VARIATIONS IN CROPPING INTENSITY AND ITS DETERMINANTS : A TALUK LEVEL STUDY OF MAHARASHTRA STATE

(1960-61 to 1975-76)

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We certify that the dissertation entitled "Variations in Cropping Intensity and Its Determinats: A Taluk Level Study of Maharashtra (1960-61 to 1975-76)" submitted by Saroj Kumar Mohanty in fulfilment of six credits out of the total requirements of Twentyfour Credits for the Degree of MASTER OF PHILOSOPHY (M.Phil) of the University is a bonafide work to the best of our knowledge and may be placed before the examiners for their consideration.

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Saroj Kumar Mohanty

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INTRODUCTION

1.1. The Role of Agriculture in Economic Development

The predominance of agrarian sector is a common feature to all developing economics. The growth of this sector acts as an engine of growth for the economy and creates a strong base for industrial development. Rising agricultural productivity supports and sustains industrial development in several important ways[1]. Firstly, it permits agriculture to realise a part of its labour force for industrial employment while meeting the increasing food needs of the non-agricultural sector. In fact, it is increasingly felt that the surplus labour available in the agricultural sector can itself be a big source of capital formation[2]. Secondly, it raises agriculture incomes thereby creating the rural purchasing power needed to buy the new industrial goods and thus foster industrial development. Further, increase in rural savings

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1. Carl Eicher and Lawrence Witt (Ed.) "Agriculture in Economic Development" Vora pub, 1970. Paper by willian H. Nicholls litle "The Place of Agriculture in Economic Development.

2. Ragnar Nurkse, Problem of Capital Formation in Underdeveloped Countries, Oxford, 1956.

which may be mobilized through direct and indirect means lead to capital formation in industrial sector. Rapid population growth and high income elasticity of demand for agricultural products especially for foodgrains call for a substantial increase in agricultural production. If agricultural supplies fail to expand in pace with the growth of demand, the results are likely to lead to a substantial rise in agricultural prices creating pressure on wage rates with their consequential adverse effects on industrial profits, investment and overall growth process. Increasing agricultural production enables agriculture to supply the major wage good (food) to general population and industrial workers in particular at a price favourable to the profitability of new industry[1]. Moreover, a large number of industries especially in developing countries are agrobased and draw their supplies of raw-materials from agricultural sector. Naturally, therefore, the steadily increasing supply of raw materials from agricultural sector becomes an important pre-requisite for expansion of such industries. Finally for quite sometime foreign exchange resources have to be contributed largely by agricultural exports.

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1. Arthur Lewis, Theory of Economic Growth, London, George Allen and Unwin, 1955, p.334.

Such resources are of critical importance to the import of capital goods and technical know-how for initiating and sustaining the process of industrialization. This indeed has been the historical experience of a number of the presently developed industrial economies; notably U.K; Japan, West Germany and so on.

1.2. Statement of the Problem

This crucial role of agriculture in economic development can be realised, provided the agricultural output grows at a rapid rate. Normally the increase in the agricultural production is possible through three different ways. Firstly, it can be expanded through the expansion of net sown area. Secondly, by relieving the scarcity of land either by enabling multiple cropping or by permitting a change over to crop and inputs which show higher physical yield and also higher economic return. Thirdly, the base can be expanded through more intensive cultivation by raising more than one crop on a given piece of land.

The most traditional means to increase agricultural production is of course expansion of area under cultivation. But in growing economies where there is increasing demand for land both for agricultural and non-

-agricultural uses, the prospect of bringing additional land under cultivation is limited. For example, there is limited scope to get land for cultivation from already limited area under forest. To maintain ecological balance at least one-third of the geographical area must be kept reserved for forest. There is often some scope to procure land from the category of land called cultivatble waste but the cost of bringing marginal and sub-marginal land under plough may be quite high. And even if such marginal lands are put to crop use the productivity would be very low and inadequately remunerative to the cultivator. In fact, it has been observed that, the extension of cultivation to marginal and sub-marginal land lead to a declining of overall productivity[1]. Therefore, the other two alternatives, viz; productivity and multiple cropping remain the major sources of growth in agricultural output.

1.3. Indian Situation:

Recently several attempts have been made to calculate the growth rates in agricultural output in India and the

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1.V.K.R.V. Rao, "Agricultural production and productivity during the plan periods: A review of the past and some reflections on the future", A.M. Khusro's (Ed.) Readings in Agricultural Development., Allied publications, Bombay, 1963, p.p. 66-87.

contribution of area and productivity to the growth in output. Y.K. Alagh and P.S. Sharma in their recent paper[1] have calculated the growth-rate for pre-Green and post--Green revolution period. They observed that during period I viz; 1960-61 to 1969-70, the trend growth rate of foodgrain output was 1·88 per cent and it rose to 2·74 in period II viz; 1969-70 to 1978-79, apparently indicating the impact of Green Revolution. The over-all growth-rate (viz; 1960-61 to 1978-79) was to the tune of 2·17 per cent. While selecting different years and dividing them in to two periods of pre and post Green Revolution, Prof.C.H. Hunumantha Rao has arrived at a slightly different results[2]. During 1960-61 to 1970-71, the foodgrain output grew at the rate of 2·5 per cent annually as against 3·3 per cent in the previous decade viz; 1949-50 to 1959-60. The annual growth in the output of agricultural commodities as a whole decelerated from 3·3 per cent in 1950s to 2·1 per cent in 1960s[3]. However,

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1.Y.K. Alagh and P.S. Sharma "Growth of crop production 1960-61 to 1978-79" Indian Journal of Agricultural Economics, April-June 1980. p.104.

2.Hanumantha Rao, Technological Change and Distribution of Gains in Indian Agriculture, Macmillan,1975, Delhi, p.3

3.In this study, annual compound growth rates have been estimated for 1950's and 1960's separately.

in case of wheat and bajra, there has been a marked acceleration in the growth-rate owing to the adoption of new technology. But in case of other crops except maize, there has been a marked deceleration in the growth rate.

About the change in area and productivity the study observed that during the first decade (1949-50 to 1959-60) the cropped area grew at the rate of 2.1 per cent per annum and it declined significantly to 0.6 per cent per annum during the decade 1960-61 to 1970-71. Opposite is true in case of productivity. It grew at the rate of 1.3 per cent in period I (1949-50 to 1959-60) and by 1.6 per cent per annum in period II. Thus the rate of growth of productivity was higher in period II. In segregating the growth of agricultural output into "Area effect" and "Yield effect": he observed that in period I about two-third of increase in output could be attributed to the increase in area and only one-third to productivity. The opposite was the trend in period II. The increase in productivity accounted for about 80 per cent of output growth because the growth rate in area as pointed out earlier was only 0.60 in period II.

Above observation reveals that area as a source of growth is going to be of a very limited use and it is the productivity which should dominate in future. The limited

scope for area expansion can also be understood by looking at some figures on land use in different states and in India. Table 1.1 gives the information of land use in India right from 1950-51 to 1975-76. It indicates that in 1951-52, the percentage of net sown area was 36.40 and it steadily grew up to 44 per cent in 1975-76. However, the expansion of area after 1965-66 was very meagre and more or less it shows the tendency of stagnation between 1970-71 and 1975-76. The other categories of land use reinforce the same print. The area under forest in 1975-76 was 20 per cent as against the minimum requirement of 33 per cent. So, in fact we need to increase the area under forest. The other land use categories namely permanent pastures and fallow land show that some marginal and sub-marginal land are still left with us but the reclamation of this area would cost us quite a lot. The cropping intensity has revealed a continuous positive trend over the period from 1950-51 to 1975-76. In 1950-51 it started with 111.00 and in the year 1975-76 it ends with 120.00.

Thus in fifties the area grew at a rapid rate and served as a major source of growth, but this rising trend was abated in later decade. Keeping in view the limitation of area, more emphasis was laid on expansion of productivity and multiple cropping and as a result in later period the growth in

Table No.1.1

Land Utilisation in India (1950-51 to 1975-76)

Year	AF/GA %	NAC/GA %	PP/GA %	MT/GA %	CW/GA %	OCF/GA %	CF/GA %	NSA/GA %
1950-51	12.4	14.6	2.0	6.1	7.0	5.3	3.3	36.4
1955-56	15.8	14.7	3.5	1.7	6.8	5.8	3.7	39.5
1960-61	17.1	14.9	4.3	1.6	6.0	3.4	3.6	40.7
1965-66	18.8	15.2	4.5	1.2	5.2	2.8	5.0	41.7
1970-71	19.6	13.7	4.1	1.3	5.4	2.7	3.2	43.1
1975-76	20.0	12.1	3.9	1.2	5.4	2.9	3.8	43.6

Where
- AF - Area Under Forest
- GA - Total Geographical Area
- NAC - Area not Available for Cultivation
- PP - Permanent Pasture
- MT - Area Under Misc. Trees
- CW - Cultivable Waste
- OCF - Other than Current Fellow
- CF - Current Fellow
- NSA - Net Sown Area

Source
- Statistical Abstract of India-1964
- Statistical Abstract of India-1978

multiple cropping was higher than the area as indicated in table 1.2. This was made possible by irrigation which grew at a faster rate and made all efforts to elevated the level of multiple cropping.

1.4. Situation in Maharashtra

In Maharashtra, agriculture is an important economic activity in which 62 per cent of working population was engaged in 1980-81 against 66.70 per cent in India as a whole. Maharastra derives smaller proportion of its income (i.e; 30 per cent) and employment from agriculture. Low share of agriculture in state's income partly reflects relatively high degree of industrial development in the state, but it is basically due to low productivity of land. The climate and soil condition in the state are such that it has led to both inferior crop-pattern and relatively low yield in respect of most of the crops. As much as 30 per cent area of the state is subjected to low and uncertain rainfall and therefore declared as drought prone. A very small proportion of area is under irrigation and hence is inadequate to overcome the instasility created by rainfall consequently the crop-pattern of the state is dominated by dry farming crops such as Jowar and Bajra which give low level of yield.

Table No. 1.2

Trends of Cropping Intensity, Level of Irrigation And Irrigation Intensity In India (1950-51 to 1975-76)

Year	Cropping Intensity	Level of Irrigation	Irrigation Intensity
1950-51	111	17.6	108
1955-56	114	18.0	113
1960-61	115	18.5	113
1965-66	114	19.2	117
1970-71	118	22.1	123
1975-76	120	24.7	124

Source : Statistical Abstract of India - 1964

Statistical Abstract of India - 1978

Since the agricultural production in the state heavily depends on rainfall and as a result, the performance of agriculture over time has not been quite satisfactory. This fact has been brought out by some studies on Maharastra. In one such study, M.P. Khare[1] has calculated compound growth rate of agriculture output for the years 1960-61 to 1971-72 and separately for the period 1961-62 to 1969-70, where he has excluded the abnormal years. The compound growth rate of agricultural production for the period 1960-61 to 1971-72 was 1.50 per cent per annum. Foodgrains production the major component of agricultural production has particularly not done well with a negative growth rate of 1.63 per annum. For the second period, to get real effect of the normal situation, he has excluded four abnormal years. 1960-61 was exceptionally a good year in the sense that although gross cropped area was not high, production of foodgrain was so high that its production level had not been crossed till 1973-74. The years, 1965-66, 1970-71 and 1971-72 were particularly bad both in terms

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1. M.P. Khare, Agricultural Development of Maharastra, Agro-Economics Research Unit, Gokhale Institute of Politics and Economics, Pune, 1977, pp.223-273.

of cultivated area and production due to drought. After eliminating these years, he still observed the state of stagnancy. Campound growth rate for total production comes to -0.07 per cent and for fodd-grain it comes to -0.23 per cent. During the same period area and productivity grew at a rate of 0.23 per cent and 0.16 per cent respectively. So over the period starting from 1960-61 to 1970-71, the agricultural output had infact declined and had shown a tendency of Stagnation till 1973-74.

However, after 1975-76 the production has shown marked improvement. One study has calculated the growth rate in output, area and productivity for the period starting from 1950-51 to 1976-77[1]. The compound growth rates have been separately calculated for period I viz; 1950-51 - 1960-61 and period II, viz; 1960-61 - 1975-76. It was observed that between 1950-51 and 1960-61 the aggregate output grew at the rate of 2.73 per cent per annum (compound) and by 4.35 per cent during the period 1960-61 to 1976-77. In period I increase in area was much higher (1.45%) than in the

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1. Ramesh G. Dandge, The Instability in Maharastra Agriculture: A Time Series Analysis. (1950-51 to 1976-77), M.Phil Thesis submitted to the Centre for the study of Regional Development, Jawaharlal Nehru University, New Delhi, 1983.

period II 0·26 per cent. It was just marginal. While productivity grew at a faster rate of 4·12 per cent per annum in period II as against 1·28 per cent in period I. The figure further indicated that area was the major source of growth in period I and the contribution of productivity was relatively less. While opposite was true in period in which growth of area was marginal but productivity was the major source of growth.

Thus like India, area as a source of growth has become less important Maharashtra. It was much more in case of Maharashtra because the proportion of net sown area was quite high compared to other states of the country and India as a whole (table 1·3 & 1·4). The limitation of area and thereby the importance of multiple cropping and productivity as a major source of output in future can be meaningfully brought out by looking at the land use figure in Maharashtra.

Extension of Land Base in Maharashtra:

Table 2·1 and 1·5 give the figure on land use for the years 1951-52, 1961-62 and 1975-76. Of the total reported area of the state (307·53 lakh hectares) 183·24 lakh hectares which accounts for 60 per cent of total area used for raising agricultural crops in 1975-76. So, the state showed relatively higher proportion of total area under

TableNo.1.3

Land Utilisation in Different States of India (1960-61)

States	AF/GA %	NAC/GA %	PP/GA %	MT/GA %	CW/GA %	OCF/GA %	CF/GA %	NSA/GA %
Andhra Pradesh	23.3	15.3	4.4	1.1	5.9	3.3	8.9	39.3
Assam	22.2	25.9	0.7	5.5	0.5	0.8	0.2	10.1
Bihar	21.6	12.8	10.3	-	5.2	4.8	7.7	46.1
Gujrat	4.9	26.6	5.0	0.2	4.0	2.3	1.8	50.2
Jammu & Kashmir	69.3	12.1	2.7	2.9	3.6	0.2	2.4	14.5
Kerela	27.2	9.2	1.2	5.2	3.7	1.6	1.7	49.5
Madhya Pradesh	31.2	9.5	8.8	4.6	7.2	3.2	1.8	36.3
Tamil Nadu	14.4	17.3	2.8	1.9	5.4	4.8	7.5	46.2
Maharashtra	17.6	8.1	4.7	0.6	3.2	3.7	3.9	58.1
Karnataka	14.1	9.0	9.0	1.9	3.4	2.7	4.3	53.2
Orissa	22.9	16.3	4.7	3.0	9.1	1.9	5.9	36.0
Punjab	3.0	27.1	1.0	0.1	3.9	N.A	4.5	60.9
Rajasthan	2.4	18.3	4.9	0.1	19.9	9.1	5.9	38.3
Uttar Pradesh	6.1	15.3	0.1	3.0	5.6	4.3	0.5	58.5
West Bengal	12.5	14.7	N.A.	7.3	N.A.	4.3	N.A.	61.8
India	17.1	14.9	4.3	1.6	6.0	3.4	3.6	40.7

Where AF - Area Under Forest
GA - Total Geographical Area
NAC - Area not Available for Cultivation
PP - Parmanent Pasture
MT - Area Under Misc. Trees
CW - Cultivable Waste
OCF - Other than Cultivable Fallow
CF - Current Fallow
NSA - Net Sown Area

Source Statistical Abstract of India - 1964

Table No.1.4

Land Utilisation in Different states of India (1975-76)

States	AF/GA %	NAC/GA %	PP/GA %	MT/GA %	CW/GA %	OCF/GA %	CF/GA %	NSA/GA %
Andhra Pradesh	23.2	15.7	2.5	0.9	15.7	4.2	8.2	40.8
Assam	5.4	11.0	0.8	1.2	0.7	0.6	0.5	11.8
Bihar	16.2	12.2	0.9	1.3	2.7	5.2	9.2	48.7
Gujrat	8.4	30.7	4.6	0.3	11.9	1.9	2.2	51.6
Jammu & Kashmir	60.8	10.7	2.3	2.0	2.8	0.2	1.9	15.3
Kerela	27.8	8.7	0.5	2.0	2.9	0.6	0.9	56.3
Madhya Pradesh	32.6	10.0	6.9	0.3	4.6	2.0	1.7	42.2
Tamil Nadu	15.2	17.9	1.4	1.6	2.9	4.0	10.9	46.1
Maharashtra	17.3	8.7	5.3	0.6	3.3	2.6	2.7	59.4
Karnataka	15,1	9.7	7.9	1.7	3.0	3.2	4.9	53.9
Orissa	40.8	5.6	3.4	3.2	2.3	1.4	3.6	39.4
Punjab	4.1	10.6	0.1	0.1	1.2	0.0	1.3	82.6
Rajasthan	5.5	13.3	5.3	0.3	19.4	6.6	5.6	44.1
Uttar Pradesh	17.4	11.5	0.9	2.7	5.1	2.1	3.3	58.6
West Bengal	13.5	6.6	N.A.	6.6	N.A.	4.1	N.A.	70.4
India	20.0	12.1	3.9	1.2	5.4	2.9	3.8	43.6

Where
- AF - Area Under Forest
- GA - Total Geographical Area
- NAC - Area not Available for Cultivation
- PP - Permanent Pasture
- MT - Area Under Misc. Trees
- CW - Cultivable Waste
- OCF - Other than Current Fellow
- CF - Current Fellow
- NSA - Net Sown Area

Source Statistical Abstract of India - 1978.

Table 1.

Extension of the land base: Average for three years

(000' Hectares)

Sl.No	Item	1951-52	1961-62	1975-76
1.	N.S.A.			
	(a) Area	16672	17981	18224
	(b) Index	100	108	110
	(c) % of total area	54.21	58.45	59.33
2.	Irrigated Area			
	(a) Area	890	1093	1749
	(b) Index	100	123	196
	(c) % of NSA	5.34	6.08	9.60
3.	A.S.M.O.			
	(a) Area	540	979	1428
	(b) Index	100	181	264
	(c) % of NSA	3.24	5.44	7.85
4.	Cropping Intensity	103.2	105	107.50

N.S.A. = Net Sown Area
A.S.M.O. = Area sown more than one

Source : (1) Maharashtra and Gujarat, Agricultural Statistics Directorate of Economic and Statistics, Government of India, 1961.

(11) Season and Crop Report of Maharashtra, (1961-62), Government of Maharashtra.

(111) Statistical Abstract of Maharashtra, (1975-76), Government of Maharashtra.

plough compared with India (46 per cent). The proportion of area sown more than once is small. In 1975-76 this was 7·84 per cent of Net sown area. The state had about 17 per cent area under forest, about 3 per cent under cultivable waste, about 5 per cent under follow land and nearly 6 per cent under permanent pastures and land under miscellaneous tree crops and so on. This fact shows that there is no scope to bring additional land under cultivation because 85 per cent of cultivable area is already being used for agriculture purposes. In these circumstances the expansion of multiple cropped area is the only solid and conducive way to increase agricultural output in the state. In 1951--52 of the total net sown area only 3·24 per cent was under multiple cropping and it increased to 5·4 per cent in 1961-62 and 7·84 per cent in 1975-76. index of area sown more than once was 2·54 in 1975-76 compared to 1·81 in 1961-62 and 1.00 in 1951-52. The cropping intensity was 103·20 in 1951-52 and increased to 107 in 1975-76.

Although area sown more than once did not increase much but it showed a steady increase. And there is great scope to increase it because out of 30 per cent of the irrigation potential only 10 per cent is being used currently. So with limited area on hand, the emphasis will have to be on multiple cropping as a source of growth in the state. Therefore,

in the present study the purpose is to examine the variations in the level of cropping intensity to locate the high and low intensity area and to identify the factors behind such variations.

1.5.Objective of the Study

The main objective of the is

(i) to analyse the inter-taluk variation in cropping intensity at three points of time viz; 1961-62, 1968-69 and 1974-75 taking as a unit of analysis in the state of Maharastra.

(ii) to identify the factors causing variation in cropping intensity.

(iii) to further examine the relationship between cropping intensity and irrigation level and different sources of irrigation.

1.6.Methodology and Statistical Technique

(i) Unit of Analysis - In this study taluk has been taken as a unit of analysis. In fact it was a difficult task to collect data for so many taluks of the state. But we decided in favour of taluk because we thought the variation would be quite prominent and revealing at taluk level. In the state of Maharashtra there were 229 taluks in 1960 but the number went up to 232 in 1975-76. For the convenience of temporal comparison we have finally selected 229 taluks for the purpose of analysis.

(ii) Study Period - As pointed out earlier, the study aims at examining the variation in cropping intensity at three points of time, viz; 1960-61, 1961-62 and 1962-63 (period 1); 1967-68, 1968-69 and 1969-70 (period II) and 1973-74, 1974-75 and 1975-76 (Period III). These years were selected for two specific purposes. Firstly, these were considered to be normal years and specifically chosen as to avoid the seasonal fluctuation in area due to weather condition. The assumption being that favourable weather condition is a pre-requisite for optimal use of land and other inputs. In order to minimise the level of fluctuation, three-year moring average has been taken. Secondly, the selection of time period has some relevance from another angle. These periods as a matter of fact represent the three different stages of agricultural development in the state. The years 1960-61, 1961-62 and 1962-63 could be described under the influence of traditional agriculture. Since the new era of improved agriculture started after the introduction of Intergrated Area Development Programme and this was actually implemented in the Kharf Season of 1963-64 in Maharashtra. However, the second period (with years 1967-68, 1968-69 and 1969-70) may be treated as a transitional period. Years included in period III (viz, 1973-74, 1974-75 and 1975-76) were

considered to be under the full influence of new technological change. This period should reflect the changes that have occured due to the technological change in the state.

Data Base:

The study is based on secondary data published by different official agencies. The major publications consulted were as follows:

(i) Statistical abstract of Bombay State published by the Government of erstwhile Bombay State 1957-58.

(ii) Season and crop report of Bombay State 1950-51 to 1954-55 published by Government of Bombay State.

(iii) Statistical abstract of Madhya Pradesh (1954-55) Published by Government of Mahdya Pradesh.

(iv) Statistical abstract of Hyderabad State, 1954-55, published by the Government of erstwhile Hyderabad State.

(v) Statistical abstract of Maharashtra for various years published by Government of Maharashtra.

(vi) Season and crop report of Maharashtra State for various years, published by Government of Maharashtra.

(vii) The performance of budget of Maharashtra published by Government of Maharashtra 1976-77 and 1977-78.

(viii) Fertilizer statistics published by fertilizer association of India for various years.

(ix) Socio-economic review and District statistical abstract published by Government of Maharashtra.

(x) Census of Maharashtra State, 1961 and 1971.

1.7. Selection of Variables

As pointed out earlier the main purpose of the study is to explain the variation in cropping intensity. To explain the variations a suitable system of explanatory variable has been developed. The following varibales have been selected for the purpose of analysis.

Dependent Variable : Cropping Intensity

Cropping intensity is defined as gross cropped area as a percentage of net sown area. Gross cropped area consists of net sown area plus area sown more than once where the net sown area refers to the physical area sown and area sown more than once represents each net sown acre times the number of additional crops raised on it during a year. Mathetmatically speaking

$$\text{Cropping Intensity} = \frac{C_1L_1+C_2L_2+ \ldots + C_nL_n}{L_1+ L_2+ \ldots + L_n} \times 100$$

$$= \frac{\sum_{i=1}^{n} C_iL_i}{\sum_{i=1}^{n} L_i} \times 100 \quad \text{Where} \quad i=1,2,\ldots,n$$

where C_i denotes the number of crops, harvested in a year, L_i stands for area used for the production of C_ith number of crops and n stands for maximum number of crops, that can be cultivated in a plot of land in a year.

In measuring the cropping intensity the long duration crops which occupy the field for twelve months or more pose the problem. If we take the area under these crops, as it is long duration it would unnecessarily depress the cropping intensity figure for some regions. To aviod and ambiguity some studies have deducted the area under these crops from gross cropped area and net sown area. We feel that this approach perhaps is not proper. This method unnecessarily hides the real picture and also depresses the cropping intensity figure of some of these regions. Therefore, in the current study area under sugarcane crop is doubled and added with GCA only because this area has been once added in both GCA and NSA. We thought that this would be a proper method. Farmers prefer to devote area to sugarcane which is twelve monthly and 18 monthly crop in Maharashtra, because the yield from sugarcane is either equal to or more than two six monthly crops. That is why farmers prefer to grow sugarcane. Maharashtra is a leading sugarcane producing state and the twelve monthly and

eighteen menthly sugarcane varieties are commonly used. Our method will take account of this fact.

Explanatory Variable

The following independent variables have been taken in this study. First set of variables which we used to explain the inter-taluk variation in cropping intensity are, rainfall, irrigation level, irrigation intensity, mechanisation index, per hectare animal use and per hectare agricultural workers. Since the main emphasis in this study is on irrigation, another set of variables, comprising different sources of irrigation like canal, tank, well have been used to explain the variation in cropping intensity. The impact of different sources of irrigation has been studied separately.

First Set-Factors Affecting Cropping Intensity:

(i) Rainfall - Among the natural factors, rainfall is the most important one which affects plant growth, crop production and use of land. Rainfall not only helps the crops to grow but feeds water to different sources of irrigation which ultimately induce farmers to adopt multiple cropping. In estimating the effect of rainfall on cropping intensity the total annual rainfall is important but its extent in crucial periods and distribution over

the seasons is equally more important[1]. In the present analysis however the total annual rainfall data has been taken for each taluk on a three-year moving average basis.

(ii) Irrigation Level

Irrigation has almost become a crucial input in Indian agriculture. It not only provides protection against uncertain rainfall but also enables the farmer to take more crops. Higher level of irrigation would provides great stability to the agricultural production. In fact, it has become a pre-requisite and once this input is made available, other new input easlily be used by farmers. The level of irrigation is defined as percentage of net irrigated area to the net sown area of the taluk.

(iii) Irrigation Intensity

Irrigation intensity indicates as to how intensively existing irrigation facilities are used. It shows the quantitative aspect of irrigation. If an area enjoys a perennial source of irrigation, then area irrigated more than once would be high and it facilitates more intensive use of land. Irrigation intensity in this study is defined as gross irrigated area as percentage of net area irrigated.

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1. Abraham T.P., 'Isolation of effects of weather on productivity including other risk as danger by pests and diseases'. Journal of Indian Society of Agricultural Statistics, Vol. 17., 1965.

(iv) Mechanisation Index:

Mechanisation is normally defined to include all power driven implements as well as other improved implements like tractor, powers tiller, thrasher, tube-well, oil engine, electric pumps and other related machineries. In developing countires like India, mechanisation in agriculture is suggested for two reasons. Firstly, to improve the production efficiency in agriculture and secondly to fill up our energy requirement. In a number of studies it was observed that mechanisation leads to timely operations and thereby promotes multiple cropping. We have used three implements namely tractor, oil engine and electric pump to form mechanisation index. In our study the mechanisation index is worked out by 'Division Method'[1] which is used as follows. The absolute data of these implements were first standardised by working out the use of oil engines and electirc pump sets per 10, 000 hectares of cultivated area and of the tractors per one lakh hectares of cultivated area. The proportion of standardised value to the mean for each implement was found out. Mechanisation index of the taluk was calculated by adding proportion of three implements available in each taluk. In Maharashtra, data

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1.Kundu A. Construction Indices for Regionalisation: An Enquiry into Methods of Analysis. Geographical Review of India, vol.37 No.1, 1975., p.23.

for tractors, oil engines and electric pumps are available for two census (1961 and 1972). We have projected the figures of the variables for 1968 and 1974 on the basis of available data.

(v) Animal Power Index

Since the level of mechanisation in Indian agriculture is low, livestock as an alternative source of energy has to play an important role in agriculture. In the absence of tractors, harvesters, etc., animals remain the only source of power in the field. The variation on the availability of animal power among regions affects the use of land differently. In the present study we have defined animal power index as the per hectare availability of working bullocks and buffaloes in a particular year. Like agricultural implements, informations about bullocks and buffaloes are available for 1961 and 1972. We have projected the figures of the variables for 1968 and 1974.

(vi) Agricultural Workers

The use of adequate labour input is yet another input which is quite vital for agricultural development. In a traditional agricultures, particularly at the earlier stages of its development labour input plays an important role. Agricultural workers consist of agricultural labourers and cultivators. Since we are concerned with avail-

-ability of working population in agriculture and its impact on cropping intensity, agricultural workers are taken for this purpose. Due to defintional problems in 1961 and 1971 census, we had no alternative but to take only male figures of agricultural workers and cultivators for our analysis.[1] Census data is available for 1961 and 1971 and by taking their annual compound growth rates we have projected the figures for 1967 and 1974. In the regression model, we have used per hectare availability of male agricultural workers.

Second Set - Different Sources of Irrigation Affecting Cropping Intensity

In the second set of regression we have tried to estimate the impact of different sources of irrigation on level of cropping intensity. Earlier, it has been pointed out that various sources of irrigation are not equally efficient in terms of their water disbursing capacities. Because all of them do not get water from the same source. Generally canals receive water from rivers and water reservors and supposed to be perennial in nature. As against canal irrigation, tank irrigation

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1.Krishnamurthy J. 'Working force in 1971 - on illuminating final results', Economic and Political Weekly, August, Spl. No., 1973.

is considered to be less efficient source of irrigation. Tank generally gets water from natural rainfall and therefore it is seasonal in character and can supply water for one season. So far as well irrigation is concerned, its perennial character is not uniform in the state. In canal - irrigated areas, well gains water through percolation and therefore it can supply water throughout the year. But in rainfed regions, it remains seasonal in character and restricts the supply only for one season. So far as the impact of various sources is concerned we assume that the canal irrigation and canal fed well-irrigation with adequate water will have strong impact on cropping intensity than the tank and rainfed well irrigation.

To give in brief, the following variables have been used in the analysis of cropping intensity.

Dependent Variable : (1) Cropping Intensity.

Independent Variables :

(1) Rainfall - Total Annual Rainfall

(2) Irrigation - Percentages of Net Area Irrigated to Net Sown Area.

(3) Irrigation Intensity - Gross area irrigated as a percentage of Net area irrigated.

(4) Mechanization - Mechanisation Index.

(5) Animal Power - Animal per hectare of Net Sown Area.

(6) Agricultural Worker - Agriculture worker per hectare of net sown are.

Sources of Irrigation:

(1) Percentage of area irrigated by canal to net area irrigated.

(2) Percentage of area irrigated by well.

(3) Percentage of area irrigated by tank.

1.8. Use of Statistical Techniques

Keeping in view the nature of analysis, a package of relevant statistical techniques are used. As pointed out earlier, the study is based on three points of time. To avoid the effect of annual fluctuations, we have taken a three year moving average. For some variables like population, bullock and fuffaloes, time series data is not available and we have projected the figures for the corresponding years. We have estimated their annual compound growth rates and the following formula for compound growth rates and data projection is as follows:

$$Y_t = Y_o(1+g/100)^t$$

Where Y_t denotes figure at terminating year, Y_o, figure at base year, t, time (between t and 0) and g, annual compound growth rate (in percentage).

(i) But for other variables like tractors, oil engines, electric pumps we have used another method to estimate the growth rate. We projected these figures for certain specific years by adopting the simple growth rate formula as follows:

$$Y_E = Y_o + \frac{(Y_t - Y_o) \times t_E}{t}$$

Where Y_E is the projected figure for the estimated year, Y_o, data at base year; Y_t, data at terminating year; t, extent of time between Y_t and Y_o, t_E, length of time period the between base year and the estimated year.

(ii) Simple correlations have been derived to see the relationship between the variables in the models.

(iii) t test has been adopted to see the significance of the regression parameters. F test has been underlined to examine the variances of the regression parameters.

(iv) Taking the cropping intensity as dependent variable and others as independent variables, a step-wise regression procedure is applied for each time period to identify the important variables which explain maximum variations in cropping intensity is the state.

(v) Some of the aspects of Maharashtra like physiography and regional variation in cropping intensity are shown through maps with suitable cartographic techniques.

1.9 Hypothesis

1. It is hypothesized that a positive relationship exists between cropping intensity and irrigated level and irrigation intensity as it has been substantiated by earlier studies.

2. It is assumed that higher the number of agricultural workers per hectare, higher will be the cropping intensity because higher cropping intensity requires more labour use.

3. Cropping intensity and mechanisation index should be positively correlated because mechanisation in agriculture promotes timely operation and thus saves time and enables farmers to take additional crops.

4. Higher the per hectare animal power, greater will be the level of cropping intensity.

5. Coming to the relationship between cropping intensity and sources of irrigation, it is assumed that sources which provide perennial water supply will have strong positive correlation with cropping intensity than the seasonal one.

CHAPTER II

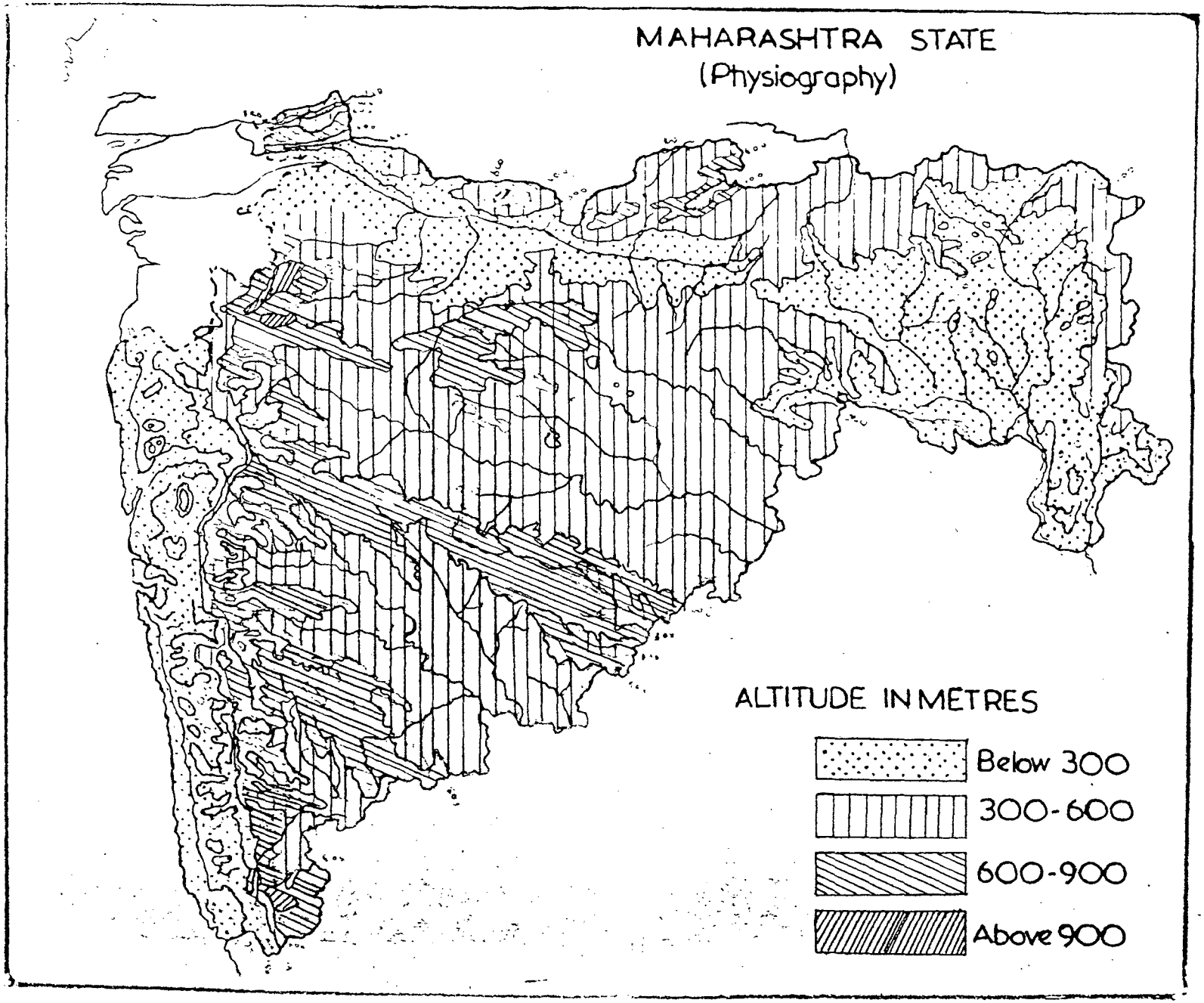
ECONOMY OF MAHARASHTRA

The basic aim of this chapter is to examine those aspects of agriculture which would enable us to have a clear idea of the setting in which our study is based. Maharashtra is located in the western part of the country and it ranks third in terms of area and population (1971) in the country. It occupies an area of 307762 sq.k.m. and a total population of 5·04 crores (according to 1971 census). The state is grouped into four different administrative zones namely Bombay, Poona, Marathwada and Nagpur division. Again the state is divided into twenty six districts and two hundred and thirty three taluks till 1976-77. We now proceed to discuss certain aspects of the geographical setting and the regional economy of Maharashtra as they are relevant to our study.

2.1. Geographical Setting

a) Physiography

The state of Maharashtra lies between $16^{0}45'$ North to $22^{0}1'$ North Latitude and $70^{0}45'$ East longitude. Physiographically, it is divided into three main regions. These regions are as follows: (See map 1)


MAHARASHTRA STATE
(Physiography)
ALTITUDE IN METRES
Below 300
300-600
600-900
Above 900

MAP-1

i) The Konkan low lands

ii) The Sahyandrian Ranges and

iii) The Deccan plateau with its major river basins.

The konkan low land is a narrow strip of land, which lies between Arabian sea on the west and Sahyandrian ranges on the east and it stretches over 31,000 sq. kms. in area. It extends over 720 km. in length and between 40 to 75 kms. in breadth. The konkan strip is completely hilly but westward and the topography opens out a low level plateau of laterite and estuarine plains of rivers.

A major part of the state, about ninety per cent of the total area is occupied by the Deccan plateau. It slopes eastwardly with certain local variations in relief. It has a general average elevation of about 2000' near the ghat,1400' in the central part and 900' in south-eastern parts of Vidharbha. Over the plateau, there are three major 'River Basins' and two sub-basins in the state. Besides a large number of rivers of varying lengths forms a network of tributaries of the main rivers. The basins are (a) Tapti basin (b) the Krishna basin, and (c) the Godavari basin, with Wardha-Wainganga sub-basin.

b) <u>Soils</u>

Maharashtra is experienced with a wide regional variation in soil structure. Barring the alluvial tracts of Tapti river and Konkan coastal strip and the non-basaltic

character of the eastern region, the dominant type of soil is one, derived from Deccan basalts which covers the major part of Maharashtra but there are significant variations according to the slope of the surface. The following types of soil are there in Maharashtra.

i) Medium black soil (Plain of basalts) which its inferior variant, the murum soil.

ii) Deep black soil or Ragur (Valley)

iii) Laterite and lateritic soil

iv) Coastal alluvium (New)

v) Old alluvium and clay loam of yellow black colour.

The iron enriched medium black soil is extensively spread over the platueau, the Sahyandry and low land has giv n rise to residual soil like rugare (Deep Black Soil). Laterite is its important varient and it is a leached out soil, poor and red in colour due to iron oxides. The medium black soil covers wide areas of the plateau of nearly all plateau districts of western Maharashtra and Western Vidharbha. Deep black soil is particularly prevalent along the river valties and are very deep along the valley of the Krishna, the Bhima, the Godavari and their tributaries. Both types of soil (deep and medium black) which are popularly called as Black soil, are very rich in calcium and magnesium carbonate but poor in

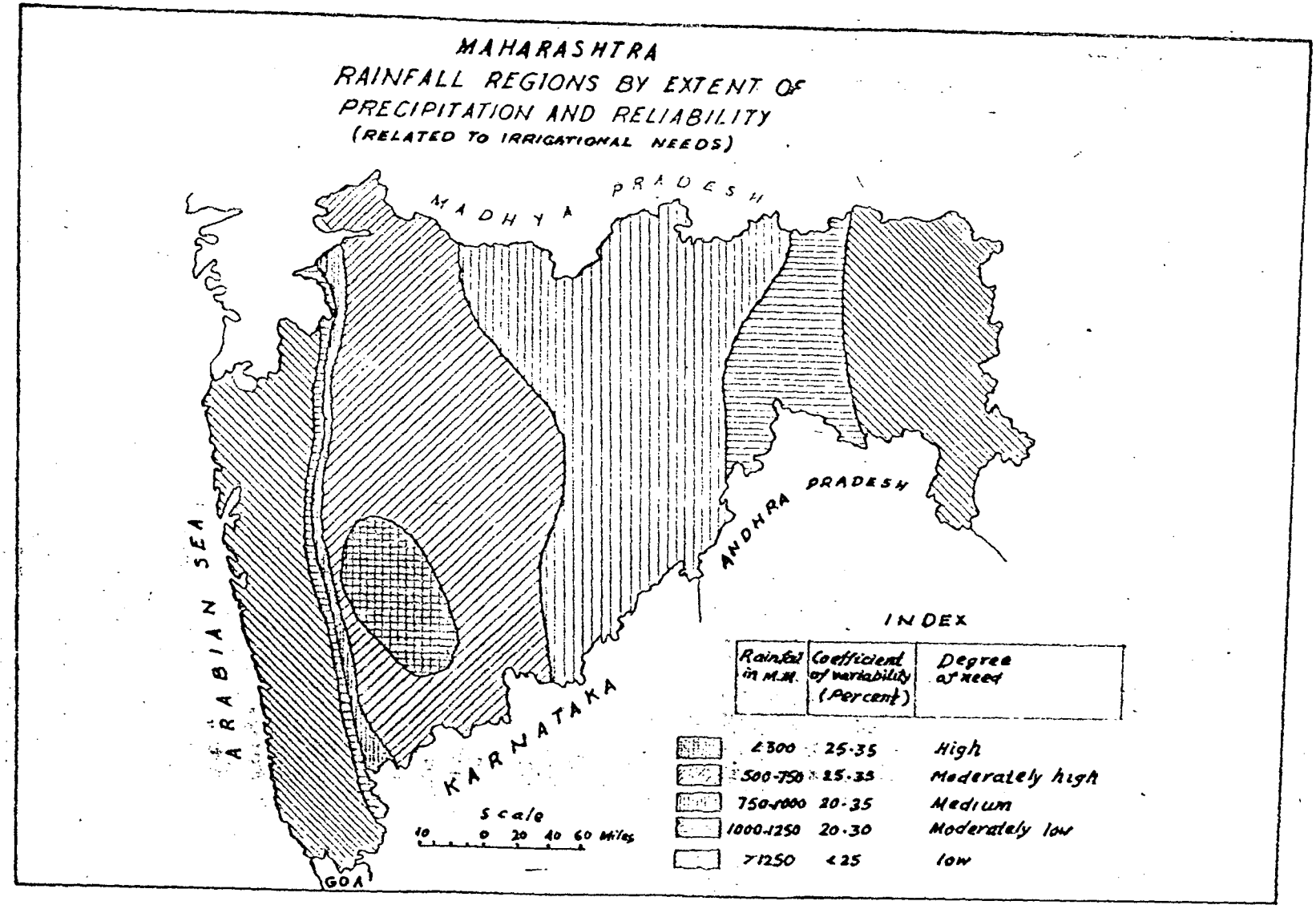
nitrogen, potash and phosphate. The laterite soils are mainly found on low level plateau and hills of Ratnagiri, Kolhapur in the West and Chandrapur district on the eastern side. In the category of alluvial soil, the river alluvial (old) soils are found in Tapti-Pune valley. The soils are deep and agriculturally productive. In coastal areas, a mixture of coastal and alluvial (new) is the common forms of the soil. These are mostly sandy loams and support cultivation of rice and vegetables. The medium fertile red soil occurs to a limited extent in the top land and hills of the mountains by sand-stones mostly of the Vaindhyan systems.

From the point of regional distribution, soils of the state show that our of the total, 40 per cent of the area is covered by coarse and light soils and 33 per cent and 27 per cent by medium and deep soils respectively. By and large, all these soils have low level of fertility.

c) Climate

Typical monsoon climate prevails in Maharashtra and the state gets maximum amount of rainfall from monsoon wide. The dominant natural factor that attects basically the life and economy of the people is the rainfall. On

the basis of regional distribution of rainfall it is possible to divide the state into three regions (see map. 2.). (1)The Konkan and Sahyandri regions receive the highest rainfall which ranges between 2500 to 3500 mm. per annum. (2)The central Maharashtra region is a low rainfall region (rain shadow area, below 800 mm). and (3) the eastern regions is a medium rainfall (1200 mm. to 1400 mm.) region. The interesting aspect of Maharashtra's rainfall is its rapid decrease to the east of the Sahyandry and rain shadow area comprising the most of the districts of central Maharashtra. However, further eastward annual precipitation shows some improvement partly due to decrease in the 'shadow effect' of western Ghats and particularly due to later rains from the Bay of Bengal monsoonal current. These regional differences in the total annual rainfall help in distinguishing three hyetal regions of Maharashtra viz. the wet, the intermediate and the semi-arid zone and eastern medium rainfall region. Apart from the regional variations in annual rainfall, equally if not more important is the seasonal regime of rainfall in Maharashtra. While the western region of Konkan and Sahyandry have a heavy concentration in the month of July and August, the eastern


MAHARASHTRA
RAINFALL REGIONS BY EXTENT OF
PRECIPITATION AND RELIABILITY
(RELATED TO IRRIGATIONAL NEEDS)
MADHYA PRADESH
ANDHRA PRADESH
KARNATAKA
ARABIAN SEA
GOA
Scale
10 0 20 40 60 Miles
INDEX
Rainfall in M.M.
Coefficient of variability (Percent)
Degree of need
<300 25-35 High
500-750 25-35 Moderately high
750-1000 20-35 Medium
1000-1250 20-30 Moderately low
>1250 <25 low

MAP. 2

region has its peak period of rainfall in late August and September and the central region with its low to medium rainfall receives its rain from both-South-West and north-east retreaving monsoon with two peak periods in early July and late August and September. These variations in the seasonal regime of rainfall have a significant bearing on agriculture of various regions.

The rainfall does not arrive in time and it ends early and abruptly. There are prolonged breaks andthe annual amount of rainfall may vary from year to year. In general, variability increases with the decrease in the total amount of rainfall. Hence raining area like the Konkan, the Sahyandries and the eastern region have a dependable rainfall. But the central region has a small amount of annual rainfall which is highly variable. This is the main factor that gives instability to Msharashtra agriculture especially in central region which has a deficient total annual rainfall and it is highly variable. The central region therefore, is a drought prone part of the state. As a matter of fact, about 30 per cent of geographical area is subjected to frequent scarcity condition and such areas have been identified as drought prone areas and it cover 87 taluks of 12 districts of the

state[1]. As agriculture is a biological process, water is a basic ingredient for the completion of its life-cycle. Water from any source either in form of rainfall or irrigation, with regulated and timely water supply can help a lot for a better harvest. In scarcity areas and even other areas, irrigation plays a crucial role in bringing stability in agricultural production. In the light of above discussion, the importance of irrigation in the state can not be over - emphasised.

Agricultural Economy

The agricultural economy of Maharashtra characterised by an underdeveloped agriculture, i.e; the climatic conditions and soil structure are not favourable for cultivation. Still cultivation is an important economic activity in the state and it has accommodated 65 per cent of the state's total labour force but contributed only 29 per cent of the state's income in 1970-71. As compared with India (44%) and some of the states like Assam (57%), U.P. (60%) and Punjab 60%), agriculture of Maharashtra only generates a small portion of the state's income. Particularly due to low productivity, agriculture has caused an embarrassing situation in the state. Farmers do not get adequate

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1. Government of Maharashtra: Performance of Budget 1976-77, Agriculture and Cooperation Department, pp.268.

incentive for agriculture, as their efforts are proved unproductive. Despande observes that farming in a state is a close adjustment of the farmers response to the local environment from its begining in the pre-monsoonal soil preparation to the harvesting of the crops. But there is a wide gap between the intensity of efforts and certainty of yield[1]. In spite of its physiographic constraints, the state has pooled 59·4 per cent of the total geographical area for cultivation and stood third in the country after Punjab (82·6%) and West Bengal (70·4) in 1975-76. As it has been pointed out that the annual growth of cultivable land is very nominal (0·03%) after 1970 and people have accepted multiple cropping as an alternative to the extensive cultivation to keep agricultural production in the same rising track. Cropping intensity (a statistical expression of multiple cropping) grew at a rate of 0·37 per cent per annum during early five years of seventies as against zeor per cent per annum during the previous decade. Because cultivable land in the state was increasing speedily in early sixties (0·30 per cent per annum) but it was slowed

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1. Despande C.D. (1971), Geography of Maharashtra, National Book Trust of India, New Delhi, p.100.

down in early seventies (0·03 per cent per annum). Thus the emergence of multiple cropping (intensive cultivation) in Maharashtra is due to the inelastic nature of cultivable land and it is more important to study the pattern of land use in the state.

2.2. Land Use Pattern:

The availability of land and its use pattern in agriculture is important. The geographical features and soil climate complex decisively influence the pattern of land use in the state. Table 2·1 gives the land use data for 1951-52, 1961-62 and 1975-76. Of the total reported area of the state (307.58 lakh hectares), 183·24 lakh hectares which accounted for sixty per cent of the total area, were used for raising agricultural crops in 1975--76. So the state showed a relatively higher proposition of total area under plough compared with the nation (46·0 per cent). The proportion of area shown more than once is small. In 1975-76, this was 7·84 per cent of net sown area. The state had about 17·0 per cent area under forest, 3·0 per cent cultivable wastes, 5·0 per cent under follow land and nearly 6·0 per cent under permanent pastures and land under miscellaneous free crops and so on.

Table 2.1

Land Utilisation Pattern: Average for three years

(000' Hectares)

Item	1951-52 Area	1951-52 % to reporting area	1961-62 Area	1961-62 % to reporting area	1975-76 Area	1975-76 % to reporting area	Percentage change 1951-52 / 1961-62	Percentage change 1961-62 / 1975-76	Percentage change 1951-52 / 1975-76
1	2	3	4	5	6	7	8	9	10
Reporting Area (Index)	30725 (1.00)	100.00	30763 (1.01)	100.00	30758 (1.00)	100.00	0.02	0.02	0.00
Forests (Index)	5478 (1.00)	17.62	5419 (1.00)	17.62	5336 (0.98)	17.36	0.02	-1.53	-1.51
Barren & Uncultivable land (Index)	2215 (1.00)	7.20	1797 (0.81)	5.84	1739 (0.78)	5.65	-18.87	-3.23	-21.49
Land put to non-agricultural uses (Index)	311 (1.00)	1.01	704 (2.26)	2.29	950 (3.05)	3.09	126.37	34.94	205.34
Culturable Wastes (Index)	1126 (1.00)	3.36	923 (0.82)	3.00	1008 (0.90)	3.28	18.03	9.21	-10.48
Permanent Pastures and growing land (Index)	698 (1.00)	2.27	1422 (2.03)	4.62	1611 (2.30)	5.24	103.73	13.29	130.08
Land under Miscellaneous Tree Crops etc. (Index)	719 (1.00)	2.34	182 (0.25)	0.59	193 (0.27)	0.62	-74.69	6.04	-73.16

1	2	3	4	5	6	7	8	9	10
Current fallow (Index)	1214 (1.00)	3.95	1162 (0.96)	3.79	870 (0.75)	2.82	-4.37	-25.06	-29.34
Other fallow (Index)	2386 (1.00)	7.74	1171 (0.49)	3.81	802 (0.35)	2.61	-50.80	-31.51	-66.33
Net Sown Area (Index)	16672 (1.00)	53.21	17981 (1.08)	58.45	18224 (1.10)	59.33	7.85	1.35	9.31
A.S.M.O. (Index)	540 (1.00)		979 (1.81)		1428 (2.55)		81.11	41.21	155.74
Gross Cropped Area (Index)	17212 (1.00)		18960 (1.10)		19652 (1.14)		10.16	3.65	14.05
Cropping Intensity	103.24		105.44		107.51				

Figure in parenthesis are index number with 1951-52 : 1.00

(1) Maharashtra and Gujarat Aggricultural statistics Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India.

(11) Season and Crop Report of Maharashtra. 1960-61, 61-62, & 62-63 Government of Maharashtra.

(111) Performance Budget of Maharashtra (1978-79) Published by Government of Maharashtra.

Looking over time, we find that net sown area and area under permanent pastures and grazing lands has been expanding and thus expansion has come largely from the decline of both cultivable waste and long duration fallows. A decline in land under miscellaneous tree crops and groves also added to the share of land under plough in the state.

For example, in 1951-52, of the total reporting area, net sown area was 54·2 per cent but in 1961-62, it increased to 58·48 per cent and again in 1975-76, it increased further to 59·3 per cent. The index of net sown area has also shown a continous increase over this period. In 1951-52 area under permanent pastures and grazing land was 2·27 per cent, it increased to 4·62 per cent and 5·27 per cent in 1961-62 and 1975-76 respectively. The index for this category of land use increased from 1·00 in 1951-52 to 2·03 in 1961-62 and to 2·30 in 1975-76. This increment in net sown and area under permanent pasture and grazing land in contributed by the decline in area under cultivable waster. In 1951-52, area under cultivable wastes was 3·36 per cent and it declined marginally to 3·28 in 1975-76. The index was 0·82 in 1961-62 and 0·90 in 1975-76, compared to 1·00 in 1951-52. Area under long duration fallow has also decreased.

In 1951-52, area under this category was 7·74 per cent but it decreased to 3·81 per cent in 1961-62 and to 2·61 per cent in 1975-76. Its index declined from 1·00 in 1951-52 to 0·49 in 1961-62 and to 0·35 in 1975-76. The decine in area under miscellaneous tree crops and groves also contributed to the increased share of land under cultivation in the state. In 1951-52, 2·34 per cent area was under this category, but it decreased to 0·59 per cent in 1961-62 and 0·63 per cent in 1975-76. The index of the category increased from 0·25 in 1961-62 to 0·27 per cent in 1975-76.

In an expanding economy like Maharashtra, more and more land is needed for building socio-economic infrastructure, rising unbanisation and other non-agricultural activities. As a result, area under non-agricultural uses has been increasing. In 1951-52, area under non-agricultural uses was just 1·01 per cent of the total geographical area of the state, and it increased to 2·29 per cent in 1961-62 and further to 3·09 per cent in 1975-76. Its index increased from 1·00 in 1951-52 to 2·26 per cent in 1961-62 and 3·05 per cent in 1975-76. The above facts put together clearly show that there is no scope to bring additional

area under cultivation, because 85 per cent ofthe cultivable area is already being used for agricultural purposes. In this circumstances, the expansion of multiple cropped area is the only solid and enduring way to increase agricultural output in the state. In 1951-52, of the total net sown area, only 3·24 per cent was under multiple cropping and it increased to 5·4 per cent in 1961-62 and 7·84 per cent in 1975-76. Index of area sown more than once was 2·54 in 1975-76 compared to 1·81 per cent in 1961-62 and 1·00 in 1951-52. The low level of multiple cropping in the state, has resulted in low cropping intensity. In 1951-52, cropping intensity was 103·2 and it increased upto 107.5 in 1975-76. Thus area sown more than once did not increase much in the state.

2.3. Cropping Pattern

The cropping pattern depicts the distribution of the gross cropped area in different crops of a region. It reveals the pattern of demand for agricultural products and the kind of agriculture prevailing in the state. In any plan for a change in the cropping pattern it is essential that we acquire a knowledge of the existing state of affairs, as also its history and the influences that shape it. The cropping pattern of the state of Maharashtra slightly differs from that of India. The

soil structure and the unfavourable climatic condition in the state have given rise to inferior crops like Jowar, bajra as against the crops like rice or wheat in other states of India. Even a cursory look at the crop pattern depicted in table 2.2 will at once bring out its most important feature, namely the predominance of foodgrains. Actually in Maharashtra, even in India, only a limited variety of crops are grown. It seems that as if in Maharashtra, there is no pattern with variety, as food-grains constitute 71·09 per cent of the gross cropped area in 1975-76. And this trend has not changed much since 1960-61. Of course, in a sense that there are number of crops like bajra, sugarcane, fruits and vegetables etc., and particularly cereals have occupied the major share in the foodgrains category and have shared about 80 per cent of the total. However, in terms of percentage change during these fifteen years, it is very nominal. Pulses have showed a better result by showing a sharp rise in its production (17·24 per cent) during these years. Area under bajna production displays a vertical rise as the area under the crop has increased by 35·37 per cent during these years. Although the sugarcane, fruit and vegetables are not important crops in the state, still their performances

Table No.2.2

Area Under Principal Crops in Maharashtra

(Figures in 00' Hectares)

Crops	1960-61 Area	1960-61 % to GCA	1975-76 Area	1975-76 % to GCA	% change from 1960-61 to 1975-76
Foodgrains	129010	68.83	138533	71.09	7.38
Cereals	106082	56.37	110910	56.92	4.55
Pulses	23523	12.49	27623	14.18	17.24
Non-Foodgrains	53627	28.48	50255	25.79	-6.28
Rice	13001	6.90	13511	6.93	3.92
Wheat	9070	4.82	9652	4.95	6.41
Jawar(K)	25496	13.54	27445	14.08	7.64
Jawar (R)	39800	21.14	33431	17.16	-16.00
Jawar (T)	65296	31.54	60876	31.14	6.36
Bajra	16359	8.69	22154	11.36	35.37
Sugarcane	1556	0.83	2145	1.10	37.85
Cotton	25000	13.30	23482	12.05	-6.07
Groundnut	10832	5.75	7584	3.89	-29.00
Fruits & Veg.	1468	0.78	2066	1.06	40.13
Gross Cropped Area	188309	100.0	194860	100.0	

Source Statistical Abstract of Maharashtra - 1962

Statistical Abstract of Maharashtra - 1976

are quite satisfactory. The most adverse results have come from ragi, jowar, cotton and groundnut, where area under these crops has been reduced during this period.

Among the foodgrains, jowar is the most important crop. It accounted for 31.14 per cent of the total cropped area and about 55 per cent of the cropped area under food-grains. Bajra is the next dominant prop in the state which has occupied more than 11 per cent of the cropped area in 1975-76 Next to bajra, rice is the popular crop (6.93 per cent) which is restricted to some pockets of the state where rainfall is very high.

Non-foodgrain is the most affected category where about 34 million hactares of land has been withdrawn from cultivation. So that the total area under non-foodgrains decreased by 6.28 per cent during this period.

However, regional distribution of cropping pattern is not uniform throughout the state. Rice is the dominant crop in Konkan and eastern districts of the state where annual rainfall is very high. Cotton is an important crop in Nagpur and Aurangabad divisions and some other districts like Dhulia and Jalgaon. Except Konkan; jowar, bajra, wheat and groundnuts are cultivated everywhere is the state. Among fruits, mango is grown mostly in Ratnagiri area, whereas orange is mostly grown in Nagpur district. Junner is

famous for potatoes and eastern Nasik for onions. The Konkan coastal land is the traditional home for cocoanut production. Major part of the state, particulary central Maharashtra is a drought prone region and the state and it is famous for its dry-land farming.

Thus the picture of cropping pattern that emerges from the above discussion is one of a frozen one with a few changes of no little significance. While foodgrains dominate, non-foodgrains start declining. Among individual crops jowar takes the lion's share in 1975-76 as before. Sugarcane among the non-foodgrains has the second biggest growth rate after fruits and vegetables. Bajra, growing much fast, has the largest chunk of rise in area under foodgrains.

2.4. Production Pattern

Agriculture of Maharashtra is considered as one of the most backward states in the country in terms of agricultural production. Climatic conditions are so fluctuating in the state that farmers are habituated with this. Table 2.3 gives a clear cut picture of the state of agriculture in Maharashtra. The year 1960-61 saw a bumper harvest, which was never repeated, even once in the subsequent thirteen years. In 1974-75, the production target broke

Table No.2.3

Index Number of Agricultural Production in Maharashtra

(Base year 1960-61)

Year	All Commodities	Food grains	Non-Foodgrains
1960-61	100.00	100.00	100.00
1961-62	85.52	86.45	84.24
1962-63	88.62	88.16	89.47
1963-64	90.32	88.24	94.24
1964-65	91.04	89.31	94.24
1965-66	65.73	61.39	73.48
1966-67	76.05	77.39	73.71
1967-68	87.38	87.59	87.01
1968-69	91.14	88.98	95.08
1969-70	88.49	86.29	92.47
1970-71	75.87	76.82	73.64
1971-72	70.58	68.41	20.68
1972-73	51.71	42.02	69.28
1973-74	90.70	96.24	80.63
1974-75	104.16	103.10	106.14

the old record, which was set in 1960-61. Particularly in 1972-73, commodities index number was 51·72, where 1960-61 was the base year. In 1974-75, foodgrains index number (103·1) trailed behind all commodities index number.

Season and crop reports of Maharashtra show production figures for 1961-62 and 1975-76. Table 2.4 delivers certain relevant information about agricultural production in the state (1961-62 and 1975-76). The major component of total food grop production, namely foodgrains have registered a large increase in production (in absolute value). The broad picture that emergos is that in the last years since 1961-62, the foodgrain production has increased by 27·76 per cent. Similar increase in production has taken place in case of rice. The output of wheat has, however, increased more sharply with more than 131 per cent, showing the largest rate of growth. This was largely because of the introduction of high yielding varieties of seeds in the irrigated areas. Some crops like ture, groundnut and cotton have registered a negative growth rate where as cotton registered the highest, in terms of physical output and groundnut, in form of percentage decline in production. Bajra production has increased by 26·53 per cent during these years.

Table No.2.4

Output of Principal crops in the State

(Figures in 000' Tonnes)

Items	1961-62 Output	1961-62 % to Foodgrain	1975-76 Output	1975-76 % to Foodgrain	% change 1961-62 over 1975-76
Foodgrains	6970	100.00	8905	100.00	27.76
Rice	1382	19.88	1902	21.36	37.65
Wheat	425	6.61	984	11.05	131.53
Jawar	3512	50.39	3679	41.31	4.76
Bajra	490	7.03	620	6.96	26.53
Ragi	164	2.35	180	2.02	9.76
Tur	373	5.35	371	4.17	-0.45
Gram	139	1.99	156	1.17	12.26
Sugarcane(Gur)	1109		2161		94.86
Groundnut	790		622		-21.27
Cotton (Lint)	1340		1106		-17.46

Source 1) Maharashtra and Gujarat Agricultural Statistics, Directorate of Economics and Statistics, Minister of Food and Agriculture.

2) Season and Crop Report, Government of Maharashtra 1975-76 and 1976-77

3) Performance Budget of Maharashtra 1978-79

Sugarcane production has shown an encouraging result among non-food grain crops by setting a new record of 94·86 per cent increase in production during 1961-62 to 1975-76. In 1961-62, sugarcane production was 1109 thousand tonnes and it increased upto 2116 thousand tonnes in 1975-76.

Among pulses, gram production was quite reasonable as it has increased by 12·26 per cent during 1961-62 to 1975-76. But cropped area, devoted for gram has declined in 1975-76 in comparison with 1961-62.

The state has experienced some changes in the pattern of agricultural production. Some broad changes have been underlined below.

(a) A marginal increase has been recorded in food-grain production (27·76 per cent) during 1961-62 to 1975-76.

(b) Jowar continued to be the major crop in the state till 1975-76 (41·31 per cent of the total foodgrains production) but its production has declined since then.

(c) Prodominance of inferior and dry crops is still persisting in the state but it is declining gradually.

(d) Wheat becomes the most outstanding crop in the state which recorded the maximum increase in food-grains production (131·53 per cent).

(e) Superior crops like wheat and rice are gradually gethering momentum to dominate the foodgrains production in the state.

(f) Among non-goodgrains, sugarcane has made a remarkable break through in its production and it is almost doubled (194·86 per cent) during 1961-62 to 1975-76.

(g) Some celebrated crops like cotton and groundnut have shown a negative growth rate in their production.

However, the state has not experienced any breakthrough in its agricultural production. Foodgrain, the major contributor to the total production has not shown any impressive performance till 1975-76. Some inferior crops like bajra, jowar, and ragi have still maintained their strong hold in total foodgrain production but gradually they are losing their positions to rice and wheat. Production of cotton and groundnut is decreasing slowly and this is compensated by sugarcane production. The most spectacular change that we can observe is that dry crops are gradually losing their battle to those crops which are more dependable on water like rice, wheat and sugarcane in Maharashtra.

2.5. Yield Level

For the growing need for agricultural production, it is the yield per hectare that can contribute towards a large expansion in output. The rist in productivity no doubt

boosts production to some extent, but it has not come up to the expectation. The inadequacy both in terms of the large needs of output which the small improvement in productivity can not meet and the big potential of land, has yet to be tapped.

Table 2.5 reveals the fact that the productivity of foodgrains is growing at a rate of 1·39 per cent per annum during 1960-61 to 1975-76. Average productivity of foodgrains has increased by 21·3 per cent during 1961-62 to 1975-76. Annual growth rates of two crops namely Rice and Wheat have registered marked improvement over total foodgrains production. In terms of productivity, wheat has shown the best performance and its annual growth rate is 4·97 per cent during 1961-62 to 1975-76 in Maharashtra. Average Yield per hectare of total food grains is 540 kgs. and some crops like rice, jowar, ragi and tur have better productivity than the composed foodgrains index in 1961-62. Among these crops, only rice could manage to restore its position and other crops have disappeared from the list in 1975-76. On the other hand, wheat which was running far behind the total average foodgrains, has stddenly reversed its position in 1975-76 by doubling its production. Instead of rice and wheat, other crops like bajra, ragi and sugarcane have performed better in terms of productivity. Only tur has faced a downward trend and

Table No. 2.5

Average Yield of Principal Crops

(Yield in kg/Hect.)

Crops	1961-62	1975-76	% change 1961-62 over 1975-76	Annual compound Growth Rate
Foodgrains	540	655	21.30	1.39
Rice	1070	1333	24.58	1.58
Wheat	448	883	97.10	4.97
Jawar	556	592	4.59	0.32
Bajra	288	338	17.36	1.15
Ragi	720	849	17.92	1.18
Tur	604	580	-3.97	-0.29
Gram	343	356	3.79	0.27
Sugarcane(Gur)	7682	9846	28.17	1.79
Groundnut	697	725	4.04	0.28
Cotton(Lint)	80	86	7.25	0.52

Source Stastistical Abstract of Maharashtra - 1961,
Stastistical Abstract of Maharashtra - 1962
Statistical Abstract of Maharashtra - 1963
Statistical Abstract of Maharashtra - 1975
Statistical Abstract of Maharashtra - 1976

showed a negative growth rate. Jowar, the leading crop in the state, has not performed well during these years. Other crops like gram, groundnut and cotton have showed marginal but positive growth rates in their productivity. However, some changes in the level of productivity have been stated below.

(a) Productivity of total foodgrains has showed a slow and positive annual growth rate (1·39 per cent) during 1961-62 to 1975-76.

(b) Better performance has been displayed by water based crops like rice, wheat and sugarcane during this period.

(c) Wheat is proved to be the outstanding crop in the state as the productivity of the crop simply doubled within a period of fourteen years.

(d) Sugarcane set a net reocrd among non-foodgrains and its productivity has increased at a rate of 1·79 per cent per annum.

(e) Traditional crops of the state like jowar, bajra, ragi, gram, groundnut and cotton have showed positive response in terms of production but this increase in productivity is very marginal.

(f) Jowar is the most popular and widely cultivated crop in Maharashtra both in terms of production (in volume) and area (i.e; NSA), has not performed well in terms of productivity.

From this discussion, it appears that Maharashtra is having a stagnent agricultural sector. Neither net sown area nor productivity per hectare is increasing steadily. Particularly, major crops of the state have not displayed any appreciable result in terms of productivity. In many cases, productivity of these crops is unchanged over years. Some encouraging results have come from wheat, rice and sugarcane, which are on their way to become major crops in the state. However, if major brakethrough can not be made to improve productivity of dry-crops, then the fate off the agriculture economy of Maharashtra will meet a tragic end.

2.6. Irrigation

Irrigation becomes a crucial factor as a safeguard against the vagaries of moonsoon. Particularly in Maharashtra, drought comes after every three to four years. In spite of this, extent of irrigation is very less in the state. Irrigation has two dimensions as it is used both intensively and extensively. In 1975-76 only 9·4 per cent of the total cultivated area was under

irrigation as against 58 per cent inP Punjab, 43 per cent in Tamilnadu, 41 per cent in Kashmir and 20 per cent in Delhi. During 1960-61 and 1975-76, area under irrigation increased by only 3.4 per cent of the net sown area.

Irrigation through different sources of irrigation is another aspect of agriculture because different sources of irrigation are not equally productive in terms of water supply. Canal irrigation is generally regarded as the perennial source of irrigation as canals get water from reservors and water is available at the time of need. Tanks get water from natural rainfall and the extent of water content can be used for only one crop. So in tank irrigated area, if farmers use to take multiple crops, then for one or two crops, they have to depend on natural showe . Similar is the result in case of well irrigation.

Table 2.6 shows the distribution of the net irrigated area, being shared by different sources of irrigation. In Maharashtra, irrigation through wells is more popular. About one fifth of the total irrigated land is irrigated by both government and private canals. Tank irrigation is also important in the state but day-by-day, people are losing their faith in it and are depending more on canal, well and other sources of irrigation. Agricultural scientists believe that controlled irrigation is the best form of

Table No.2.6

Area Irrigated by Different Sources of Irrigation

(Figures in 000' Hectares)

Items	1961-62 Area	1961-62 % to NIA	1974-75 Area	1974-75 % to NIA	% Change 1961-62 over 1974-75
Govt. Canal	211	19.52	320	19.85	51.66
Private Canal	30	2.78	19	1.18	-36.67
Wells	611	56.51	936	58.07	53.19
Tanks	187	17.30	232	14.39	24.06
Other Sources	42	3.89	105	6.51	150.00
NIA	108	100.00	1612	100.00	49.12
AIMO	152	14.06	312	19.91	111.18
GIA	1233	114.52	1933	120.05	56.77

NIA - Net Irrigated Area

AIMO - Area Irrigated More than Once

GIA - Gross Irrigated Area.

Source: 1) Maharashtra, Gujarat Agricultural Statistics, Government of India 1961.

2) Performance Budget of Maharashtra 1978-79.

irrigation and tube-well irrigation is the best form of controlled irrigation. This may be another reason for the rising inclination towards other sources of irrigation.

Maximum increase in the area of different sources of irrigation has been recorded by other sources of irrigation (150 per cent). Area under Government canal has increased by 51.66 per cent but private canal shows a negative trend. In spite of the negative aspect of well irrigation, it has brought (325 thousand hectares) maximum land under irrigation during 1966-67 and 1975-76.

Particulary, during these years, net area irrigated has increased by 49.12 per cent but area irrigated more than once has expanded by 111.18 per cent. Area irrigated more than once does not cover a substantial part in net area irrigated, as a result of which gross irrigated area has increased by 56.77 per cent. However, in 1961-62 only 14.52 per cent of the irrigated area got irrigation facility at least twice in a year but this figure improved (20.05 per cent) in 1975-76.

In spite of the low irrigated area in the state, response of the state is positive in terms of irrigated land use. Double irrigated land has increased appreciably. But with this amount of irrigated land, pattern of agriculture can not take a sharp turn.

2.7. Area Under HYV

The crop of the new technology consists of the High-Yielding Varieties of seeds. Born out of scientific research, these seeds envisaged inputs in new form and new combination. The researched new seeds could perform wonders, if these were fertilized heavily, the key element in the menu of agricultural crops. The large grains, rather than leaves, that these seeds promise need protection while in the process of growth through pesticides. With an assured and adequate water, the inputs of seeds, chemical fertilizers and pesticides; it will give a good harvest. But in a water scarcity area, it is very difficult to expect a good harvest.

Table 2.9 shows how cultivated areas were devoted to different high yielding varieties crops. Paddy, wheat, jowar and bajra showed an impressive note became area under these crops (HYV) steadily started rising. Area under HYV bajra was recorded highest in 1973-74 (68.58 times more that 1966-67), but then it started declining. Maximum area was drawn by HYV wheat (976,000 Hect.) as against jowar (834,000 Hect.), rice (539,000 Hect) and bajra (409,000 hect.) in 1975-76. Among major crops, wheat recorded the highest improvement for diverting area towards it.

Table No.2.7

Area Under High Yielding Varieties in Maharashtra

(Figures in 000' Hectares)

Crops	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
Paddy	76	68	129	185	216	232	217	393	363	539
(Indices)	(100)	(089)	(1.70)	(2.43)	(2.84)	(3.05)	(2.86)	(5.17)	(4.86)	(7.09)
Wheat	43	14	64	152	211	207	310	377	407	976
(Indices)	(1.00)	(0.33)	(1.49)	(3.53)	(4.91)	(4.81)	(7.21)	(8.77)	(9.47)	(22.70)
Jawar	115	493	533	323	501	329	337	540	468	834
(Indices)	(1.00)	(4.29)	(4.63)	(2.81)	(4.36)	(2.86)	(2.93)	(4.70)	(4.07)	(7.25)
Bajra	12	104	213	302	481	198	292	823	624	408
(Indices)	(1.00)	(8.67)	(19.25)	(25.17)	(4.03)	(16.50)	(2.33)	(68.58)	(52.00)	(34.08)
Maize	54	11	11	8	6	3	3	9	11	27
(Indices)	(1.00)	(0.20)	(0.20)	(0.15)	(0.11)	(0.06)	(0.06)	(0.17)	(0.20)	(0.50)
TOTAL AREA UNDER H.Y.V.										
State	300	690	968	970	1415	969	1159	2142	1868	2785
(Indices)	(100)	(2.30)	(3.23)	(3.27)	(4.72)	(3.23)	(3.86)	(7.14)	(6.23)	(9.28)
India	1886	6036	9297	11413	15383	18173	22321	26038	27337	31888
(Indices)	(1.00)	(3.20)	(4.93)	(6.06)	(8.16)	(9.64)	(11.84)	(13.81)	(14.49)	(16.91)

Source: High Yielding Varieties Programme Coverage of Area, State-Wise and Cropwise (1966-67) to 1980-81), Ministry of Agriculture.

The state did not respond much towards HYV production till 1972-73 but then it took a sudden take off. However, the state's reponse to HYV was not impressive, as it has done in the country, as a whole.

2.8. Mechanisation

Mechanisation in agriculture is an important factor to renovate the agriculture for higher production. This process helps the agriculture in two ways: Firstly, it tries to increase the level of productivity by deep ploughing, proper showing and controlled irrigation and secondly, it ettempts to save time and energy during harvest, preparing land for the next crop. It has got two disadvanges as it is more capital-intensive, and it is a technique to displace labourers. In many cases, it is found that labour and Mechanisation are complementary factors in stead of competitive.

According to 1960-61 Agricultural Implements census, the state had 1427 tractors, 63744 oil engines and 7100 electric pump sets. In 1972 census, tractors have increased to 6186, oil enginer to 173678 and electric pumps to 169778. During 1960-61 to 1972-73 oil engiones have more than doubled whereas tractors increased five times more. The increase in case of electric pumps was quite high and it has gone up by about twenty two times

more in 1972. In comparasion with other states, Maharashtras has stood fairly at a better position. Maharashtra had 18 power operated pumps per 1000 hectare of net cropped area in 1968-69 as against 12·0 for India as a whole.

2.9.Fertilizer

Introduction of high yielding varieties in agriculture has opened a new dimension for massive fertilizer use. Farmers have realised that fertilizer is used to remove the dificiencies in soil so that it will give an ample of scope to the hybrid plants to grow rapidly. The types of soil in the state lack nitrogen, phosphate and therefore it requires constant use of fertilizer. In 1960-61, The consumption on nitrogen and phosphate was 17653 metric tonnes and the same was by 261703 metrix toones in 1973-74. Within this period, the consumption of fertilizer increased by more than fifteen times. The state showed an encouraging result in fertilizer consumption. However, inspite of the rapid increase, the per hectare consumption was very low. In 1971-72 per hectare consumption was 11·5 kg. as against a national average of 14·5 kg. Per hectare applications of fertilizers in the state. Consumption of fertilizer was less in Maharashtra because the extent of irrigation facilities was very low in the state.

CHAPTER III

INTER-TALUK VARIATIONS IN CROPPING INTENSITY IN MAHARASHTRA STATE

The main objective of this chapter is to examine the inter-taluk variations in cropping intensity in the state of Maharashtra at three points of time, viz 1960-62, 1967-69 and 1973-75. A five-fold classification has been worked out on the basis of levels of cropping intensity to identify the cluster of taluk in various classified groups. An attempt to locate such clusters will enable us to identify the areas of high medium and low cropping intensity and the regional pattern. Effort is also made to examine the inter-class movement of taluks during the period under consideration. The emerging pattern of variations would then lay down the basis for an analysis of identification of factors causing such variations, which we would analyse in the next chapter.

Period I: (1960-61, 1961-62 and 1962-63)

The first period is considered to the one of the most favourable phase in the history of agricultural production in the state of Maharashtra. Table 3.1

gives information for period I. In this period, the average cropping intensity for the state as a whole

Table 3.1

Cropping Intensity

Period I

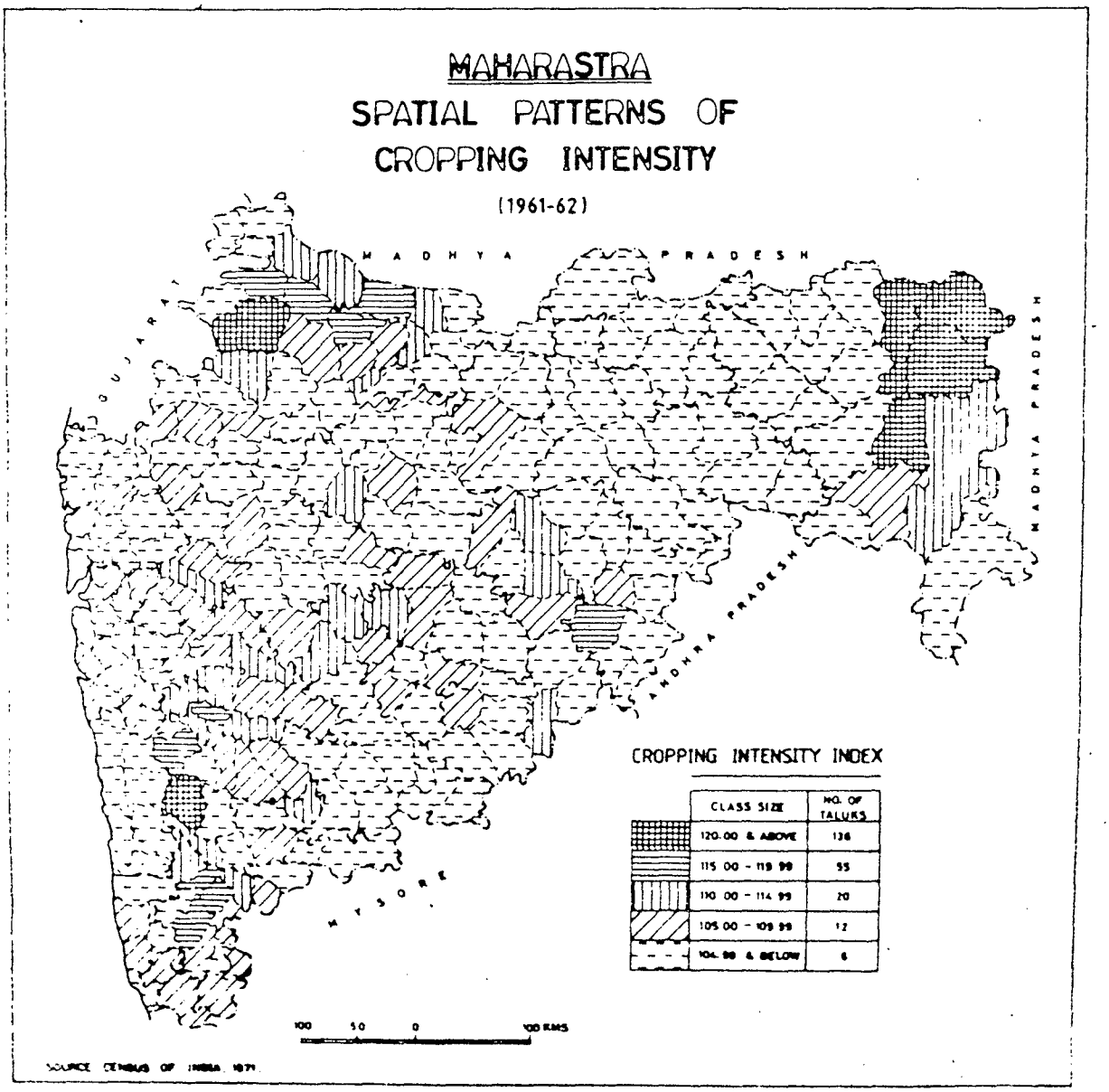
Sl.	Items	1961-62
1.	Lowest Figure	100.010
2.	Highest Figure	140.250
3.	Range	40.254
4.	Mean	105.100
5.	Standard Deviation	6.656
6.	Co-efficient of Vatiation	0.063
7.	Total No.of Taluks	229
8.	No.of Taluks above Mean	94
9.	No. of Taluks below Mean	135

(on the basis of taluk average) was 105.16. Out of 229 taluks of the state, as many as 135 taluks displayed cropping intensity below the state average and only 94 above this average. The cropping intensity figure, revealed wide variation among the taluks. This variation ranges between 100.01 to 140.25. However, the maghitude

of internal variation in cropping intensity was not large because as given in table 3·1, the co-efficient of variation was of a low order viz, 6·33 per cent.

In order to explain the regional pattern of taluks, a five-fold classification was worked out. Taluks with cropping intensity below 105 were defined as very low level taluks and those between 105 and 110 as low level. Taluks, having cropping intensity ranging between 115 to 120 treated as high level and those with more than 120 were designed as very high level taluks. Taluks having cropping intensity between 110 and 115, were treated as Medium range taluks. It should be noted that present classification of taluks on the basis of levels of cropping intensity is devised for Maharashtra and therefore, it can not be generalised for the country as a whole. Such a classification is made on the basis of the spread of the cropping intensity figures in different taluks of the state.

Table 3.2 provide the information for 229 taluks of 25 districts of the state. It gives the number of taluks and their percentages to total taluk in five categories of cropping intensity. This fact is clearly depicted in Map.3. It reveals a very uneven and depressing picture.


MAHARASTRA
SPATIAL PATTERNS OF
CROPPING INTENSITY
(1961-62)
M A D H Y A P R A D E S H
GUJARAT
ANDHRA PRADESH
MADHYA PRADESH
MYSORE
CROPPING INTENSITY INDEX
CLASS SIZE
NO. OF TALUKS
120.00 & ABOVE
115.00 - 119.99
110.00 - 114.99
105.00 - 109.99
104.99 & BELOW
100 50 0 100 KMS
SOURCE CENSUS OF INDIA 1971

MAP. 3

Table No. 3·2

Classification of Taluks on the Basis of Levels of Cropping Intensity

Period - I

(1960-61, 1961-62 & 1962-63)

(Three Years Moving Average)

Name of the Districts	CROPPING INTENSITY GROUPS					Total No. of Taluks
	I	II	III	IV	V	
	Very Low	Low	Medium	High	Very High	
	100 to 104.99	105 to 109.99	110 to 114.99	115 to 119.99	120 & above	
Ahmednagar	8	4	1	0	0	13
Akola	6	0	0	0	0	6
Amaravati	6	0	0	0	0	6
Aurangabad	9	2	1	0	0	12
Bhandara	0	0	0	0	3	3
Beed	3	2	2	0	0	7
Buldana	4	1	0	0	0	5
Chandrapur	3	1	1	0	1	6
Dhulia	3	2	1	3	1	10
Jalgaon	6	3	2	2	0	13
Kolaba	6	8	0	0	0	14
Kholapur	2	5	1	4	0	12
Nagpur	5	0	0	0	0	5
Nanded	6	1	0	1	0	8

Name of the Districts	CROPPING INTENSITY GROUPS I Very Low 100 to 104.99	II Low 105 to 109.99	III Medium 110 to 114.99	IV High 115 to 119.99	V Very High 120 & above	Total No of Taluks
Nasik	8	4	1	0	0	13
Osmanabad	6	4	1	0	0	11
Parvani	4	2	2	0	0	8
Pune	4	6	4	0	0	14
Ratnagiri	11	4	0	0	0	15
Sangli	4	2	0	0	0	6
Satara	3	3	2	2	1	11
Sholapur	11	0	0	0	0	11
Thane	10	2	0	0	0	12
Wardha	3	0	0	0	0	3
Yeotmal	5	0	0	0	0	5
Group Total	136	55	20	12	6	229
Percentage of Group Total to total Taluks	59.4	24.0	8.7	5.2	2.6	100.0

Note: Figures show the absolute number of taluks in five cropping intensity groups for 25 districts of the state and total

Of the total taluks as many as 59·4 per cent of taluks were in the category of very low cropping intensity which ranges between 100 to 104·99. The precentage of taluks reduced drastically as we move from very low to very high intensity group. It was 59·4, 24·0, 8·7, 5·2 and 2·6 per cent for group very low, low, medium, high and very high respectively. Thus in absolute number of 229 taluks, as many as 136 indicated very low and another 55 low cropping intensity. Only 18 taluks had high to very high intensity and there were only 20 taluks in medium cropping intensity group. Thus, in majority of taluks of the state the cropping intensity was low.

Table 3.3 also gives the district wise distribution of taluks in five groups.

a) In the very high intensity groups, were included all taluks of Bhandara district and one each of Chandrapur, Dhulia and Satara district. Gondia taluk of Bhandara district has recorded the highest cropping intensity (140·25) in the state. Incidentally it may be noted that these districts enjoyed rainfall and irrigation level.

b) Coming to the high intensity group, Dhulia and Satara had once again shown better performance. The additi n was made by Kolhapur, Jalgaon and Nanded districts. Within these taluks, cropping intensity varied

Table No. 3.3

Percentage Distribution of Taluks in Various Categories of Cropping Intensity in the Districts of Maharashtra State

Period - I

(1960-61, 1961-62 and 1962-63)

(Three Years Moving Average)

Name of the Districts	CROPPING INTENSITY GROUPS I Very Low 100 to 104.99	II Low 105 to 109.99	III Medium 110 to 114.99	IV High 115 to 119.99	V Very High 120 & above	Total No. of Taluks
Ahmednagar	61.5	30.8	7.7	0.0	0.0	100.0
Akola	100.0	0.0	0.0	0.0	0.0	100.0
Amaravati	100.0	0.0	0.0	0.0	0.0	100.0
Aurangabad	75.0	16.7	813	0.0	0.0	100.0
Bhandara	0.0	0.0	0.0	0.0	100.0	100.0
Beed	42.9	28.6	28.6	0.0	0.0	100.0
Buldana	80.0	20.0	0.0	0.0	0.0	100.0
Chandrapur	50.0	16.7	16.7	0.0	16.7	100.0
Dhulia	20.0	20.0	10.0	30.0	10.0	100.0
Jalgaon	46.2	23.1	15.4	15.4	0.0	100.0
Kolaba	42.9	57.1	0.0	0.0	0.0	100.0
Kholapur	16.7	41.7	8.3	33.3	0.0	100.00
Nagpur	100.0	0.0	0.0	0.0	0.0	100.0
Nanded	75.0	12.5	0.0	12.5	0.0	100.0

Name of the Districts	CROPPING INTENSITY GROUPS I Very Low 100 to 104.99	II Low 105 to 109.99	III Medium 110 to 114.99	IV High 115 to 119.99	V Very High 120 & above	Total No of Taluks
Nasik	61.5	30.8	7.7	0.0	0.0	100.0
Osmanabad	54.5	36.4	9.1	0.0	0.0	100.0
Parvani	50.0	25.0	25.0	0.0	0.0	100.0
Pune	28.6	42.5	28.6	0.0	0.0	100.0
Ratnagiri	73.3	26.7	0.0	000	0.0	100.0
Sangli	66.7	33.3	0.0	0.0	0.0	100.0
Satara	27.3	27.3	18.2	18.2	9.1	100.0
Sholapur	100.0	0.0	0.0	0.0	0.0	100.0
Thane	83.3	16.7	0.0	0.0	0.0	100.0
Wardha	100.0	0.0	0.0	0.0	0.0	100.0
Yeotmal	100.0	0.0	0.0	0.0	0.0	100.0
State Average	59.4	24.0	8.7	5.2	2.6	100.0

Note: Figures indicate the percentage of taluks in each category of Cropping intensity to total number of taluks of districts.

between 116·84 in Khandala (Satara District) to 119·66 in Shahada taluk of Dhulia district.

c) In medium category which ranges between 110 to 114·99, there were 20 taluks drawn from 12 dis ricts.

However, maximum number of taluks (Four) came from Pune District followed by Beed Satara, Kolhapur and Parbhani districts.

d) There were fifty five taluks where cropping intensity was found to be low. These taluks came from eighteen districts of the state. The cropping intensity varied between 105·0 for alibag taluk (Kolab) to 109·527 for Roha taluk of the same district. Maximum number of taluk came from Kolaba (eight), Pune (6) Nanded (4), and Nasik (4) district.

e) Finally coming to the last category, as observed earlier, maximum number of taluks (viz, 136) had very low intensity of cropping. The interesting observation is that except Bhandara district, all other districts had taluks either of low or of very low intensity. So the over all level of cropping intensity turned out to be low. And this feature was not confined to a few regions only but widely spread among majority of taluks of the state.

Yet one notices few duster of districts with some specific characteristics. Table 3.3 shows that in all taluks of six districts namely Akola, Amaravati, Nagpur, Sholapur, Wardha and Yeotamad, the level of cropping intensity was very low as the cropping intensity varies between 101 to 104.99. There another group of districts where more than seventy per cent of taluks of a district were under low category. Except Bhandra district, no district had shown a better performance in the very high category group. Districts like Dhulia followed by Satara, Sangli and Jalgaon had produced a better result in the high intensity category. Second and third categories registered an encouraging picture as the participation rate of the districts in these categories was much higher. However, all other categories of cropping intensity had been over shadowed by low cropping intensity as it accounted 59.4 per cent of taluks in the state.

Period II (1967-68, 1968-69 and 1969-70)

In period II, the over all distributional pattern of taluks has not changed much and various aspects of cropping intensity have also remained same. Table 3.4 and 3.6 give figure for period II. The average level of cropping

intensity for the state as a whole has almost remained constant. It was 105·22 in period II as against 105·16 in period I. There were 99 taluks above the mean level and 140 below the mean level. So there was only a small addition of five taluks in period II.

Table 3.4

Cropping Intensity

Period II

Sl.	Items	1968-69
1.	Lowest Figure	100.030
2.	Highest Figure	141.14
3.	Range	41.141
4.	Mean	105.224
5.	Standard Deviation	6.441
6.	Co-efficient Variation	0.061
7.	Total No.of Taluks	229
8.	No. of Taluks above Mean	99
9.	No. of Taluks below Mean	140

The value of standard deviation of the cropping intensity has remained constant in period II. And since

the mean level was the same, the co-efficient of variation has also remained constant at the same level. Even the range of cropping intensity has remained stagnant. Thus, at the state level, the cropping intensity has not improved much. Stagnation in cropping intensity was inevitable because the percentage of area under irrigation at state level had not shown much improvement. It increased from 6 per cent in period I to 7 per cent in period II.

A complete picture of different taluks in various groups of cropping intensity is given in table 3·5. Although it revealed some change in the composition of taluks in five groups, the over all pattern of distribution has not changed significantly. Like the earlier period, majority of taluks (about 55 per cent) indicate a very low level of cropping intensity and another 30 per cent, a low level of cropping intensity. So as many as 85 per cent of taluks falls under the low level of cropping intensity. Only 5 per cent taluks were in high to very high cropping intensity group.

So far as the change in the composition of taluks was concerned, table revealed the following points. Firstly it is interesting to note that, both in absolute and percentage term, the taluks in very low intensity group have declined in period II. The number of such taluks has reduced from

Table No.3·5

Classification of Taluks on the Basis of Levels of Cropping Intensity

Period - II

(1967-68, 1968-69 & 1969-70)

(Three Years Moving Average)

Name of the Districts	CROPPING INTENSITY GROUPS					Total No. of Taluks
	I	II	III	IV	V	
	Very Low 100 to 104.99	Low 105 to 109.99	Medium 110 to 114.99	High 115 to 119.99	Very High 120 & above	
Ahmednagar	8	4	1	0	0	13
Akola	6	0	0	0	0	6
Amaravati	6	0	0	0	0	6
Aurangabad	4	8	0	0	0	12
Bhandara	0	0	0	1	2	3
Beed	2	5	0	0	0	7
Buldana	4	1	0	0	0	5
Chandrapur	3	1	0	0	2	6
Dhulia	2	3	2	2	1	10
Jalgaon	5	4	3	0	1	13
Kolaba	7	4	3	0	0	14
Kholapur	1	4	3	3	1	12
Nagpur	5	0	0	0	0	5
Nanded	5	3	0	0	0	8

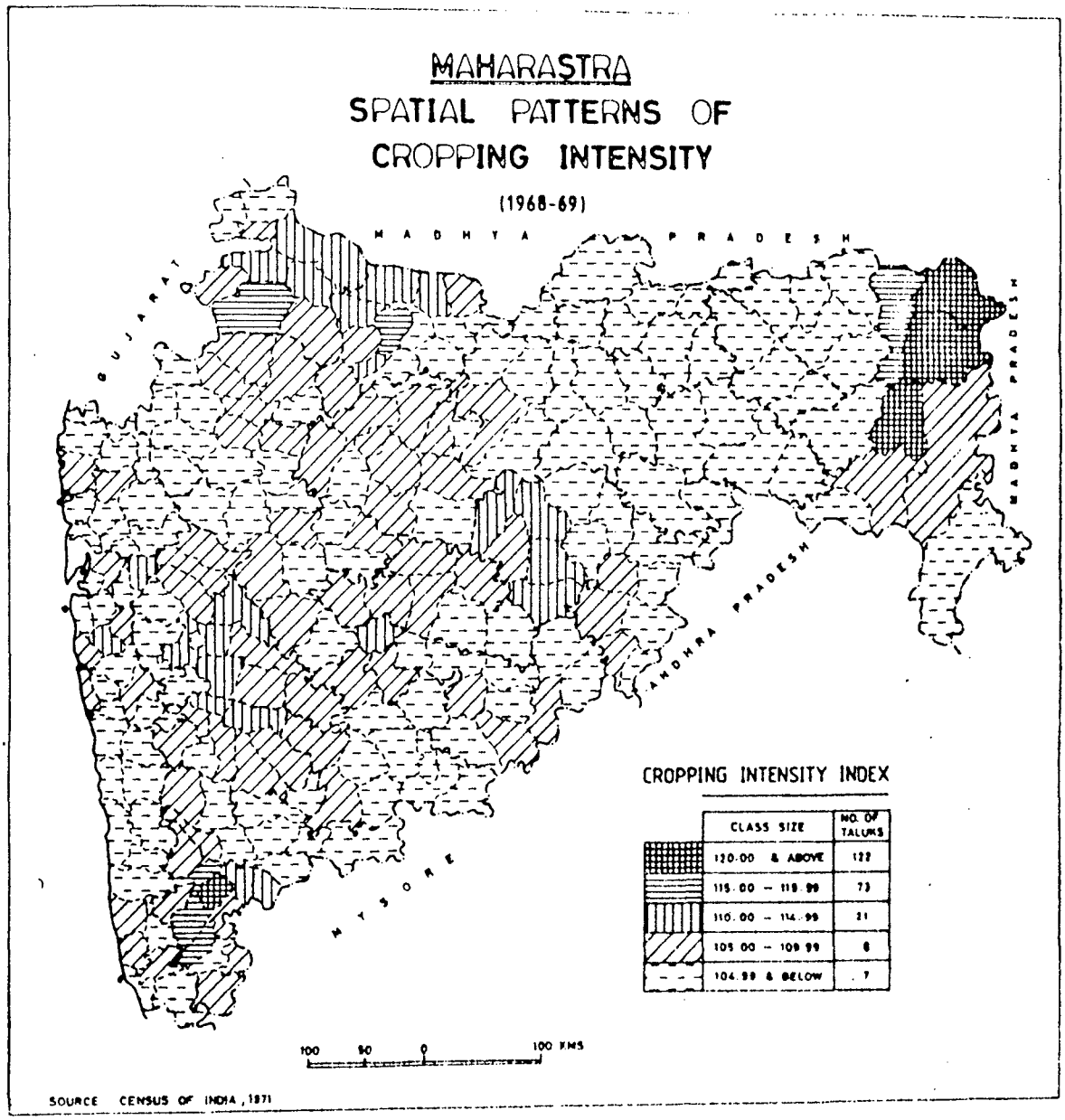
Name of the Districts	CROPPING INTENSITY GROUPS I Very Low 100 to 104.99	II Low 105 to 109.99	III Medium 110 to 114.99	IV High 115 to 119.99	V Very High 120 & above	Total No. of Taluks
Nasik	7	6	0	0	0	13
Osmanabad	7	4	0	0	0	11
Parvani	3	1	4	0	0	8
Pune	4	7	3	0	0	14
Ratnagiri	12	3	0	0	0	15
Sangli	2	4	0	0	0	6
Satara	3	6	2	0	0	11
Sholapur	8	3	0	0	0	11
Thane	10	2	0	0	0	12
Wardha	3	0	0	0	0	3
Yeotmal	5	0	0	0	0	5
Group Total	122	73	21	6	7	229
Percentage of Group Total to Total Taluks	53.3	31.9	9.2	2.6	3.1	100.0

Note: Figures show the absolute number of taluks in five cropping intensity groups for 25 districts of the state and total.

136 to 122 and this leads to fall in percentage of taluks in the group from 59 in period 1 to 53 in period II. But the imporvement in the level of cropping intensity was marginal and as a result most of the taluks which have experienced the improvement shifted to low level of cropping intensity. Secondly, the number of taluks in medium and very high cropping intensity group has remained same. But there is a fall in the number of taluks in the very high intensity group and about 9 taluks of this group has entered into the low intensity group. So the size of taluks in low cropping intensity group has increased substantially because of shift of taluks from very low intensity group to high intensity group. In conclusion, it should be said that there was some improvement in the levels of cropping intensity of very low intensity group.

Table 3.5 shows the district-wise distribution of taluks in five categories. A similar picture of the distribution of taluks in various cropping intensity groups is also depicted in Map.4. It revealed the following pattern.

a) It was observed that five taluks of three districts had shown very high cropping intensity. Chandrapur and Bhandara districts which had very high cropping


MAHARASTRA
SPATIAL PATTERNS OF
CROPPING INTENSITY
(1968-69)
MADHYA PRADESH
GUJARAT
ANDHRA PRADESH
MADHYA PRADESH
MYSORE
CROPPING INTENSITY INDEX
CLASS SIZE
NO. OF TALUKS
120.00 & ABOVE 122
115.00 – 119.99 73
110.00 – 114.99 21
105.00 – 109.99 8
104.99 & BELOW 7
100 50 0 100 KMS
SOURCE CENSUS OF INDIA, 1971

MAP. 4

intensity in period I, maintained the lead in Period II. The only addition came from Kolhapur district. Incidentally Kolhapur, Bhandara and Chandrapur districts, enjoyed a high level of rainfall and irrigation.

b) Five districts of Dhulia, Bhandara, Chandrapur, Jalgaon and Kolhapur shared seven taluks of high intensity groups. Dhulia, Jalgaon and Kolhapur district had major share in this group, in the period I also.

c) Twenty one taluks from eight districts of the state came in the medium cropping intensity group. Comparatively, small number of districts experienced medium level of cropping intensity. Parbhani district had highest percentage of taluks (50 per cent) in this category followed by Dhulia, Kolhapur, Jalgaon , Pune and Satara.

d) Finally coming to the very low and low level of cropping intensity, it was observed that although the percentage share of districts varied from each other by and large, most of the district had some taluks in very low cropping intensity group. In fact, of the 25 districts of the state, as many as 23 districts had the taluks of low cropping intensity. Bhandara and Kolhapur were the only districts without any taluk in this category. Some of the districts which had 75 per cent of taluks in very low group were Akola, Amaravati, Buldana, Nagpur, Ratnagiri, Sholapur, Thane, Wardha and Yeotmal.

In the light of above description we can point out a few cluster of districts with common level of cropping intensity. Table 3.6 shows that all the taluks of seven districts namely Akola, Amaravati, Nagpur, Sangli, Wardha and Yeotmal had experienced a very low level of intensity. and more than 75 per cent of taluks of Buldana, Ratnagiri, Solapur, Thane district had shown very low cropping intensity. On the other hand, all the taluks of Bhandara and some taluks of Kolhapur district had a very high cropping intensity. In the intermediate categories of low and medium cropping intensity, the percentage store of districts are differed from each other and, as a result, no clear cut cluster has emerged.

Period III

(1973-74, 1974-75 and 1975-76)

Year 1975-76 is considered as an important year, for Maharashtra state. In this year, for the first time the production level of 1960-61 was crossed and the state indicated a positive growth from the stagnation in agricultural production over last decade.

Table 3.7 gives information for this period. The average cropping intensity for this period was 107·36. It has shown a marked improvement over period I and II.

Table No.3.6

Percentage Distribution of Taluks in Various Categories of Cropping Intensity in the Districts of Maharashtra State

Period - II

(1967-68, 1968-69 & 1969-70)

(Three Years Moving Average)

Name of the Districts	CROPPING INTENSITY GROUPS					Total No. of taluks
	I	II	III	IV		
	Very Low	Low	Medium	High	Very High	
	100 to 104.99	105 to 109.99	110 to 114.99	115 to 119.99	120 & above	
Ahmednagar	61.5	30.8	7.7	0.0	0.0	100.0
Akola	100.0	0.0	0.0	0.0	0.0	100.0
Amaravati	100.0	0.0	0.0	0.0	0.0	100.0
Aurangabad	33.3	66.7	0.0	0.0	0.0	100.0
Bhandara	0.0	0.0	0.0	33.3	66.7	100.0
Beed	28.6	71.4	0.0	0.0	0.0	100.0
Buldana	80.0	20.0	0.0	0.0	0.0	100.0
Chandrapur	50.0	33.3	0.0	0.0	16.7	100.0
Dhulia	20.0	30.0	20.0	20.0	10.0	100.0
Jalgaon	38.5	30.8	23.1	7.7	0.0	100.0
Kolaba	50.0	28.6	21.4	0.0	0.0	100.0
Kholapur	8.3	33.3	25.0	25.0	8.3	100.0
Nagpur	100.0	0.0	0.0	0.0	0.0	100.0
Nanded	62.5	37.5	0.0	0.0	0.0	100.0

Name of the Districts	CROPPING INTENSITY GROUPS I Very Low 100 to 104.99	II Low 105 to 109.99	III Medium 110 to 114.99	IV High 115 to 119.99	V Very High 120 & Above	Total No of taluks
Nasik	53.8	46.2	0.0	0.0	0.0	100.0
Osmanabad	63.6	36.4	0.0	0.0	0.0	100.0
Parvani	37.5	12.5	50.0	0.0	0.0	100.0
Pune	28.6	50.0	21.4	0.0	0.0	100.0
Ratnagiri	80.0	20.0	000	0.0	0.0	100.0
Sangli	33.0	66.7	0.0	0.0	0.0	100.0
Satara	27.3	54.5	18.2	0.0	0.0	100.0
Sholapur	72.7	72.3	0.0	0.0	0.0	100.0
Thane	83.3	16.7	0.0	0.0	0.0	100.0
Wardha	100.0	0.0	0.0	0.0	0.0	100.0
Yeotmal	100.0	0.0	0.0	0.0	0.0	100.0
Stage Average	53.3	31.9	9.2	2.6	3.1	10 .0

Note: Figures indicate the percentage of taluks in each category of Cropping intensity to total number of taluks of districts.

Out of 229 taluks of the state, as many as 132 have displayed the cropping intensity below state average and 97

Table 3.7

Cropping Intensity

Period III

SI	Items	1974-75
1.	Lowest Figure	100.050
2.	Highest Figure	144.924
3.	Range	44.924
4.	Mean	107.363
5.	Standard Deviation	8.882
6.	Co-efficient of variations	0.083
7.	Total No.of Taluks	229
8.	No. of Taluks below Mean	97
9.	No. of Taluks below Mean	132

above the average. As compared to earlier periods, the magnitude of gap between lowest and highest was quite. The upper limit has increased upto 145·0 but the lower limit has remained at 100·05. It may be pointed out that, although the cropping intensity has experienced an improve-

ment in its level and it was achieved at the cost of growing inter-taluk disparities in the state. The standard deviation which was almost constant in last two periods had increased to 8·88 from 6·44 in period II. and in spite of some improvement in mean level, the co-efficient of variation has increased to 0·083 in period III from 0·061 in period II and 0·063 in period I. Thus the improvement in cropping intensity was accompanied by increasing disparties among the taluks of the state.

Taluks in different groups had shown a considerable improvement in their cropping intensity level in period III period over period II. Table 3.8 shows the district-wise distribution of taluks in various classified groups of gropping intensity. A true picture of the distribution of taluks is stated in Map.5. The percentages of Taluks in very low, low, medium, high and very high category were 43·7, 30·6, 13·5, 5·7 and 6·5 respectively. The percentage of taluks in very low group has reduced to 43·70 in period III from 55·3 per cent in period II and 59·4 in period I. Consequently proportion of taluk in medium, high and very high group has increased considerably. In fact, in this period, there was a movement of taluks from very low group to medium-high and very high group, and hence the jumps were substantial.

Table No.3-8

Classification of Taluks on the Basis of Levels of Cropping Intensity

Period - III

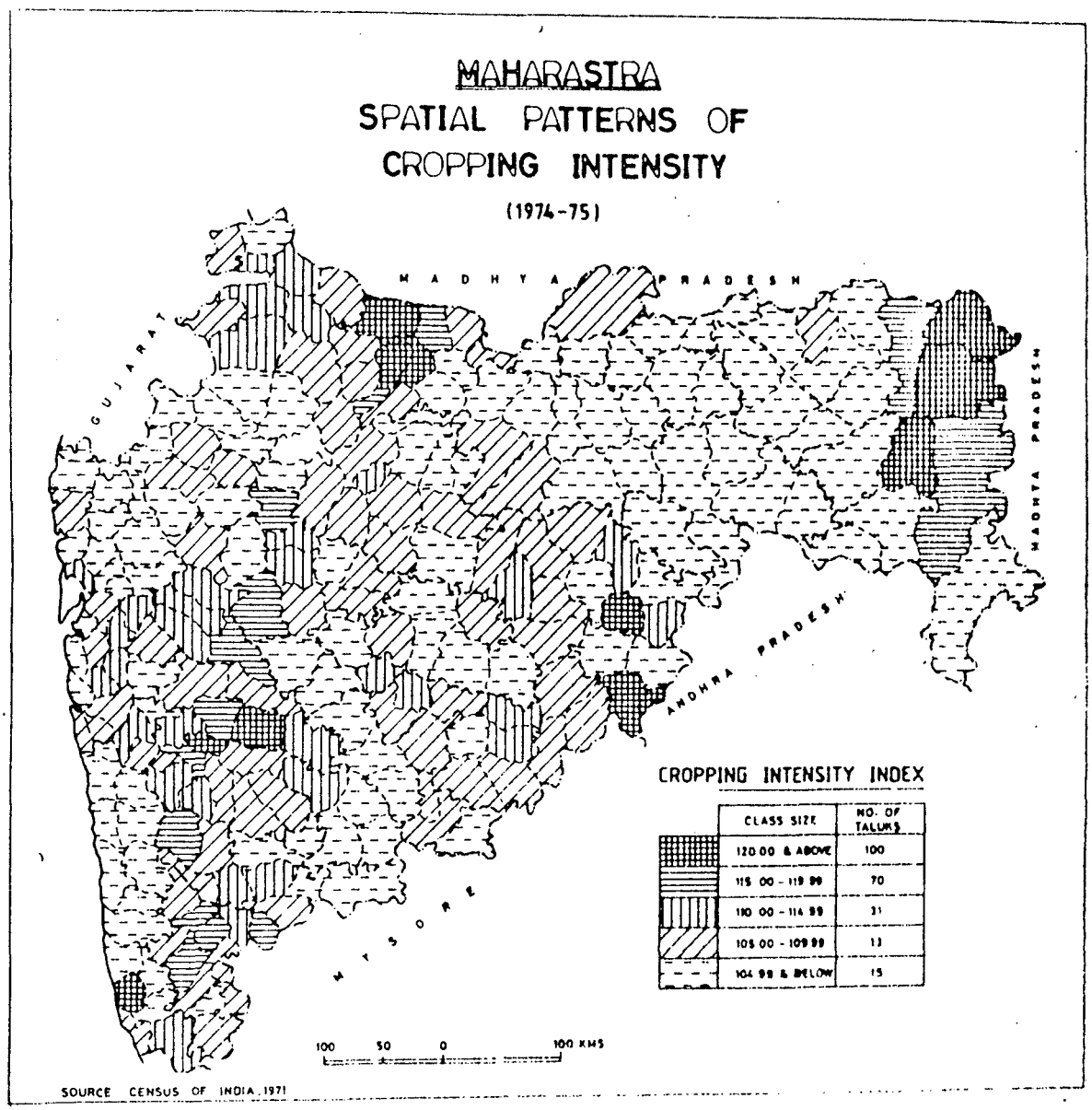
(1973-74, 1974-75 & 1975-76)

(Three Years Moving Average)

Name of the Districts	CROPPING INTENSITY GROUPS					Total No. of Taluks
	I	II	III	IV	V	
	Very Low	Low	Medium	High	Very High	
	100 to 104.99	105 to 109.99	110 to 114.99	115 to 119.99	120 & above	
Ahmednagar	4	4	3	2	0	13
Akola	6	0	0	0	0	6
Amaravati	5	1	0	0	0	6
Aurangabad	6	6	0	0	0	12
Bhandara	0	0	0	0	3	3
Beed	5	2	0	0	0	7
Buldana	3	2	0	0	0	5
Chandrapur	4	0	0	1	1	6
Dhulia	1	4	4	1	0	10
Jalgaon	1	6	0	2	4	13
Kolaba	3	6	5	0	0	14
Kholapur	1	6	1	3	1	12
Nagpur	4	1	0	0	0	5
Nanded	4	0	1	0	3	8

Name of the Districts	CROPPING INTENSITY GROUPS I Very Low 100 to 104.99	II Low 105 to 109.99	III Medium 110 to 114.99	IV High 115 to 119.99	V Very High 120 & above	Total No. of Taluks
Nasik	9	4	0	0	0	13
Osmanabad	1	7	3	0	0	11
Parvani	1	5	2	0	0	8
Pune	2	4	5	2	1	14
Ratnagiri	12	1	1	0	1	15
Sangli	3	1	2	0	0	6
Satara	0	6	2	2	1	11
Sholapur	7	3	1	0	0	11
Thane	10	1	1	0	0	12
Wardha	3	0	0	0	0	3
Yeotmal	5	0	0	0	0	5
Group Total	100	70	31	13	15	229
Percentage of Group Total to Total Taluks	43.7	30.6	13.5	5.7	6.5	100.0

Note: Figures show the absolute number of taluks in five cropping intensity groups for 25 districts of the state and total.


MAHARASTRA
SPATIAL PATTERNS OF
CROPPING INTENSITY
(1974-75)
MADHYA PRADESH
GUJARAT
ANDHRA PRADESH
MADHYA PRADESH
MYSORE
CROPPING INTENSITY INDEX
CLASS SIZE
NO. OF TALUKS
120.00 & ABOVE
100
115.00 - 119.99
70
110.00 - 114.99
31
105.00 - 109.99
13
104.99 & BELOW
15
100 50 0 100 KMS
SOURCE CENSUS OF INDIA, 1971

MAP. 5

However, it may be noted that inspite of general improvement, the proportion of taluk in very low and low group was still higher than in high and very high group.

A district wise ditribution of taluk is stated below:

a) As observed earlier, the percentage of taluk in the very high category has registered a marked improvement over earlier periods by pooling more taluks from other categories. As many as eight districts namely Bhandara, Jalgaon, Nanded, Chandrapur, Kolhapur, Pune Ratnagiri and Satara had contributed towards the total of 14 taluks. However, maximum numb r of taluks came from Bhandara (3), Nanded (3) and Jalgaon(4).

b) Similarly, high category has shown some improvement over 1968-69 by sharing 13 taluks of the state as against 6 in period I. These were shared by seven districts of the state. These districts were Kolhapur, Ahmednagar, Pune, Jalgaon, Satara, Dhulia and Chandrapur.

c) As compared to above two categories, medium category has shown a much improvement in period III. As many as 31 taluks had experienced medium level of cropping intensity, while there were 20 taluks in period I. Major contribution in this category came from districts of Ahmednagar Dhulia, Kolaba, Osmanabad, Pune, Sangli and Satara.

d) Finally in case of very low category, its position had improved remarkably.

The number of taluks reduced to 100 from 136 in period I and 122 in period II. Although the number of taluks in this category was high, compared to other two years, the percentage was fairly low.

Table 3.9 gives the percentage distribution of taluks in various categories for different district of the state. On the basis of this, we can identify the cluster of districts with low and high cropping intensity.

Table reveals that all taluks of Akola Wardha and Yeotmal district have shown a very low level of cropping intensity. And there was another group of six districts where 70 per cent of taluk falls in the very low category of cropping intensity. So there were nine to ten districts in the state where 70 per cent and above suffered from very low cropping intensity. At the other extreme Bhandara was the only district, in which all the taluks had exhibited very high cropping intensity. The other districts of the state had shown varied share in low, medium and high cropping intensity and no clear cut cluster of districts was really emerged.

Table No. 3.9

Percentage Distribution of Taluks in Various Categories of Cropping Intensity in the Districts of Maharashtra State

Period - II

(1973-74, 1974-75 & 1975-76)

(Three Years Moving Average)

Name of the Districts	CROPPING INTENSITY GROUPS					Total No. of taluks
	I	II	III	IV	V	
	Very Low 100 to 104.99	Low 105 to 109.99	Medium 110 to 114.99	High 115 to 199.99	Very High 120 & above	
Ahmednagar	30.8	30.8	23.1	15.4	0.0	100.0
Akola	100.0	0.0	0.0	0.0	0.0	100.0
Amaravati	83.3	16.7	0.0	0.0	0.0	100.0
Aurangabad	50.0	50.0	0.0	0.0	0.0	100.0
Bhandara	0.0	0.0	0.0	0.0	100.0	100.0
Beed	71.4	28.6	0.0	0.0	0.0	100.0
Buldana	60.0	40.0	0.0	0.0	0.0	100.0
Chandrapur	66.7	0.0	0.0	16.7	16.7	100.0
Dhulia	10.0	40.0	40.0	10.0	0.0	100.0
Jalgaon	15.4	46.2	000	15.4	23.1	100.0
Kolaba	21.4	42.9	35.7	0.0	0.0	100.0
Kholapur	8.3	50.0	8.3	25.0	8.3	100.0
Nagpur	80.0	20.0	0.0	0.0	0.0	100.0
Nanded	50.0	0.0	12.5	0.0	21.4	100.0

Name of the Districts	CROPPING INTENSITY GROUPS I Very Low 100 to 104.99	II Low 105 to 109.99	III Medium 110 to 114.99	IV High 115 to 119.99	V Very High 120 & above	Total No. of taluks
Nasik	69.2	30.8	0.0	0.0	0.0	100.0
Osmanabad	9.1	63.6	27.3	0.0	0.0	100.0
Parvani	12.5	62.5	25.0	0.0	0.0	100.0
Pune	14.3	28.6	35.7	14.3	7.1	100.0
Ratnagiri	80.0	6.7	6.7	0.0	6.7	100.0
Singli	50.0	16.7	33.3	0.0	0.0	100.0
Satara	0.0	54.5	18.2	18.2	9.1	100.0
Sholapur	63.6	27.3	9.1	0.0	0.0	100.0
Thane	83.6	8.3	8.3	0.0	0.0	100.0
Wardha	100.0	0.0	0.0	0.0	0.0	100.0
Yeotmal	100.0	0.0	0.0	0.0	0.0	100.0
Stage Average						

Note : Figures indicate the percentage of taluks in each category of Cropping intensity to total number of taluks of districts.

Inter-Taluk Variation in Cropping Intenisty - An Over All View

So far have analysed the regional pattern of cropping intensity in various taluks of Maharashtra at three points of time, separately. Now, we are in a position to draw some general conclusions regarding the changes in cropping intensity and its regional pattern over period under study. (See Table 10) The relevant points, that have been emerged through the preceding analysis are given as follows:

(i) Over the last fifteen years the average cropping intensity (on the basis of taluk average) has shown a considerable improvement . The average level of cropping intensity (Table 3·11) which was 105·16 in period I went up to 107·37 in period III. But this progress was achieved only in last period of the study. In the earlier periods of the study, the level of cropping intensity was almost stagnant.

(ii) Secondly, it was observed that although cropping intensity has experienced an improvement in it level, it was achieved at the cost of growing inter-taluk disparity. In the course of imbalance development of irrigational facilities in the state, only some taluks have developed and developed faster than the other and created wide gap between them. This has been well indicated by the increase in the values of standerd deviations and

Table No. 3.10

Distribution of Taluks in Various Classified Groups of Cropping Intensity in Maharastra State

(Three Years Moving Average)

Category	NUMBER OF TALUKS IN EACH GROUP				PERCENTAGE OF TALUKS IN EACH GROUP TO TOTAL		
	1960-61 1961-62 1962-63	1967-68 1968-69 1969-70	1973-74 1974-75 1975-76	Standard Deviation	1960-61 1961-62 1962-63	1967-68 1968-69 1969-70	1973-74 1974-75 1975-76
I.(100-104.99)	136	122	100	14.82	59.4	53.3	43.7
II.(105-109.99)	55	73	70	7.81	24.0	31.9	30.6
III.(110-114.99)	20	21	31	4.96	8.7	9.2	13.5
IV.(115-119.99)	12	6	13	3.09	5.2	2.6	5.7
V.(120 & above)	6	7	15	4.03	2.6	3.1	6.5
Standard Deviation	48.19	45.28	33.96				

Table No. 3.11

A General Profile of the State on the Basis of Cropping Intensity

(Three Years Moving Average)

Items	PERIOD		
	1960-61 1961-62 1962-63	1967-68 1968-69 1969-70	1973-74 1974-75 1975-76
Lowest Figure	100.01	100.03	100.05
Highest Figure	140.25	141.14	144.92
Range	40.25	41.14	44.87
Mean	105.16	105.22	107.36
Standard Dev.	6.67	6.44	8.88
Coff.Variation	0.063	0.061	0.083
No.of Taluks	229	229	229
Above Mean	94	99	97
Below Mean	135	130	132

co-efficients of variation. The value of the standard deviation, which stood at 6·67 in period I, increased up to 8·83 in period III. In spite of an improvement in the mean level of cropping intensity, the co-efficients of variations had increased from 6·30 per cent in period I to 8·83 per cent in period III. Thus the improvement in the levels of cropping intensity was accompained by growing disparities among taluks of the state.

(iii) Coming to the regional pattern of 229 taluks and their distribution in five categories, it was observed that majority of taluks in period I, II and III had suffered from very low level of cropping intensity. Although the percentage was comparatively low in period III. For example 59.4 per cent 55.00 per cent and 43·7 per cent of taluks were found in very low cropping intensity group in period I, period II and period III respectively, in fact, if we combine category first and second together (viz. varly low and low cropping intensity) then as many as 84 per cent, 85 per cent and 74 per cent of taluks were found in the low category of intensity in period I, period II and Period III respectigely. As we move from very low level of cropping intensity to very high level of cropping intensity, the percentages of taluks considerably fall to a low figure.

Thus, by and large, majority of taluks in the state were characterised by low level of cropping intensity and a few showed high level of cropping intensity.

iv) However, the analysis reveals that over a period of 15 years a substantial change had occured in the composition of taluks in five categories of cropping intensity. This was a matter of great satisfaction from the point of view of future development. It was noticed that the percentage of taluks in lower category (which is composed of very low and low groups) has considerably reduced between the periods of the study. The share of taluk in low intensity group has reduced from 74 per cent in period III from the level of 85 per cent in period II Consequently, this reduction of taluks in low category had led to increase in the proportion of taluks in medium and high intensity groups. The share of taluk in later group had increased from 7·8 per cent in the period I to 12 per cent in period II. and from 8·7 per cent to 13·5 per cent for the medium group. This indicated that increase in the levels of cropping intensity was not only shared by so called developed taluks (in terms of cropping intensity) of the state alone but the gain also shared by the low intensity

taluks. As a result some of the taluks from very low intensity group had moved on to low and medium categories of cropping intensity. This was a favourable sign, in the sense that, the fruits of development had also shared by less developed taluks of the state.

However, it may be noted that as many as 85 taluks of the state in the category of very low cropping intensity had continued to be in the same state through out the study period. Therefore, the study pointed to the urgent need for an improvement of cropping intensity in these taluks.

CHAPTER IV

Determinants of Cropping Intensity in Maharashtra
A Step-Wise Regression Analysis

Regional analysis of cropping intensity in the preceding chapter has revealed a wide variations in different taluks of Maharashtra. The main objective of this chapter is to identify the relevant factors which caused such variations in cropping intensity. In order to materialise the above goal, a step-wise regression analysis has been used. The step-wise regression is a particular type of multiple regression which tries to trace out the best possible set of exogenous variables to explain maximum variation in the endogenous variable. In this type of regression, the dependent variable is loosely hypothesised to be related with a set of independent variables and then a search is made for important ones. At the first instance, the step-wise analysis picks up the most important variable from the regression model and in subsequent steps, it starts taking variables one after another depending on the significance of variables. The significance of the exogenous variables in the model is judged on the basis of their partial correlation, co-efficients with the dependent variable. The independent variable, which has the highest partial correlation

co-efficient with the dependent variable will enter in the first step. At every step of regression, t values, standard errors, F values of the regression co-efficient(s) and multiple correlation co-efficient, multiple R square, standard error, t values of the regression equation are given, thus indicating the changes in the overall position of the equation, due to the inclusion of an additional variable in the model. The step-wise procedure continues until all the significant variables are included in the model.

Before the step-wise regression, we plotted different independent variables graph papers along with the dependent variable. It was found from the scattered diagram that the pattern of the distribution of the scatters was taking a non-linear trend. When all the variables were transformed into logarithimic form and plotted on a graph papers, it showed a linear trend. Considering the behaviour of the scattered diagrams, we have taken multiplicative forms of regression model to explain the variations in the cropping intensity.

Determinats of Cropping Intensity

The results of the regression analysis are described in two different sections. The first section

deals with impact of six variables on cropping intensity and in the second section, we tried to analyse the impact of various sources of irrigation on cropping intensity. Regarding the factors affecting cropping intensity, we have described the results for each period separately. The proposed variables, included in the model are as follows:

First Set of Regressions:

Dependent Variable:

Y = Cropping Intensity

Independent Variables:

X_1 = Annual Rainfall

X_2 = Irrigation Intensity

X_3 = Levels of Irrigation

X_4 = Mechanisation Index

X_5 = Animal Power per hectare

X_6 = Agricultural worker per hectare.

Section I

Period - I (1960-61, 1961-62 & 1962-63)

Correlation Matrix

Correlation matrix is a preface to a step-wise regression, because it displays the relationship between the independent and the dependent variables and between the independent variables. The correlation matrix for 1961-62 (Appendix - 2A) reveals that irrigation level irrigation intensity are significantly related with cropping intensity. The noticiable feature is that the irrigation level is significant at one per cent and irrigation intensity at five per cent level. The other variable namely animal power, annual rainfall, mechanisation index and agricultural workers have shown a weak relationship with cropping intensity. The correlation matrix also gives the inter-correlation between the explainatory variables. It indicates that the rainfall has significant but negative relationship with irrigation level, irrigation intensity, mechanisation index and positive relationship with animal power and agricultural workers. Incidentally mechanisation index is negatively related with animal power and agricultural workers and positively related with levels of irrigation.

The correlation between rainfall and other variables like irrigation level, irrigation intensity and mechanisation index reveals a mixed situation in Maharashtra. The Konkan region receives highest rainfall in the state, but its irrigation level is very low. Because of its physiography and unfavourable slope, water can not be stored for irrigational purposes. However, in another rainfall region, irrigation level is higher in comparison to the central region (which is popularly known as a Drought Prone Area) and it has a higher irrigation base. By and large, irrigation has shown a negative relationship with rainfall. In such a situation, the negative relationship between mechanisation index and agricultural workers, animal power is quite obvious. At this stage it may be noted that, although the independent variables were mutually related, the correlations were not strong enough to disturt the regression result.

Regression Result

The results for 1961-62 are depicted in table 4·1 (for detailed result see Appendix-2B). The table shows that, all the six variables, put together, show 20 per cent variations in the cropping intensity. Thus inter-taluk variation in cropping intensity accounted by these variables was very high. Among the explainatory variables,

Table No.4.1

Factors Affecting Cropping Intensity in Maharashtra

A Step-Wise Regression Result - 1961-62

Regression step No	Explainatory Variables	R	R^2
I	Level of Irrigation*	0.372	0.138
II	Level of Irrigation*, Animal Power*	0.405	0.164
III	Level of Irrigation*, Animal Power* Irrigation Intensity*	0.436	0.190
IV	Level of Irrigation*, Animal Power* Irrigation Intensity*, Rainfall@@	0.442	0.200
V.	Level of Irrigation*, Animal Power*, Irrigation Intensity**, Rainfall@, Mech. Index@	0.449	0.206

* - Significant at 1% level

** - Significant at 5% level

@ - Significant at 10% level

@@ - Significant at 15% level

Table No. 4.2

Factors Affecting Cropping Intensity In Maharashtra

Step-Wise Regression Co-Efficients

(1960-61, 1961-62 & 1962-63)

Variables	Step 1	Step 2	Step 3	Step 4	Step 5
Level of Irrigation	.372*	.401*	.377*	.359*	.382*
Animal Power		.162*	.209*	.267*	.267*
Irrigation Intensity			.172*	.159*	.148**
Rainfall				-.101@@	-.140Q
Mechanisation Index					-.092Q

* Significant at 1 per cent level

** Significant at 5 per cent level

Q Significant at 10 per cent level

@@ Significant at 15 per cent level

irrigation has emerged as the most important exogenous variable with a highest multiple correlation (R) with the dependent variable. In the second step, animal power per hectare has improved the R square from 13·8 per cent to 16·4 per cent. And this was followed by irrigation intensity in the third step. In the later steps, rainfall, mechanisation index and agricultural workers have appeared in the regression equations but their contribution to multiple R square was marginal.

Coming to the significant level, all the variables have turned out to be significant significant but variables like irrigation level, irrigation intensity and animal power were significant at one per cent level. On the contrary, other variables like mechanisation index, agricultural workers and rainfall were significant at ten per cent or fifteen per cent level of confidence.

If we have to identity the most significant set of variables from the step-wise regression model, then the choice will have to be made on the basis of value of statistical standlys like: R^2, F and t tests and also economic reasonings. In this period, only irrigation level, followed by animal power and irrigation intensity were considered significant, variables in explaining

the variations in cropping intensity. These three variables put together accounted 19 per cent of variation in the cropping intensity and the remaining other variables added only 1·6 per cent to the existing value of the R^2. The value of the R^2 started rising at a faster rate upto the third step and later it increased marginally. Thus in period I, extent of irrigation and its intensive use, along with animal power, really determined the level of cropping intensity in the state. The final equation for the three variables is given as follows:

$$Y = 87{\cdot}70\ X_3^{.377^*}\ X_5^{.209^*}\ X_2^{.172^*}\ e$$

S.E. of b = (36·70) (10·70) (7·19)

R^2 = 19·0 per cent

* = Significant at 0·01 level.

Period II (1967-68, 1968-69 and 1969-70)

Correlation Matrix

The correlation matrix for 1968-69 (Appendix-3A) shows that level of irrigation and irrigation intensity were significantly related with the cropping intensity. Once again, level of irrigation was significant at one per cent and irrigation intensity at ten per cent level.

Other variables like mechanisation index animal power and rainfall revealed a weak relation with cropping intensity. The correlation matrix also provides information about the relationship between the explainatory variables. Like the earlier period, rainfall once again showed a negative correlation with irrigation intensity, irrigation level and mechanisation index. But on the other hand, it has indicated positive relationship with the animal power and agricultural workers. Similarly, Mechanisation index has revealed a negative relationship positive relationship with the level of irrigation. The explaination for such kind of relationship was given in the earlier section. In all the cases, level of significance was quite high (viz. at one per cent level). Animal power has registered a positive correlation with agricultural workers.

Thus the pattern of correlation between the explainatory variables and with the dependent variable shows the same pattern as it was observed in the earlier period. There has not been much change in the nature of agriculture in period II and the impact of the traditional inputs was noticiable in the state .

Regression Result

Result of the step-wise regression for 1968-69 are given in table 4.3 (and for detail results see Appendix -3B). Table shows that all the variables put together explain 13 per cent of variation in the cropping intensity which was low as compared to the last period. In the first step, level of irrigation came out as the most significant variable in the model with the highest multiple correlation (R)with cropping intensity. And it was followed by irrigation intensity which emerged as the second best variable in the model. In the first step, R^2 was 11.0 per cent and this figure had improved in the second step (12.2 per cent). Mechanisation index has appeared in the third step with the very little improvement in R square. In the subsequent steps, animal power and rainfall emerged in later steps but with the addition of these two variables, the net addition to the existing R square was very marginal.

The significance test of the regression co-efficients showed that irrigation intensity, level of irrigation and animal power were turning significant at different levels. Among these variables, irrigation was significant at one per cent level while irrigation intensity at 15 per cent level in the next step. But when mechanisation index emerged in the third step, co-efficient of

Table No. 4.3

Factors Affecting Cropping Intensity in Maharashtra

(A Step-Wise Regression Result - 1968-69)

Regression Step No.	Explainatory Variables	R	R^2
I	Level of Irrigation*	0.341	0.116
II	Level of Irrigation*, Irrigation Intensity@@	0.349	0.122
III	Level of Irrigation*, Irrigation Intensity@, Mechanisation Index	0.355	0.126
IV	Level of Irrigation* Irrigation Intensity@, Mechanisation Index, Animal Power.	0.357	0.128
V	Level of Irrigation* Irrigation Intensity@, Mechanisation Index, Animal Power, Rainfall.	0.362	0.131

* - Significant at 1% level

** - Significant at 5% level

@ - Significant at 10% level

@@ - Significant at 15% level

Table No.4.4

Factors Affecting Cropping Intensity In Maharashtra

Step-Wise Regression Co-Efficients

(1967-68, 1968-69 & 1969-70)

Variables	Step 1	Step 2	Step 3	Step 4	Step 5
Level of Irrigation	.341*	.329*	.369*	.368*	.359*
Irrigation Intensity		.075@@	.081@	.094*	.098@
Mechanisation Index			-.075	-.060	-.081
Animal Power				.050	.112@@
Rainfall					÷.097

* Significant at 1 per cent level

** Significant at 5 per cent level

@ Significant at 10 per cent level

@@ Signifcant at 15 per cent level

irrigation intensity showed some improvement in terms of levels of significante. Although Mechanisation index appeared in the third step and animal power in the next, both were proved significant. The introduction of rainfall in the last step suddenly improved the power of irrigation intensity and animal power in the regression.

Thus the regression results indicated that like period I, irrigation level, irrigation intensity and mechanisation were important variables and accounted for a major portion of explaination of the variations in cropping intensity is the state. Other variables added very little to the R square. The animal power which was an important variable in period I, turned out to be less important in period II. One thing that has surprised us in the negative value of the power of the mechanisation index in the regression which might be due to its close association (positive) with irrigation and irrigation intensity. Or it might be due to some other reasons which we are not in a position to explain. The final equation for irrigation leve, irrigation intensity and mechanisation index is stated as follows:

$$Y = 89.13\ X_3^{.369^{*}}\ X_2^{.081^{@}}\ X_4^{-.075}\ e$$

S.E. of b = (·003) (·081) (·050)

R^2 = 12·6 per cent

* = Significant at 0·001 level

@ = Significant at 0·10 level

Period III (1973-74, 1974-75 and 1975-76)

Correlation Matrix

The correlation matrix for the last period viz, 1974-75 is given in appendix-4A. It shows a pattern as it was observed in earlier periods. Once again, irrigation level, irrigation intensity were turned out to be significant variables. No other variable was significantly related with cropping intensity, except mechanisation index, which showed a wide positive correlation with cropping intensity. Among the explainatory variables rainfall was negatively related with irrigation intensity mechanisation index and level of irrigation. And the correlations of rainfall with the first two variables were significant at one per cent and at five per cent level respectively. Mechanisation index continued to maintain a negative correlation with animal power and agricultural workers, However, later variables were proved significant at one per cent level. This tendency was observed throughout the study period. Thus, the pattern of inter-relationship between dependent and independent variables had not chaned much between period III and period II. One more interesting point is that irrigation intensity was positively correlated with mechanisation index, and it was repeated through out the study period.

Regression Result

The step-wise regression result reveals that (table 4.5) level of irrigation is themost significant explainatory variable in the model with the highest multiple correlation (R). (For detail results see Appendix-4B). In the first step, it individually explained 8·7 per cent of the total variation in the cropping intensity as the R square was recorded at ·087. In the second step, irrigation intensity emerged as an important variable in the model. Both irrigation level and irrigation intensity put together explained 10·9 per cent variation in cropping intensity. Mechanisation index cropped up in the thrid stesp and enhanced the multiple R square to 11·0 per cent. The last three variables added very little to the R square.

The significance test of the regression co-efficients revealed that the irrigation level, irrigation intensity and mechanisation index are turning significant at all steps of regression. Irrigated intensity and level of irrigation were turning significant at one per cent level. On the other hand, mechanisation index was significant at ten per cent level in the third step. However, the introduction of rainfall in the fourth step, adversely affected the significance of the mechanisation index.

Table No. 415

Factors Affecting Cropping Intensity in Maharashtra

A Step-Wise Regression Result - 1974-75

Regression Step No.	Explainatory Variables	R	R^2
I	Level of Irrigation*	0.295	0.087
II	Level of Irrigation*, Irrigation Intensity*.	0.330	0.109
III	Level of Irrigation*, Irrigation Intensity*, Mechanisation Index@.	0.340	0.116
IV	Level of Irrigation*, Irrigation Intensity*, Mechanis-tion Index@@, Rainfall.	0.340	0.117

* - Significant at 1% level

** - Significant at 5% level

@ - Significant at 10% level

@@ - Significant at 15% level

Table No.4.6

Factors Affecting Cropping Intensity in Maharashtra

Step-Wise Regression Co-Efficients

(1973-74, 1974-75 & 1975-76)

Variables	Step 1	Step 2	Step 3	Step 4
Level of Irrigation	.295*	.289*	.341*	.342
Irrigation Intensity		.148*	.161*	.164*
Mechanisation Index			-.098@	-.094@@
Ranifall				.011

*Significant at 1 per cent level

**Significant at 5 per cent level

@Significant at 10 per cent level

@@Significant at 15 per cent level

Coming to the identification of important variables, once again it was observed that irrigation level, irrigation intensity and mechanisation index were jointly accounted a major part of the explained variations in cropping intensity. Rest of the variables were found less significant in the model. The final equation for these three variables is given below.

$$Y = 99{\cdot}54 \; X_3^{.341^*} \; X_2^{.162^*} \; X_4^{-.98^@} \; e$$

S.E. of b = (·005) (·028) (·005)

R^2 = 11·6 per cent

* = Significant at 0·01 level

@ = Significant at 0·10 level

The earier analysis of the regression result of the three periods lead us to the conclusion that it is the irrigation level and its intensive use which really determines the level of cropping intensity and the differences in its level lead to the variations in cropping intensity in different taluks of Maharashtra. The other variables were found less important in this analysis. The animal power was important in early sixties but its effectiveness was reduced in later periods. Mechanisation index also found significant in influencing the level of cropping intensity in the state. Since the statistical results of mechanisation index were not consistant, we would not like to say anything about it in a consolidate form.

Section II

Variations in the Cropping Intensity and Sources of Irrigation

In an attempt to identify the determinants of cropping intensity we found that irrigation and its intensive use was really the important governing factor. Variation in this variable led to the disparities in the levels of cropping intensity in different taluk of the state. In this section, our objective is to analyse the effect of different sources of irrigation on cropping intensity. Intensity of irrigation use, heavily depends on the timely supply of water. Different sources of irrigation, which contribute towards the total irrigation, differ significantly in their capacity to supply timely water to the field. The canal irrigation and canal-fed well irrigation are supposed to be efficient than tank irrigation. Normally canal irrigation in perennial in nature, while tank irrigation provides water for a particular season. The capacity of well to supply regular water will depend on several factor such as rainfall, toporaphy, etc.

In Maharashtra, one can find a wide regional variations in area, irrigated by different sources of irrigation. Well irrigation accounted for about sixty per cent of area under irrigation and is widely spread over the state. On

the other hand, canal and tank were confinded to certain region. To understand the effect of different sources of irrigation on cropping intensity, we have used a step-wise regression for three point of time. The variables included in the model are as follows:

Dependent variable:

Y = Cropping Intensity

Independent Variables:

X_7 = Canal Irrigation

X_8 = Well Irrigation

X_9 = Tank Irrigation

All the explainatory variables in this regression model are expressed as a percentage to the total irrigated are and they are computed separately for three points of time.

When these variables were plotted on graph papers separately with the dependent variable, the scattered diagrams showed a non-linear trend. But when they were plotted on a logarithimic scale, the scattered diagrams depicted a linear trend. Keeping this fact in view, a multiplicative form of regression model was used in our analysis. The results of the step-wise regressions for three periods are anaysed below.

Correlation Matrix

The correlation matrix shows the inter-relationship between the cropping intensity and the three exogenous variables included in the model. Appendix-5A depicts the correlation matrix for the first period (1960-61 to 1962-63). Three sources of irrigation showed positive correlation with the endogenous variable. Canal and tank irrigation were significant at one per cent and well at five per cent level. Different sources of irrigation had indicated a negative correlation with each other. The correlation co-efficient between percentage of area under well and tank was significant at one per cent level.

The correlation matrix for the second period (1967-68, 1968-69 and 1969-70) shows that correlations between cropping intensity and exogenous variables were positive in each case, where canal and tank irrigation were significant at five per cent and ten per cent respectively. Well irrigation was negatively correlated with canal and tank, and it was significant at one per cent level with the later.

Correlation matrix for third period (i.e, 1973-74 to 1975-76), also reveals the same pattern (Appendix-7A). All sources of irrigation registered a positive relationship with the cropping intensity. However, irrigation was the

only variable significant at one per cent level. Correlation between the various sources of irrigation followed the pattern of earlier periods and showed negative relationship. The correlation between well and tank was significant at one per cent level.

From the above discussion, it is clear that all the different sources of irrigation have revealed a positive impact on the cropping intensity but with a varing intensity. Canal irrigation has proved to be the most significant source of irrigation, followed by tank and well irrigation. However, the magnitude of the correlation co-efficient of canal and cropping intensity has decreased steadily over the period under study. Well irrigation has shown a positive but weak relation with cropping intensity. Another important point was with the negative inter-correlation of independent variables with themselves. The negative relationship between tank irrigation and well is quite significant throughout the study period.

Regression Result

We started with the assumption that all sources of irrigation would indicate positive impact on cropping intensity, but the impact would vary from one source of irrigation to another. The step-wise result for period I

(Appendix-5B) shows that canal irrigation has a strong impact on cropping intensity with a high multiple correlation (0.274) and it was significant at one per cent level. In the first step, it individually explains 7.5 per cent of the variation in cropping intensity. The inclusion of tank irrigation in the second step has increased the R square to 12.60 per cent and proved significant at one per cent level of significante. The inclusion of well irrigation is the third step has not improved R square much. However, it was significant at ten per cent level. The inclusion of well irrigation in the third step has depressed the magnitude of the regression co-efficients of the other variables.

I_n the second period also, canal and tank irrigation have turned out to be significant at one per cent level. (Appendix-6B). However compared to other sources of irrigation the impact of canal irrigation was evident. The multiple correlation between the cropping intensity and canal irrigation was 0.266 and is the first step it explained 7.1 per cent variation in the cropping intensity. The inclusion of tank irrigation has improved the figure of multiple R square from 7 per cent in the first step to 10.6 per cent in the second. On the other hand, well

irrigation has remained insignificant and added only 0.1 per cent to the multiple square.

In the last period, the regression results (appendix-7B) have once again revealed the importance of canal irrigation. Canal irrigation has explained maximum amount of variation in cropping intensity and it is significant at one per cent level. Tank irrigation which entered is the second step was significant and one per cent level, but its significance level was reduced to 5 per cent is the third step. The introduction of well irrigation in the third step improved the regression parameter of canal and tank irrigation. And it has also added substantially to the multiple R square.

On the basis of above analysis final equations for the three periods are given as follows:

Period I:

$$Y = 104.47 \; X_7^{.289^*} \; X_9^{.227^*} \; e$$

S.E. of b = (.002) (.003)

$R = 12.6$ per cent

Period II

$$Y = 104.95 \; X_7^{.227^*} \; X_9^{.187^*} \; e$$

S.E. of b = (.002) (.003)

$R^2 = 10.6$ per cent

Periof III

$$Y = 109{\cdot}65 \; X_7^{.221^*} \; X_9^{.141^*} \; X_8^{.128^*} \; e$$

S.E. of b = (.003) (.004) (.004)

R^2 = 6.4 per cent

* - Significant at 1 per cent

** - Significant at 5 per cent

The final equation has revealed that is all the period under consideration canal irrigation was an important factor to affect cropping intensity it was closely followed by tank irrigation. However, the tank irrigation, which showed a greater impact on cropping intensity in the earlier period, has gradually reduced its influence on cropping intensity in the last period. Finally, well irrigation, which was not an important variable in the earlier period has become an important variable in the latter period, presumably, due to mechanisation of well irrigation.

Overall Postion of the Variable

In the preceeding section we analysed the regresion result for three periods and identified the relevant variables, which governed the cropping intensity in the state. Now we are in a position to derive some general conclusions regarding the determinats of cropping intensity and their

changing role is the periods under consideration. The general conclusions that have emerged, are given as follows:

1) In this study, six variables were used to explain the inter-taluk variation in cropping intensity. It was hypothesised that the selected variables would show a positive relationship with cropping intensity and explain the maximum variance in cropping intensity. By and large, all the variables have indicated a positive relations with cropping intensity in all the periods. But among them, irrigation level, and irrigation intensity indicated a very strong and significant relationship with cropping intensity. Other variables showed weak relationship with cropping intensity. Among them animal power in period I and mechanisation index in period II and III, were found to be important.

2) The pattern of inter-relationship between the independent variables have reveated some intensting results. During all the periods, annual rainfall has shown a negative relationship with irrigation level, irrigation intensity and mechnisation index, and a positive relationship with animal power and agricultural workers. The negative. The negatige relation of rainfall with these three variables, in fact, is a complex but a real situation in Maharashtra.

The distribution of these veriables is not quite consistent. The Konkan region (Thane, Kolaba and Ratnagiri districts) receives highest rainfall in the state but it has a low level of irrigation. Although the rainfall is high but because of its physiography and unfavourable slope, the region could not develop the irrigational facilities through canal or tank irrigation. The duration of moncoon rainfall is confind to five months of Khari season. In fact, this region faces the problem of drinking water during rabi season. Contrary to this another high rainfall region (viz, Bhandara and Chandrapur districts) has got a high level of irrigation and therefore cropping intensity is also high. The central region of Maharashtra (which covers twelve districts of the state), is drought prone areas, has managed to achive moderate level of irrigation due to a net work of canals. Thus the typical combination of rainfall with irrigation had led to (inverse relationship between annual rainfall on the one hand and irrigation level, irrigation intensity and Mechanisation index on the other. Mechanisation index has maintained a positive relationship with irrigation intensity and it has become more strong in later period. Irrigation intensity which expresses the quality of irrigation depends on the mechanisation of irrig tion structure.

In our study the mechanisation of irrigation is a major component of the mechanisation index and hence the positive relation between the two. Growing mechanisation will necessarily have negative impact on the use of animal power and agricultural workers. And therefore, in all the periods, mechanisation index has shown a negative relationship with animal power and agricultural workers.

3) The regression result shows that, all variables, included in the model put together have explained a low percentage of variations in cropping intensity in the state. In fact, the explained portion has reduced over a period of time. This means, other variables out side the model, were equally responsible for the variation in cropping intensity. In the course of technological change in the state, new variables like short duration varieties of crops (particularly of jawar and bajra), fertilizer, new equipment etc., have emerged and probably affected the cropping intensity level. Because of the non-availability of data we could not make use of these variables in the model. Inclusion of there variables would have improved the multiple R square.

However, among the selected variables, irrigation level has turn out to be most important factor through out the study period. It was closely followed by irrigation

intensity. In fact, those two variables put together, have a explained a major portion of the explained variations in cropping intensity. Although animal power was important in the early periods of our study, it was gradually pused back in the subsequent periods. In such a situation the importance of mechanisation in the state was quite evident in the latter period. Although mechanisation index has improved the magnitude of R square, it was not a significant varable in the model.

4) Coming to the power of beta index, irrigation level has once again, shown a strong impact on cropping intensity. It was followed by irrigation intensity. But compared to the irrigation its beta index was small. In the first period the animal power was equally important but it had lost its influence in the latter period.

5) It was interesting to note that over the period the level of technology is agriculture has shown a considerable improvement. As a result, the co-efficient of the double logarithmic regression model has increased gradually.

6) Different sources of irrigation had shown a positive relationship with cropping intensity but canal irrigation due to its perennial character proved to be the most significant variable in all the periods under study. Tank was

the second best source of irrigation in the state, though the well irrigation was relatively less significant in the early period, it has consolidated its position during the subsequent periods. On the contrary, tank irrigation has experienced a reversal trend in later period.

Thus to sum up, the irrigation and its intensity was the most dominant factor to affect the level of cropping intensity in the state. This led us to the conclusion that inorder to improve the level of cropping intensity in the state, priority will have be given to the expansion of irrigation facilities. Among various sources of irrigation, expansion of the canal irrigation and mechanisation of well irrigation would bring a substantial change in cropping intensity. Even expansion of area under tank irrigation in certain region (namely is low rainfall zone with cropping pattern dominanted by Rabi season) will lead to high level of cropping intensity.

CHAPTER V

SUMMARY OF THE FINDINGS AND CONCLUSION

5.1. The main objective of the study was to examine the inter-taluk varations in cropping intensity in Maharashtra in 1960-1963, 1967-1970 and 1973-1975 and to identify the possible causes behind it. In the preceeding analysis we have dealt with these aspects in detail. An attempt is made to summarize the main findings of the study and to note the implications emerging out of it in this chapter.

5.2. Inter-Taluk Varations in Cropping Intensity

(a) The analysis regarding the changes in the cropping intensity reveals that the average cropping intensity, at the state level (on the basis of taluk average) has experienced a significant improvement during the period under study. The level of cropping intensity has increased from 105·16 in 1960-61, to 107·37 in 1975-76. However, in mid 1960's the cropping intensity has not shown any improvement and it was almost staganated at the earlier level. So the progress was only achieved in the latter period. It was observed that, although cropping intensity has experienced an improvement in it level, it was materialized at the cost of

growing inter-taluk disparities. This has been well brought out by the higher value of standard deviation and co-efficient of variations. The standard deviation, which was 6·67 in the period 1 has increased upto 8·83 in period III. And notwithstanding the improvement in the mean level of cropping intensity, the co-efficient of variation had increased from 6·30 in period 1 to 8·83 in period III. Thus the improvement in the level of cropping intensity was accompanied by moderate but growing disparities in the taluks of the state.

(b) The findings also revealed wide variations in the level of cropping intensity. It was observed that the cropping intensity varied from 100·00 to 140·25 in 1960-1963 and in 1973-76 it varied between as low a figure as 100.00 to 145.00. The majority of taluks were characterized by low level of cropping intensity and very few showed higher level. For example 84 per cent, 85 per cent, and 74 p r cent of taluks were found in low category in period I, II and III respectively. A small proportion of taluks (i.e. 7.00 per cent) managed to achieve high level of cropping intensity.

(c) However, over the la t fifteen years a substiantial change had occured, atleast in the composition of taluks in the five categories of cropping intensity. It was

observed that proportion of taluks in low category has reduced greatly between the study periods. The percentage of taluks in the low intensity (very low plus low intensity group) group has decreased from 85 per cent in period I to 75 per cent in period III. As a result, the percentage of taluks in high and very high intensity groups has enhanced from 7.80 per cent in period I to 13.50 per cent in period III. So there was a movement of taluk from low intensity group to high intensity group. This indicated that overall progress in cropping intensity was not only shared by all ready developed taluk of the state but also by the relatively less developed ones. This was definitly a favourable sign, since the gain of development were also shared by less developed regions of the state. However, this little gain should not hide the other side of the picture. As many as 85 taluks of the low intensity group had continued to stay in the same state of affair throughout the study period. Therefore, the study pointed out the urgent need for an improvement in cropping intensity in this group of taluks.

5.3. Determinents of Cropping Intensity

On an a priori basis, six explanatory variables were considered relevant for explaining varations in cropping intensity. It was hypothesised that, irrigation level,

irrigation intensity, annual rainfall, machanization index, animal power and agricultural workers would bear a positive relationship with cropping intensity and explain maximum variations. The regression result have significantly proved the hypotheis in case of irrigation level, irrigation intensity, and animal power. The other variables have also shown positive relationship, but it was weak in magnitude.

The level of cropping intensity depends on the inter-action of several institutional, technological and environmental factors. It has not been possible in this study to fully analyse the results of all factors. Nevertheless, some patterns seems to be emerging in Maharashtra state. In the beging, it may be pointed out, that the variables used in the model, have explained relatively low proportion of variations in cropping intensity. Infact, the explained part has reduced in the latter period of the study. It means, there were other variables out side the model, which were also important in determining the cropping intensity. The new technological inputs like short duration varieties (particully, Jawar and Bajra), fertilizer, and the machanical inputs seem to have become important in the state. Inclusion of these variables would have improved the explained

part of the model. Yet from the point of view of individual inputs, the regression result led to interesting conclusions. The results show that, irrigation level, irrigation intensity and animal power were important variables in first peridd of the study viz; 1960-63. In the latter two periods also irrigation level and irrigation intensity turn out to be important variables and accounted for major part of the variations in cropping intensity. The animal power, which was an important variable in period I had reduced its influence, instead mechanization index has shown some improvement in the latter periods.

Coming to the power of the beta index, irrigation level had once again shown a stronger impact on the cropping intenstiy, and it was followed by irrigation intensity. As noted earlier, among the different sources of irrigations, canal irrigation, because of its perennial character had proved to be the most significant variable. Tank irrigation had also indicated some impact on cropping intensity.

The results also revealed some kind of complementarity between the variables and this seem to have increased in the latter p riods atleast for some variables. The mechanization index has shown a positive relation with irrigation level and irrigation intensity and their by

indicate that the level of machanization would be high in area of high irrigation and intensity. Irrigation intensity which expresses the quality of irrigation depends on the machanization of irrigation structures (particulally that of well irrigation). In our study the machanization of irrigation is a major component of machanization index and hence the positive relation is the result. Machanization index and irrigation normally should go hand in hand.

5.4. Implications and Suggestions

The findings of the study provides some important implications for raising the cropping intensity in the state. However, these should be considered in the light of the limitations of the study and be used to enunciate broad guide lines. We observed that irrigation and its intensive use was the important variable in all the years. And further cropping intensity was more responsive to irrigation. Because of these reasons irrigation is going to be a major input for raising the cropping intensity in the state. The present study, more than confirmed the findings of the earlier studies. It also reveals tht the level of irrigation is not only important but its intensive use is also equally important. Therefore, canal irrigation and machanization of well irrigation which ensure perennial water supply would require special development efforts.

Even the expansion of area under tank irrigation in certain regions would lead to high level of cropping intensity. The irrigation potential in Maharashtra state is estimated to be 30 per cent . The state is curently utilizing only 10 per cent of this potential. Twenty per cent of the potential is yet be used. And the use of this additional water is going to improve the cropping intensity level in the state significantly, because the state does not have any alternative to raise the agricultural output except through cropping intensity.

Appendix - 2 A

Factors Associated With Cropping Intensity

CORRELATION MATRIX

(1960-61, 1961-62 & 1962-63)

Variables	Y	X_1	X_2	X_3	X_4	X_5	X_6
Y-Cropping Intensity	1.00	-.064	.218@	.332*	.045	.069	-.031
X_1-Rainfall		1.00	-.315*	-.331*	-.456*	.450*	.502*
X_2-Irrigation Intensity			1.00	.194@@	.060	-.306*	-.224@
X_3-Levels of Irrigation				1.00	.361*	-.207@	.133
X_4-Mechanisation Index					1.00	-.274*	-.501*
X_5-Animal Power						1.00	.031
X_6-Agricultural Workers							1.00

* - Significant at 1 per cent level.

@ - Significant at 5 per cent level.

@@ - Significant at 10 per cent level.

APPENDIX-I

Pattern of Cropping Inensity in Various Taluks of Maharashtra

Taluk code	Name of the Taluk and District	1960-61 1961-62 1962-63	1967-68 1968-69 1969-70	1973-74 1974-75 1975-76
1	2	3	4	5
	AHMEDNAGAR DISTRICT			
1	Ahmednagar	104.12	104.03	105.99
2	Rahuri	104.07	105.56	110.14
3.	Shrirampur	102.72	102.75	111.08
4	Newasa	100.01	104.28	104.41
5	Shevgaon	106.14	106.35	108.81
6	Pathardi	104.81	104.88	106.58
7	Jamkhed	105.04	112.47	110.28
8	Karjat	110.89	104.84	104.87
9	Shrigonda	106.49	106.26	104.15
10	Parner	104.28	107.19	117.43
11	Akola	104.90	102.78	105.22
12	Sangamner	108.74	103.52	104.25
13	Kopargaon	104.75	103.65	115.97
	AKOLA DISTRICT			
14	Akola	100.90	101.05	103.40
15	Akot	100.32	100.28	103.50
16	Murtizapur	100.20	100.49	101.04
17	Mangrulpir	100.52	100.63	102.07
18	Washim	101.42	103.37	102.96
19	Balapur	100.15	100.60	101.37
	AMRAVATI DISTRICT			
20	Amaravati	100.25	100.40	102.39
21	Achalpur	100.49	101.26	103.01
22	Morshi	100.28	100157	102.75
23	Chandur	100.64	100.31	104.70
24	Dargapur	100.13	100.30	101.95
25	Melghat	103.22	101.15	106.56

1	2	3	4	5
	AURANGABAD DISTRICT			
26	Aurangabad	107.07	107.48	109.70
27	Khuldabad	103.89	105.87	105.18
28	Kannad	102.45	108.74	107.35
29	Soegaon	106.07	102.02	101.69
30	Sillod	103.26	106.10	101.97
31	Bhakardan	102.80	106.84	103.51
32	Jafferabad	103.84	104.17	102.46
33	Jalna	104.87	107.50	108.03
34	Ambad	102.96	104.30	104.74
35	Paithan	103.19	106.74	108.23
36	Gangapur	113.75	103.01	105.93
37	Vaijapur	102.50	105.34	109.48
	BHANDARA DISTRICT			
38	Bhandra	121.89	118.81	120.28
39	Gondia	140.25	140.87	141.99
40	Sakoli	135.41	130.17	141.50
	BEED (BHIR) DISTRICT			
41	Beed	105.98	106.51	103.86
42	Georai	106.06	106.14	104.24
43	Manjlegaon	101.14	106.22	107.59
44	Ambejogai	100.08	104.89	102.20
45	Kaij	103.59	103.06	102.90
46	Patoda	114.62	108.26	108.50
47	Ashti	112.89	108.15	103.68
	BULDANA DISTRICT			
48	Chikhli	105.68	106.89	108.87
49	Malkapur	100.29	100.85	102.67
50	Jalgaon	100.33	100.26	102.07
51	Khangaon	100.31	100.64	104.99
52	Mohkar	104.506	104.81	109.37

1	2	3	4	5
	CHANDRAPUR DISTRICT			
53	Chandrapur	107.09	105.31	104.38
54	Warora	102.48	102.35	101.78
55	Bramhapuri	140.23	126.25	131.86
56	Gadhiroli	114.21	107.93	117.53
57	Sironcha	101.83	101.12	101.07
58	Rajura	100.00	100.11	100.21
	DHULE (DHULIA) DISTRICT			
59	Dhule	106.89	109.63	108.03
60	Sakri	111.63	112.23	108.14
61	Nawapur	103.41	105.20	107.09
62	Nandurbar	118.29	113.26	112.07
63	Taloda	107.16	106.76	111.61
64	Akkalkuwa	101.02	103.30	106.47
65	Akrani	100.59	100.21	101.27
66	Shahada	119.43	118.75	116.75
67	Shirpur	120.95	115.56	112.41
68	Sindkheda	119.66	113.18	110.86
	JALGAON DISTRICT			
69	Jalgaon	111.96	103.81	123.85
70	Chopda	117.29	112.75	120.68
71	Yawal	105.89	105.17	115.07
72	Raver	101.92	106.48	106.89
73	Edlabad	101.67	103.68	107.05
74	Bhurawal	102.48	102.38	103.15
75	Jamner	101.72	102.16	104.34
76	Pachora	104.07	103.80	107.63
77	Chalisgaon	101.93	107.49	105.93
78	Bhadgaon	111.16	111.30	117.38
79	Parola	105.16	106.69	107.75
80	Erandol	109.04	115.79	132.17
81	Amalner	119.76	112.98	108.64

1	2	3	4	5
	KOLABRA DISTRICT			
82	Alibag	105.01	104.56	101.17
83	Uran	101.71	100.87	101.25
84	Panvel	105.24	106.03	106.70
85	Karjat	109.37	114.67	112.79
86	Khalapur	102.77	102.25	110.71
87	Pan	102.77	102.23	105.03
88	Sudhagad	102.80	106.48	110.00
89	Roha	109.53	112.76	113.11
90	Mangaon	106.55	104.38	107.26
91	Mahad	107.30	107.47	111.62
92	Poladpur	101.03	101.28	105.75
93	Mhasala	102.83	101.03	108.07
94	Shriwardhan	106.72	105.21	107.41
95	Murud	106.26	106.01	108.59
	KOLHAPUR DISTRICT			
96	Karvir	119.20	123.43	123.64
97	Panhala	113.37	116.50	115.52
98	Hatkanangle	111.40	112.36	114.78
99	Shirol	106.53	112.74	119.40
100	Kagal	107.85	107.03	107.00
101	Gadhing-laj	108.43	108.73	107.69
102	Chandgad	105.15	106.28	107.81
103	Ajna	102.38	104.36	103.25
104	Bhudargad	107.85	116.67	109.09
105	Radhanagari	116.04	116.31	116.25
106	Bavda	104.78	110.01	107.59
107	Shahuwadi	111.22	109.39	106.96
	NAGPUR DISTRICT			
108	Kotel	101.46	102.95	104.80
109	Saoner	100.57	101.89	107.92
110	Ramtek	102.12	101.17	101.43
111	Nagpur	100.72	101.39	102.13
112	Umrer	100.25	101.91	100.61

1	2	3	4	5
	NANDED DISTRICT			
113	Nanded	107.06	105.55	121.55
114	Hadgaon	100.32	102.67	104.29
115	Kinwat	100.36	100.20	104.24
116	Bhokar	102.51	101.48	110.11
117	Biloli	101.13	103.55	104.90
118	Degloor	101.60	101.97	124.37
119	Mukhed	104.68	106.16	132.43
120	Kandhar	117.47	105.09	104.13
	NASIK DISTRICT			
121	Baglan	110.00	108.85	104.39
122	Chandor	106.41	105.62	101.88
123	Dindori	103.29	101.59	107.23
124	Igatipuri	109.50	103.07	100.82
125	Kalwan	101.95	105.19	103.30
126	Malegaon	101.64	105.75	104.89
127	Nandgaon	101.39	104.22	106.82
128	Nasik	103.73	104.17	109.33
129	Niphad	100.01	105.92	105.27
130	Peint	105.51	101.23	100.00
131	Sinnar	102.90	100.68	103.30
132	Surgana	101.71	100.00	100.32
133	Yeola	101.18	109.93	103.48
	OSMANABAD DISTRICT			
134	Osmanabad	107.09	108.68	104.41
135	Kallam	106.53	104.87	106.95
136	Latur	102.42	102.20	113.41
137	Ahmedpur	100.39	100.85	107.05
138	Udgir	100.88	100.30	107.17
139	Nilanga	112.52	106.56	109.81
140	Ausa	102.78	102.23	111.93
141	Omerga	105.65	106.57	109.24
142	Tuljapur	100.29	100.48	105.40
143	Paranda	105.18	107.54	109.32
144	Bhoom	100.18	100.00	113.16

1	2	3	4	5
	PARBHANI DISTRICT			
145	Parbhani	111.73	113.71	108.84
146	Jintur	114.74	114.10	109.22
147	Hingoli	103.76	103.58	106.28
148	Kalamnuri	100.42	104.81	112.21
149	Basmath	100.31	104.89	104.58
150	Gangakhed	108.35	110.37	109.18
151	Pathri	104.82	106.82	112.19
152	Pathur	106.24	114.08	109.38
	PUNE DISTRICT			
153	Pune City	101.74	105.77	108.80
154	Haveli	109.41	113.12	107.15
155	Khed	107.61	108.14	114.31
156	Ambegaon	113.81	107.33	114.98
157	Junnar	106.90	108.69	114.43
158	Shirur	107.39	114.17	117.86
159	Daund	110.61	106.87	109.52
160	Indapur	106.20	106.69	110.19
161	Baramati	105.48	107.87	120.69
162	Purandhar	112.01	112.01	119.64
163	Bhor	111.09	104.56	113.12
164	Velke	103.60	100.34	103.30
165	Mulshi	104.34	101.57	103.48
166	Mawal	103.64	101.78	107.52
	RATNAGIR DISTRICT			
167	Ratnagiri	102.13	100.00	102.78
168	Guhagar	100.61	101.81	101.34
169	Dapoli	101.20	100.10	101.04
170	Mandangad	100.50	102.13	103.51
171	Khed	103.99	102.72	101.38
172	Chiplun	101.25	101.43	101.73
173	Sangameshwar	101.64	104.51	100.63
174	Lanja	100.49	101.07	100.41
175	Rajapur	103.46	102.01	101.64

1	2	3	4	5
176	Kankawali	100.95	100.92	100.81
177	Kudal	108.01	105.53	102.93
178	Sawantabadi	106.49	103.93	110.56
179	Vengurla	104.58	101.77	109.52
180	Malwan	108.71	107.83	122.75
181	Devgad	106.96	105.30	103.45
	SANGLI DISTRICT			
182	Miraj	103.00	108.14	109.03
183	Tasgaon	107.71	108.98	110.11
184	Khanapur	104.77	105.76	104.46
185	Atpadi	103.78	103.54	104.73
186	Jath	102.61	102.11	102.09
188	Walwa	107.72	109.28	111.21
	SATARA DISTRICT			
190	Satara	104.83	103.30	110.93
191	Wai	114.07	108.91	116.61
192	Khandala	116.84	114.89	134.24
193	Koregaon	108.91	108.31	109.99
194	Phaltan	133.09	107.65	116.60
195	Man	105.82	108.40	105.97
196	Khatav	107.55	107.10	107.71
197	Kharad	103.91	102.63	108.79
198	Patan	112.22	113.60	106.46
199	Jaoli	118.39	108.02	114.13
200	Mahabaleswar	102.98	103.73	108.33
	SHOLAPUR DISTRICT			
201	Sholapur North	103.53	101.94	107.49
202	Barshi	103.00	102.47	105.44
203	Akkalkot	102.79	102.46	103.07
204	Solapur South	104.09	102.91	105.72
205	Mohol	102.71	102.54	103.91
206	Mangalvedhe	101.58	103.46	104.57
207	Pandhappur	102.77	102.75	103.03
208	Sangale	103.64	106.10	104.59

1	2	3	4	5
209	Malshiras	104.43	105.50	112.43
210	Karmala	104.96	108.58	104.84
211	Madha	102.98	103.23	103.86
	THANE DISTRICT			
212	Thane	102.28	100.51	110.16
213	Bassein	109.06	104.12	101.22
214	Palghar	103.22	105.94	108.63
215	Dahanu	101.89	100.52	101.86
216	Talasara	102.29	102.48	104.08
217	Jawahar	100.20	100.37	101.14
218	Mokhada	102.72	104.28	100.59
219	Wada	107.73	107.20	100.94
220	Bhiwandi	101.16	101.04	102.28
221	Shahapur	101.05	100.93	101.55
222	Murbad	100.88	101.00	101.18
223	Kalyan	101.60	100.69	103.03
	WARDHA DISTRICT			
225	Wardha	100.60	102.31	102.73
226	Arvi	101.43	101.04	102.92
227	Hinganghat	100.78	100.79	101.35
	YEOTMAL DISTRICT			
228	Yeotmal	100.49	100.94	101.39
229	Kelapur	101.03	100.98	101.31
230	Wani	101.01	100.80	101.24
231	Pusad	100.56	100.86	101.73
232	Darwha	100.55	100.61	101.74

Appendix- 2 B

Factors Affecting Cropping Intensity in Maharashtra(Detailed Result)

STEP-WISE ANALYSIS (Regression Results)

(1960-61, 1961-62 & 1962-63)

Step Variable	Regression co-efficient	S.E. of Bs	R	R^2	Increase in R^2	F'value of the Equ.	S.E.of the Eq.	F'values of Bs	t values of Bs
Step 1									
X_3	.372*	.003	.372	.138	.138	35.768	.024	35.768	5.931
Step 2									
X_3	.401*	.003						41.261	6.423
X_5	.162*	.007	.405	.164	.026	21.733	.024	6.772	2.602
Step 3									
X_3	.377*	.003						36.697	6.058
X_5	.209*	.007						10.699	3.271
X_2	.172*	.024	.436	.190	.026	17.289	.026	7.186	2.681

Step Variable	Regression co-efficient	S.E.of B's	R	R^2	Increase in R^2	F'value of the Equ.	S.E.of the Eq.	F'values of Bs	t values of B's
Step 4									
X_3	.359*							31.552	5.617
X_5	.267*	.009						11.315	3.364
X_2	.159*	.025						6.081	2.466
X_1	-.101@@	.007	.442	.200	.010	13.371	.024	1.504	1.226
Step 5									
X_3	.382*	.003						33.252	5.766
X_5	.267*	.009						11.389	3.374
X_2	.148**	.025						5.158	2.271
X_1	-.140@	.008						2.561	1.600
X_4	-.092@	.003	.449	.206	.006	11.069	0024	1.691	1.300

* - Significant at 1 per cent level
** - Significant at 5 per cent level
@ - Significant at 10 per cent level
@@ - Significant at 15 per cent level

Appendix - 3 A

Factors Associated With Cropping Intensity

CORRELATION MATRIX

(1967-68,1968-69 & 1969-70)

Variables	Y	X_1	X_2	X_3	X_4	X_5	X_6
Y-Cropping Intensity	1.00	-.119	.164@@	.341*	.132	-.028	-.027
X_1-Rainfall		1.00	-.291*	-.330*	-.491*	.445*	.583*
X_2-Irrigation Intensity			1.00	.149	.157	-.306*	-.341*
X_3-Levels of Irriagation				1.00	.528*	-.190@@	.141
X_4-Mechanisation Index					1.00	-.349*	-.542*
X_5-Animal Power						1.00	.193@@
X_6-Agricultural Workers							1.00

* - Significant at 1 per cent level.

@ - Significant at 5 per cent level.

@@ - Significant at 10 per cent level.

Appendix- 3 B

Factors Affecting Cropping Intensity in Maharashtra (Detailed Result)

STEP-WISE ANALYSIS (Regression Results)

(1967-68, 1968-69 & 1969-70)

Step Variable	Regression co-efficient	S.E.of B's	R	R^2	Increase in R^2	F'value of the Equ.	S.E.of the Equ.	F'values of B's	t values of B's
Step 1									
X_3	.341*	.003	.341	.116	.116	29.843	.023	29.844	5.463
Step 2									
X_3	.329*	.003						27.360	5.231
X_2	.075@@	.024	.349	.122	.005	15.650	.023	1.403	1.181
Step 3									
X_3	.369*	.003						25.073	5.007
X_2	.081@	.024						1.626	1.275
X_4	-.075	.003	.355	.126	.004	10.785	.023	1.048	1.024

Step Variable	Regression co-efficient	S.E.of B's	R	R^2	Increase in R^2	F'value of the Equ.	S.E.of the Equ.	F'values of B's	t values of B's
Step 4									
X_3	.368*	.003						25.910	5.090
X_2	.094@	.025						2.020	1.421
X_4	-.060	.003						0.602	00776
X_5	.050	.007	.357	.128	.002	8.201	.023	0.518	0.720
Step 5									
X_3	.359*	.003						23.414	4.838
X_2	.089@	.025						1.806	1.344
X_4	-.081	.004						1.013	1.006
X_5	.002@@	.009						1.387	1.178
X_1	-.097	.009	.362	.132	.004	6.741	.023	0.911	0.954

* - Significant at 1 per cent level
** - Significant at 5 per cent level
@ - Significant at 10 per cent level
@@ - Significant at 15 per cent level

Appendix - 4 A

Factors Associated With Cropping Intensity

CORRELATION MATRIX

(1973-74, 1974-75 & 1975-76)

Variables	Y	X_1	X_2	X_3	X_4	X_5	X_6
Y-Cropping Intensity	1.00	-.079	.165@@	.295*	.113	.001	-.051
X_1-Rainfall		1.00	-.324*	-.217@	-.392*	.153	.512*
X_2-Irrigation Intensity			1.00	.041	.157	.040	-.193@
X_3-Levels of Irrigation				1.00	.542*	-.063	.221@
X_4-Mechanisation Index					1.00	-.149	-.531*
X_5-Animal Power						1.00	.053
X_6-Agricultural Workers							1.00

* - Significant at 1 per cent level.

@ - Significant at 5 per cent level.

@@ - Significant at 10 per cent level.

Appendix- 4 B

Factors Affecting Cropping Intensity in Maharashtra (Detailed Result)

STEP-WISE ANALYSIS (Regression Results)
(1973-74, 1974-75 & 1975-76)

Step Variable	Regression co-efficient	S.E.of B's	R	R^2	Increase in R^2	F'value of the Equ.	S.E.of the Equ.	F'values of B's	t values of B's
Step 1									
X_3	.295*	.004	.295	.087	.087	21.288	.031	21.289	4.614
Step 2									
X_3	.289*	.004						20.794	4.560
X_2	.148*	.020	.330	.109	.022	13.572	.031	5.433	2.331
Step 3									
X_3	.341*	.005						20.532	4.531
X_2	.161*	.021						6.301	2.510
X_4	-.098@	.005	.340	.116	.007	9.263	.031	1.646	1.283
Step 4									
X_3	.342*	.005						20.461	4.523
X_2	.164*	.022						5.960	2.441
X_4	-.094@@	.005						1.379	1.174
X_1	.011	.009	.340	.114	.001	7.191	.031	0.023	0.152

* - Significant at 1 per cent level
** - Significant at 5 per cent level
@ - Significant at 10 per cent level
@@ - Significant at 15 per cent level

Appendix - 5 A

Sources of Irrigation Affecting Cropping Intensity

CORRELATION MATRIX

(1960-61, 1961-62 & 1962-63)

Variables	Y	X_7	X_8	X_9
Y-Cropping Intensity	1.00	.274@	.170@@	.208@
X_7-Canal Irrigation		1.00	-.114	-.065
X_8-Well Irrigation			1.00	-.276@
X_9-Tank Irrigation				1.00

* - Significant at 1 per cent level

@ - Significant at 5 per cent level

@@ - Significant at 10 per cent level

Appendix - 5 B

Sources of Irrigation Affecting Cropping Intensity in Maharashtra
(Detailed Result)

STEP-WISE ANALYSIS (Regression Results)

(1960-61, 1961-62 & 1962-63)

Step Variable	Regression co-efficient	S.E.of B's	R	R^2	Increase in R^2	F'value of the Equ.	S.E. of the Equ.	F'values of B's	t values of B's
Step 1									
X_7	.274*	.002	.274	.075	.075	18.45	.025	18.45	4.30
X_2									
Step 2									
X_7	.289*	.002						21.50	4.636
X_9	.227*	.003	.355	.126	.051	16.33	.024	13.21	3.635
Step 3									
X_7	.278*	.002						19.586	4.426
X_9	.203*	.003						9.773	3.126
X_8	.083@@	.002	.364	.132	.006	11.45	.024	1.608	1.268

* - Significant at 1 per cent level
** - Significant at 5 per cent level
@@ - Significant at 15 per cent level

Appendix - 6 A

es of Irrigation Affecting Cropping Intensity

CORRELATION MATRIX

(1967-68, 1968-69 & 1969-70)

	Y	X_7	X_8	X_9
Intensity	1.00	.266@	.018	.171@@
rrigation		1.00	-.024	.006
rrigation			1.00	-.257@
rigation				1.00

@ - Significant at 1 per cent level

@ - Significant at 5 per cent level

@ - Significant at 10 per cent level

Appendix - 6 B

Sources of Irrigation Affecting Cropping Intensity in Maharashtra (Detailed Result)

STEP-WISE REGRESSION ANALYSIS

(1967-68, 1968-69 & 1969-70)

Step Variable	Regression co-efficient	S.E.of B's	R	R^2	Increase in R^2	F'value of the Equ.	S.E of the Equ.	F'values of B's	t values of B's
Step 1									
X_7	.266*	.002	.266	.071	.071	17.302	.024	17.302	4.160
Step 2									
X_7	.277*	.002						19.330	4.397
X_9	.187*	.003	.325	.106	.035	13.373	.023	18.147	2.910
Step 3									
X_7	.275*	.002						18.998	4.359
X_9	.193*	.003						9.101	3.017
X_8	.034	.002	.327	.107	.001	8.982	.023	0.282	0.532

* - Significant at 1 per cent level
** - Significant at 5 per cent level

Appendix - 7 A

Sources of Irrigation Affecting Cropping Intensity

CORRELATION MATRIX

(1973-74, 1974-75 & 1975-76)

Variables	Y	X_7	X_8	X_9
Y-Cropping Intensity	1.00	.194@	.071	.091
X_7-Canal Irrigation		1.00	-.109	-.088
X_8-Well Irrigation			1.00	-.234@
X_9-Tank Irrigation				1.00

* - Significant at 1 per cent level

@ - Significant at 5 per cent level

@@ - Significant at 10 per cent level

Appendix - 7B

Sources of Irrigation Affecting Cropping Intensity in Maharashtra (Detailed Result)

STEP-WISE REGRESSION ANAYSIS

(1973-74, 1974-75 & 1975-76)

Step Variable	Regression co-efficient	S.E.of B's	R	R^2	Increase in R^2	F'value of the Equ.	S.E.of the Equ.	F'values of B's	T values of B's
Step 1									
X_7	.194*	.003	.194	.032	.038	8.919	.032	8.920	2.987
Step 2									
X_7	.204*	.003						9.822	3.134
X_9	.109@	.004	.223	.049	.012	5.899	.032	2.809	1.442
Step 3									
X_7	.221*	.003						11.427	3.380
X_9	.141**	.004						4.432	2.105
X_8	.128**	.004	.254	.064	.150	5.205	.032	3.677	1.183

* - Significant at 1 per cent level
** - Significant at 5 per cent level
@ - Significant at 10 per cent level

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