satyapriya, V.S., "Pulses: Growth, regional distribution and area response", IJAE, 1982.

Table 1.1 : Area, production, yield per hectare of pulses, population and daily per capita availability of pulses in India

Year	Population (in million)	Area under pulses (million hectare)	Production of pulses (million tonnes)	Yield Kgm/ hec.	Daily per capita availability of pulses
1960-61	442.4	23.1	12.7	547	69.0
1964-65	482.5	23.8	12.4	520	61.6
1966-67	504.2	22.1	8.3	377	39.6
1970-71	538.9	22.4	11.6	516	51.2
1980-81	675.2	22.6	11.2	493	30.9
1984-85	750.9	22.7	11.9	526	38.1

Source : Estimates of area and production of principal crops in India.

: Statistical abstract of India

: Economic survey of different years.

Table 1.2 : Daily per capita total nutritional supply in 1981-83 in selected countries.

	Countries in the world	Calories (Nos)	Proteins (Gm)	Fat (Gm)
1.	World	2665	69	63
2.	Canada	3421	98	156
3.	U.S.A.	3647	106	167
4.	China	2602	61	35
5.	India	2088	51	34
6.	Pakistan	2236	59	46
7.	France	3528	108	162
8.	U.K.	3162	87	143
9.	Australia	3382	97	137
10.	U.S.S.R.	3426	101	98

Source: Bulletin on food statistics

Table 1.3 : Percentage Annual compound growth rate in area, production and yield of pulses in India

	1960-61 to 1966-67	1966-67 to 1984-85	1960-61 to 1984-85
Production	-5.89	1.91	-0.259
Area	-0.697	0.14	-0.088
Yield	-5.18	1.76	-0.156

Table 1.4 : Area and production of foodgrains and their components

	1960-61	1970-71	1980-81	1984-85
Area (in million hec.)				
i) Coarse cereals	44.4(38)	45.6(37)	41.9(33)	39.2(31)
ii) Pulses	23.1(21)	22.4(18)	22.6(18)	22.7(18)
iii) Rice	34.2(29)	37.7(30)	40.1(32)	41.2(33)
iv) Wheat	13.3(11)	18.0(15)	22.2(17)	23.6(19)
v) All foodgrains	115.1(100)	123.5(100)	127.4(100)	126.7(100)
Production(in million tonnes)				
i) Coarse cereals	23.3(29)	27.4(26)	29.0(23)	31.2(21)
ii) Pulses	12.7(15)	11.6(11)	11.2(8)	11.9(8)
iii) Rice	34.0(42)	41.9(40)	49.7(40)	58.6(40)
iv) Wheat	11.1(14)	23.4(22)	35.2(28)	44.2(30)
v) All foodgrains	81.1(100)	104.3(100)	124.2(100)	145.9(100)

Note : Figures in brackets are percentages to all foodgrains.

Source: Derived from statistics in "Area and Production of Principal crops - 1981-84, 1984, Government of India; and Economic survey 1985-86", 1986, Government of India.

Table 1.5 : Statewise percentage share of area under pulses to all India, to gross cropped area and gross irrigated area to gross cropped area.

	State	1960-61	1970-71	1975-76	1983-84
1.	Punjab-state's share of area under pulses	3.74	1.84	1.79	0.84
	PA/GCA	19.08	7.29	6.35	2.84
	GIA/GCA	55.94	74.72	73.84	89.9
2.	Haryana - state's share of area under pulses	6.65	5.14	4.88	3.03
	PA/GCA	35.04	23.30	21.90	12.52
	GIA/GCA	26.29	44.99	50.30	63.2
3.	U.P. - state's share of area under pulses	18.84	16.53	12.90	11.88
	PA/GCA	20.93	16.05	13.56	11.16
	GIA/GCA	25.49	35.95	40.18	48.5

Contd... table 1.5

4. Bihar-state's share of area under pulses	9.66	5.55	6.26	5.17
PA/GCA	21.0	11.34	13.57	11.87
GIA/GCA	18.56	24.18	29.80	34.8
5. Rajasthan-state's share of area under pulses	12.48	16.05	18.32	15.72
PA/GCA	21.49	21.62	26.09	19.61
GIA/GCA	12.50	14.66	17.12	21.3
6. M.P.-state's share of area under pulses	15.44	18.84	19.60	21.12
PA/GCA	20.48	20.65	22.45	21.97
GIA/GCA	5.16	7.41	8.29	12.7
7. Maharashtra - state's share of area under pulses	9.74	11.05	11.91	12.58
PA/GCA	12.49	12.90	14.81	14.01
GIA/GCA	6.48	8.58	11.04	12.7

Contd...table 1.5

8. A.P.-state's share of area under pulses	5.18	5.23	5.92	6.36
PA/GCA	10.58	10.50	9.93	11.19
GIA/GCA	29.39	31.64	34.93	37.8
9. Karnataka-state's share of area under pulses	5.33	5.02	5.88	6.68
PA/GCA	12.15	12.88	8.56	13.71
GIA/GCA	9.22	12.45	15.30	16.9

where

PA = Area under Pulses

GCA = Gross cropped area

GIA = Gross irrigated area

Table 1.6 : Statewise growth rates in average area, production and yield of total pulses for the trienniums 1971-73 and 1983-85

State	Percentage Ann. comp. Growth rate 1983-85 over 71-73		
	Area	Production	Yield
A.P.	0.259	3.02	2.74
Bihar	-1.99	-0.49	1.53
Haryana	-4.23	-5.28	-1.102
Karnataka	1.87	2.86	0.95
M.P.	1.08	1.12	0.03
Maharashtra	2.09	4.45	2.41
Punjab	-4.92	-5.95	-1.07
Rajasthan	0.03	0.93	0.89
U.P.	-1.58	-1.03	0.55

Table 1.7: Cross-classification of states by 1971-73 yield level and growth rate over the triennium 1971-73 and 1983-85.

Yield level \ Growth rate	1.5 to 4.5%	0 to 1.5%	Negative
600 kgm per hectare & above			Punjab Haryana
400 to 600 kgm per hectare	Bihar	M.P. U.P.	
Less than 400 kgm per hectare	A.P. Maharashtra	Rajasthan Karnataka	

Table 1.8 : Cross-classification of states by 1983-85 yield level and growth rate over the triennium 1971-73 and 1983-85.

Yield level \ Growth rate	1.5 to 4.5%	0 to 1.5%	Negative
600 kgm per hectare & above	Bihar	U.P.	Punjab
400 to 600 kgm per hectare		M.P. Rajasthan	Harayan
Less than 400 kgm/ hectare	A.P. Maharasthra	Karnataka	

CHAPTER-II

SOME CHARACTERISTICS OF SELECTED DISTRICTS

2.1 HARYANA:

Agriculture production has risen progressively because of the infrastructure having been built since the reception of the state. The production of foodgrains had a quantum jump from 25.92 lakh tonnes in 1966 to nearly 81.46 lakh tonnes showing growth rate of 5.86 per cent per annum during 1965-66 to 1985-86. The production of rice has risen seven times; the production of wheat five times and potatoes four times; while that of cotton has increased to two and a half times during the same period. During 1985-86, 27.10 lakh hectares area was under high yielding varieties of wheat, rice, maize and bajra crops. This was merely 0.17 lakh hectares during 1966-67. The per hectare consumption of fertilizers has gone up over twenty fold from a mere 2.90 kg per hectare during 1966-67 to about 71 Kg. per hectare in 1986-87. The irrigation base has reached at 63.2 per cent during 1983-84. These various factors like introduction of HYV of cereals, use of fertilizer for HYV and high irrigation base have had a dempening effect on area , production and yield of pulses in this state. In all the districts of Haryana, except Mahendragarh which have also

shown around 29 per cent irrigation base during 1983-84, have shown irrigation base more than 30 per cent which is a crucial point for shift of area under pulses to cereals according to Prof.Kusum Chopra. The production of pulses mainly depends upon area under pulses, therefore, it is expected that production will decline with the decline in area under pulses. The irrigation base in all the districts of Haryana has increased at high rate since 1960-61 as a consequence of this, cropping pattern have shown substantial increase in area under wheat and rice but on the other hand, area under gram and total pulses as a percentage to gross cropped area and irrigated area under pulses as a percentage to gross irrigated area have declined sharply (Table 2.1). Therefore, with the introduction of high yielding varieties of cereals and non foodgrains like cotton, pulses become a second preference in farmer's decision in the states like Haryana where high irrigation base is in existance and new high yielding varieties are easily available for farmers. Farmers are eager to adopt new technology without any hesitation. Pulses continue to loose area to HYV of Wheat, rice, maize and bajra because of per hectare yields of HYV are more than that of pulses despite the fact that pulses prices are higher than HYV of wheat, cotton, rice, maize and bajra.

Area under gram and total pulses has also declined due to disappearance of cereal-pulse crop mixtures because the plant population tends to be very high under the new varieties of cereals. The pulses cultivation in this state is confined to the relative dry or less irrigated area as a consequence, production and productivity of pulses have declined during 1960-61 to 1984-85.

2.2 RAJASTHAN

Rajasthan is considered as agriculturally backward state which has a small irrigation base of 12.5 per cent during 1960-61 and 21.3 per cent during 1983-84. Irrigation is a main wheel around which all incentives of agricultural development move from time to time. The development of agriculture is considered with the increase in production but the production can increase with the introduction of high yielding varieties and new agriculture technology. It is a well known fact that HYV can be grown with high irrigation base. Agriculture production in this state is dependent on rainfall. Area and production of gram, tur and total pulses in the state has not declined during 1960-61 to 1984-85 because pulses are more profitable than cereals in relatively dry region.

It has observed that cropping intensity has increased in all the districts of Rajasthan with the increase of irrigation base and area under gram has also increased, except Jaipur, Swai Madhopur and Tonk, as a result of increase in irrigation base during the period 1960-61 to 1984-85. But three districts like Ajmer, Bhilwara and Chittorgarh have shown decline in irrigation base, among these three districts two of them namely Ajmer and Bhilwara have shown decline in area under gram also but, on the other hand, Chittorgarh has shown increase in area under pulses. The decline in irrigation base is due to the larger increase in gross cropped area than the increase in gross irrigated area. Irrigated area under pulses to gross irritated area is almost same over the period in these three districts (Table 2.2). It has been seen that if irrigation base has been increased in any district and irrigation base of that district is still less than 10 per cent than there is tendency that irrigated area under pulses would increase but there is one exception to this, i.e., Banswara. If irrigation base increases between 10 to 20 per cent, the irrigated area under pulses declines. This has been shown by Alwar and Swai Madhopur. The percentage area under tur is very small in all the districts of Rajasthan and with the increase in irrigation in the district, tur does not show much variation in area during 1960-61 to 1984-85.

2.3 MADHYA PRADESH

The state is endowed with vast agricultural mineral and industrial resources. The state remains backward even though it is blessed with rich resources. The average industrial production is very low as compared to the available potential. The agriculture productivity per hectare is less than the national average because of inadequate irrigation facilities. The economy of Madhya Pradesh is primarily agriculture based. Nearly 80 per cent of the population lives in village, over 43.5 per cent of the land area is cultivable, of which 14.4 per cent has been under irrigation during 1985-86. Forests cover nearly 32 per cent of the total area of the state. The main foodcrops include Rice, Wheat, Jowar, Maize, Bajra and pulses. The main commercial crops are oil-seeds, cotton and sugarcane.

At the time of formation of the state in 1956, 1.52 crores hectares of land was under cultivation which increased to 2.2 crore hectares in 1982-83 showing growth rate of 1.37 per cent per annum. The aggregate agricultural output was 86 lakh tonnes in 1956 and 127.84 lakh tonnes in 1982-83 showing growth rate of 1.47 per cent per annum. The fertilizer consumption increased from 0.125 lakh tonnes to 2.281 lakh tonnes in the same period. The irrigated area in this state has increased from 8.2 lakh hectares to 23.32

lakh hectare during 1956 to 1983. The number of irrigation pumps iuncreased from 265 in 1956 to 4.71 lakhs in 1983. The irrigation base was 5.16 per cent in 1960-61 and 12.7 per cent during 1983-84. It has been seen that whenever irrigation base has increased the area under total pulses has increased during the period in most of the districts. But the districts where the irrigation base has crossed the 20 per cent level during the period, area under total pulses has declined in those districts such as Balagat, Durga, Gwalior, Morena and Raipur (Table 2.3). It has also been seen that the districts where gram's area to total area under pulses is high, area under gram has been declined in those districts. It shows that area under gram has been shifting to other pulses also because total area under pulses have not declined whrereas there is a decline in area under gram. One finds that the proportion of area under tur to total area under pulses is very low but the district where area under tur was more than 5 per cent to total pulses during 1962 has shown either constancy or decline in area under tur during 1960-61 to 1984-85. Majority of the districts have shown marginal increase in area under tur. The cropping intensity in general is very low. There are very few districts which show a cropping intensity of more than 120 per cent which is itself low. Therefore, low cropping intensity in M.P. has resulted in

not allowing to increase in the area under crops. It has been observed that if irrigation base has increased in the districts but still it is less than 15 per cent, then irrigated area under pulses to gross irrigated area has a tendency to increase but on the other hand, if irrigation base has increased after 15 per cent then irrigated area under pulses to gross irrigated area has a tendency to decline (Table 2.3) . It is possible that when irrigation base in the district has increased after 15 per cent the irrigated area under tur has shifted towards cotton crop.

SUMMARY OF FINDINGS:

(1) The area under gram and total pulses in Haryana has declined as a consequence of sharp increase in irrigation during 1960-61 to 1984-85 in this state, as a result area has shifted to wheat.

(2) Gram and tur did not loose area in majority of the districts in Rajasthan because irrigation base in this state is low and only the pulses can assure some yields. A few districts have shown decline in area under gram because these districts have irrigation base around 20 per cent or more as a consequence of which HYV of cereals are being grown in these districts.

(3) 'Area under tur did not show significant increase with the increase in irrigated area as has been shown by gram in Rajasthan during the same period.

(4) In M.P., the districts where share of gram is very high to total pulses area, gram has lost its area to other high yielding rabi pulses because with the increase in irrigation base in these districts total area under pulses have shown increase but area under gram has shown decline during 1960-61 to 1984-85.

(5) In M.P., the districts showing 5 per cent or more area under tur to total area under pulses during early sixties did not show any increase in area under this crop. Area under tur in these districts has a tendency to either remain constant or decline during the period under study.

Table 2.1 Share of Gram and total pulses in district's cropping pattern, cropping intensity, Irrigation base and irrigated area under pulses as percentage to gross cropped area in Haryana.

District	GA/GCA		Tot Puls/GCA		GCA/NSA		GIA/GCA		IA PULS/GIA	
	1962	1984	1962	1984	1962	1984	1962	1984	1962	1984
1. Ambala	15.6	8.8	21.4	12.5	136.9	149.8	10.38	57.62	0.0	4.8
2. Gurgaon	26.0	7.2	26.5	8.2	123.9	153.5	11.62	49.62	4.1	3.9
3. Hissar	43.1	29.5	44.3	29.8	125.3	141.2	30.13	57.04	32.1	19.5
4. Jind	34.4	19.7	35.0	20.6	133.4	152.7	51.39	81.95	20.9	11.9
5. Karnal	24.5	3.5	26.7	4.5	139.1	157.9	34.75	91.86	10.4	2.3
6. Mahindergarh	31.7	22.9	33.0	23.0	150.9	148.2	3.91	28.53	27.9	4.6
7. Rohtak	28.1	12.7	28.4	12.9	140.3	141.1	31.10	59.52	17.8	8.8

where

GA = Area under Gram

TOT PULS = Area under total pulses

NSA = Net sown area

GIA = Gross irrigated area

IA PULS = Irrigated Area under pulses

Table 2.2 Share of Gram, Tur and Total Pulses in district's cropping pattern cropping intensity, irrigation base, Irrigated area under pulses as percentage to Gross Irrigated area in Rajasthan

District	GA/GCA		TA/GCA		TOT PULS/GCA		GCA/NSA		GIA/GCA		NPULS/GIA	
	1962	1984	1962	1984	1962	1984	1962	1984	1962	1984	1962	1984
1. Ajmer	9.9	8.8	0.1	0	10.1	8.8	118.4	124.5	27.22	23.85	3.2	3.9
2. Alwar	7.0	20.8	0.6	1.3	7.6	22.1	130.1	133.5	10.16	20.0	9.1	6.5
3. Banswara	2.0	13.4	1.6	2.0	3.7	15.4	125.4	131.7	2.65	7.4	16.5	13.9
4. Bharatpur	4.8	16.2	1.2	0.6	6.0	16.8	118.3	120.5	20.03	19.65	28.4	11.4
5. Bhilwara	12.1	6.2	0.0	0.0	12.1	6.2	137.5	139.6	53.76	41.58	4.9	4.0
6. Bundi	6.4	12.8	0.0	0.2	6.4	13.1	107.4	115.3	20.10	42.19	9.7	10.9
7. Chittor-garh	2.8	11.1	0.1	0.2	2.9	11.3	125.1	138.5	30.93	26.58	2.4	2.5
8. Dungar-pur	4.6	12.9	0.5	0.8	5.2	13.7	135.5	138.5	7.02	9.81	6.0	6.5
9. Ganga-nagar	1.4	32.6	0.0	0.0	1.4	32.7	104.0	111.8	28.01	48.36	28.3	22.6
10. Jaipur	17.0	10.7	0.3	0.3	17.3	11.0	113.9	119.1	24.25	30.09	7.7	10.7
11. Jalawar	0.9	11.2	0.6	1.0	1.5	12.2	110.8	119.2	7.85	12.39	4.1	6.0
12. Jhunjhunu	1.6	12.1	0.0	0.0	1.6	12.1	105.6	117.3	2.37	4.76	1.3	2.5

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13.	Kotah	Kotah	1.4	13.5	0.1	0.1	1.5	13.5	103.5	109.2	6.62	24.64	13.4	21.5
14.	Pali	Pali	2.9	4.7	0.0	0.1	2.9	4.8	104.8	112.5	22.91	23.04	0.8	0.9
15.	Swai Madhopur		20.0	12.6	0.6	0.5	20.6	13.1	116.0	119.8	14.31	19.08	14.4	10.9
16.	Sikar		2.6	5.1	0.0	0.0	2.6	5.1	103.3	109.9	5.81	9.61	3.5	8.0
17.	Sisohi		2.3	4.9	0.2	1.1	2.5	6.0	110.4	120.9	23.49	33.7	1.3	2.1
18.	Tonk		14.3	11.1	0.1	0.0	14.4	11.1	107.6	110.7	14.48	16.53	3.0	3.3

Where

(i) GA = Area under Gram
(ii) TA = Area under Tur
(iii) GCA = Gross Cropped Area
(iv) TDT PULS = Area under total pulses
(v) NSA = Net sown
(vi) GIA = Gross irrigated area
(vii) IAPULS = Irrigated area under pulses.

Table 2.3 : Share of Gram, Tur and Total Pulses in district's cropping pattern, Cropping intensity, irrigation base and irrigated area under pulses as percentage to gross irrigated area in M.P.

District	GA/GCA 1962	GA/GCA 1984	TA/GCA 1962	TA/GCA 1984	TOT PULS/GCA 1962	TOT PULS/GCA 1984	GCA/NSA 1962	GCA/NSA 1984	GIA/GCA 1962	GIA/GCA 1984	IAPULS/GIA 1962	IAPULS/GIA 1984
1. Balagat	8.0	1.6	0.5	0.6	15.5	7.0	140.6	129.8	24.37	36.68	0.0	0.2
2. Bastar	0.4	0.2	0.4	0.3	9.5	6.4	104.6	104.1	2.17	1.23	0.0	0.4
3. Betul	9.0	7.4	7.4	7.5	24.6	24.1	109.2	112.1	4.5	10.11	16.6	10.8
4. Bhind	29.1	22.6	5.8	5.1	38.6	34.9	103.1	106.2	8.20	2.62	20.9	11.8
5. Bilaspur	2.1	3.9	0.9	0.7	9.7	7.6	129.2	120.3	8.23	13.99	0.0	0.1
6. Chhatarpur	14.8	13.2	1.8	2.1	22.4	22.7	111.5	114.0	16.09	18.68	15.2	9.7
7. Chhindwara	9.2	6.7	3.8	5.5	16.9	27.9	106.8	110.8	3.13	8.9	11.8	10.6
8. Damoh	9.1	14.4	1.2	1.5	14.8	26.2	107.7	109.3	3.94	3.36	0.9	1.6
9. Datia	26.3	25.8	2.1	4.4	33.1	38.2	101.7	104.0	3.36	20.3	13.3	8.9
10. Dewas	6.3	8.2	3.9	4.6	12.6	15.1	102.4	110.7	1.76	9.53	16.9	17.1
11. Dhar	10.5	9.9	2.2	1.8	13.6	24.0	109.2	114.7	3.51	10.49	6.1	6.7
12. Durga	3.7	4.2	2.5	1.8	12.4	9.5	131.6	132.8	7.18	23.01	0.0	0.3
13. East Nimar	1.7	1.6	3.3	3.0	13.8	16.0	103.4	106.3	2.23	9.38	3.0	6.0
14. Guna	15.9	15.6	0.4	0.3	19.5	19.6	104.0	104.4	2.54	2.69	8.5	11.1
15. Gwalior	21.4	16.6	2.3	3.9	27.9	26.0	106.0	108.8	23.39	23.98	6.7	5.3
16. Hoshangabad	11.7	10.6	4.9	7.5	18.6	21.7	101.5	102.7	1.27	12.08	2.7	9.6

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17. Indore	12.1	16.5	9.1	5.2	24.8	25.8	104.2	118.4	3.15	14.24	11.9	11.5
18. Jabal-pur	19.6	15.9	1.8	1.5	27.7	24.9	116.7	117.0	2.66	4.66	0.6	0.9
19. Jhabua	8.6	6.9	1.7	1.7	22.7	29.4	110.8	112.8	1.02	5.46	18.1	20.9
20. Mandsaur	7.7	15.6	0.8	1.1	12.2	29.9	118.2	138.1	9.23	2.74	3.4	7.7
21. Mandla	5.1	3.8	0.5	0.6	13.8	9.7	121.1	118.4	0.23	1.38	1.0	1.8
22. Morena	23.8	15.7	4.0	4.8	30.4	23.2	110.5	113.2	4.72	39.67	14.9	14.6
23. Narsim-pur	30.8	31.9	2.8	6.3	40.7	56.4	103.2	104.8	1.17	9.15	1.2	4.2
24. Panna	10.3	12.1	2.2	2.8	15.2	18.4	111.6	111.9	2.66	5.24	10.3	5.5
25. Raigarh	0.4	0.6	0.4	0.4	12.4	11.3	107.0	106.3	0.98	4.25	1.3	0.6
26. Raipur	Ø 6	0.3	0.5	0.3	10.7	4.1	135.5	129.5	12.45	25.86	0.0	0.1
27. Raisen	22.3	19.9	0.7	3.0	33.2	36.9	101.4	101.2	0.65	2.19	1.5	2.8
28. Rajgarh	5.3	9.1	1.9	2.5	10.4	14.5	106.8	110.9	4.59	4.75	8.0	22.7
29. Ratlam	11.0	14.6	1.4	1.3	15.7	26.7	110.1	122.7	5.28	7.75	7.9	8.3
30. Rewa	9.4	10.7	5.3	2.7	19.8	16.7	122.2	125.4	0.24	3.98	1.7	1.4
31. Sagar	7.7	11.2	0.9	0.8	17.9	22.4	103.7	106.3	1.48	3.20	4.5	4.6
32. Satna	8.8	9.0	3.2	3.8	15.3	15.3	118.7	119.8	0.98	2.62	4.6	2.3
33. Sehore	8.4	11.7	3.3	4.0	15.6	19.7	103.1	106.0	3.27	6.66	7.9	10.9
34. Seomi	7.9	7.1	0.6	1.1	14.1	15.5	108.9	106.4	5.98	6.61	0.2	1.3
35. Shahdol	3.7	2.3	1.2	2.2	10.2	9.3	111.6	112.8	0.22	1.15	0.7	0.4
36.												

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36. Shahja-pur	4.3	10.3	2.8	3.3	9.9	17.8	105.3	112.5	3.36	7.38	8.7	30.3
37. Shivpuri	8.1	9.9	0.7	0.2	14.8	17.9	111.4	114.0	12.29	16.88	11.8	12.4
38. Sidhi	7.0	9.1	4.1	5.7	16.2	17.5	124.9	130.1	0.30	1.99	3.4	3.9
39. Tikam-garh	4.7	5.8	0.3	0.4	12.1	14.9	122.3	126.3	24.44	28.73	19.5	13.3
40. Surguja	1.6	0.9	1.2	1.1	13.7	10.8	112.2	112.2	0.54	2.03	1.3	1.0
41. Ujjain	8.9	13.7	2.0	2.6	13.3	21.3	103.8	113.5	1.79	8.47	8.7	16.0
42. Vidisha	17.5	19.0	0.4	0.8	20.8	25.3	102.2	102.7	0.26	1.73	1.2	14.8
43. West Minar	2.2	1.7	2.9	3.3	12.1	19.3	107.8	110.0	3.13	13.27	4.6	5.2

CHAPTER-III

GROWTH IN AREA, PRODUCTION AND YIELD

In this chapter the growth rates of area, production and yield have been analysed to see the comparative performance of the various districts. It will also helps to analyse the contributions in growth of production in terms of area and yield. Growth rates in area, production and yield have been calculated by Semi log function with time as an independent variable such as

$$\log Y = a + bt$$

Linear function such as $y = a + bt$ has not been taken to calculate growth rate because when only time is a independent variable and the linear function is based on the assump-tion that the growth of agricultural output in the current year does not depend upon the previous year. This assumption seems to be unrealistic in the case of economic time series data. Therefore, use of linear equation for the estimation of growth rates over the period of time is inappropriate. What is worse, the linear rate of growth postulated to be constant over the period, it is sought to be converted into an equivalent compound rate of growth because the linear rate of growth is found to be not very

convenient for any comparison of growth between two periods, between two regions or between two crops. Logically, if we need to estimate the compound rate of growth over the period, the right and proper procedure is to choose the log linear function log y = a +bt and not the linear one y = a+bt.

It is obvious that if the linear rate of growth is constant over the period, the compound rate of growth cannot be constant; in fact the the former implies a declining compound rate of growth. This is made the basis for fitting both the linear and the log linear functions and if the linear function yields a higher value of R^2 than does the log linear function, it is taken as evidence that the compound rate of growth over the period is not constant but is declining. If the value of R^2 in both the cases are equal or nearly equal then it is difficult to decide whether the rate of growth is constant or declining. Therefore, it is illogical choosing between the linear and the log linear functions on the basis of R^2 values. In this study, the analysis is carried out with the log linear function only as it directly gives the compound growth rates which are more sensible.

All the growth rates during 1960-61 to 1984-85 have been estimated on the basis of three yearly moving averages

because the secular trend in the cropped area, production and yield of various crops are found out by removing the short term fluctuations. The data of area and production have been taken only for those districts which are predominant in the production of gram and tur pulse during 1960-61 to 1984-85. As has been mentioned in the first chapter some districts of Haryana state have been clubbed to make them comparable over time.

Growth of cropped area, under the crop (Gram or tur) and its yield are the two main factors responsible for the growth in the production. For analyses all the districts have been divided into seven categories on the basis of growth in production of the crop. The seven categories are as follows:-

1. Districts showing positive significant growth in production due to positive significant growth in cropped area as well as yield per hectare.

2. Districts showing positive significant growth in production due to positive significant growth in area but growth in yield per hectare is either non-significant or negative significant.

3. Districts showing positive significant growth in production due to positive significant growth in yield

per hectare but growth in cropped area is either non-significant or negative significant.

4. Districts showing negative significant growth in production due to negative significant growth in cropped area as well as yield per hectare.

5. Districts showing negative significant growth in production due to negative significant growth in cropped area but growth in yield per hectare is either non-significant or positive significant.

6. Districts showing negative significant growth in production due to negative significant growth in yield per hectare but growth in cropped area is either non-significant or positive significant.

7. Districts showing non-significant growth in production due to (a) growth in cropped area is positive significant but growth in yield per hectare is negative significant.(b) The growth in yield per hectare is positive significant but growth in cropped area is negative significant, (c) The growth in cropped area as well as yield per hectare are non-significant, and (d) only one of the cropped area and yield shows significant growth.

3.1 GRAM:

In the first category one finds that there are twenty-three districts which have shown positive significant growth in production due to positive significant growth in cropped area as well as yield per hectare during 1960-61 to 1984-85. Among these twenty-three districts; eleven of them belong to M.P. such as Dewas, Dhar, Guna, Hoshangabad, Indore, Mandsaur, Raigarh, Rajgarh, Ratlam, Shajapur and Sidhi and the remaining twelve districts belong to Rajasthan such as Ajmer, Bundi, Chittorgarh, Dungarpur, Jaipur, Jalore, Jalawar, Jhunjhunu, Jodhpur, Kotah, Nagaur and Sikar (Table 3.1). If one looks at the growth rate of area under gram and growth rate in yield per hectare during 1960-61 to 1984-85 their respective contribution to the growth in production on gram, one can easily say that the production has increased due to increase in cropped area though the increase in yield per hectare is significant but very small. This is because pulses are grown in dry land or relatively less irrigated land and there is no scope for shift of area and also there is not much improvemnent in their yields as one cannot use fertilizers and related inputs. Area under pulses has increased mainly due to increase in gross cropped area and gram is still grown as a mixed crop in the absence of assured irrigation in these districts which have shown increase in area under gram.

In the second category, there are fourteeen districts which have shown positive growth in production due to positive growth in cropped area during 1960-61 to 1984-85. Among these fourteen districts; twelve of them belong to M.P. such as Bilaspur, Chhatarpur, Demoh, East Nimar,Jhabua, Raisen, Sagar, Tikamgarh, Shivpuri, Ujjain, Vidisha and Narsimhpur and the remaining two districts belong to Rajasthan such as Swai Madhopur and Tonk. Production has increased due to increase in cropped area in the districts of M.P. and Rajasthan because both the states have very low irrigation base. So the major share of the increased gross cropped areea has remained under pulses because there are no competing crops like wheat towards which area could have shifted. Therefore, area under gram has increased mainly due to increase in gross cropped area.

In the third category, there are seven districts which have witnessed positive significant growth in production of gram due to positive significant growth in yield per hectare during the period . Among these seven districts, two of them belong to M.P. such as Detia and Sehore and the remaining five districts belong to Rajasthan such as Alwar, Bharatpur, Bhilwara, Ganganagar and Sirohi. It has been observed that yield per hectare of gram has increased in these districts due to better irrigation facilities which

also resulted in the shift of area under gram away from this crop.

In the fourth category, there are only two districts which have witnessed negative significant growth due to negative significant growth in area as well as yield per hectare of gram during the period. Both the districts belong to Haryana such as Jind and Karnal. It has been observed that since 1960-61 the irrigated area has been increasing rapidly in Haryana because of large investments in tubewells and canals and as a consequence HYV of wheat and rice introduced in the state and per hectare yield of gram could not compete with per hectare yield of wheat. Therefore, area under gram has shifted towards wheat crop during the period. The yield per hectare of gram has shown negative growth in two districts mainly because of yield per hectare of gram in these districts was high before the introduction of HYV of wheat and after the introduction of HYV of wheat, good irrigated land shifted from gram to wheat and remaining marginal land could not give high yield despite the fact that irrigated area under pulses in these districts has increased during the period.

In the sixth category, there are eight districts which have shown negative significant growth in production of gram due to negative significant growth in area under gram during

1960-61 to 1984-85. Among these eight districts; three of them belong to Haryana such as Ambala, Gurgaon and Rohtak and the remaining five districts belong to M.P. such as Balagat, Betul, Durga, Gwalior and Surguja. It has already mentioned that area under gram has declined during the period because of increase in irrigated area in these district, the area under pulses might have shifted towards wheat crop.

In the seventh category, there are eighteen districts which have shown non significant growth in production of gram during the period. Among these eighteen districts; two of them showed non-significant growth due to positive significant growth in area and negative significant growth in yield per hectare. These districts are Banswara and Churu in Rajasthan. Four of them showed non significant growth in production due to negative significant growth in area and positive significant growth in yield per hectare. These four districts are Bhind and Raipur in M.P.; Pali in Rajasthan and Mahendergarh in Haryana. Six of them showed non significant growth in production due to non-significant growth in area under as well as yield per hectare. These six districts are Hissar in Haryana; Bastar, Panna, Rewa, Seoni and Shahdol in M.P. and the remaining six districts which have shown non significant growth in production due to

negative significant growth in area and non-significant growth in yield per hectare. These districts are Chhindwara, Jabalpur, Mandla, Morena and Satna in M.P. and Barmer in Rajasthan. It has observed that if area under gram showed increase , that area was marginal as a result yield showed decline and the production could not increase. In some districts yield showed positive growth but area under gram showed decline in those districts. It might have happened that with the increase of irrigation yield of gram showed increase but good irrigated land shifted towards the wheat crop. In the six districts which have shown non-significant growth in production due to non-significant growth in area as well as yield per hectare during the period. It might have happened due to low irrigation base in these districts and the gross cropped area could not increase and yield did not increase due to marginal land under the cultivation of gram during the period.

3.2 **TUR:**

In the first category, there are twenty five districts which have shown positive significant growth in production due to positive significant growth in area under the crop as well as yield per hectare of tur during 1960-61 to 1984-85. Among these twenty five districts; twenty of them belong to M.P. such as Chhatarpur, Chhindwara, Demoh, Detia, Dewas,

Gwalior, Hoshangabad, Jhabua, Mandsaur, Morena, Narsimhpur, Panna, Raisen, Rajgarh, Ratlam, Seoni, Shajapur, Sidhi, Tikamgarh and Ujjain and the remaining five districts belong to Rajasthan such as Dungarpur, Chittorgarh, Jaipur, Kotah and Sirohi reported in Table 3.2 under the category 1. It has been observed from the table that production of tur has increased due to major contribution by area increase and marginal increase in yield of tur during the period. The yield of tur could not increase at high rate because the area which had increased under the crop were marginal lands or low irrigated and improper management by farmers. Area under tur has increased due to increase in gross cropped area and cultivation of tur as mixed crop in the districts under this category.

In the second category, there are six districts which have shown positive significant growth in production due to positive significant growth in area under tur during the period. Among these six districts; five of them belong to M.P. such as East Nimar, Guna, Shahdol, Vidisha and West Nimar and the remaining one district belongs to Rajasthan namely Ganganagar. The reason for the increase in area under tur is same as has been given in category one is increase in gross cropped area and tur does not face competition from the crops like rice and cotton in these

states. The competiting crops for tur are rice and cotton but the cultivation of rice in M.P. and Rajasthan is not very profitable because it requires assured irrigation and cotton cultivation is also not very profitable.

In the third category, one finds that there are nine districts which have witnessed positive significant growth in production due to positive significant growth in yield per hectare during the period. All of them belong to M.P. such as Balagat, Betul, Bhind, Indore, Mandla, Sagar, Satna, Sehore and Udaipur reported in Table 3.2 under the category third. Yield per hectare of tur might have increased due to some increase in irrigation and better farming.

In the fifth category, one finds that there are five districts which have shown negative significant growth in production due to negative signficant growth in area under tur during the period. Among these five districts; four of them belong to M.P. such as Durg, Raigarh, Raipur and Shivpuri and the remaining one district namely, Bharatpur belongs to Rajasthan. (Table 3.2). The area under tur might have declined due to inter-pulse movement in area. The other reason is area shifted towards commercial crops like cotton.

In the sixth category, there is only one district in Rajasthan namely Swai Madhopur which has shown decline in production of tur due to decline in yield per hectare of tur during the period has reported in Table 3.2. Tur is not one of the major pulse crops in Rajasthan. So it might be possible that farmers in Rajasthan do not care much about tur cultivation which is also a main cause along with less irrigatioin for the negative growth in yield of tur.

In the seventh category, one finds that there are nine districts which have shown non-signficant growth in production during the period reported in Table 3.2 under the category of seventh. Among the nine districts, six of them belong to M.P. showed non significant growth in production due to negative signicant growth in area and positive significant growth in yield. The remaining three districts belong to Rajasthan such as Jalawar, Alwar and Banswara; Jalawar showed non-significant growth in production due to positive signficant growth in area under tur and negative significant growth in yield and Alwar showed non-significant growth in production due to non significant growth in area as well as yield during the period.

SUMMARY OF FINDINGS:

1. It has been observed that growth of production of gram and tur has been mainly due to the growth of area under these crops. As there are no districts which show that negative growth in production is due to negative growth in yield only.

2. In Haryana, production of gram has declined mainly due to decline in area under gram as a consequence of sharp increase in irrigation and area being diverted to wheat for which new technology became available leading to substantially high rates of yield as compared to gram. There are only two districts which have shown negative growth in yield per hectare during the study period because of the production of gram getting confined only to the marginal lands.

3. In case of tur crop only one district, namely, Swai Madhopur in Rajasthan showed that production has declined mainly due to yield decline otherwise the yield of tur has remained constant in majority of the districts.

4. In M.P. and Rajasthan, some districts have shown that production of gram and tur has increased due to

increase in yield only mainly because of little expansion of irrigation, which did not allow the shift away of the area.

Table 3.1 : Districtwise Growth in Production of Gram during 1960-61 to 1984-85.

District	Ann.Comp. growth in production	Ann.Comp. growth in area	Ann. Comp. growth in yield
Category I			
1. Dewas (M.P.)	4.479*	3.742*	0.71*
2. Dhar (do)	3.58*	1.89*	1.657*
3. Guna (Do)	4.56*	3.267*	0.423*
4. Hoshangabad (do)	2.135*	0.985*	0.69*
5. Indore (do)	4.88*	3.233*	0.523*
6. Mandsaur (do)	11.523*	9.75*	0.663*
7. Raigarh (do)	1.776*	1.112*	0.196*
8. Rajgarh (do)	5.895*	4.817*	0.386*
9. Ratlam (do)	6.734*	5.476*	0.398*
10. Shajapur (do)	8.06*	6.66*	0.804*
11. Sidhi (do)	3.74*	2.10*	0.434*
12. Ajmer (Rajasthan)	3.75*	2.02*	1.52*
13. Bundi (do)	10.08*	8.29*	1.13*
14. Chittorgarh (do)	14.43*	13.12*	0.38*
15. Dungarpur (do)	8.36*	6.47*	1.38*
16. Jaipur (do)	10.17*	9.54*	0.43*
17. Jalore (do)	9.56*	7.67*	0.618*
18. Jalanor (do)	13.9*	12.91*	0.415*
19. Jhunjhunu (do)	10.79*	9.97*	0.53*
20. Jodhpur (do)	8.58*	6.67*	1.37*
21. Kotah (do)	12.03*	11.56*	0.44*
22. Nagpur (do)	12.63*	11.51*	0.59*
23. Sikar (do)	11.08*	10.72*	0.64*

Contd...

Category II

1. Bilaspur (M.P.)	3.91*	4.05*	-0.138
2. Chattarpur (do)	2.145*	1.726*	0.44
3. Damoh (do)	3.339*	3.167*	0.167
4. East Nimar (do)	2.356*	1.803*	0.195
5. Jhabua (do)	3.09*	3.806*	-0.296
6. Raisen (do)	2.189*	1.181*	0.379
7. Sagar (do)	6.03*	4.17*	0.573
8. Tikamgarh (do)	3.14*	2.47*	0.65
9. Shivpuri (do)	3.25*	2.27*	0.389
10. Ujjain (do)	5.50*	5.3*	0.192
11. Vidisha (dp)	2.97*	3.36*	-0.37
12. Narsimhpur (do)	2.75*	1.464*	0.445
13. Swai Madhopur (Rajasthan)	7.86*	7.57*	0.22
14. Tonk (do)	3.07*	2.64*	0.22

Category III

1. Datia (M.P.)	2.614*	0.096	2.518*
2. Sehore (do)	1.459*	0.717	0.29*
3. Alwar (Rajasthan)	2.79*	1.05	1.8*
4. Bharatpur (do)	1.5*	-0.04	1.55*
5. Bhilwara (do)	3.52*	1.21	1.99*
6. Ganganagar (do)	3.72*	1.42	1.99*
7. Sirohi (do)	1.79*	-0.52	1.24*

Category IV

1. Jind (Haryana)	-4.52*	-2.45*	-2.12*
2. Karnal (do)	-14.56*	-12.8*	-2.0*

Contd...

Category V			
1. Ambala (Haryana)	-6.59*	-5.00*	-1.66
2. Gurgao (do)	-7.71*	-9.09*	1.527*
3. Rohtak (do)	-5.72*	-5.27*	-0.47
4. Balagat (M.P.)	-1.75*	-2.96*	1.247
5. Betul (do-)	-1.77*	-1.2*	-0.58
6. Durga (do)	-2.56*	-2.33*	-0.231
7. Gwalior (do)	-2.2*	-1.98*	-0.262
8. Surguja (do)	-1.93*	-2.07*	0.043
Category VI	N.A.	N.A.	
Category VII			
(a)			
(1) Banswara (Rajasthan0	1.38	3.97*	-2.69*
(2) Churu (do)	-0.5	3.14*	-2.17*
(b)			
(1) Bhind (M.P.)	-0.03	-1.54*	1.535*
(2) Raipur (do)	-1.05	-2.25*	0.344*
(3) Pali (Rajasthan)	0.71	-1.29*	1.28*
(4) Mahindergarh (Haryana)	-1.36	-2.93*	1.62**
(c)			
(1) Hissar (Haryana)	-0.62	0.138	-0.758
(2) Bastar (M.P.)	-0.3 08	-0.80	0.499
(3) Panna (do)	0.787	0.033	0.250
(4) Rewa (M.P.)	1.16	-0.01	0.359
(5) Seoni (do)	-0.685	-0.15	-0.15

Contd...

(6)	Shahdol (M.P.)	-1.11	-0.883	-0.07
(D)				
(1)	Chhindwara (M.P.)	-1.22	-1.94*	0.733
(2)	Jabalpur (do)	-1.21	-1.12*	-0.045
(3)	Mandla (do)	-0.542	-1.22*	0.246
(4)	Morena (do)	-1.18	-2.25*	0.453
(5)	Satna (do)	-0.68	-1.5*	0.255
(6)	Barmer (Rajasthan)	0.78	-0.719	1.59*

Where

* = significant at 1% level

Table 3.2 : Districtwise Growth in Production of Tur during 1960-61 to 1934-85.

District		Ann.comp. Growth in production	Ann.comp. Growth in area	Ann.Comp. Growth in yield
Category I				
1. Chhatarpur	M.P.	4.554*	3.392*	0.361*
2. Chhindwara	(do)	3.919*	2.895*	0.503***
3. Demoh	(do)	3.699*	2.54*	0.394**
4. Detia	(do)	5.049*	3.708*	0.757*
5. Dewas	(do)	3.525*	1.344*	0.705*
6. Gwalior	(do)	5.967*	3.106*	0.957*
7. Hoshangabad	(do)	3.677*	2.642*	0.506**
8. Jhabua	(do)	3.909*	2.491*	0.404**
9. Mandsaur	(do)	3.315*	1.93*	0.47**
10. Morena	(do)	3.287*	0.749***	1.55*
11. Narsimhpur	(do)	6.598*	5.211*	0.675*
12. Panna	(do)	2.853*	1.167**	0.811*
13. Raisen	(do)	10.424*	8.572*	0.977*
14. Rajgarh	(do)	6.702*	5.169*	0.482**
15. Ratlam	(do)	2.634*	1.012**	0.585*
16. Seoni	(do)	4.285*	3.03*	0.573**
17. Shajapur	(do)	4.592*	3.204*	0.807*
18. Sidhi	(do)	4.585*	3.107*	0.642*
19. Tikamgarh	(do)	7.006*	5.051*	0.627*
20. Ujjain	(do)	4.07*	2.358*	0.586*
21. Chittorgarh	(Rajasthan)	7.762*	7.422*	0.341*
22. Dungarpur	(do)	8.592*	7.617*	0.509*
23. Jaipur	(do)	3.232**	2.02**	0.335***
24. Kotah	(do)	7.409*	6.595*	0.538*
25. Sirohi	(do)	7.26*	6.64*	0.351*

Contd...

Category II				
1. East Nimar	(M.P)	1.27**	1.088**	0.147
2. Guna	(do)	2.052**	1.222**	0.276
3. Shahdol	(do)	2.624*	2.289*	0.034
4. Vidisha	(do)	5.255*	4.688**	0.198
5. West Nimar	(do)	2.30*	1.385**	0.22
6. Ganganagar	(Rajasthan)	7.484*	8.42*	-0.94
Category III				
1. Balagat	(M.P.)	1.642**	0.466	0.566***
2. Betul	(M.P.)	1.505**	0.187	0.497**
3. Bhind	(do)	2.367*	-0.746*	1.093*
4. Indore	(do)	1.515*	-1.98*	0.775*
5. Mandla	(do)	1.699**	0.62	0.502**
6. Sagar	(do)	1.978*	0.458	0.514*
7. Satna	(do)	1.448**	0.22	0.479*
8. Sehore	(do)	1.913*	0.499	0.509*
9. Udaipur	(Rajasthan)	7.354*	7.007	0.392*
Category IV		N.A.	N.A.	
Category V				
1. Durga	(M.P.)	-7.63*	-6.79*	-0.33
2. Raigarh	(do)	-1.03*	-1.16*	0.05
3. Raipur	(do)	-2.84*	-3.22*	0.51**
4. Shivpuri	(do)	-3.15*	-3.66*	0.192
5. Bharatpur	(Rajasthan)	-2.52**	-3.31*	0.499***
Category VI				
1. Swai Madhopur	(Rajasthan)	-2.83*	-0.82	-1.12*

Contd...

Category VII

(a)			
1. Jalawar (Rajasthan)	-0.49	2.425*	-0.72*
(b)			
1. Bastar (M.P.	0.19	-1.19**	0.672**
2. Bilaspur (do)	-0.22	-1.45*	0.51**
3. Dhar (do)	0.824	-0.435**	0.35**
4. Jabalpur (do)	-0.14	-1.36*	0.58*
5. Rewa (do)	-0.19	-2.34*	0.59*
6. Surguja (do)	-0.44	-1.08*	0.296**
(c)			
(1) Alwar (Rajasthan)	0.694	1.303	-0.25
(d)			
(1) Banswara (Rajasthan)	-0.42	0.95	-0.46*

* = Significant at 1 % level
** = Significant at 5 % level
*** = Significant at 10 % level

CHAPTER-IV

ACCELERATION AND DECELERATION IN GROWTH OF PULSES

To see acceleration and deceleration in growth, Quadratic function has been fitted such as:-

$$\log Y = a+bt+ct^2 \ldots\ldots (1)$$

where b and c are coefficient of t and t^2 respectively. Coefficient of t shows growth and coefficient of t^2 shows acceleration and deceleration in growth rates. The function (1) has been fitted because semi log function fitted in the last chapter such as:-

$$\log Y = a+bt \ldots\ldots (2)$$

gives uniform growth rate over the period. It is a fact that growth rate need not be uniform over the period. It should be noted that the function (2) is a special case of the function (1) when $c = 0$. Hence, to judge whether the rate of growth is uniform, one needs to test whether c is significantly different from zero. The test involves that whether the improvement in R^2 due to the introduction of the additional parameter c is statistically significant or not. If it is, it is evident that the rate of growth is not uniform over the period; depending upon the sign of c, it is either increasing or decreasing.

There is said to be a problem of multicollinearity posed by fitting log Y = a+bt +ct^2 because of correlation between t and t^2 and it is sought to be resolved by measuring time (t) not from the beginning of the first year (calling the first year 1) but from the mid-point of period, namely (n+1/2). If we refer to time so measured by t , then its square (t^2) are orthogonal and it makes for some convenience in the estimation of the parameter and the subsequent test of significance. Hence, the procedure may be adopted. But this should not cause an impression that the normal procedure of measuring time from the beginning of the first year is somehow erroneous because of multicollinearity. Either procedure would give the same essential results. Moreover, while the shifting of zero of time to the mid-point of the period has certain computational convenience, it may be more than outweighed by the requirement that there should be no gap in the time series. The correlation between t and t^2 will not cause any more problem than a minor computational inconvenience and does not deserve special attention on that account.

Seventy three districts for gram crop and fifty-five districts for tur crop have been taken into consideration. Further, disaggregation of these districts like that among the seventy-three districts of gram; fourtythree of them

belong to M.P., twenty-three of them belong to Rajasthan and the remaining seven districts belong to Haryana. It should be noted that the remaining five districts of Haryana have been clubbed with existing seven districts to make them comparable. Two districts of M.P. and three districts of Rajasthan have been taken out of study because most of the data for these years for production and area in these five districts was negligible. Among the fifty-five districts of tur; fourty-three of them belong to M.P. and the remaining twelve districts belong to Rajasthan. For the tur crop also the districts which have not considered for the study are having negligible production and area.

In order to observe acceleration and deceleration in growth rate in various districts, nine categories are made on the basis of the sign and statistical significance of the coefficient of t and coefficient of t^2 as follows:-

Category 1: Districts showing positive growth at increasing rate. In this category, the coefficients of t and t^2 both will be positive significant.

Category 2: Districts showing positive growth at decreasing rate. In this category, the coefficient of t will be positive significant but coefficient of t^2 will be negative significant.

Category 3: Districts showing negative growth at decreasing rate. In this category, the coefficient of t will be negative significant but coefficient of t^2 will be positive significant.

Category 4: Districts showing negative growth at increasing rate. In this category, the coefficients of t and t^2 both will be negative significant.

Category 5: Districts tending to acceleration in growth. In this category, the coefficient of t will be non-significant and the coefficient of t^2 will be positive significant.

Category 6: Districts tending to deceleration in growth. In this category, the coefficient of t will be non-significant and the coefficient of t^2 will be negative significant.

Category 7: Districts showing positive constant growth rates. In this category, the coefficient of t will be positive significant and the coefficient of t^2 will be non-significant.

Category 8: Districts showing negative constant growth rates. In this category, the coefficient of t will be

negative significant and the coefficient of t^2 will be non-significant.

Category 9: Districts showing stagnation. In this category, the coefficient of t and t^2 both will be non-significant.

4.1 GRAM:

4.1.1 Area under Gram:

The result shows that there are no districts in the first category i.e. area under gram is not accelerating over the period. That may be because of the fact that as the irrigation expands, the area shift towards the wheat and in the dry areas the gross cropped area is not expanding rapidly. Where as in the second category, 31 districts out of 73 districts which have shown that area under gram has increased at declining rate during 1960-61 to 1984-85. Among these thirty-one districts; three of them belong to Haryana such as Ambala, Karnal and Rohtak; sixteen of them belong to M.P. such as Betul, Bhind, Chhatarpur, Chhindwara, Detia, Gwlior, Indore, Mandla, Morena, Panna, Raigarh, Shahdol, Sidhi and Tikamgarh and the remaining twelve districts belong to Rajasthan such as Barmer, Bhilwara, Chittorgarh, Churu, Dungarpur, Jaipur, Jalore, Jalawar, Jodhpur, Nagaur, Pali and Sikar (Table 4.1). There are

various reasons for this declining rate of increase in area under gram during the period. It has been observed that under less risky conditions, the farmers have always preferred to grow high yielding varieties of cereals instead of pulses. Secondly, pulses are grown mainly in semi-arid interior regions of the country where there is growth in gross cropped area was also low and inter-crop change in area has not been in the favour of gram. The quadratic growth function is a good fit. For all the districts under this category there is a significant improvement in the correlation coefficient for all the thirty one districts.

In the third category, there are ten districts which have shown that area under gram has declined at declining rate during the study period. Among these ten districts; nine of them belong to M.P. such as Demoh, Hoshangabad, Mandsaur, Narsimhpur, Raipur, Raisen, Ratlam, Sagar and West Nimar and the remaining one district belong to Haryana such as Hissar. All the district in this category, except Hissar, have not shown irrigation base more than 15 per cent which shows that only irrigated area under gram might have shifted to other rabi crops because of small irrigation base, only irrigated land can shift from gram to wheat. In Hissar, area which has declined under gram must have come under wheat crop. The quadratic function is good fit,

except for Hissar, for all the districts which have come under this category.

In fifth category, there are only two districts which have shown tendency to acceleration in the growth of area under gram during the period . These districts are Bilaspur and Guna in M.P. Gram is major crop among the pulses in M.P., so with increase in gross cropped area the area under gram will increase because HYV of cereals are not more profitable in these district with existing irrigation level. The regression function is good fit for both the districts in this category.

In the sixth category, there are two districts which have shown tendency to deceleration in growth of area under gram. Both the districts belong to Haryana such as Gurgaon and Mahindergarh . (Table 4.1). It has observed that irrigation base has high in these districts, therefore, gram has lost the area to wheat. Gram crop will have continued to lost area unlessor until the yield of gram will be less than wheat. The regression function is good fit for both the districts in this category.

In the seventh category, there are two districts such as Jhunjhunu and Kotah in Rajasthan which have shown positive constant growth in area under gram during the

period.(Table 4.1). One can see that irrigation base in jhunjhunu district is very low as a consequence the increase in gross cropped area will be low which is main reason for constant growth in area under gram in this district. On the other hand, Kotah has shown higher percentage of irrigated area of more than 20 per cent. It might be possible that marginal lands could have increased under gram and some irrigated land shifted to wheat as a consequence the growth in area is a positive but at constant rate. The regression function is good fit for both the districts.

In the eighth category, there is only one district in M.P. namely Surguja which has shown negative constant growth in area under gram during the period. It might be possible that gram has continued to lost irrigated area to wheat. The regression function is good fit for this district.

In the nineth category, there are twenty five district which has shown stagnancy in area under pulses during the period. Among these twenty-five districts; seventeen of them belong to M.P. such as Seoni, Durga, Balagat, Bastar, Dhar, East Nimar, Jhabua, Jabalpur, Dewas, Rajgarh, Rewa, Satna, Sehore, Shivpuri, Vidisha, Shajapur and Ujjain; seven of them belong to Rajasthan such as Ajmer, Bundi, Sirohi, Swai Madhopur, Tonk, Bharatpur and Ganganagar and the remaining one district belong to Haryana such as Jind. It

has been seen that majority of the districts in this category have shown low irrigation base and low cropping intensity which are main factor responsible for increase in gross cropped area and with the increase of gross cropped area in M.P. and Rajasthan, area under gram could have increased. On the other hand, districts which have high irrigation base and high cropping intensity, it is true that irrigated area under gram has been shifted to wheat and marginal land came under gram and cropping intensity has also not helped in increasing the area under gram. Therefore, these districts showed stagnancy in area under gram. Among these twenty-five districts, the regression function is not good fit only for five districts such as Seoni, Bastar and Rewa in M.P. and Bharatpur and Ganganagar in Rajasthan.

4.1.2 **YIELD OF GRAM**:

In the second category, there are eighteen districts which have shown positive growth in yield of gram at declining rate during the period. Among these eighteen districts, 4 of them belong to Haryana such as Ambala, Jind, Karnal and Rohtak; 5 of them belong to M.P. such as Balagat, Indore, Morena, Raisen and Rewa and the remaining nine districts belong to Rajasthan such as Ajmer, Alwar, Barmer, Bharatpur, Bhilwara, Dungarpur, Ganganagar, Kotah and Swai

Madhopur (Table 4.3). Yield of Gram has increased due to increase in irrigated area under gram although irrigated area under gram or total pulses still have very small as a proportion to gross irrigated area. It is true that pulses are less responsive than high yielding varieties of cereals to the availability of more favourable conditions of higher rainfall or irrigation at least under available technology as a consequence the irrigated land has been shifted from pulses to HYV of cereals. The non-availability of HYV of gram is one of the major factors which are responsible for its declining rate of growth in yield and stagnant yield per hectare over the period . The regression function is good fit, except Rewa, for all the districts of this category.

In the third category, there are eighteen districts which have shown negative growth at declining rate in yield of gram during the period. Among these eighteen distgricts, fifteen of them belong to M.P. such as Chhatarpur, Demoh, Detia, Guna, Gwalior Mandla, Panna, Raigarh, Ratlam, Sehore, Shahdol, Shajapur, Shivpuri, Tikamgarh and Vidisha and remaining three districts belong to Rajassthan such as Banswara, Churu and Jalore (Table 4.3). There are many reasons for this sharp decline in yield of gram in these districts such as irrigated land has been shifted towards wheat and Marginal or fallow or low standard land has been

coming under gram. It is a reality that without the use of irrigation, fertilizer and HYV of gram, the yield per hectare of gram will decline with the addition of low standard land. The regression functiuon is good fit, except vidisha, for all the districts in this category.

In the fifth category, there are only two distrricts one each in Madhya Pradesh, namely Sagar and Rajasthn namely Sirohi which have shown acceleration in growth of yield during the period. It has happened due to marginal, increase in the factors which can boost the yield level of gram. The regression function is good fit for both the districts in this category.

In the seventh category, there is only one district namely Jhunjhunu in Rajasthan which has shown constant positive growth during the period. It has observed that with the addition of new dry land under the gram crop, there was no scope for increasing rate of growth in yield per hectare of gram. It could have either declined or constant over the period. The regression function is good fit for this district.

In the ninth category, there are thirty four districts, which have shown stagnancy in yield per hectare during the period. Among these thirty four districts; three of them

belong to Haryana such as Gurgaon, Hissar and Mahindergarh; twenty two belong to M.P. such as Bastar, Chhindwara, Bilaspur, Dewas, Dhar, Durga, East Nimar, Jabalpur, Mandsaur, Raipur, Raigarh, Satna, Sidhi, Ujjain, Betul, Bhind , Hoshangabad, Jhabua, Narsimhpur, Seoni, Surguja and West Nimar and the remaining nine districts belong to Rajasthan such as Bundi, Jodhpur, Pali, Tonk, Jalawar, Nagaur, Chittorgarh, Jaipur and Sikar (Table 4.3). The yield per hectare in these districts is remain stagnant due to traditional cultivation of gram at dry land. The regression function is good fit for sixteen districts out of thirty four districts in this category. These districts are Dewas, Dhar, Mandsaur, Raipur, Sidhi, Bhind, Hoshangabad and West Nimar in M.P.; Bundi, Jodhpur, Pali, Nagaur, Chittorgarh, Jaipur and Sikar and Gurgaon in Haryana,

4.1.3 **PRODUCTION OF GRAM:**

In the second category, there are twenty five districts which have shown increase in production at decreasing rate during 1960-61 to 1984-85. Among these twenty-five districts; five of them belong to Haryana such as Ambala, Gurgaon, Jind, Karnal and Rohtak; seven of them belong to M.P. such as Balagat, Indore, Morena, Raigarh, Rewa, Satna andSidhi and the remaining thirteen districts belong to

Rajasthan such as Ajmer, Alwar, Barmer, Bharatpur, Bhilwara, Chittorgarh, Dungarpur, Ganganagar, Jalawar, Jodhpur, Nagaur, Swai Madhopur and Sikar. In some districts, production has increased at declining rate because of area under these districts has also increased at declining rate during the period and the remaining districts has shown increase in production at declining rate due to yield of gram has increased at declining rate. The regression function is good fit for all the districts in this category.

In the third category, there are twelve districts which have shown decline in production at declining rate during the period. Among these twelve districts; eleven of them belong to M.P. such as Bastar, Chhatarpur, Demoh, Guna, Hoshangabad, Mandsaur, Ratlam, Sagar, Shivpuri, Vikdisha and West Nimar and the remaining one district belong to Rajasthan such as Banswara. The production has declined in these districts due to decline in area and low productivity of gram. The regression function is good fit, except Bastar, for all the districts in this category during the period.

In the fifth category, there is only one district in M.P. such as Shajapur which has shown acceleration in the growth of gram production during the period. In this

district, area under gram has stagnant. Therefore, production has shown acceleration in growth due to yield. The regression function is good fit for this district.

In the sixth category, there is also one district which is in M.P. such as Betul has shown that production of gram has decelerated during the study period. It has due to declining rate of growth in area under gram. (Table 4.2). The regression function is good fit for this district.

In the seventh category, there are four districts which have shown positive constant rate of growth in production of gram during the period. All the four districts belong to Rajasthan such as Jhunjhunu, Jaipur, Kotah and Pali. Jhunjhunu has shown positive growth rate in production due to constant growth rate in area and yield during the period. Jaipur and Pali have shown constant positive growth due to stagnant yield rate and Kotah has shown constancy in growth of production of gram mainly due to area under gram is also showed constancy in growth. The regression function is good fit for all the four districts in this category.

In the nineth category, there are thirty districts which have shown stagnancy in production of gram during the period. Among these thirty districts; twenty three of them

belong to M.P. such as Jhabua, Surguja, Tikamgarh, Narsimhpur, Bhind, Chhindwara, Dewas, Dhar, Jabalpur, Raisen, Rajgarh, Shahdol, Ujjin, Bilaspur, Detia, East Nimar, Gwalior, Mandla, Durga, Panna, Raipur, Sehore and Seoni; six of them belong to Rajasthan such as Bundi, Churu, Sirohi, Jalore,and Tonk and the remaining two districts belong to Haryana such as Hissar and Mohindragarh. The production of gram has shown stagnancy in these districts mainly due to decline in cropped area and marginal increase in yield or cropped area and yield remain stagnant or in some districts, cropped area has increased and decline in yield. The regression function is not good fit for eleven districts out of thirty districts in this category. These districts are Bhind, Chhindwara, Jabalpur, Mandla, Panna, Raipur and Seoni in M.P.; Churu and Tonk in Rajasthan and Hissar and Mahindergarh in Haryana.

4.2 TUR:

4.2.1 AREA UNDER TUR:

In the second category, there are thirty five districts which have shown increase in area under tur at declining rate during the period. Among these thirty five districtgs, thirtyone of them belong to M.P. such as Balagat, Bastar, Betul, Bhind, Chhatarpur, Chhindwara, Detia, Dewas, Dhar,

Guna, Gwalior, Jabalpur, Mandsaur, Mandla, Morena, Narsimhpur, Panna, Raigarh, Raipur, Ratlam, Sagar,Satna, Seoni, Shahdol, Shajapur, Sidhi, Surguja, Tikamgarh, Ujjain, Vidisha and West Nimar and the remaining four districts belong to Rajasthan such as Chittorgarh, Dungarpur, Kotah and Sirohi (Table 4.4). The area under tur has increased although at declining rate in 35 districts out of 55 districts which have included for the study because tur does not face strong competition, like gram from wheat, from cereals in kharif season. It does not mean that there is not competiting crop for tur during kharif season. Cotton and Rice are commercial HYV crops in kharif season also. But rice can grow with highly assured irrigation with good quantity of rainfall also. Rice in both the states like M.P. and Rajasthan is not much profitable because of uncertain rainfall and less availability of assured irrigation. The second competiting crop is cotton, but tur has an advantage over the cotton crop as being part of the people's daily diet. Therefore, small and marginal holdings in M.P. and Rajasthan continue to grow pulses especially gram, tur and moong are main among all the pulses. The uncertainty in the cultivation of cotton and rice is more than tur in M.P. and Rajasthan. Therefore, with the increase in gross cropped area or with the increase of tur mixed crop's area, the area under tur has incrased in these

districts during the period. The regression function is good fit for all the districts, except Sagar, in this category during the period.

In the third category, there are three districts which have shown that area under tur has declined at declining rate during the period. Among these three districts, two of them belong to Rajasthan such as Jalawar and Madhopur and the remaining one district belongs to M.P. such as Demoh. It has observed that area has declined under tur because irrigated area under tur might have shifted towardss cotton and rice. Thre regression function is good fit for all these three districts.

In the seventh category, there is only one district namely Udaipur in Rajasthan which has shown constant positive growth in area under tur during the period. This district have high irrigation base as a consequence irrigated area hgas been shifted towards commercial crops and tur is not major pulse crop in Rajasthan. Therefore, growth in area under tur is positive constrant because it might be cultivate as mixed with cotton during the period. The regression functiuon is good fit for this district.

In the eighth category, there are two districts such as Rewa and Shivpuri in M.P. which have shown constant

negative growth in area under tur during the period. It might be due to area under tur has been shifted to cotton because cotton is more profitable crop than tur in irrigated land. The regression function is good fit for both the districts.

In the ninth category, there are fourteen districts which have shown stagnancy in area under tur during the period. Among these fourteen districts, nine of them belong to M.P. such as Bilaspur, East Nimar, Durga, Hoshangabad, Raisen, Rajgarh, Jhabua, Sehore and Indore and the remaining five districts belong to Rajasthan such as Ganganagar, Alwar, Banswara, Bharatpur and Jaipur. It might be possible that the ara under tur has remain constant over the period due to increase in marginal land under tur and the equal to marginal land which has had increased under tur the irrigated land under tur might be shifted to cotton and rice with the increase in irrigation base. The regression function is good fit, except East Nimar, Sehore, Alwar, Banswara and Jaipur for all districts in this category.

4.2.2 YIELD OF TUR:

In the second category, there are thirteen districts which have shown positive growth at decling rate in yield of tur during the period. Among these thirteen districts,

seven of them belong to M.P. such as Bhind, Guna, Indore, Jhabua, Mandsaur, Rajgarh and Satna and the remaining six districts belong to Rajasthan such as Alwar, Bharatpur, Chittorgarh, Dungarpur, Ganganagar and Sirohi. The majority of these districts have shown increase in irrigation base during the period which is the main factor responsible for increase in yield of tur. The irrigation can increase the yield per hectare of tur but the total yield per hectare will be less as compared with cotton and rice yield in irrigated area as a consequence irrigatged land has shifted from tur to rice or cotton. When irrigation base is less then irrigated land will continue under the cusltivation of tur during kharif season and it will boost the yield per hectare. The regression function is good fit, except Guna, for all the district which have come under the second category.

In third category, there is only one district such as Betul which has shown that the yield of tur has declined at declining rate during the period. It has due to the marginasl land has been increased as a consequence yield per hectare showed negative growth. The regression function is good fit for this district.

In the fifth category, there is only one district such as Jabalpur in M.P. which has shown acceleration in yield of

tur during the period. The regression function is good fit for this district.

In the seventh category, there are two districts such as Kotah and Udaipur in Rajasthan which have shown constant positive growth during the study period. The tur in Rajasthan is not major pulse crop. Therefore, it continue to grow at small proportion or mixed with cotton and it gave constant positive growth in yield. The regression function is good fit for both the districts in this category.

In the ninth category, there are thirty seven districts which have shown stagnancy in yield of tur during the period. Among these thirty seven district, thirty three belong to M.P. such as Detia, Gwalior, Shajapur, Sidhi, Chhindwara, East Nimar, Hoshangabad, Sagar, Raisen, Ratlam, Tikamgarh, Bastar, Demoh, Durga, Narsimhpur, Panna, Shahdol, Surguja, Mandla, Balagat, Bilaspur, Chhatarpur, Dewas, Dhar, Morena, Raipur, Rewa, Sehore, Seoni, Shivpuri, Ujjain, Vidisha and West Nimar and the remaining four districts belong to Rajasthan such as Banswara, Jalawar, Jaipur and Swai Madhopur. The yield to tur has remain constant in these districts because of marginal land under the cultivation of tur, non availability of HYV of tur and negligible fertilizer consumption for tur crop. The

regression function is good fit for the districts in this category such as Detia, Gwalior, Shajapur, Sidhi, Hoshangabad, Sagar, Raisen, Ratlam, Tikamgarh, Dewas, Morena, Rewa, Sehore, Ujjain, Bunswara, Jalawar and Swai Madhopur.

4.2.3 **PRODUCTION OF TUR:**

In the second category, there are twenty seven districts which have shown positive growth in production at declining rate during the period. Among these twenty seven districts, twsenty two of them belong to M.P. such as Bhind, Chhatarpur, Detia, Dewas, Guna, Gwalior, Indore, Mandsaur, Mandla, Morena, Narsimhpur, Raigarh, Raipur, Sagar, Satna, Seoni, Shajapur, Sidhi, Surguja, Tikjamgarh, Ujjain and Vidisha and the remaining five districts belong to Rajasthan such as Alwar, Bharatpur, Chittorgarh, Dungarpur and Sirohi (Table .4.5). In the majority of these districts production has increased at declining rate because cropped area has had also shown increase at declining rate during the period. The regression function is good fit, except Alwar,for all the districts in this category.

In the third category, there is only one district such as Swai Madhopur in Rajasthan which has shown that the production of tur has declined at declining rate during the

period. The possible reason for this is the irrigated area might have shifted from tur to cotton or rice and with the increasze of gross cropped area, the area under tur did not increase during the period. The regression function is good fit for this district.

In the fifth category, there is only one distrrict such as Demoh in M.P. which has shown acceleration in growth during the period. It has due to positive growth in yield of tur in this district because area under tur has declined during the period. The regression function is good fit for this district.

In the seventh category, there are five districts which have shown constant positive growth in production of tur during the period. Among these five districts, three of them belong to M.P. such as Dhar, Guna and Ratlam and the remaining two districts belong to Rajasthan such as Kotah and Usdaipur. Four districts such as Dhar, Panna, Ratlam and Kotah has shown constant positive growth in productionof tur mainly due to increase in area at declining rate in these districts and the remaining one district namely Udaipur has shown constant positive growth in production due to area as well as yield have shown positive constant growth in this district during the period. The regression function

is good fit, except Dhar, for all the districts in this category.

In the ninth category, there are twenty one districts which have shown stagnancy in production of tur during the period. Among these twentyone districts, seventeen of them belong to M. P. such as Bastar, Shahdol, Raisen, Rajgarh, West Nimar, Chhindwsara, Balagat, Bilaspur, Jabalpur, Jhabua, Rewa, Betul, Durga, East Nimar, Hoshangabad, Sehore and Shivpuri and four of them belong to Rajasthan such as Banswara, Ganganagar, Jaipur and Jalawar. The regression function is good fit for the districts in this category such as Shahdol Raisen, Rajgarh, West Bengal, Chhindwara, Jhabua, Durga, Hoshangabad, Sehore, Shipuri and Ganganagar.

SUMMDARY OF FINDINGS:

It has been observed that area, production and yield of gram and tur have not been accelerating over the period and there are no district where it is decelerating at an increasing rate. Therefore, there are not many districts which have shown negative growth in area, production and yield of gram and tur. The production of both the crops have shown increase in half of the districts which have been selected for study. This increase in production is due to an increase in area under these crops only. The yield of

gram and tur did not show much increase except eighteen in districts for gram and thirteen districts for tur. More than half of the total districts studied have shown stagnancy in yield of gram and tur during the period. It has also been observed that irrigated area under gram and tur has been shifted to other crops and the marginal lands continue to come under the cultivation of gram and tur which is also one of the factors responsible for stagnancy of yield of gram and tur in man y districts. There are other factors which are responsible for stagnancy in yield of both the crops such as non availability of HYV of gram and tur, uncertain rainfall, use of pesticides and insecticides is also negligible for the control of pests, use of fertilizer is also negligible for the both the crops and improper management by the farmer.

Area under the tur crop has increased in 64 per cent of the total districts as compare to 43 per cent of the total districts in case of gram crop. It may be because tur crop faces less competition from HYV of rice and cotton as compare to gram. Gram faces tough competition from wheat during rabi season.

Table 4.1 : Acceleration and declaration of growth in area under gram during 1960-61 to 1984-85.

Functional form : $\log Y = a + bt + ct^2$

District		b	t value	c	t value	R^2
CATEGORY II						
1. Ambala	(Haryana)	0.865*	4.614	-0.006*	-4.891	0.88*
2. Karnal	(do)	0.842*	4.205	-0.007*	-4.89	0.96*
3. Rohtak	(do)	0.166**	1.722	-0.002**	-2.282	0.95*
4. Betul	(M.P.	0.262*	4.077	-0.002*	-4.268	0.81*
5. Bhind	(do)	0.129*	7.84	-0.001*	-8.788	0.98*
6. Chhatarpur	(do)	0.069*	2.665	-0.004**	-2.011	0.96*
7. Chhindwara	(do)	0.113*	3.006	-0.001*	-3.534	0.95*
8. Detia	(do)	0.100*	1.827	-0.001**	-1.811	0.38
9. Gwalior	(do)	0.204*	7.187	-0.002*	-7.54	0.93*
10. Indore	(do)	0.178**	2.428	-0.001**	-1.997	0.92*
11. Mandla'	(do)	0.278*	3.339	-0.002*	-3.489	0.75*
12. Morena	(do)	0.197*	3.049	-0.002*	-3.405	0.90*
13. Panna	(do)	0.226*	2.846	-0.002*	-2.846	0.54**
14. Raigarh	(do)	0.379*	8.568	-0.003*	-8.33	0.92*
15. Shehdol	(do)	0.432*	4.206	-0.003*	-4.296	0.73*
16. Sidhi	(do)	0.3003*	13.938	-0.002*	-12.98	0.99*
17. Tikamgarh	(do)	0.306*	5.45	-0.002*	-5.02	0.94*
18.						

Contd....

18. Alwar	(Raj.)	1.002*	6.42	-0.007*	-6.36	0.82*
19. Banswara	(do)	0.641*	2.838	-0.004*	-2.58	0.84*
20. Barmer	(do)	1.245*	6.056	-0.008*	-6.096	0.81*
21. Bhilwara	(do)	0.605*	4.749	-0.004*	-4.658	0.76*
22. Chittorgarh	(do)	0.216*	20.18	-0.001*	-6.39	0.99*
23. Churu	(Raj)	0.633*	3.24	-0.004*	-3.18	0.75*
24. Dungarpur	(do)	1.098*	2.774	-0.007*	-2.617	0.72*
25. Jaipur	(do)	0.239*	8.588	-0.002*	-4.40	0.99*
26. Jalore	(do)	0.594**	2.144	-0.004**	-1.879	0.84*
27. Jalawar	(do)	0.218*	12.86	-0.001*	-4.289	0.99*
28. Jodhpur	(do)	0.975*	3.232	-0.006*	-3.08	0.73*
29. Nagaur	(do)	0.246*	17.50	-0.002*	-8.67	0.99*
30. Pali	(do)	0.354**	2.057	-0.003**	-2.134	0.53**
31. Sikar	(do)	0.190*	12.79	-0.001*	-5.429	0.99*
Category III						
1. Hissar	(Har.)	-0.254**	-1.808	0.002**	1.819	0.37
2. Demoh	(M.P.)	-0.329**	-2.406	0.0024*	2.635	0.81*
3. Hoshangabad	(do)	-0.135*	-4.22	0.001*	4.53	0.89*
4. Mandsaur	(do)	-0.713*	-3.175	0.006*	3.592	0.92*

Contd...

5. Narsimhpur (M.P.)	-0.227*	-4.399	0.002*	4.686	0.88*
6. Raipur (do)	-0.310*	-4.114	0.002*	3.814	0.88*
7. Raisen (do)	-0.176*	-4.747	0.001*	5.07	0.90*
8. Ratlam (do)	-0.264**	-2.345	0.002*	2.82	0.94*
9. Sagar (do)	-0.225**	-2.52	0.002*	2.98	0.93*
10. West Nimar (do)	-0.706**	-2.234	0.005**	2.33	0.66**
Category V					
1. Bilaspur (M.P.)	-0.021	-0.592	0.0004**	1.733	0.98*
2. Guna (do)	-0.096	-1.707	0.001**	2.285	0.96*
Category VI					
1. Gurgaon (Haryana)	0.234	1.659	-0.002**	-2.336	0.97*
2. Mahindergarh(do)	0.288	1.69	-0.002**	-1.755	0.70*
Category VII					
1. Jhunjhunu (Raj.)	0.165*	0.121	-0.001	-1.899	0.99*
2. Kotah (do)	0.168*	6.74	-0.001	-1.67	0.99*
3.					
Category VIII					
1. Surguja (M.P.)	-0.200*	1.495	0.001	1.339	0.68*
2.					
Category IX					
1. Jind (Har.)	0.219	1.529	-0.002	-1.704	0.71*
2. Seoni (M.P.)	0.041	1.412	-0.0003	-1.465	0.40

Contd...

3.						
3.	Durga (M.P.)	-0.168	-1.368	0.001	1.176	0.74*
4.	Balagat (do)	-0.105	-0.454	0.001	0.324	0.58**
5.	Bastar (do)	-0.096	-1.111	0.001	1.018	0.49
6.	Dhar (do)	-0.012	-0.134	0.0002	0.342	0.75*
7.	East Nimer (do)	(-0.139	-1.045	0.001	1.180	0.69**
8.	Jhabua (do)	-0.453	-1.123	0.003	1.216	0.50**
9.	Jabalpur (do)	-0.009	-0.252	-0.00002	-0.619	0.87*
10.	Dewas (do)	0.046	0.494	-0.001	-0.102	0.91*
11.	Rajgarh (do)	0.102	0.942	-0.0004	-0.508	0.92*
12.	Rewa (do)	0.058	0.489	-0.0004	-0.49	0.11
13.	Satna (do)	0.187	1.172	-0.001	-1.268	0.51**
14.	Sehore (do)	0.026	0.211	-0.0001	-0.154	0.30
15.	Shivpuri (do)	0.043	0.677	-0.0001	-0.328	0.89*
16.	Vidisha (do)	0.077	0.583	-0.0003	-0.333	0.81*
17.	Shajapur (do)	0.048	0.75	0.0001	0.26	0.98*
18.	Ujjain (do)	0.03	0.23	0.0002	0.166	0.91*
19.	Ajmer (Raj)	-0.195	-0.935	0.002	1.033	0.50**
20.	Bundi (do)	-0.042	-0.292	0.001	0.848	0.96*
21.	Sirohi (do)	-0.035	-0.307	0.0001	0.166	0.61**

Contd...

22. Swai Madhopur(Raj.)	0.06	0.244	0.0001	0.052	0.85*
23. Tonk (do)	0.099	0.443	-0.001	-0.328	0.54**
24. Bharatpur (do)	-0.345	-1.685	0.002	1.684	0.35
25. Ganganagar (do)	-0.317	-1.58	0.002	1.65	0.47

Table : 4.2 : Acceleration and declaration of growth in production of gram during 1960-61 to 1984-85.

Functional gorm : $\log y = a + bt + ct^2$

District	b	t value	c	t value	R^2
Category II					
1. Ambala (Har.)	1.435*	4.298	-0.01*	-4.506	0.83*
2. Gurgaon (do)	0.476**	2.151	-0.004**	-2.515	0.90*
3. Jind (do)	0.733*	2.988	-0.005*	-3.179	0.78*
4. Kernal (do)	1.473*	4.604	-0.011*	-5.1	0.9*
5. Rohtak (do)	0.613*	3.524	-0.005*	-3.866	0.89*
6. Balagat (M.P.)	0.32**	2.53	-0.002*	-2.67	0.69*
7. Indore (do)	0.315*	3.87	-0.002*	-3.288	0.96*
8. Morena (do)	0.465*	3.764	-0.003*	-3.86	0.71*
9. Raigarh (do)	0.251*	4.111	-0.002*	-3.826	0.87*
10. Rewa (do)	0.399**	2.363	-0.003**	-2.296	0.54**
11. Satna (do)	0.199**	1.782	-0.001**	-1.844	0.47
12. Sidhi (do)	0.323**	2.459	-0.002**	-2.18	0.85*
13. Ajmer (Raj.)	2.068*	3.601	-0.013*	-3.379	0.82*
14. Alwar (do)	3.325*	3.203	-0.022*	-3.194	0.69*
15. Barmer (do)	2.046*	5.075	-0.014*	-4.98	0.77*

Contd...

16. Bharatpur (Raj.)	1.542*	5.647	-0.009*	-5.33	0.90*
17. Bhilwara (do)	1.208*	4.178	-0.007*	-3.83	0.85*
18. Chittorgarh (do)	0.167*	10.03	-0.0004**	-2.0004	0.99*
19. Dungarpur (do)	1.853*	4.597	-0.012*	-4.334	0.87*
20. Ganganagar (do)	2.53*	4.539	-0.016*	-4.312	0.85*
21. Jalawar (do)	0.194*	5.853	-0.001**	-2.176	0.97*
22. Jodhpur (do)	1.027*	3.513	-0.006*	-3.234	0.86*
23. Nagaur (do)	0.215*	8.05	-0.001*	-3.63	0.98*
24. Swai Madhopur (Raj.)	0.862**	2.538	-0.005**	-2.317	0.80*
25. Sikar (do)	0.153*	6.959	-0.001**	-2.204	0.98*
Category III					
1. Bastar (M.P.)	-0.205**	-1.775	0.001**	1.75	0.38
2. Chhatarpur (do)	-0.236*	-3.066	0.002*	3.346	0.86*
3. Damoh (do)	-0.876*	-6.229	0.006*	6.468	0.89*
4. Guna (do)	-0.320**	-2.171	0.003**	2.475	0.87*
5. Hoshangabad (do)	-0.188**	-1.989	0.002**	2.317	0.88*
6. Mandsaur (do)	-0.644**	-2.507	0.005*	2.938	0.93*
7. Ratlam (do)	-0.363*	-2.616	0.003*	3.088	0.94*
8. Sagar (do)	-0.315*	-3.634	0.003*	4.312	0.97*
9. Shivpuri (do)	-0.391*	-3.478	0.003*	3.765	0.87*
10. Vidisha (do)	-0.205**	-1.873	0.002**	2.143	0.84*

contd....

11. West Nimar (M.P.)	-0.744**	-2.468	0.005**	2.532	0.55**
12. Banswara (Raj)	-0.696*	-2.749	0.005*	2.806	0.57**
Category V					
1. Shajapur (M.P.)	-0.154	-1.578	0.002**	2.47	0.98*
Category VI					
1. Betul (M.P.)	0.155	1.627	-0.001**	-1.817	0.75*
Category VII					
1. Jhunjhunu (Raj.)	0.131*	4.732	-0.0004	-1.044	0.98*
2. Jaipur (do)	0.156*	4.019	-0.001	-1.543	0.97*
3. Kotah (do)	0.157*	5.032	-0.001	-1.421	0.98*
4. Pali (do)	0.365**	1.754	-0.002	-1.674	0.50**
Category IX					
1. Jhabua (M.P.)	-0.506	-1.452	0.004	1.54	0.51**
2. Surguja (do)	-0.267	-1.73	0.002	1.606	0.62**
3. Tikamgarh (do)	-0.114	-1.52	0.001	1.934	0.92*
4. Narsimhapur (do)	-0.246	-1.324	0.002	1.472	0.66*
5. Bhind (do)	0.108	1.222	-0.001	-1.226	0.26
6. Chhindwara (do)	0.113	0.633	-0.001	-0.699	0.37
7. Dewas (do)	0.09	0.659	-0.0003	-0.339	0.87*
8. Dhar (do)	0.095	0.617	-0.0004	-0.389	0.78*
9. Jabalpur (do)	0.118	0.716	-0.001	-0.79	0.41

Contd...

10. Raisen (M.P.)	0.074	0.654	-0.0004	-0.464	0.71*
11. Rajgarh (do)	0.143	0.848	-0.001	-0.509	0.88*
12. Shahdol (do)	0.146	1.046	-0.001	-1.127	0.45
13. Ujjain (do)	0.07	0.475	-0.0001	-0.113	0.89*
14. Bilaspur (do)	-0.003	-0.046	0.0003	0.705	0.96*
15. Detia (do)	-0.13	-1.001	0.001	1.202	0.75*
16. East Nimar (do)	-0.083	-0.458	0.001	0.537	0.59**
17. Gwalior (do)	-0.163	-1.164	0.001	1.006	0.69*
18. Mandla (do)	-0.059	-0.489	0.0004	0.445	0.26
19. Durga (do)	-0.003	-0.015	-0.002	-0.121	0.60**
20. Panna (do)	-0.002	-0.015	0.0001	0.094	0.40
21. Raipur (do)	-0.23	-1.259	0.002	1.202	0.39
22. Sehore (M.P.)	-0.143	-1.117	0.001	1.232	0.56**
23. Seoni (do)	-0.04	-0.367	0.0002	0.305	0.33
24. Bundi (Raj.)	-0.05	-0.243	0.001	0.796	0.95*
25. Churu (do)	-0.693	-1.974	0.005	1.961	0.40
26. Sirohi (do)	-0.274	-1.545	0.002	1.646	0.55**
27. Jalore (do)	0.368	1.515	-0.002	-1.141	0.90*
28. Tonk (do)	0.053	0.165	-0.0002	-0.071	0.46
29. Hissar (Har.)	-0.056	-0.229	0.0003	0.204	0.15
30. Mahindergarh (do)	0.349	1.264	-0.003	-1.315	0.37

Table 4.3 : Acceleration and decleration of growth in yield of gram during 1960-61 to 1984-85.

Functional form : $\log y = a + b t + ct^2$

District	b	t value	c	t value	R^2
Category II					
1. Ambala (Har.)	0.57*	3.029	-0.004*	-3.121	0.65*
2. Jind (do)	0.514*	2.84	-0.004*	-2.96	0.68*
3. Karnal (do)	0.632*	3.653	-0.005*	-3.773	0.72*
4. Rohtak (do)	0.446*	2.908	-0.003*	-2.942	0.56**
5. Balagar (M.P.)	0.425*	1.837	-0.003**	-1.834	0.45
6 Indore (do)	0.042**	2.011	-0.0003**	-1.757	0.82*
7. Morena (do)	0.117**	2.362	-0.001**	-2.272	0.58**
8. Raisen (do)	0.106**	1.957	-0.001**	-1.888	0.50**
9. Rewa (do)	0.120**	1.899	-0.001**	-1.844	0.46
10. Ajmer (Raj.)	0.186*	3.794	-0.001*	-3.489	0.88*
11. Alwar (Raj.)	0.221**	2.488	-0.001**	-2.289	0.77*
12. Barmer (do)	0.239*	4.328	-0.002*	-4.046	0.88*
13. Bharatpur (do)	0.256*	6.653	-0.002*	-6.259	0.93*
14. Bhilwara (do)	0.1002*	2.576	-0.001**	-2.085	0.94*
15. Dungarpur (do)	0.212*	6.113	-0.001*	-5.719	0.93*
16. Ganganagar (do)	0.391*	8.164	-0.003*	-7.771	0.94*

Contd...p/

17. Kotah (Raj.)	0.014*	3.708	-0.0001*	-2.59	0.90*
18. Swai Madhopur (do)	0.295*	3.464	-0.002*	-3.442	0.62**
Category III					
1. Chhatarpur (M.P.)	-0.305*	-5.131	0.002*	5.905	0.77*
2. Damoh (do)	-0.546*	-3.514	0.004*	3.528	0.62**
3. Datia (do)	-0.23**	-2.483	0.002*	2.759	0.85*
4. Guna (do)	-0.078**	-1.946	0.001**	2.052	0.59**
5. Gwalior (do)	-0.148*	-3.127	0.001*	3.031	0.65*
6. Mandla (do)	-0.116*	-4.421	0.001*	4.518	0.75*
7. Panna (do)	-0.116*	-4.669	0.001*	4.775	0.77*
8. Raigarh (do)	-0.038*	-4.043	0.0003*	4.253	0.83*
9. Ratlam (do)	-0.035**	-2.081	0.0003**	2.318	0.81*
10. Sehore (do)	-0.066**	-2.518	0.001*	2.631	0.65*
11. Shahdol (do)	-0.078*	-4.818	0.001*	4.777	0.74*
12. Shajapur (do)	-0.069**	-2.184	0.001**	2.436	0.83*
13. Shivpuri (do)	-0.176*	-4.892	0.001*	5.004	0.79*
14. Tikamgarh (do)	-0.42*	-4.885	0.003*	4.964	0.76*
15. Vidisha (do)	-0.282**	-1.913	0.002**	1.889	0.41
16. Banswara (Raj.)	-0.812*	-3.827	0.005*	3.702	0.74*
17. Churu (do)	-0.729*	-4.714	0.005*	4.576	0.79*

Contd...

18. Jalore (Raj.)	-0.092**	-2.401	0.001**	2.564	0.73*
Category V					
1. Sagar (M.P.)	-0.033	-1.596	0.0003**	1.874	0.85*
2. Sirohi (Raj.)	-0.092	-1.555	0.001**	1.764	0.77*
Category VII					
1. Jhunjhunu (Raj.)	0.007**	2.494	-0.00002	-0.65	0.95*
Category IX					
1. Gurgaon (Har.)	0.24	1.633	-0.002	-1.532	0.55**
2. Hissar (do)	0.197	1.059	-0.0014	-1.101	0.31
3. Mahindergarh (do)	0.06	0.287	-0.0003	-0.211	0.39
4. Bastar (M.P.)	-0.109	-1.551	0.001	1.624	0.47
5. Chhindwara (do)	0.006	0.032	0.00001	0.006	0.20
6. Bilaspur (do)	0.018	0.304	-0.001	-0.309	0.14
7. Dewas (do)	0.044	0.651	-0.0003	-0.547	0.51**
8. Dhar (do)	0.107	1.229	-0.001	-1.042	0.73*
9. Durga(do)	0.165	1.084	-0.001	-1.101	0.25
10. East Nimar (do)	0.022	0.839	-0.0001	-0.765	0.41
11. Jabalpur (do)	0.058	0.845	-0.0001	-0.852	0.19
12. Mandsaur (do)	0.03	0.579	-0.0002	-0.452	0.58**
13. Raipur (do)	0.095	0.731	-0.0002	-0.629	0.50**
14. Raigarh (do)	0.012	0.263	-0.0001	-0.179	0.44
15. Satna (do)	0.007	0.171	-0.0001	-0.112	0.31

cont'd...

16. Sidhi (M.P.)	0.005	0.152	-0.00001	-0.028	0.56**
17. Ujjain (do)	0.041	0.519	-0.0003	-0.495	0.17
18. Betul (do)	-0.107	-1.21	0.001	1.145	0.40
19. Bhind (do)	-0.022	-0.264	0.0003	0.446	0.71*
20. Hoshangabad (do)	-0.021	-0.714	0.0001	0.957	0.80*
21. Jhabua (do)	-0.021	-0.316	0.0001	0.269	0.25
22. Narsimhpur (do)	-0.001	-0.018	0.0001	0.096	0.39
23. Seoni (do)	-0.021	-0.646	0.0001	0.601	0.28
24. Surguja (do)	-0.016	-0.604	0.0001	0.622	0.16
25. West Nimar (do)	-0.037	-0.361	0.0002	0.244	0.54**
26. Bundi (Raj.)	-0.033	-0.911	0.0003	1.217	0.86*
27. Jodhpur (do)	-0.002	-0.072	0.0001	0.606	0.95*
28. Pali (do)	-0.004	-0.059	0.0001	0.281	0.77*
29. Tonk (do)	-0.026	-0.321	0.0002	0.347	0.16
30. Jalawar (do)	0.007	0.902	-0.0001	-0.371	0.49
31. Nagaur (do)	0.006	0.969	-0.0001	-0.048	0.77*
32. Chittorgarh (do)	0.003	1.223	0.00001	0.227	0.83*
33. Jaipur (do)	0.001	0.229	0.0004	0.923	0.89*
34. Sikar (do)	0.005	0.864	0.0002	0.358	0.84*

Table 4.4 : Acceleration and declaration of growth in area under tur during 1960-61 to 1984-85.

Functional form : $\log y = a + bt + ct^2$

District	b	t value	c	t value	R^2
Category II					
1. Balaget (M.P.)	0.226*	9.78	-0.002*	-9.59	0.92*
2. Bastar (do)	0.411*	3.012	-0.003*	-3.103	0.64**
3. Betul (do)	0.193*	13.58	-0.002*	-13.47	0.95*
4. Bhind (do)	0.126**	2.247	-0.001**	-2.382	0.67*
5. Chhatarpur (do)	0.356*	4.152	-0.002*	-3.766	0.91*
6. Chhindwara (do)	0.268*	3.14	-0.002*	-2.81	0.88*
7. Datia (do)	0.287*	3.77	-0.002*	-3.295	0.93*
8. Dewas (do)	0.354*	7.90	-0.002 *	-7.61	0.92*
9. Dhar (do)	0.102**	2.552	-0.001*	-2.663	0.64**
10. Guna (do)	0.413*	2.924	-0.003*	-3.811	0.73*
11. Gwalior (do)	0.608*	10.298	-0.004*	-9.788	0.96*
12. Jabalpur (do)	0.307*	3.636	-0.002*	-3.80	0.77*
13. Mandsaur (do)	0.637*	6.525	-0.004*	-6.335	0.87*
14. Mandla (do)	0.462*	5.864	-0.003*	-5.789	0.80*
15. Morena (do)	0.507*	7.655	-0.003*	-7.548	0.87*
16. Narsimhpur (do)	0.565*	5.623	-0.004*	-5.121	0.94*

Contd...

17. Panna (M.P.)	0.338*	2.282	-0.002**	-2.206	0.54**
18. Raigarh (do)	0.224*	6.152	-0.002*	-6.477	0.91*
19. Raipur (do)	0.176**	2.427	-0.002*	-3.025	0.95*
20. Ratlam (do)	0.245*	2.685	-0.002*	-2.577	0.64**
21. Sagar (do)	0.208**	2.188	-0.002*	-2.142	0.48
22. Satna (do)	0.377*	5.283	-0.003*	-5.318	0.77*
23. Seoni (M.P.)	0.659*	6.576	-0.004*	-6.283	0.91*
24. Shahdol (do)	0.454*	12.091	-0.003*	-11.497	0.97*
25. Shajapur (do)	0.155*	2.696	-0.001**	-2.154	0.95*
26. Sidhi (do)	0.380*	10.536	-0.003*	-9.696	0.98*
27. Surguja (do)	0.357*	5.097	-0.003*	-5.256	0.82*
28. Tikamgarh (do)	0.66*	2.727	-0.004**	-2.526	0.78*
29. Ujjain (do)	0.386*	3.719	-0.003*	-3.498	0.82*
30. Vidisha (do)	0.767*	4.95	-0.005*	-4.66	0.88*
31. West Nimar (do)	0.121*	4.484	-0.001*	-3.977	0.94*
32. Chittorgarh (Raj)	0.183*	9.036	-0.001*	-4.637	0.99*
33. Dungarpur (do)	0.197*	13.36	-0.003*	-7.282	0.99*
34. Kotah (do)	0.134*	12.13	-0.001*	-4.739	0.99*
35. Sirohi (do)	0.153*	6.956	-0.001*	-2.799	0.99*

Contd...

Category III					
1. Damoh (M.P.)	-0.126**	-1.803	0.001**	2.161	0.89*
2. Jalawar (Raj.)	-0.241**	-1.558	0.002**	1.714	0.68*
3. Swai Madhopur (do)	-0.595*	-2.802	0.004*	2.766	0.54**
Category VII					
1. Udaipur (Raj.)	0.111*	4.794	-0.0003	-1.09	0.99*
Category VIII					
1. Rewa (M.P.)	-0.112**	-1.965	0.001	1.551	0.91*
2. Shivpuri (do)	-0.177**	-1.77	0 001	1.402	0.90*
Category IX					
1. Bilaspur (do)	0.072	1.339	-0.001	-1.615	0.84*
2. East Nimar (do)	0.547	1.566	-0.004	-1.536	0.35
3. Durga (do)	0.099	0.589	-0.001	-1.536	0.91*
4. Hoshangabad (do)	0.094	1.212	-0.001	-0.879	0.88*
5. Raisen (do)	0.196	1.271	-0.001	-0.738	0.94*
6. Rajgarh (do)	0.142	0.818	-0.001	-0.528	0.84*
7. Jhabua (do)	-0.036	-0.376	0.001	0.634	0.82*
8. Sehore (do)	-0.111	-0.96	0.001	1.004	0.31
9. Indore (do)	-0.032	-0.452	-0.0002	0.329	0.56**
10. Ganganagar (Raj.)	-0.903	-1.256	0.007	1.508	0.91*
11. Alwar (do)	0.405	1.006	-0.003	-0.952	0.31
12. Banswara (do)	0.232	1.155	-0.002	-1.109	0.33
13. Bharatpur (do)	0.062	0.581	-0.001	-0.998	0.91*
14. Jaipur (do)	0.052	0.225	-0.002	-0.140	0.42

Table 4.5 : Acceleration and deceleration of growth in production of during 1960-61 to 1984-85.

Functional form : $\log y = a + bt + ct^2$

District	b	t value	c	t value	R^2
Category II					
1. Bhind (M.P.)	0.480	4.43	-0.003*	-4.22	0.83*
2. Chhatarpur (do)	0.412*	2.727	-0.003**	-2.434	0.86*
3. Datia (do)	0.545 *	3.40	-0.003*	-3.04	0.90*
4. Dewas (do)	0.485*	3.30	-0.003*	-3.098	0.83*
5. Guna (do)	0.721*	3.89	-0.005*	-3.78	0.72*
6. Gwalior (do)	0.893*	4.582	-0.006*	-4.288	0.88*
7. Indore (do)	0.324**	1.981	-0.002**	-1.89	0.55**
8. Mandsarur (do)	0.862*	6.922	-0.006*	-6.666	0.90*
9. Mandla (do)	0.427*	2.783	-0.003*	-2.675	0.65*
10. Morena (do)	0.749*	3.38	-0.005*	-3.15	0.82*
11. Narsimhpur (do)	0.503**	2.296	-0.003**	-2.006	0.85*
12. Raigarh (do)	0.167**	2.35	-0.001**	-2.487	0.69**
13. Raipur (do)	0.303**	1.933	-0.002**	-2.119	0.74*
14. Sagar (do)	0.330*	2.904	-0.003*	-2.756	0.72*
15. Satna (do)	0.615*	5.636	-0.004*	-5.509	0.89*
16. Seoni (do)	0.776*	3.157	-0.005*	-2.989	0.75*

Contd...

17. Shajapur (M.P.)	0.358*	2.973	-0.002**	-2.523	0.93*
18. Sidhi (do)	0.653*	3.052	-0.004*	-2.799	0.83*
19. Surguja (do)	0.294*	2.79	-0.002*	-2.887	0.55**
20. Tikamgarh (do)	0.688**	2.22	-0.004**	-2.005	0.78*
21. Ujjain (do)	0.543*	3.315	-0.003*	-3.07	0.83*
22. Vidisha (do)	0.837*	3.478	-0.005*	-3.268	0.81*
23. Alwar (Raj.)	1.142**	2.42	-0.007**	-2.408	0.47
24. Bharatpur (do)	0.875*	3.011	-0.006*	-3.101	0.64**
25. Chittorgarh (do)	0.177*	7.57	-0.001*	-4.433	0.98*
26. Dungarpur (do)	0.208*	10.359	-0.002*	-6.373	0.98*
27. Sirohi (do)	0.172*	4.824	-0.001*	-2.865	0.98*
Category III					
1. Swai Madhopur (Raj.)	-0.907*	-3.893	0.006*	3.688	0.82*
Category V					
1. Jemoh (M.P.)	-0.159	-1.468	0.001**	1.305	0.88*
Category VI					
1. Dhar (M.P.)	0.275**	1.769	-0.002	-1.718	0.43
2. Panna (do)	0.316**	2.12	-0.002	-1.868	0.82*
3. Ratlam (do)	0.258**	1.87	-0.002	-1.683	0.74*
4. Kotah (Raj.)	0.108*	4.426	-0.001	-1.517	0.98*
5. Udaipur (Raj.)	0.078*	4.096	-0.0001	-0.415	0.99*

Contd...

Category IX

1. Bastar (M.P.)	0.384	1.714	-0.003	-1.706	0.35
2. Shahdol (do)	0.313	1.665	-0.002	-1.529	0.64**
3. Raisey (do)	0.227	1.529	-0.001	-0.802	0.97*
4. Rajgarh (do)	0.436	1.455	-0.003	-1.24	0.77*
5. West Nimar (do)	0.297	1.351	-0.002	-1.248	0.53**
6. Chindwara (do)	0.021	0.082	+0.0001	0.071	0.64**
7. Balagat (do)	0.228	1.249	-0.002	-1.161	0.48
8. Bilaspur (do)	0.128	0.693	-0.001	-0.71	0.18
9. Jabalpur (do)	0.140	0.911	-0.001	-0.92	0.20
10. Jhabua (do)	0.238	1.245	-0.002	-1.046	0.75*
11. Rewa (do)	0.102	0.572	-0.001	-0.583	0.14
12. Betul (M.P.)	-0.104	-0.599	0.001	0.686	0.44
13. Durga (do)	-0.054	-0.191	-0.0002	-0.089	0.83*
14. East Nimar (do)	-0.014	-0.087	0.0002	0.168	0.41
15. Hoshangabad (do)	-0.046	-0.405	0.0006	0.72	0.86*
16. Sehore (do)	-0.052	-0.551	0.0005	0.751	0.74*
17. Shivpuri (do)	-0.058	-0.266	0.0002	0.121	0.63**
18. Banswara (Raj.)	-0.044	-0.172	0.0003	0.155	0.09
19. Ganganagar (do)	0.836	0.717	-0.004	-0.579	0.77*
20. Jaipur (do)	0.042	0.117	-0.0001	-0.028	0.43
21. Jalawar (do)	-0.186	-1.466	0.001	1.428	0.36

Table 4.6 : Acceleration and decerleration of growth in yield of tur during 1960-61 to 1984-85.

Functional form : $\log y = a + bt + ct^2$

District	b	tvalue	c	t value	R^2
Category II					
1. Bhind (M.P.)	0.128*	2.736	-0.001**	-2.178	0.81*
2. Guna (do)	0.116**	2.12	-0.001**	-1.971	0.45
3. Indore (do)	0.124**	2.556	-0.001**	-2.398	0.72*
4. Jhabua (do)	0.093**	1.898	-0.001**	-1.817	0.52**
5. Mandsaur (do)	0.087**	1.725	-0.001**	-1.633	0.53**
6. Rajgarh (do)	0.107**	1.919	-0.001**	-1.834	0.53**
7. Satna (do)	0.074**	1.695	-0.001**	-1.587	0.57**
8. Alwar (Raj.)	0.222**	2.537	-0.002*	-2.568	0.51**
9. Bharatpur (do)	0.177**	2.195	-0.001**	-2.135	0.50**
10. Chittorgarh (Raj.)	0.014*	4.965	-0.0002*	-3.872	0.90*
11. Dungarpur (do)	0.022*	4.951	-0.0002*	-3.903	0.86*
12. Ganganagar (do)	1.012*	1.916	-0.007**	-1.935	0.51**
13. Sirohi (do)	0.012*	3.313	0.0001**	-2.389	0.95*
Category III					
1. Betul (M.P.)	-0.116**	-2.087	0.001**	2.178	0.56**
Category V					
1. Jabalpur (M.P.)	-0.086	-1.664	0.001**	1.777	0.59**

contd...

Category VII					
1. Kotah (Raj.)	0.012**	1.414	-0.0001	-0.754	0.79*
2. Udaipur (do)	0.007*	2.909	-0.0001	-1.387	0.95*
Category IX					
1. Detia (M.P.)	0.083	1.522	-0.001	-1.383	0.64**
2. Gwalior (do)	0.088	1.64	-0.001	-14467	0.73*
3. Shajapur (do)	0.073	1.647	-0.001	-1.467	0.73*
4. Sidhi (do)	0.083	1.482	-0.001	-1.371	0.57**
5. Chhindwara (do)	-0.127	1.527	0.001	1.589	0.43
6. East Nimar (do)	-0.173	-1.383	0.001	1.395	0.30
7. Hoshangabad (do)	-0.072	-1.363	0.001	1.465	0.52**
8. Sagar (do)	0.061	1.438	-0.0004	-1.319	0.58**
9. Raisey (do)	0.005	0.120	0.00003	0.089	0.75*
10. Ratlam (do)	0.003	0.082	0.00002	0.063	0.62**
11. Tikamgarh (do)	0.003	0.086	0.00002	0.083	0.68*
12. Bastar (do)	-0.017	-0.239	0.0002	0.334	0.46
13. Demoh (do)	-0.014	-0.306	0.0001	0.395	0.44
14. Durga (do)	-0.059	-0.723	0.0004	0.684	0.25
15. Narsimpur (do)	-0.024	-0.518	0.0003	0.620	0.49
16. Panna (M.P.)	-0.029	-0.776	0.0002	0.793	0.19
17. Shahdol (do)	-0.053	-0.947	0.0004	0.954	0.21
18. Surguja (do)	-0.031	-0.908	0.0002	0.996	0.46

contd...

19. Mandla (M.P.)	-0.02	-0.354	-0.0002	-0.44	0.43
20. Balagat (do)	0.007	0.082	-0.0001	-0.017	0.33
21. Bilaspur (do)	0.031	0.436	-0.0002	-0.365	0.37
22. Chhatarpur (do)	0.015	0.414	-0.0001	-0.313	0.49
23. Dewas (do)	0.046	0.944	-0.0003	-0.801	0.63**
24. Dhar (do)	0.059	1.204	-0.0004	-1.135	0.42
25. Morena (do)	0.066	1.029	-0.0004	-0.792	0.80*
26. Raipur (do)	0.051	0.852	-0.0003	-0.767	0.44
27. Rewa (do)	0 063	1.273	-0.0004	-1.155	0.57**
28. Sehore (do)	0.032	0.669	-0.0001	-0.517	0.65*
29. Seoni (do)	0.057	0.752	-0.0004	-0.677	0.40
30. Shivpuri (do)	0.047	0.839	-0.0003	-0.806	0.25
31. Ujjain (do)	0.057	1.201	-0.0004	-1.168	0.61**
32. Vidisha (do)	0.026	0.6003	-0.0002	-0.557	0.26
33. West Nimar (do)	0.059	0.990	-0.0004	-0.954	0.28
34. Banswara (Raj.)	-0.09	-1.693	0.001	1.606	0.51**
35. Jalawar (do)	-0.0002	-0.011	-0.0001	-0.33	0.88*
36. Jaipur (do)	-0.007	-0.137	0.0001	0.203	0.34
37. Swai Madhopur (do)	-0.079	-0.921	0.0004	0.791	0.59**

* = significant at 1% level and ** = significant at 5% level

CHAPTER-V

DECOMPOSITION OF THE VARIABILITY IN GROWTH RATES:

In the earlier chapters growth rates in output, area and yield along with acceleration and deceleration have been analysed. In this chapter, it is intended to study the variability in growth rates of output as a result of variability in area and yield growth rates. This may help to identify the sources of change in instability in production over different period.

Since production is equal to area multiplied by yield, taking first differences of the logarithm of production, the percentage increase or decrease in the output of the crop from its previous year's level can be approximately expressed as the total of the corresponding increases or decreases in its area and yield

$$Got = Gat + Gyt \quad \ldots\ldots\ldots\ldots\ldots (1).$$

Where Got, Gat and Gyt are the annual growth rates in output, area and yield of the crop in year 't'. Clearly, over a time period of the specified length T, the year to year change in production and its two constituent components will not remain constant, unless their respective paths precisely follow a log-linear function of time over the

period. Moreover, decomposition of the variability in annual output growth rates may help to identify the sources of change in instability in production over different periods. The variability in annual output growth rates over a specified period of length T can be decomposed as:

$$V(Go) = V(Ga) + V(Gy) + 2Cov(Ga, Gy) \quad \ldots\ldots\ldots (2).$$

Since the relative emphasis in production strategy may change from period to period, the two components of output growth rates may trace similar or dissimilar patterns over different periods. The nature of the association between these two components is important as they influence the variability in annual output growth rates over the period. Variability in annual output growth rate is reinforced if year to year changes in these two components are positively correlated; it is dampened if they are negatively correlated.

The sign of the covariance terms in (2) may provide some insight regarding the production strategy that might have been followed during the period. Thus, under rainfed conditions, if intensive cultivation is practised with yield -augmenting and land-augmenting techniques like multiple cropping, area and yield growth rates may become more sensitive to weather changes and production may increase

with increasing amplitude of fluctuation in it. On the other hand, if intensification of production is carried out under more controlled conditions with strengthening of land infrastructure facilities like irrigation, drainage, flood control etc, variability in the annual growth rates may decline and production may increase at a fairly stable rate.

In this chapter an attempt has been made to decomposition of the variability in annual output growth rates of selected pulses(Gram and Tur) during the period 1960-61 to 1984-85 in selected districts of three states (Haryana, M.P. and Rajasthan). Sixtysix districts for gram and fourtynine districts for tur crop have been selected for analysis. The annual growth rates have been calculated on the three yearly moving average data. It has been stated earlier too that variability in output growth rate depends upon the variability in growth rate of area, production and covariance of both.

5.1 GRAM:

It has been noted that the instability in area is lower than yield during most of the years (Table 5.1). The instability in the production of gram might have occurred

during the period because marginal and less fertile land might have been increasingly brought under cultivation of gram crop. Since the yield from such marginal lands would be more sensitive to variations in rainfall and it is a fact that gram is grown generally in dry land areas or low irrigated areas, this might have contributed to increase in instability in yield. It is observed that in most of the years the correlated change in area and yield has turned to be negative (Table 5.1) indicating stabilizing impact on the instability in output of gram.

It has been observed that there are twenty districts which have shown instability in annual output growth rates of gram has occurred due to variability in annual growth rates in area, production and positive correlation between area and yield during 1963-1984 (Table 5.2). The instability in area and yield may be due to addition in marginal and less fertile land under the cultivation of gram and such land would be more sensitive to variation in rainfall and changes in prices, as such sensitivity can be expected to be greater in a period when scope for autonomous expansion in area becomes limited. The correlation between area and yield has turned positive in these districts because of two possible reasons. such as increase in irrigation in these districts and rainfall during sowing

months of gram. These twenty districts are Ambala, Gurgaon, Karnal and Mahindergarh, in Haryana; Chatarpur, Detia, Dewas, Dhar, East Nimar, Narsimhpur, Raipur, Ratlam and Shahdol in M.P. and the remaining seven districts belong to Rajasthan such as Ajmer, Alwar, Bharatpur, Bundi, Chittorgarh, Motah and Swai Madhopur.

There are fourty six districts which have shown instability in annual output growth rates of gram due to variability in annual growth rates of area and yield but the contribution of correlated movements between area and yield turned to negative (Table 5.3) indicating the stabilizing impact on instability in output during the period. There fourty six districts are Hissar, Jind and Rohtak in Haryana; Balagat, Bastar, Betul, Bhind, Bilaspur, Chhindwara, Demoh, Durga, Guna, Gwalior, Hoshangabad, Indore, Jabalpur, Jhabua, Mandsaur, Mandla, Morena, Panna, Raigarh; Raisen, Rajgarh, Rewa, Sagar, Satna, Sehore, Seoni, Shajapur, Shivpuri, Sidhi, Surguja, Tikamgarh, Ujjain, Vidisha and West Nimar in M.P. and the remaining nine districts belong to Rajasthan such as Banswara, Bhilwara,Dungarpur, Ganganagar, Jaipur, Jalawar, Sikar, Tonk and Udaipur. In these districts yield did not increase with increase in area under gram or vice versa.

5.2 TUR:

Like gram crop, tur has also witnessed that the instability in area under tur is lower than its yield during most of the years (Table 5.4). The instability in production of tur may be due to change in irrigated land under tur crop during the period and fluctuations in rainfall during sowing and growing months of this crop which can affect its yield. It can be said that the expansion of area under tur might have had a stabilizing impact on output fluctuations because instability in area is lower than its yield. The correlated change in area and yield growth rate has turned out to be negative in most of the years.

Table 5.5 shows that there are twenty districts which have shown that instability in annual output growth rates of tur is due to variability in annual growth rates in area, yield and positive correlation betweend area and yield during the period among these twenty districts; seventeen of them belong to M.P. such as Baster, Bilaspur, Chhindwara, Detia, Gwalior, Indore, Jhabua, Narsimphpur, Rajgarh, Ratlam, Sagar, Seoni, Shivpuri, Tikamgarh, Ujjain, Vidisha and West Nimar and the remaining three districts belong to Rajasthan such as Alwar, Banswara and Jaipur. In these districts, irrigation has marginally increased over the period as a result area and yield might have increased

marginally because tur does not face tough competition from rice and cotton during kharif season in the states like M.P. and Rajasthan.

Table 5.6 shows that there are twenty-nine districts which have shown that instability in annual output growth rates of tur has occurred due to variability in annual area growth rates and variability in annual yield growth rates but the contribution of corelated movements between area and yield indicating the stabilizing impact of these movements during the period. Among these twenty nine districts, twenty six of them belong to M.P. such as Balagat, Betul, Bhind, Chhatarpur, Demoh, Dewas, Dhar, Durga, East Nimar, Guna, Hoshangabad, Jabalpur, Mandsaur, Mandla, Morena, Panna, Raigarh, Raipur, Raisen, Rewa, Satna, Sehore, Shahdol, Shajapur, Sidhi and Surguja and the remaining three districts belong to Rajasthan such as Bharatpur, Jalawar and Swai Madhopur.

In the case of tur, there is not much difference between the districts showing negative correlation between area and yield and the districts showing positive correlation between area and yield because tur does not face tough competition from cotton and rice in these states. Therefore, tur cultivation might have continued on irrigated land in those districts which have some irrigation base but

not very high and the correlation between area and yield of tur in those districts must be positive. On the other hand, the districts where area and yield of tur have negative correlation it might be possible that tur has cultivated on marginal land in those districts.

SUMMARY OF FINDINGS:

The variation in annual output growth rate of gram and tur has depended upon the variation in area growth rate, variation in yield growth rate and correlated change in area and yield growth rate. It has been observed that annual growth in area and yield are responsible for instability in output in all the districts but the correlated change in area and yield growth rate has been negative for 70 per cent of the total districts in the case of Gram and 59 per cent of the total districts in the case of tur during the period. Therefore, majority of the districts have witnessed that yield has not been increasing with the increase in area under gram and tur and vice versa during the period. It has been due to the fact that the cultivation of gram and tur have taken place in relative dry land or marginal lands in those districts. If there is addition in marginal land under these crops then there is no possibility of increase in yield level. On the other hand, the correlated change in area and yield growth rate has been positive for 41 per cent

of the total districts in the case of tur and 30 per cent of the total districts in the case of Gram which has shown that between gram and tur, tur as compare with gram has cultivated on more irrigated land. Therefore, the districts which have correlation between area and yield positive are more in case of tur if one compare in percentage to total.

It has been observed that the instability in area is lower than in yield for most of the years for both the crops gram and tur.

Table 5.1: Decomposition of Instability in Annual Growth Rates of Gram output during 1963 to 1984

Year	Variation in annual output growth rate	Variation in area growth rate	Variation in yield growth rate	Correlated change in Area and yield growth rate
1963	11.411	4.624	9.099	-2.312
1964	9.705	4.206	8.620	-3.122
1965	5.498	2.607	3.564	-0.673
1966	4.994	7.23	2.576	-4.795
1967	3.374	0.767	4.324	-1.747
1968	2.289	1.497	1.409	-0.617
1969	2.117	1.687	1.408	-0.978
1970	3.363	1.181	2.316	-0.134
1971	1.515	1.474	1.126	-1.086
1972	1.264	0.939	0.923	-0.598
1973	4.348	1.208	1.825	1.315
1974	1.766	1.256	0.751	-0.241
1975	4.099	1.473	1.722	0.905
1976	2.667	0.686	1.998	-0.018
1977	1.657	0.323	1.084	0.249
1978	1.620	0.449	1.186	-0.014
1979	2.645	2.462	2.012	-1.829
1980	3.452	1.929	0.856	0.667
1981	6.207	1.211	4.104	0.892
1982	3.310	1.180	2.762	-0.632
1983	7.225	2.373	1.987	2.865
1984	1.322	1.754	3.168	-3.599

Table 5.2 : Decomposition of Instability in Annual Growth Rates of Gram output during 1963 to 1984.

District	Variation in annual output growth rate	Variation in area growth rate	Variation in yield growth rate	Correlated change in area and yield growth rate
1. Ambala(Haryana)	9.542	2.592	6.113	0.837
2. Gurgao (-do-)	6.793	2.929	2.682	1.181
3. Karnal (-do-)	9.969	3.386	5.298	1.285
4. Mahindergarh (-do-)	9.576	3.470	4.303	1.803
5. Chhatarpur(M.P.)	1.129	0.069	0.886	0.176
6. Detia (-do-)	2.109	0.298	1.296	0.516
7. Dewas (-do-)	1.300	0.534	0.394	0.372
8. Dhar (-do-)	2.389)	0.551	1.579	0.259
9. East Nimar (-do-)	1.784	0.949	0.487	0.348
10. Narsimhpur(do)	2.001	0.142	1.619	0.240
11. Raipur (-do-)	2.119	0.588	0.871	0.661
12. Ratlam (-do-)	1.313	0.685	0.479	0.148
13. Shahdol (-do-)	2.114	0.675	1.009	0.429
14. Ajmer(Rajasthan)	51.758	4.319	47.055	0.384
15. Alwar (-do-)	18.575	3.998	14.282	0.295
16. Bharatpur (-do-)	25.217	6.397	7.356	11.464
17. Bundi (-do-)	14.561	1.814	7.475	5.273
18. Chittorgarh(-do-)	6.219	2.608	2.156	1.454
19. Kotah (-do-)	12.142	10.947	0.754	0.441
20. Swai Madhopur(-do-)	4.271	2.162	2.049	0.059

Table 5.3: Decomposition of Instability in Annual Growth Rates of Gram Output During 1963 to 1984.

District	Variation in annual output growth rate	Variation in area growth rate	Variation in yield growth rate	Correlated change in area and yield growth rate
1. Hissar(Harayana)	4.361	1.358	3.549	-0.547
2. Jind (-do-)	5.495	1.285	4.907	-0.696
3. Rohtak (-do-)	3.780	1.114	3.089	-0.422
4. Balagat (M.P.)	1.497	10.323	10.696	-19.522
5. Bastar (-do.)	1.450	0.736	0.762	-0.048
6. Betul (-do-)	0.907	0.293	0.771	-0.157
7. Bhind (-do.)	1.299	0.064	1.336	-0.101
8. Bilaspur (-do.)	0.413	0.167	0.342	-0.097
9. Chhindwasa (-do-)	1.789	0.107	1.971	-0.288
10. Demoh (-do.)	2.859	0.997	3.266	-1.405
11. Durga (-do.)	2.507	0.567	1.959	-0.019
12. Guna (-do-)	2.165	0.483	1.854	-0.172
13. Gwalior (-do-)	2.684	0.146	2.805	-0.267
14. Hoshangabad(-do-)	0.792	0.115	0.758	-0.079
15. Indore(-do-)	0.704	0.396	0.407	-0.099
16.Jabalpur(-do-)	2.097	0.094	2.443	-0.439
17. Jhabua (-do-)	10.441	18.147	6.112	-13.818
18. Mandsaur(-do-)	3.730	4.947	2.845	-4.063
19. Mandla (-do-)	1.177	0.455	0.799	-0.077
20. Morena (-do-	1.745	0.430	1.557	-0.242
21. Panna (-do-)	1.397	1.147	1.212	-0.962
22. Raigarh(-do-)	0.529	0.242	0.289	-0.002
23. Raisen (-do-)	1.085	0.113	1.299	-0.327

Contd...Table 5.3

24. Rajgarh(M.P.)	2.151	1.113	1.482	-0.444
25. Rewa (-do-)	1.898	0.644	2.933	-1.679
26. Sagar (do)	1.280	0.819	0.825	-0.363
27. Satna (do)	1.495	1.169	2.059	-1.734
28. Sehore (do)	1.611	1.011	0.844	-0.244
29. Seoni(do)	1.068	0.059	1.094	-0.085
30. Shajapur(do)	0.883	1.098	0.853	-1.068
31. Shivpuri (do)	1.321	0.242	1.221	-0.142
32. Sidhi (do)	1.581	0.112	1.594	-0.124
33. Surguja (do)	3.263	2.171	1.467	-0.375
34. Tikamgarh(dp)	0.652	0.512	1.177	-1.036
35. Ujjain (do)	1.240	0.774	0.722	-0.256
36. Vidisha (do)	0.969	2.778	2.912	-4.720
37. West Nimar(do)	6.661	8.009	2.649	-3.998
38. Banswara(Rajasthan)	7.874	9.852	13.059	-15.037
39. Bhilwara(do)	15.412	2.925	18.641	-6.153
40. Dungarpur(do)	12.247	6.260	8.499	-2.512
41. Ganganagar(do)	21.164	23.479	2.869	-5.186
42. Jaipur (do)	60.388	3.064	64.647	-7.322
43. Jalawar (do)	7.151	11.125	2.129	-6.105
44. Sikar (do)	12.511	5.953	6.634	-0.077
45. Tonk (do)	4.110	1.978	3.581	-1.449
46. Udaipur (do)	6.119	3.521	3.459	-0.861

Table 5.4 : Decomposition of Instability in Annual Growth Rates of tur output during 1962 to 1984.

Year	Variation in annual output growth rate	variation in area growth rate	variation in yield growth rate	correlated change in area and yield growth rate
1963	3.348	0.867	2.576	-0.094
1964	1.509	2.022	1.183	-1.696
1965	1.719	1.226	0.625	-0.132
1966	2.803	0.825	2.449	-0.471
1967	5.506	1.169	3.414	0.922
1968	2.126	1.421	1.244	-0.539
1969	2.024	1.894	1.184	-1.055
1970	2.090	1.006	1.087	-0.002
1971	2.398	1.353	1.348	-0.303
1972	1.446	0.786	1.009	-0.349
1973	1.739	0.700	1.464	-0.425
1974	2.776	4.837	5.148	-7.208
1975	5.882	2.916	1.942	1.024
1976	5.348	2.066	2.362	0.920
1977	2.200	5.012	5.105	7.917
1978	3.629	2.737	0.637	0.256
1979	2.373	1.068	1.084	0.221
1980	2.150	0.899	1.748	-0.497
1981	9.366	3.724	3.032	2.609
1982	2.897	1.591	2.397	-1.090
1983	1.648	2.289	0.967	-1.608
1984	3.908	1.779	2.161	-0.033

Table 5.5 : Decomposition of instability in annual growth rates of Tur output during 1963 to 1984

District	Variation in annual output growth rate	Variation in area growth rate	Variation in yield growth rate	Correlated change in area and yield growth rate
1. Bastar (M.P.)	3.604	1.294	1.945	0.366
2. Bilaspur (do)	1.916	0.221	1.376	0.320
3. Chindwara (do)	4.668	0.481	3.315	0.872
4. Detia (do)	4.577	0.944	2.985	0.648
5. Gwalior (do)	4.250	0.522	3.115	0.614
6. Indore (do)	3.038	0.761	2.130	0.146
7. Jhabua (do)	4.205	0.582	3.443	0.179
8. Narsimhpur (do)	2.748	0.665	1.363	0.720
9. Rajgarh (do)	5.332	1.610	2.208	1.514
10. Ratlam (do)	2.093	0.927	1.055	0.110
11. Sagar (do)	3.046	0.699	2.200	0.148
12. Seoni (do)	4.289	0.578	2.862	0.848
13. Shivpuri (do)	4.064	1.256	2.229	0.580
14. Tikamgarh (do)	6.656	3.849	1.434	1.373
15. Ujjain (do)	2.701	0.772	1.539	0.390
16. Vidisha (do)	6.336	2.479	1.909	1.947
17. West Nimar(do)	4.855	0.078	4.498	0.309
18. Alwar (Rajasthan)	35.768	21.235	9.967	4.566
19. Banswara (do)	9.736	4.752	4.179	0.805
20. Jaipur (do)	14.616	5.842	5.968	2.805

0.221
1.376
0.320
1.917

Table 5.6 : Decomposition of Instability in Annual Growth Rates of Tur Output During 1962 to 1984.

District	Variation in annual output growth rate	Variation in area growth rate	varitation in yield growth rate	correlated changes in area and yield growth rate
1. Balagat (M.P.)	1.876	0.066	1.880	-0.069
2. Betul (do)	3.025	0.058	2.929	-0.028
3. Bhind (do)	1.134	0.316	1.416	-0.597
4. Chhatarpur (do)	2.177	0.377	1.956	-0.155
5. Demoh (do)	2.975	0.516	2.740	-0.282
6. Dewas (do)	1.587	0.436	1.402	-0.251
7. Dhar (do)	2.791	0.158	2.945	-0.309
8. Durga (do)	3.786	1.616	2.675	-0.505
9. East Nimar (do)	2.015	17.202	20.545	-35.732
10. Guna (do)	3.221	1.531	2.042	-0.352
11. Hoshangabad (do)	1.448	0.787	1.269	-0.609
12. Jabalpur (do)	1.949	0.325	1.669	-0.045
13. Mandsarur (do)	1.807	0.869	1.498	-0.560
14. Mandla (do)	2.272	0.509	1.941	-0.179
15. Morena (do)	3.366	0.607	2.928	-0.170
16. Panna (do)	3.579	1.859	4.199	-2.479
17. Raigarh (do)	0.682	0.131	0.786	-0.235

Contd...

18. Raipur (do)	1.793	0.226	1.880	-0.383
19. Raisen (do)	2.245	2.892	2.185	-2.832
20. Rewa (do)	3.697	0.393	3.700	-0.396
21. Satna (do)	2.131	0.656	2.511	-1.037
22. Sehore (do)	0.772	0.527	0.729	-0.485
23. Shahdol (do)	3.112	0.253	3.553	-0.695
24. Shajapur (M.P.)	1.521	0.472	1.275	-0.226
25. Sidhi (do)	4.475	0.284	4.570	-0.379
26. Surguja (do)	1.105	0.277	0.836	-0.008
27. Bharatpur (Raj)	12.694	2.630	12.917	-2.853
28. Alwar (do)	2.952	2.709	1.392	-1.149
29. Swai Madhopur (do)	9.113	5.493	8.661	-5.035

CHAPTER VI

SUMMARY AND CONCLUSION:

Pulses not only play a role of cheap protein supplier in the absence of animal proteins for majority of the population in India but also carry out a much important task of fertility maintenance by supplying nitrogen to the soil through symbiosis in a croping sequence. Even then, the production of pulses has declined during 1960-61 to 1984-85. This decline in pulses production coupled with high rate of population lead to decline in daily per capita availability of pulses. It has been noted that daily per capita availability of pulses in India is muchlower than the minimum required quantity of pulses. The daily per capita availability of pulses have been declining continuously which will lead to a serious imbalance in Indian diet especially for poor masses and non-vegetarians. But the growth in production of foodgrains has been marginally higher than growth in population. This growth in production of foodgrains due to the substantial growth in superior cereals viz. wheat and rice because of green revolution in the mid-sixties.

The objective of the study was examine the growth pattern of area, production and yield of gram and tur

pulses in different districts and analyse the interdistrict variations in growth of area, production and yield of gram and tur pulses. Further, an attempt was made to study the interdistrict variations of acceleration and deceleration in growth rate of area, production and yield and lastly,attention was given to examine the growth pattern of production by decomposing it into growth of yield and area under gram and tur during the period from 1960-61 to 1984-85. The important findings of the study are discussed below:

6.1 The area under gram and total pulses in Haryana has declined due to sharp increase in irrigation-base during the period. Because of the expansion of the irrigation base, area under gram (the major pulse crop in the state) has been shifted to wheat cultivation since total per acre yield of wheat is much higher than that of gram. It is, thus,observed that increase in area under wheat at a high rate caused sharp decline in area under gram crop during the period as both the crop are grown in this state in the rabi season. Therefore, it can be said that gram crop has lost its area to wheat in the state of Haryana.

6.2 In Rajasthan, area under gram has increased and area under tur has almost remained constant during the period.

There was no decline in area under the two crops in the state which may be due to low irrigation base of the state. In the absence of irrigation facilities and only pulses can assure some yield in the dry regions and the superior cereals cannot compete with the pulses. A few districts have shown decline in area under gram mainly due to the fact that the percentage of area irrigated in these of districts was more than 20 per cent of the gross cropped area. As a result, HYV of cereals have been replacing pulses in these districts.

6.3 In M.P., it has been observed that gram has lost its area to other rabi pulses in those districts where share of area under gram was very high. With the increase in irrigation base of these districts total area under pulses have shown an increase but the percentage of area under gram has shown a decline during the period which may be due to the fact that a major portion of the increased area might have been diverted to other pulses.

6.4 It is found that in M.P., the districts which showed five per cent or more area under tur to total area under pulses during early sixties did not show an increase in area under this crop. Area under tur in these districts has remained constant or declined during the period.

6.5 It has been observed that the production of gram and tur crops mainly depend upon the area under these crops because growth rates in production of these crops are very near to growth rates in area under these crops. It has also been noted that growth rate in yield of gram and tur in selected districts has been much lower than growth rate in area under these crops. It is true that gram and tur are grown in relative dry land in India where new agricultural technology and HYV are inappropriate. Therefore, there is no scope for increasing yield of gram and tur Thus, the production of gram and tur has mainly depended upon area under these crops.

6.6 In Haryana, the production of gram has declined mainly due to decline in area under this crop but the yield per hectare of gram has remained constant during the period.

6.7 The production of gram has not declined due to decline in yield among the selected districts of the states because remaining land under gram give the same yield without the use of irrigation,fertilizer and HYV of seeds. On the other hand, there is only one district namely Swai Madhopur in Rajasthan which has shown that the production of tur has declined mainly due to decline in yield per hectare. It might be possible that irrigated land under tur had shifted

to rice or cotton and marginal land has remained under the cultivation of tur in this district. As a result, yield has declined which leads to a decline in production of tur in this district.

6.8 There are some districts in M.P. and Rajasthan which have shown that the production of gram and tur has increased due to increase in yield only. It is a fact that during early sixties yield level of these pulses was very low and it has increased during the period because of some improvement in irrigated area under these crops. Therefore, the production has increased due to increase in yield.

6.9 In M.P. and Rajasthan, the number of districts showing negative growth rate in production of gram and tur was very small.

6.10 It has been observed that area, production and yield of gram and tur have not been increasing at increasing rate over the period and there are no district where these are declining at declining rate. It has also been noted that there are not many districts which have shown negative growth in area, production and yield of gram and tur. The production of both the crops have shown increase in half of the districts which have been selected for study. It has

been due to the fact that majority of the disricts show increase in area under these crops. Yield of gram and tur crops did not show increase except eighteen districts for gram and thirteen districts for tur crop. More than half of the total districts have shown stagnancy in yield of gram and tur during the period. It may be due to non-availability of HYV of gram and tur, uncertain rainfall, negligible use of pesticides and insecticides for the control of pests limited use of fertilizer for both the crops and improper management by the farmers.

6.11 Area under tur crop has increased in 64 per cent of the total selected districts while the area under gram has increased in 43 per cent of the selected districts. It may be because tur crop faces less competition from HYV of rice and cotton in kharif season as compared to gram which is facing tough competition from wheat during rabi season.

6.12 It has been observed that instability in area under gram and tur has lower than instability in yield of these crops.

6.13 The variation in annual output growth rate of gram and tur has depended upon the variation in growth of area, production and correlated change in area and yield. The

variation in growth of area and yield have turned positive in all the districts under consideration but the variation in correlated growth in area and yield has been negative for 70 per cent of the total districts in the case of gram and 59 per cent of the total districts in the case of tur crop. It may be due to the fact that the cultivation of gram and tur have taken place in relative dry land in those districts. If there is addition of marginal land, the possibility of increase in yield is very less. On the other hand, the variation in correlated growth in area and yield has turned possitive for 41 per cent of the total districts in the case of tur and 30 per cent of the total districts in the case of gram. It shows that among gram and tur, more irrigated land might have been used for the cultivation of tur crop.

POLICY IMPLICATIONS:

Pulses should be grown where there is low irrigation facilities exist because pulses can give more yield than superior cereals with low irrigation and small doses of fertilizer. On the other hand, superior cereals have required intensive irrigation facilties.

There is need to increase the production of pulses because the increase in production of pulses will fulfil two

purposes. The first and very important one is that it will reduce the nutritional imbalance in Indian diet and secondly, it will increase the overall production in the rainfed agriculture. For increasing the production of pulses, there is need to undertake certain appropriate measures such as introduction of HYV of all types of pulses. It has been seen that there is a considerable improvements in the production of moong recently because of introduction of new varieties. It should be extended to other types of pulses also.

The production of pulses had been severely affected by pests and diseases in the past because pulses are grown in dry regions and the farmers in those regions are unable to bear the cost of insecticide and pesticides. Therefore, there is need to provide credit to the farmers which can enable them to purchase these inputs and control pest and diseases.

There is need to improve storage facility for pulses which should be cheap and within the reach of an average farmer because inadequate facilties to store pulses affected their use and caused their cultivation less profitable. Insect and rodent infestation and mold growth during post-harvest handling and inadequate storage and distribution facilities have caused substantial losses to pulses both

qualitatively and quantitatively. A combination of fumigation and pest-proofing of bags has reportedly preserved seed in sound condition for about six months.

Like the cereals, there is need of support prices of pulses. The fixation of prices will eliminate the uncertainty of prices during the harvesting season. This measure can encourage the farmers to grow more pulses in the states like M.P. and Rajasthan.

There is need to increase irrigation along with drainage system in pulse growing states because it has been seen that pulses production has been severely affected by droughts and non-seasonal rainfall in major pulse growing states. If some irrigation facilities are made available through the stored or collected water of rainfall, droughts can not affect the production of pulses and adequate drainage system will never allow it to destroy any crop by high rainfall.

Special emphasis should be given to introduce those varieties of pulses which would be highly appropriate in water logging areas. Two types of HYV of pulses are required in India. One would be appropriate in dry land or low irrigated land and second should be highly responsive to

the availability of more favourable conditions of higher rainfall or irrigation at least under available technology.

It is necessary to grow pulses in non-traditional areas so that they should not face competition from the major cereal crops and attempts should be made to fit cultivation of pulses into an intensive crop rotation in major pulse growing states. The short duration high yielding varieties. Which can be grown in any season can increase production of pulses because in highly irrigated areas, the farmers can grow pulses between two commercial crops. For example, there is time between wheat harvesting and growing season of rice.

Thus, it can be said that pulses occupy an important place in the Indian diet. A wide variety of pulses are available and acceptable to all sections of the people. They are rich in proteins, and serve as a low-cost food to meet protein needs of a large section of the people in this country. Animal protein has become a luxury article of food these days. Therefore, the Govt should come forward with an appropriate strategy consistent with all these suggestions and make sincere efforts to increase the productivity of the important crop that acts a major supplier of protein to the poor masses of the country.

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