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**LEVELS OF FERTILIZER USE IN MAHARASHTRA**

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PUNE 411 004 (INDIA)**

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## FOREWORD

Indian agriculture has undergone a transformation since the mid-sixties with the onset of Green Revolution. The main features of this revolution are introduction of high yielding varieties, increased area under irrigation and high doses of (chemical) fertilizers. Although the use of fertilizers was recommended even before this time, the attention on this input has got focussed as the high yielding varieties respond well to high fertilizer doses. Various agricultural institutions in the country are engaged in recommending the fertilizer doses for the high yielding varieties under irrigated and rainfed conditions along with the doses for traditional varieties. For administrative and growth-planning purposes data on use of fertilizers are collected by the state agencies for each district for each type of fertilizer as well as by nutrients released by these fertilizers. However estimates of use levels of fertilizers for individual crops and further separate estimates for irrigated and unirrigated components of these crops are not routinely available in the official data.

To make up for this lacuna the Agro-Economic Research Centre in the Institute took up the present study for Maharashtra State at the instance of the Ministry of Agriculture, Government of India. The Mahatma Phule Agricultural University authorities were kind enough to make available the relevant data from the detailed data collected under the 'Comprehensive Scheme for Studying Cost of Cultivation of Principal Crops' by the centre located at the University. The present study covers a state-wide sample of 400 cultivators for 1983-84 and a different sample of 600 cultivators for 1984-85.

This work was taken up during the last quarter of 1985 and a brief analysis for 1983-84 was incorporated in a preliminary report by the end of 1986. The final detailed analysis

(2)

for both the years in the present form was completed in July 1989. Because of the renewal of interest in the fertilizer usage due to the cut in the fertilizer subsidy in the Union Budget of 1991-92, it was decided to publish this study for wider circulation. It is hoped that the study will be found useful by the planners, policy-makers and researchers in the country in general and in Maharashtra in particular.

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Director

October 30, 1991

## PREFACE

In the present study a detailed analysis of levels of fertilizer input is attempted for the state as a whole, for four agro-climatic regions, for individual crops, for irrigated and rainfed components for the two years 1983-84 and 1984-85. The presentation of this study could have been more compact but it may be pointed out that the emphasis has been on avoiding any loss of information. The reader is requested to bear with the author on this count.

Grateful acknowledgement is made of the help extended by the Director Dr. M. P. Dhongade and Field Officer Dr. D.L.Sale along with the staff of the 'Comprehensive Scheme for Studying Cost of Cultivation of Principal Crops' located in the Mahatma Phule Agricultural University. The present study could not have been undertaken without their unstinted cooperation.

Shri Inamdar, Research Assistant, Shri Khodaskar, Field Inspector, Shri Dete, Shri Kasbe, Investigators worked on this project and their work has been meticulous. Shri D.B.Sardesai in charge of Computer and Statistical Section along with Smt. Kher, Smt. A. Kulkarni, Smt. K. Barve and Shri Marathe handled the enormous job of computer analysis with their customary expertise. The typists Shri Athale, Shri Ambardekar, Smt. Mahajan, Smt. Marathe, Smt. Gangal and Shri Moghe worked as a team to complete the necessary typing work. The author is grateful to all of them along with the rest of the staff who were directly or indirectly involved with the work relating to the study.

Lastly, the author is grateful to the Institute authorities for their encouragement in the completion of this study.

October 30, 1991

M. P. Khare

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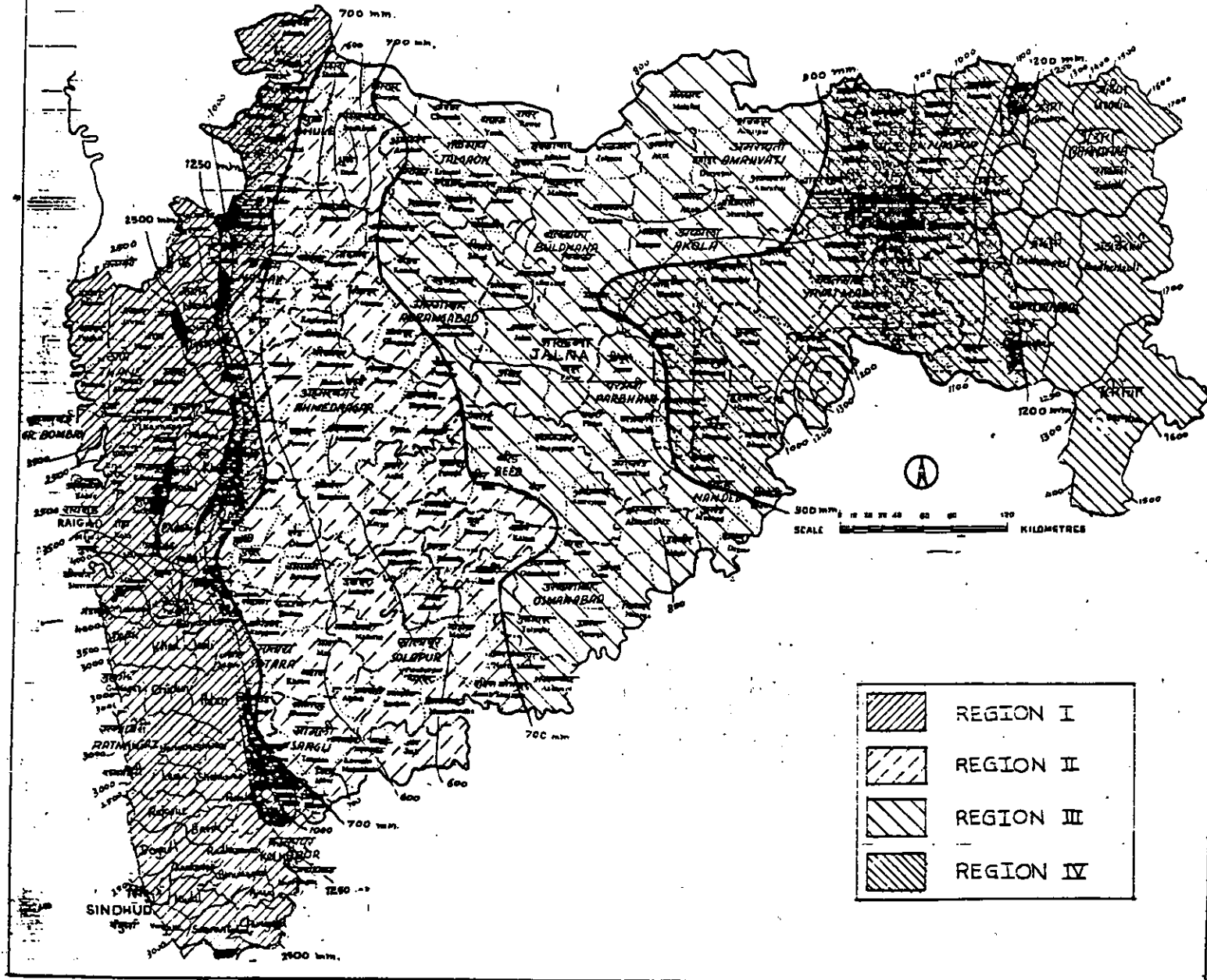
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महाराष्ट्र राज्याचे पर्जन्यमान व जमिनींच्या प्रकारानुसार प्रमुख विभाग  
 AGRO-CLIMATIC ZONES OF MAHARASHTRA STATE



CHAPTER I  
INTRODUCTION

1.1 To cope with the ever increasing population, growth in agriculture is of paramount importance. This is true of country as a whole and perhaps more so for the State of Maharashtra, an agriculturally deficit State. The growth in agriculture can itself be achieved only by modernizing agriculture, when one considers the magnitudes involved in relation to the relevant time horizon.

The basic features of modernizing agriculture are irrigation and adoption of high-yielding varieties but not necessarily in that order. One may state the two features as irrigation or assured rainfall and use of high-yielding varieties (HYV). Basic characteristics of HYV being its high-fertilizer responsiveness, from the point of inputs, the basic features may again be stated as irrigation/assured rainfall, adoption of HYV, use of chemical fertilizers (and plant-protection measures). Levels of use of fertilizers themselves thus become worth close examination. The present study tries to look into this aspect of use of fertilizers in Maharashtra.

1.2 Although the decision-making unit in agriculture is the individual farmer, the State has an important role to play as in many other economic activities. State has not only to try to promote growth in agriculture by taking care that the inputs are being provided but it has to keep collecting information on the economic activity of agriculture and constantly review the progress that is achieved (i.e. it has to 'monitor' the growth, to use the management jargon). The statistical information that is collected and published by the Department of Agriculture, Maharashtra State, is, not surprisingly, enormous. Districtwise data on rainfall (which is also given centrewise), distribution

of land under various categories of land use, information on sources of irrigation and land irrigated by them, irrigated cropping pattern, 'total' cropping pattern, production of principal crops and productivity, farm harvest prices, prevalent wage rates, etc., are published annually in the Season and Crop Reports. To this the Directorate of Agriculture has recently added the Epitome of Agriculture in Maharashtra (Volumes I and II) which gives information on additional aspects like percentage area under HYV for important crops, consumption of nutrients N,P,K from fertilizers, information on agro-climatic zones, some results on fertilizer trials on farmer's fields, HYV seeds, insecticides and pesticides distributed through official channels and so on. Some of the data pertaining to Maharashtra (compiled by the Directorate of Agriculture) are published at the national level, e.g. estimates of yield of irrigated and unirrigated crops (for State as a whole, not districtwise), in publications of Directorate of Economics and Statistics, Ministry of Agriculture.

1.3 In all this, we find that information on use of fertilizers is rather inadequate. Apart from (districtwise) data on consumption of nutrients N,P,K in 'Fertilizer Statistics' published by the Fertilizer Association of India (and 'distribution of fertilizers according to its type' like straight fertilizers, mixed fertilizers and composite fertilizers for different States - this last aspect not districtwise) and information published in the recently introduced Epitome of Agriculture in Maharashtra little else regularly published material is available on fertilizer use in Maharashtra State with a statewide coverage. What is particularly needed is the basic information on the cropwise levels of fertilizer use covering the State as a whole. That is, in addition to ad-hoc studies in different areas, a simultaneous assessment is somewhat basic for a reasonable assessment

of existing levels of fertilizer use and hence for policy formulation. Fortunately we have two such statewide surveys in 1970-71 and 1976-77. The former being a part of 26th round of NSS (by the NSS, Department of Statistics, Ministry of Planning, Government of India, published in July 1976) and the latter as Agricultural Census 1976-77, Maharashtra State : Report on Input Survey, Department of Agriculture, Government of Maharashtra (published in May 1980). While the NSS survey covers 310 villages and over 2,500 farm households, the Input Survey is relatively massive, covering 810 villages and over 16 thousand farm households. We, however, will not go into the results and comparative picture of fertilizer survey as this is already covered in the study 'Agricultural Growth and Potential in Maharashtra' taken up at the instance of the Planning Commission by the Agro-Economic Research Centre, located at the Institute. This unpublished report was submitted both to the Planning Commission and the Ministry of Agriculture in 1984. We may refer to some of the results of that study at appropriate places.

1.4 The present study tries to assess levels of fertilizer use for various crops, in various regions in Maharashtra and tries to relate these levels with the adoption of new varieties and irrigation. The source for the empirical data has been the Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops located at the Mahatma Phule Agricultural University (MPAU), Rahuri, covering entire Maharashtra.\* We cover two years : 1983-84 and 1984-85. For 1983-84, 400

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\* We gratefully acknowledge the cooperation extended by the Office of the Director and the Field Officer of the Comprehensive Scheme Centre at the Mahatma Phule Agricultural University (MPAU), Rahuri for getting the relevant material xeroxed at the MPAU. We had useful discussions with the staff of the Field Officer of the Centre. We are also grateful for discussions with the Head of Department of Economics and his colleagues on the staff.

cultivators data from 40 centres were available while for 1984-85 the sample was a bigger one of 600 cultivators with a different set of 60 centres, and in both cases respondents were spread over all agro-climatic zones of Maharashtra. Although data were taken from the Comprehensive Scheme Centre at MPAU, we take the responsibility for inaccuracies and inadequacies in the methodology and results of the present study.\*\* It may be mentioned that a Preliminary Report covering some quick results for 1983-84 was submitted to the Ministry of Agriculture in 1986.

1.5 The data in Comprehensive Scheme has its focus on representation of important crops and with this view, farmers are selected from different agro-climatic zones so that 13 crops important from the national point of view are covered. We will look at fertilizer use on these major crops under rainfed and irrigated conditions as well as under HYV or traditional varieties for the two years 1983-84 and 1984-85 in this study. In the chapters that follow, we take up the background of the study and the methodology of the selection of sample and broad characteristics of the sample in succession over two chapters. In Chapter IV we cover the results and the analysis is rounded up by a chapter on conclusion.

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\*\* The relevant data collected by us from the MPAU was computerized by the Statistical Section of our Institute headed by Shri Sardesai. We are grateful to him and his staff.

We also acknowledge the able assistance of Shri M.R.Inamdar, Research Assistant who worked during the final stages of this Report.



CHAPTER II  
THE BACKGROUND

2.1 In this chapter we briefly examine growth of fertilizer consumption in Maharashtra over the last 20-25 years. We also compare the per hectare consumption levels in Maharashtra with those of other States in the country. Then we take a look at the growth of agriculture in Maharashtra over the same period so that a background is created for the study of consumption levels of fertilizers in the two years 1983-84 and 1984-85 for the selected farmers.

If we look at the growth of consumption of nutrients N and P between the year 1960-61 (year in which Maharashtra State as we know today came into existence) and the latest year for which data are available viz: 1986-87, we see that in the year 1960-61 N and P levels for Maharashtra were 11,780 and 4,873 tonnes respectively while for the latest available year 1986-87 (Fertilizer Statistics, 1986-87) these two levels are 3,97,900 and 1,59,400 metric tonnes respectively. This indicates enormous increases in consumption of nutrients, with annual compound growth rates of 14.50 per cent per annum for N and 14.35 per cent per annum for P respectively over a period of 26 years. These are excellent rates by any standard but we must also concede that they could be a bit exaggerated due to the initial low levels.

Over the entire period consumption of N,P,K has also been increasing consistently. For example, if we take average (i.e. per year) for trienniums 1961-1964, 1967-70, 1974-77, and 1980-83, (the last of these trienniums 1980-83 is just before our two reference years of the present study viz. 1983-84 and 1984-85) then the levels of N and P per hectare of gross cropped area (GCA) appear as follows. (We consider only N and P - and not K - for brevity.)

Table 2.1 : Fertilizer Consumption in Maharashtra (1961-62 to 1982-83)

	(Triennial verages of Nutrients in Tonnes)			
	N	P	N/ha (kg)	P/ha (kg)
1961-64	21566	7586	1.13	0.40
1967-70	87964	36303	4.55	1.88
1974-77	177880	56133	9.05	2.86
1980-83	293900	110900	14.51	5.47

The compound growth rates (per cent per annum) for various periods are :

	N	P
1961-64 to 1980-83	14.74	15.16
1974-77 to 1980-83	8.72	12.02
1967-70 to 1980-83	9.72	8.97

Thus over a span of about 20 years (data on averages of trienniums, hence we consider period e.g. 1961-64 as centred on 1962-63, etc., thus 1962-63 to 1981-82 makes a period of 20 years although total number of years are 23) the N and P consumption growth rates are at about 15 per cent per annum, quite comparable to the 1960-61 to 1986-87 period rates mentioned in the preceding paragraph. However, in more 'recent' periods like 1974-77 to 1980-83 or 1967-70 to 1980-83 we get growth rates between 8 and 12 per cent per annum and this would be a more reasonable assessment of growth because initial levels are not as low as obtained in 1960-61.

The per hectare of gross cropped area (GCA) consumption of N and P has been increasing steadily over the years and we see that from a mere 1.13 kg/ha in 1961-64, the consumption of N has increased to 14.51 kg/ha in 1980-83, i.e., the period

just prior to our years of 1983-84 and 1984-85. Now 'Fertilizer Statistics' gives us N,P,K for more recent years. For example, N and P levels for 1983-84, 1984-85 and 1986-87 are as follows :

	N (tonnes)	P (tonnes)
	-----	-----
1983-84	397500	143300
1984-85	359200	129300
1986-87	397900	159400
Average	384900	144667

Thus 1983-87 averages for N and P (we did not have the figures for 1985-86 but that should not really matter) are substantially higher than 1980-83 averages. Consequently, N and P per hectare (of GCA) in 1983-84, for example, are 18.82 and 6.87 kg respectively, much higher than 1980-83 level of 14.51 and 5.47 kg. respectively. Although we have gross cropped area data only upto 1983-84 (Fertilizer Statistics, 1986-87), we have area data for major crops covering more than 85 per cent of GCA for 1984-85 and 1985-86. (These data presented later in Table 2.9), and area under these major crops for these last two years appear to be of the same order as 1982-84. Thus we have to accept that from 1983-84 there is a substantial increase in per hectare consumption in N by about 4 kg/ha. and this is not due to decrease in GCA.

2.2 Although consumption of N (and P) has increased by good growth rates of around 10 per cent and per hectare (of GCA) use levels increased from about 5 kg/ha. (1967-70) to 18.82 kg/ha. in 1983-84, consumption levels have always been low in Maharashtra compared to other States. In Table 2.2 per hectare consumption levels are given for important States along with irrigated area proportions and one finds that in 1983-84 N/ha of GCA at all-India level is 30.20 kg/ha whereas Maharashtra has this level at 18.82 kg/ha. Many other States have much higher

levels with Punjab leading (101-26 kg) followed by Uttar Pradesh, Haryana, Tamil Nadu, Andhra Pradesh, etc. (all above 45 kg).

We also present net irrigated area/net sown area proportions and the nexus between high irrigation ratios starting with Punjab (85.68 per cent) and leading to Andhra Pradesh (33.91 per cent) is obvious enough. We also present similar data for 1976-77 and apart from relatively low levels of the past for all States, poor level of Maharashtra is quite apparent. We can safely say that low irrigation ratio has been and continues to be the reason for low levels of fertilizer use in Maharashtra. Irrigation percentage even in 1983-84 is just 10.73 per cent.

2.3 As mentioned at the beginning of this chapter, we now have a quick look at Maharashtra's agriculture by looking at various familiar variables of agriculture and growth in them (especially growth in production and productivity).

To get an idea of the area under major crops, irrigation and production, Table 2.3 is presented. Here data for the triennium 1980-81 to 1982-83 from Epitome of Agriculture 1984-85 (Director of Agriculture, Government of Maharashtra) are averaged to find a relatively recent picture of agriculture in Maharashtra. If we look at foodgrains (that is, all cereals and pulses) we see that Maharashtra's production basket has kharif jowar (32 per cent), rice (23 per cent), rabi jowar (16 per cent) as the three main components followed by wheat (9 per cent) and bajra (6 per cent) although by area, rabi jowar has the highest area followed by kharif jowar (18 and 15 per cent of GCA) with bajra and rice coming up almost simultaneously (8 per cent each of GCA). This indicates lesser productives of rabi jowar and bajra. About 13 per cent of gross cropped area comes under irrigation. This gross irrigated area is shared by major crops of wheat, rice, sugarcane and rabi jowar in that order. While more than 50 per cent of wheat crop is taken under irrigated conditions

(sugarcane is taken entirely under irrigation), 27 per cent of rice and about 10 per cent of rabi jowar is taken under irrigated conditions. Among non-foodgrains, cotton is a major crop with 13 per cent share of gross cropped area (GCA), followed by groundnut and safflower and these are taken mostly under rainfed conditions. Sugarcane has just 1.77 per cent of GCA but covers 14 per cent of irrigated area and is a crop important in more ways than one, as we shall see later.

To consider growth in agriculture we have to see the interplay of important variables over a period of time. We consider period from 1967-68 (when agriculture in Maharashtra started coming out of a series of bad years) to the year 1982-83, a period of 16 years. This provides a 'basis' for the two years under consideration, viz. 1983-84 and 1984-85. We use triennium 1967-68 to 1969-70 (written as 1967-70) as the starting point, triennium 1974-75 to 1976-77 as a mid-point and 1980-81 to 1982-83 as the end-point although for the last mentioned period data are provisional (source : Season and Crop Reports upto 1979-80 and for remaining years, Epitome of Agriculture, 1984-85). In passing we may also note that the triennium 1967-70 is an appropriate starting point as this triennium is also chosen as the 'base period' for Maharashtra's index number of agricultural production for the new series introduced from the year 1974-75 (Statistical Abstract of Maharashtra State, 1974-75, published in 1978). We use averages of these trienniums (i.e. the trienniums get 'centred' on the middle year) to assess growth. The time points neatly avoid the three successive bad years of 1970-71, 1971-72 and 1972-73.

Taking these time-points we consider absolute changes and the growth rates in various crops in Tables 2.4 to 2.8. These changes cover a period of 16 years and the other period is labelled the 'recent period' which covers period between

the triennial average centred on 1975-76 and 1981-82 - a period of 7 years (or 9 years if we consider the beginning of the triennium 1974-75 as 1974-75 and 1982-83 as the end of the triennium 1982-83). Such a division of the time-span gives us overall trend as well as the trend which is perhaps more relevant to fertilizer use viz., the recent trend. Among these six tables we particularly focus our attention on Table 2.6 which gives us changes in production and look at other tables for supplementary information.

From this main Table 2.6, we first note that foodgrains as a whole have increased at an annual compound growth rate of 3.09 per cent over the 'entire period' (that is, to remind us, from triennium 1967-70 to 1980-83) but over the 'recent period' (from triennium 1974-77 to 1980-83) the growth rate is just 1.78 per cent per annum, indicating a slowing down of production of foodgrains. (The population growth rate for the State between 1971 and 1981 being 2.20 per cent per annum, we see that although over 'entire' period production increased at a faster rate, in the 'recent period' this rate is falling below population rate). Looking at the absolute contributions to increased production, major contributors to additions in production are kharif jowar, rice and wheat over the 'entire' period. The performance is similar for recent period but notable is the stagnation-minor setback in wheat. Thus while kharif jowar and to some extent rice have made consistent additions over the entire period, for wheat, after 1974-77 there is stagnation-minor decline. This is somewhat surprising because although area under wheat, by and large declined in the recent period (see Table 2.4), irrigated area has increased substantially (Table 2.5).

Kharif jowar with hardly any irrigation is a major and

consistent performer over the period, followed by rice. Area-production-productivity rates (Table 2.8) substantiate this fact as growth in productivity appears to be the major factor for these two crops. Rabi jowar, the crop with largest area is a different case altogether. Even with increased area under the crop, it is not a major contributor to additions to production. This is because this crop provides major fodder and the fodder requirement perhaps plays a crucial role in the cropping pattern adopted by a cultivator. The 1983-84 data of 400 cultivators indicates that fodder value is about 70 per cent of the grain value in case of rabi jowar. No other crop comes anywhere close to this. (For kharif jowar, similar ratio is 35 per cent.)

Performance of pulses appears to be an indifferent one and the growth or decline appears to be due equally to area and productivity, the recent years period of course showing a decline (Table 2.8). Sugarcane, the prima donna of Maharashtra's agriculture has a consistent production growth rate of 6 per cent per annum. Performance of the major oilseed, viz. groundnut, is far from satisfactory while that of cotton, indifferent. Looking at area-production-productivity growth rates (Table 2.8 again), we see that good growth in production of sugarcane is mainly on account of area while declines in groundnut are only due to area.

2.4 Having considered important variables which show the nature of agriculture in Maharashtra and growth (or changes) in these variables over the period 1967-68 to 1982-83, we try to see how the two years under consideration (viz. 1983-84 and 1984-85) compare with the period 1980-83, the immediately preceding the period. That is, are these two reference years more or less normal?

This is not a question easy to answer. In Table 2.9 we have compiled data on area, production and productivity of important crops as well as important crop-groups like total cereals and total pulses, etc., for four years 1982-83 to 1985-86. For the years 1982-83 to 1984-85, the data are obtained from 'Area and Production of Principal Crops in India' (1984-84) and for the year 1985-86, data are taken from 'Indian Agriculture in Brief' (1987), both publications of Directorate of Economics and Statistics, Ministry of Agriculture. The seventeen crops and crop groups presented here generally cover more than 85 per cent of the gross cropped area in these years which is an adequate coverage.

First thing to note is the foodgrains production. This is as follows :

1982-83	9.22 million tonnes
1983-84	10.95 million tonnes
1984-85	9.74 million tonnes
1985-86	8.78 million tonnes.

While there are ups and downs, foodgrains production in 1983-84 and 1984-85 is neither exceptionally high nor exceptionally low. In fact the triennial average over 1980-83 comes to 9.84 million tonnes (see Table 2.6) in between the production figures for 1983-84 (10.95 million tonnes) and 1984-85 (9.74 million tonnes). If we think that 1983-84 figure of 10.95 million tonnes is rather too high, we have only to remember that for 1977-78, 1979-80 and 1981-82 the foodgrains production was also over 10 million tonnes. Same is more or less true of production of total cereals and total pulses. A feature of 1983-84 is good production of cereals as well as pulses. Among cereals, 1980-83 average is always between the production figures for 1983-84 and 1984-85 with the former



exceeding the latter except for rabi jowar where 1984-85 figure is higher. For pulses 1980-83 average is 945 thousand tonnes while figures for both 1983-84 and 1984-85 are both higher at 1257 and 1114 thousand tonnes.

Are the two years 1983-84 and 1984-85 'normal' for other major crops? To answer this question we have to first identify other major crops. For this we take recourse to the weights used in the State's index of production. From the index number of production data (base triennium 1967-70) from the 'Statistical Abstract of Maharashtra State' published by Directorate of Economics and Statistics, Government of Maharashtra we see that foodgrains as whole cover 55.49 (per cent) of total weightage of 100. Major constituents being rice 11.52, kharif jowar 11.45, rabi jowar 9.67, bajra 5.80 and wheat 4.81. Among pulses tur has a weight of 4.46 and 'other pulses' together weight of about 6. Among non-foodgrains, sugarcane has a weight of 21.64 followed by groundnut (9.25) and cotton (8.43). Sugarcane thus carries the highest weight, higher than any other foodgrain or non-foodgrain crop. (This is what we mean by sugarcane being important in 'more ways than one' mentioned in Section 2.3 earlier.)

So how 'normal' is the production of sugarcane, cotton and groundnut crops in the two years under consideration? For sugarcane 1980-83 'base period' production is 30240 thousand tonnes of cane while in the two reference years it is lower but consistent at 26549 and 26367 thousand tonnes respectively. Thus for this 'prima donna' crop, the production is consistent lower in the two reference years. For cotton, 1980-83 production is 1453 thousand bales while in the reference years there is a sharp decline in 1983-84 to 814 thousand bales but again

back to 'normal' 1467 thousand bales in 1984-85. For groundnut, production in both the reference years is higher at 807 and 854 thousand tonnes (pod) compared with base period 1980-83 figure of 613 thousand tonnes. Thus to sum up, production of most of the cereals is 'normal' in the two reference years while for sugarcane it is consistently lower in reference years but for cotton it is decidedly low in 1983-84 but 'normal' in 1984-85 while for groundnut it is consistently higher than normal in reference years.

2.5 We also have data for 1985-86 (Table 2.9) and one cannot but notice the fact of overall setback in cereals (but pulses remain steady), sugarcane and groundnut but cotton reaches new heights. This year 1985-86 is really first of the bad years for the State but the year is fortunately out of the purview of the present study.

Table 2.2 : Consumption of N per Hectare for Major States for 1983-84

(Figures in brackets are those for 1976-77)

State	Consumption of N hect. of gross cropped area (kg.)	Consumption of N per hect. of net cropped area (kg.)	Net irrigated area/Net sown area (%)
All India	30.20 (14.5)	37.19	29.80 (24.6)
Madhya Pradesh	8.53 (4.3)	10.04	14.42 (10.7)
Rajasthan	8.41 (4.4)	9.73	20.18 (17.3)
Uttar Pradesh	49.67 (24.9)	72.08	57.19 (47.5)
Bihar	21.18 (11.9)	28.67	33.21 (34.9)
Orissa	6.54 (6.0)	10.43	30.80 (17.8)
West Bengal	30.43 (13.6)	44.68	37.07 (23.3)
Haryana	45.61 (22.4)	72.06	60.83 (49.3)
Punjab	101.26 (42.7)	167.74	85.68 (76.6)
Andhra Pradesh	45.74 (22.5)	53.56	33.91 (32.4)
Tamil Nadu	43.54 (24.1)	57.67	44.78 (38.8)
Gujarat	30.42 (13.4)	33.08	23.37 (12.8)
Maharashtra	18.82 (9.9)	21.73	10.73 (8.3)

Fertilizer Statistics 1983-84 (For N per hect.) and 1986-87  
(for G.C.A., N.S.A. and Irrigation Proportions)

**Table 2.3 : Cropping Pattern, Irrigation and Production in Maharashtra - Average of the Triennium 1980-81 to 1982-83**

(Area in thousand ha., production in thousand tonnes)

C r o p	Area	% of GCA	% of food-grains area	Irrigated area	% to Gross irrigated area	Production	% to total foodgrains
1. Rice	1502	7.41	10.76	403.4	15.64	2249	22.35
2. Wheat	1077	5.32	7.72	575.8	22.34	908	9.23
3. Kharif Jowar	2972	14.67	21.30	33.7	1.31	3121	31.72
4. Rabi Jowar	3581	17.68	25.66	343.9	13.34	1536	15.61
5. Bajra	1614	7.97	11.57	50.5	1.96	661	6.72
6. Ragi	224	1.11	1.61	N.A.	-	218	2.21
7. Total cereals including other cereals	11243	55.50	80.58	1460.9	56.67	3396	90.41
8. Tur	697	3.44	5.00	1.7	0.07	395	4.01
9. Gram	442	2.18	3.17	95.6	3.71	153	1.60
10. Total pulses including other pulses	2710	13.33	19.42	97.3	3.77	945	9.60
11. Total foodgrains	13953	66.87	100.00	1553.2	60.45	9340	100.00
12. Sugarcane	353	1.77	-	358.0	13.39	3024	-
13. Cotton	2677	13.21	-	136.6	5.30	1453	-
14. Groundnut	791	3.90	-	23.6	1.11	619	-
15. Safflower	536	2.64	-	N.A.	-	233	-
16. Sunflower	133	0.66	-	N.A.	-	82	-
17. Gross Cropped Area including remaining crops	20259	100.00	-	2577.7	100.00	-	-

Production of sugarcane is in terms of gur, of cotton in terms of thousand bales of 170 kg., of groundnut in terms of pods.

Table 2.4 : Area Changes and Area Growth Rates of Principal Crops in Maharashtra 1967-68 to 1982-83

(Area in thousand ha.)

C r o p	Triennial Averages			Absolute Change 1974-77 to 1980-83	Entire Change period	Growth Rate (% p.a.)	
	1967-70	1974-77	1980-83			1974-77 to 1980-83	Entire period
1. Rice	1330.4	1411.9	1502.0	90.1	171.6	1.04	0.94
2. Wheat	834.7	1095.2	1077.0	-18.2	242.3	-0.28	1.98
3. K. Jowar	2524.9	2782.5	2972.0	189.5	447.1	1.11	1.26
4. R. Jowar	3274.5	3340.8	3581.0	240.2	306.5	1.16	0.69
5. Bajra	2061.3	1793.7	1614.0	-179.7	-447.3	-1.74	-1.86
6. Ragi	213.7	208.0	224.0	16.0	10.3	1.24	0.36
7. Total cereals including other cereals	10489.5	10892.1	11243.0	350.9	753.5	0.53	0.53
8. Tur	615.7	642.6	697.0	54.4	81.3	1.36	0.96
9. Gram	348.7	425.0	442.0	17.0	93.3	0.65	1.84
10. Total pulses including other pulses	2641.9	2892.2	2710.0	-182.2	68.1	-1.08	0.20
11. Total foodgrains	13131.4	13784.4	13953.0	168.6	821.6	0.20	0.47
12. Sugarcane (Gur)	193.8	271.1	358.0	86.9	164.2	0.74	4.83
13. Cotton	2742.8	2386.0+	2677.0	291.0	-65.3	1.94	-0.19
14. Groundnut	915.2	853.2	791.0	-62.2	-124.2	-1.25	-1.11
15. Safflower	372.9	488.1	536.0	47.9	163.1	1.57	2.83
16. GCA including all remaining crops	19351.8	19651.0	20259.0*	608.0	907.2	0.51	0.35

+ Actual average 2322 (thousand ha.) but adjusted to match average in Table on Production.

\* Average of 1980-81 and 1981-82 only.

Table 2.5 : Changes and Growth Rates in Area under Principal Irrigated Crops in Maharashtra 1967-68 to 1982-83

(Area in thousand ha.)

C r o p	Triennial Averages			Absolute Change		% of crop area irrigated			Growth rate % p.a.	
	1967-70	1974-77	1980-83	1974-77 to 1980-83 (P <sub>1</sub> )	Entire period (P <sub>2</sub> )	1967-70	1974-77	1980-83	(P <sub>1</sub> )	(P <sub>2</sub> )
1. Rice	307.1	369.5	403.4	33.9	96.3	23.08	26.17	26.86	1.47	2.12
2. Wheat	239.7	460.4	575.8	115.4	336.1	23.72	42.04	53.46	3.80	6.97
3. K. Jowar	20.7	40.4	33.7	-6.7	13.0	0.82	1.45	1.13	-2.97	3.82
4. B. Jowar	276.5	373.0	343.9	-29.1	67.4	8.44	11.16	9.60	-1.34	1.69
5. Bajra	47.5	66.4	50.5	-15.9	3.0	2.30	3.70	3.13	-4.45	0.47
6. Total cereals including other cereals	915.3	1339.0	1460.9	121.9	545.6	8.73	12.29	12.99	1.46	3.66
7. Tur	2.7	2.3	1.7	-0.6	-1.0	0.44	0.36	0.24	-4.91	-3.50
8. Gram	50.4	65.5	95.6	30.1	45.2	14.45	15.41	21.63	6.50	5.04
9. Total pulses including other pulses	61.4	72.7	97.3	24.6	35.9	2.32	2.51	3.59	4.98	3.60
10. Total foodgrains	976.6	1411.8	1558.2	146.4	581.6	7.74	10.24	11.17	1.66	3.66
11. Sugarcane	193.8	271.1	358.0	86.9	164.2	100.00	100.00	100.00	4.74	4.83
12. Cotton	63.2	73.5*	136.6	63.1	73.4	2.30	3.03	5.10	10.98	6.11
13. Groundnut	16.0	27.2	28.6	1.4	12.6	1.75	3.19	3.61	0.34	4.57
14. Gross irrigated area including all remaining crops	1552.1	2115.4	2577.7	462.3	1025.6	8.02	10.76	12.72	3.35	3.93

\* Average of 1974-75 and 1977-78. P<sub>1</sub> = recent period. P<sub>2</sub> = entire period.

Table 2.6 : Changes and Growth Rates in Production of Principal Crops in Maharashtra 1967-68 to 1982-83

(Thousand tonnes)

C r o p	Triennial Averages			Absolute Change		Growth Rate (% p.a.)	
	1967-70	1974-77	1980-83	1974-77 to 1980-83	Entire period	1974-77 to 1980-83	Entire period
1. Rice	1366.1	1914.0	2249.0	335.0	882.9	2.72	3.91
2. Wheat	334.2	955.3	903.0	-47.3	523.8	-0.84	6.84
3. K. Jowar	1707.8	2412.8	3121.0	703.2	1413.2	4.38	4.75
4. R. Jowar	1434.2	1503.4	1536.0	27.6	74.2	0.30	0.53
5. Bajra	635.5	603.2	661.0	57.8	25.5	1.54	0.30
6. Ragi	157.0	173.0	214.0	36.0	57.0	3.12	2.41
7. Total cereals including other cereals	5793.2	7743.5	8896.0	1152.5	3097.8	2.34	3.35
8. Tur	299.3	359.7	395.0	35.3	95.7	1.57	2.16
9. Gram	102.1	151.9	153.0	6.1	55.2	0.66	3.36
10. Total pulses including other pulses	828.6	1106.9	945.0	-161.9	116.4	-2.60	1.02
11. Total foodgrains (items 7 + 10)	6626.8	8350.4	9841.0	990.6	3214.2	1.73	3.09
12. Sugarcane (Gur)	1420.7	2232.0	3024.0	792.0	1603.3	5.19	5.98
13. Cotton	1361.0	1474.0+	1453.0	-21.0	92.0	-0.24	0.50
14. Groundnut	628.0	621.6	619.0	-2.6	-9.0	-0.07	-0.11
15. Safflower	52.5*	136.0	233.0	97.0	230.5	7.24	13.83

Cotton in thousand bales of 170 kg.

+ Over about 25 years, cotton output has been over 1000 (in thousand bales of 170 kg.) except for 1970-71 (435) and 1975-76, 1976-77 (730 and 847). The actual triennial average for 1974-77 is thus 1110 but we have replaced it with average for 1974-75 and 1977-78 to eliminate the two bad years.

\* Average of 1963-69 and 1969-70.

Table 2.7 : Productivity of Principal Crops in Maharashtra  
1967-68 to 1982-83

C r o p	(Qtls/ha.)		
	1967-70	1974-77	1980-83
1. Rice	10.27	13.56	14.97
2. Wheat	4.60	8.72	8.43
3. K. Jowar	6.76	8.67	10.50
4. R. Jowar	4.33	4.51	4.29
5. Bajra	3.08	3.36	4.09
6. Ragi	7.35	8.56	9.55
7. Total cereals including other cereals	5.53	7.11	7.91
8. Tur	4.86	5.60	5.67
9. Gram	2.95	3.57	3.57
10. Total pulses including other pulses	3.14	3.83	3.49
11. Total foodgrains	5.05	6.42	7.05
12. Sugarcane (Gur) in tonnes	7.33	8.23	8.45
13. Cotton (lint)	0.84	1.05	0.92
14. Groundnut (pods)	6.86	7.28	7.82
15. Safflower	1.41	3.81	5.28



**Table 2.8 : Growth Rates of Area, Production and Productivity for Maharashtra 1967-68 to 1982-83**

C r o p	(Growth rate % p.a.)					
	1974-77 to 1980-85			Entire period 1967-70 to 1980-83		
	Area	Produc- tion	Produc- tivity	Area	Produc- tion	Produo tivity
1. Rice	1.04	2.72	1.66	0.94	3.91	2.94
2. Wheat	-0.28	-0.84	-0.56	1.98	6.84	4.76
3. K. Jowar	1.11	4.33	3.23	1.26	4.75	3.45
4. R. Jowar	1.16	0.30	-0.85	0.69	0.53	-0.16
5. Bajra	-1.74	1.54	3.31	-1.86	0.30	2.20
6. Ragi	1.24	3.12	1.86	0.36	2.41	2.04
7. Total cereals including other cereals	0.53	2.34	1.80	0.53	3.35	2.81
8. Tur	1.36	1.57	0.21	0.96	2.16	1.19
9. Gram	0.65	0.66	0.01	1.84	3.36	1.49
10. Total pulses including other pulses	-1.08	-2.60	-1.54	0.20	1.02	0.82
11. Total foodgrains	0.20	1.73	1.58	0.47	3.09	2.61
12. Sugarcane	4.74	5.19	0.43	4.83	5.98	1.10
13. Cotton	1.94	-0.24	-2.14	-0.19	0.50	0.69
14. Groundnut	-1.25	-0.07	1.19	-1.11	-0.11	1.01
15. Safflower	1.57	7.24	5.58	2.83	13.93	10.70

**Table 2.9 : Area Production and Average Yield per Hectare of Crops in Maharashtra**

(Area in thousand hectares.  
Production in thousand tonnes.  
Yield per hectare in kgs.)

Crop	1982-83			1983-84		
	Area	Production	Average yield	Area	Production	Average yield
1. Kh. Jowar	2871.3	3263.0	1136	2951.5	3096.3	1049
2. R. Jowar	3775.7	1339.5	368	3589.0	1582.1	441
3. Bajra	1389.5	444.9	320	1312.5	903.0	501
4. Ragi	225.3	215.0	952	223.1	240.9	1056
5. Cotton * (Lint)	2643.0	273.4 (1603.5)	103	2635.2	138.4 (314.0)	52
6. Sugarcane (Gur)	325.3	31360.3	96256	294.0	26549.1	90303
7. Groundnut (Pods)	715.6	550.5	769	810.1	807.3	997
8. Safflower	547.2	277.6	507	563.1	373.3	657
9. Tur	680.3	398.9	536	731.2	437.0	666
10. Mung	454.7	147.9	325	503.8	170.3	335
11. Udid	471.7	150.7	319	536.1	186.7	348
12. Rice	1486.3	1943.8	1311	1521.3	2460.6	1617
13. Wheat	1022.7	803.3	736	1183.2	1142.1	965
14. Gram	436.8	147.9	339	494.9	211.3	428
15. Total cereals	11029.4	8252.7	743	11593.3	9694.1	836
16. Total pulses	2574.2	962.9	374	2961.1	1257.7	425
17. Total foodgrains	13603.6	9215.6	679	14554.4	10951.3	753

contd.

Table 2.9 : (contd.)

	Area	Production	Average yield	Area	Production	Average yield
	1934-35			1935-36		
1. Kh. Jowar	2370.2	2966.6	1034	N.A.	N.A.	N.A.
2. R. Jowar	3691.6	1335.3	497	N.A.	N.A.	N.A.
3. Bajra	1761.3	566.2	321	N.A.	N.A.	N.A.
4. Ragi	227.4	261.9	1152	N.A.	N.A.	N.A.
5. Cotton * (Lint)	2634.5	249.4 (1466.9)	93	2753.0	322.2 (1394.7)	117
6. Sugarcane (Gur)	292.6	26367.4	90114	265.3	23705.6	89354
7. Groundnut (Pods)	824.6	354.3	1036	626.4	421.5	736
8. Safflower	610.5	364.1	596	N.A.	N.A.	N.A.
9. Tur	753.1	435.2	640	325.3	471.3	571
10. Mung	512.9	153.8	310	533.3	194.2	364
11. Udid	463.0	91.7	198	453.7	174.3	334
12. Rice	1519.7	1936.2	1274	1540.6	2131.3	1416
13. Wheat	933.6	856.5	366	391.5	644.4	731
14. Gram	509.3	201.7	396	533.3	175.6	329
15. Total cereals cereals	11311.0	3621.5	762	11231.5	7614.9	673
16. Total pulses	2333.4	1114.3	393	2359.7	1164.1	407
17. Total foodgrains	14144.4	9735.3	633	14091.2	3779.0	623

\* Figures in the brackets relate to production of cotton (lint) in '000 bales of 170 kg. each.

Source : Area and Production of Principal Crops in India (1934-35) DES, Ministry of Agriculture (1932-33 to 1934-35). For 1935-36, Indian Agriculture in Brief, DES, Ministry of Agriculture, 21st Ed. (1937).

## CHAPTER III

### THE SAMPLE

3. In this chapter we consider the basis on which the sample is selected under the Cost of Cultivation Scheme at the Mahatma Phule Agricultural University (MPAU) and note some of the broad characteristics of the same before embarking on the analysis of data, to be taken up in the next chapter.

3.1 In choosing a methodology of selection of cultivators who are the ultimate units in the sample, the first requirement one can think of is that this sample should be geographically well-distributed over climatically different parts of the State. Officially nine different Agro-Climatic zones are recognized in Maharashtra\*. The Cost of Cultivation Scheme considers these in more detail and in fact twelve agro-climatic zones are considered for the purpose of the selection of sample. In the present section we get ourselves acquainted with these zones. In Table 3.1 the twelve agro-climatic zones are presented alongwith their prominent characteristics. Broadly, one can group zones into the (relatively) high rainfall region of Western Maharashtra (covering first three zones in the table), the scarcity region (covering next four zones), the assured rainfall region (zones eight to ten) and again the high rainfall region but of Eastern Maharashtra as the fourth region. We do not know the distribution of State cultivated area over these regions but from what information we have at MPAU collected from official sources (discussed in subsequent sections in the present chapter) on prominent crops in Maharashtra, the first region of 'western-high rainfall' category has about 7 per cent of State (gross) cropped area, the scarcity region (of four zones - zones 4 to 7) has over 30 per cent, the assured rainfall region has about 40 per cent while high rainfall eastern zones - region four -

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\* Epitome of Agriculture (1983-84), Part II, p.10-11, Directorate of Agri., Maharashtra State.

has about 20 per cent share of State gross cropped area. While high rainfall (western) region has rice and similar kharif crops, scarcity region has jowar (kharif and rabi), bajra and the assured rainfall region has kharif jowar-cotton while the high rainfall-eastern zones' in region is again kharif but mainly cotton and rice. It is distinguished from first region because not only it is different geographically, but rainfall is somewhat lower and unlike Konkan region, there is tank irrigation. We also mention a well-known fact here that most of the canal-well irrigation is in the scarcity region and hence this region has a mixture of highly irrigated crops like sugarcane, wheat and fruits like grapes with more common crops like kharif-rabi jowar, bajra, groundnut taken under rainfed conditions.

3.2 We now come to the methodology of selection of sample of cultivators. As stated at the beginning of the previous section, first requirement one can think of is that the sample should be well distributed over the climatically different areas. - Further, being a cost of cultivation scheme, another requirement would be that it should adequately cover important crops. Thirteen important crops are covered by this Scheme. These are: kharif jowar, rabi jowar, bajra, ragi, cotton, sugarcane, onion, groundnut, sunflower, tur, mung and udid. But we have already noted in the previous chapter that rice and wheat are very important crops (apart from gram among pulses) to the State but these are excluded by the Scheme because from All-India point of view, perhaps Maharashtra is not noted as an important State in relation to these two crops. Thus the sampling methodology takes into consideration twelve agro-climatic zones and the thirteen crops mentioned above as the two important factors in selection of sample.

One would naturally like to look at the cropping pattern in these agro-climatic zones for allotting centres

from which selection of cultivators is to follow. Unfortunately, routinely compiled (and published) data on agriculture has district as the unit and the agro-climatic zones cut across these districts. For the purpose of the Scheme (i.e. Cost of Cultivation Scheme unit at MPAU) the Department of Agriculture specially compiled data of area (and production) under the selected crops (1978-79) for the twelve zones, details of which are presented in the tables, from Table 3.2 to Table 3.6. According to the sampling methodology, 'centres' were to be allotted to different zones on the basis of 'area under 13 crops'. Each centre was to consist of a cluster of one to three villages and each cluster was to contribute 10 farmers distributed equally over five size holding groups after farmers in the entire cluster were arranged according to cultivated area and five groups formed so that each size group contains equal cultivated area.

Thus for the allotment of 'centres' to zones, area under 13 selected crops is to form the basis and these data are presented in Table 3.2. Before going into the methodology of allotting centres, let us look at this area data itself in Table 3.2. The reference year for this data was reported as 1978-79 and if we compare cropwise (State) area in this table (the last row) with the official (i.e. Season and Crop Reports, Epitomes of Agriculture etc.) area data based on district as the unit, we see that there is a broad agreement. Only marked difference occurs in area figures for kharif jowar and rabi jowar, the two main crops of the State. Here we see that for all the zones together, kharif jowar area adds to 38,317 in hundred ha., and rabi jowar adds to 21,436 hundred ha., but official (Season & Crop) figures have rabi jowar exceeding kharif jowar area. In fact if we look at kharif and rabi jowar areas over years, rabi jowar area always exceeds that of kharif jowar. One of course appreciates the fact that agro-climatic

zonewise area figures are not routinely compiled and as taluka-district boundaries and zone boundaries cut across each other, attempt at compiling agro-climatic zonewise areas would always involve some inaccuracies. In any case as we shall see later, after centres are allotted to zones and sample of 400 farmers for 1983-84 and of 600 farmers for 1984-85 are taken, area under rabi jowar for selected farmers does exceed that for kharif jowar, especially for the year 1983-84.

3.3 In Table 3.3 cropping pattern of each zone in terms of percentage of total area under 13 crops is presented while in Table 3.4 percentage share of each zone in a given crop's State area is presented (i.e. State area under kharif jowar = 100 and share of Zone IX is 31.59 per cent of this etc.). Thus while Table 3.3 indicates how cropping pattern differs in different zones, Table 3.4 indicates importance of each zone in a given crop. Table 3.4 is crucial in allotment of 'centres' to different zones. To achieve the twin objective of distribution of sample households over different (agro-climatic) zones as well as adequate area coverage under the selected crops which differ greatly in their shares of cropped area of the State, the Scheme uses Table 3.4 where shares of zones in area of each given crop (i.e. crop area = 100) are presented. Here all thirteen crops are on equal footing. The percentage shares appearing under each crop in this table are averaged for each zone (across the selected crops) to arrive at a figures which we call 'mean percentage share' of that zone and is in fact noted in the last column of Table 3.4. Thus, for example, although zones III and IV have 6 to 7 per cent of total (13 crops) area as noted in Table 3.1 last column, Table 3.4 ensures that these zones cover about 10 per cent of 'centres' (and hence 10 per cent of sample cultivators) because zone III share in ragi is 46 per cent, in sugarcane 20 per cent, in groundnut 25 per cent etc., averaging to

10.56 per cent 'mean share'. Thus although areawise ragi, sugarcane are not important in the State, the procedure of averaging in Table 3.4 ensures about 10 per cent allocation of centres to this zone. On the other hand, Zone V covering 17 per cent of total (13 crop) area (Table 3.1), by Table 3.4 gets about same share (15.22 per cent) of centres. Similarly although Zones IX and XI share 20 per cent each of total (13 crop) area (Table 3.1), Zone IX gets a share of centres of 22 per cent while Zone XI gets a share of 13 per cent according to Table 3.4 because the former has a better variety of crops (of the selected crops) with a high share in State crop area while the latter zone has just three important crops. This is the methodology adopted for selection of centres and eventually the households. As mentioned above, the Department of Agriculture has also compiled zonewise data for production of selected crops for the year, 1978-79. These data, (as available at the MPAU) are presented in Table 3.5. In Table 3.6 percentage share of each zone in the production of a given crop (state production of a given crop in Table 3.5 = 100) is presented. Again these percentage shares are averaged over selected crops to obtain a 'mean percentage (production) share', similar to the one obtain in Table 3.4. These mean percentages are not much dissimilar to 'mean area percentage shares' and a broad area-production relationship appears to prevail. If one looks at each crop then one can discern some differences, indicating productivity differentials but by and large, a broad agreement exists. This production data, however, does not play a role in the allocation of centres.

3.4 The actual allocation of centres to various zones for the two years is presented in Table 3.7. It can be seen that shares of different zones in the 40 centres in 1983-84 closely follow the 'mean percentage shares' of Table 3.4. In 1984-85 centres were increased to 60 (and an entirely new sample of 60



centres taken as mentioned earlier) but allocation of centres is slightly different than the 'mean percentage area shares', with the first four zones receiving lesser proportion of centres while share of Zone XI increasing from 13 to 20 per cent (from 5 centres in 1983-84 to 12 centres in 1984-85 as indicated in the table). This departure reportedly occurred due to administrative difficulties in running additional centres in the first four zones and the desire to cover most important foodgrain crop of kharif jowar more extensively. As can be seen from Table 3.3, Zone XI is one of zones with largest areas under kharif jowar and instead of 8 centres, it got 12 centres.

In the sample selection the centres themselves were so distributed within a zone that two centres do not fall within the same taluka in that zone. As mentioned in earlier sections, from each centre, consisting of one to three villages, 10 farmers were selected, making 400 farmers for 1983-84 and 600 farmers for 1984-85.

3.5 With this background it would be natural to enquire whether and to what extent the cropping patterns of these selected farmers in different zones conform to the zonal cropping patterns discussed earlier. But before we do so, it is to be noted that the analysis we undertake in subsequent pages is not by the twelve zones but by regrouping these zones into four regions because analysis of data of twelve zone cumbersome. The four regions into which these zones are regrouped here also have relatively sharper differences in agro-climatic characteristics and the differences in fertilizer use are likely to come out better for the four regions. The four regions are as follows :

Region I : High rainfall region in W.Maharashtra covering zones I, II and III

Region II : Scarcity region covering zones IV, V, VI and VII

(separately (in addition to the State level) becomes

Region III : Assured rainfall region covering Zones VIII, IX and X

Region IV : High rainfall region in Eastern Maharashtra with rice-kharif jowar and cotton areas, covering Zones XI and XII

One may notice that in section 3.1 we in fact discussed zones with these groupings.

With this regrouping into the four regions, it would only be proper to look at the data of Tables 3.1 to 3.4 based on zonal acreages specially compiled by the Department of Agriculture for the Cost of Cultivation Scheme at MPAU and find out to what extent the acreages of sample farmers conform in four regions to these 'basic' acreages. In Tables 3.8 to 3.10 the specially compiled zonal data are regrouped and presented for the four regions. Similar data for the selected farmers are presented in Tables 3.11 to 3.13 for 1983-84 and in Tables 3.14 to 3.16 for 1984-85.

First thing to note is the total area under selected crops for different regions. From the last but one row of Tables 3.10, 3.13 and 3.16 we see that regionwise 13 crop total area shares by and large conform, as follows :

Region	'Basic' Data (Table 3.10)	Selected farmers	
		1983-84 (Table 3.13)	1984-85 (Table 3.16)
I	7.22	4.49	3.97
II	31.28	31.80	23.28
III	39.71	49.26	51.74
IV	21.79	14.45	21.01
Total	100.00	100.00	100.00

Region I area is underrepresented and Region III area is somewhat over-represented but the departures for the 1984-85 sample are more pronounced for reasons already noted. But we say that by and large 13 crop total 'conforms' because in

spite of crops-on-equal footing method adopted, departures, which would be inevitable anyway in any sampling, are not serious. Incidentally, we also note that while for Regions II and IV proportion of number of farmers to total is of the same order as proportion of area, for Region I proportion of area is smaller and for Region III proportion of area is higher being 'rice' (intensive) and 'mainly cotton' (extensive cultivation) areas respectively. /mainly

3.6 What about the regional and 'State' cropping pattern for 13 crops for basic data and for the selected farmers? For this one has to look at Tables 3.9, 3.12 and 3.15. For Maharashtra, Table 3.9 shows that 'big' foodgrain crops like kharif jowar, rabi jowar and bajra together cover 55 per cent of area and these crops for 1983-84 and 1984-85 for the selected farmers cover percentage of similar order, i.e. around 52 per cent. Cotton, among non-foodgrains, has 18 per cent area in Table 3.9 and selected farmers it is 17 per cent in 1983-84 and 20 per cent 1984-85, a good conformation. Other crops have below 5 per cent shares in Table 3.9 and for some of them, the shares rise to as high as 10 per cent (e.g. mung) but by and large shares of crop within 13-crop aggregate are of similar magnitudes. But we have already noted that sugarcane is a crop par excellence in the State and we note that its share in 'basic' Table 3.9 is 2.61 per cent but for 1983-84 and 1984-85 sample farmers this percentage is higher at 6 and 5 per cent respectively. It would be worth pointing out that sugarcane area includes cane harvested in the reference year as well as cane that is 'standing' in the reference years. For the fertilizers use, the focus of the study, it is harvested cane that is of relevance because it covers fertilizer use from planting to maturity and the 'standing' part has in fact to be left out of analysis. In both the years area under sugarcane is around 110 hectares

and 47 hectares out of the total cane (a proportion 42 per cent) is 'standing' according to the footnotes to Table 3.11 and 3.14. If we consider harvested cane only (as we do in the next chapter on Results), the percentage share in 13-crop aggregate would come close to 3 per cent.

But noticeable and already-commented-upon fact is the dominance of kharif area over rabi jowar area in the zonewise 'basic' area figures supplied to the Mahatma Phule Agricultural University (Table 3.2) whereas the published figures (over many years) by the Directorate of Agriculture (Season and Crop Report, Epitomic of Agriculture, Indian Agriculture in Brief) indicate rabi jowar area as the dominant one. (This fact was mentioned in Section 3.1.) As an illustration, let us see the rabi jowar/kharif jowar area ratios for 1978-79 (Season and Crop Report) the reference year for the zonewise figures supplied to MPAU, 1980-83 triennial average (Table 2.3) as well as published figures for 1983-84 and 1984-85 (Table 2.9).

	Rabi jowar/kharif jowar area
1978-79	1.13
Triennium 1980-83	1.20
1983-84	1.22
1984-85	1.29

In fact this dominance of rabi jowar area is almost always true for Maharashtra. On the other hand Table 3.2 figures on which sampling is based and the 1983-84 and 1984-85 ratios based on selected farmers, the ratios are

	Rabi jowar/ kharif jowar area
'Basic' figures (in Table 3.2 on which sampling is based)	0.56
1983-84 sample farmers (Table 3.11)	1.32
1984-85 sample farmers (Table 3.14)	1.00

Thus sample farmers' area under rabi jowar exceeds their area under kharif jowar, as it should, in spite of the adverse 0.56 ratio based on 'basic' figures. The 1984-85 ratio indicates kharif jowar area equal to rabi jowar because as can be seen from Table 3.12 to Table 3.15 the increased number of centres are more than expected in Region III which has large areas under kharif jowar. Before going on to discuss cropping pattern within regions for sample farmers, let us mention that the crop of sunflower (share of 0.13 per cent in basic table) from the 13 crop aggregate was dropped in the cropwise analysis for sample farmers as the area under it was too small and the crop of rice, wheat and gram had to be added to the list when analysing fertilizer consumption.

3.7 When we compare cropping pattern of selected farmers within 13-crop aggregate of different regions with the basic regional patterns of Table 3.9 we have to keep in mind the fact that kharif jowar area is over-represented as described in the previous section and further that we have no way of knowing in which regions this has happened because zonal/regional boundaries cut across taluk/district boundaries for which data are routinely compiled. Thus the departures for sample farmers may sound exaggerated.

But we note that basically important crops are well represented in the cropping patterns of selected farmers (Tables 3.12 and 3.15) and it is the order of importance crops that is at times affected. For Region I important crops according to basic table (Table 3.9) are ragi (18.37 p.c.), rabi jowar (18.78 per cent), groundnut (17.40 per cent) etc., while for 1983-84 selected farmers it is sugarcane (29.23 per cent), groundnut (14.46 per cent) and rabi jowar (10.11 per cent) but ragi is well below (7.29 per cent). The departures in order as well as shares are rather striking but in 1984-85 we have for selected farmers ragi (25.29 per cent), groundnut

(16.10 per cent) followed by kharif and rabi jowar (15 and 14 per cent) which is a slightly better agreement. For Region II (the drought-prone region) rabi jowar (40.37 per cent) and bajra (25.28 per cent) are the most important covering 2/3 of area and for 1983-84 the shares for sample farmers are quite close (39.30 and 29.67 per cent) and reasonably close in 1984-85 (47.52 per cent and 18.86 per cent respectively) but both the crops cover around 2/3 of area for both the years for the selected farmers.

Regions III and IV are the cotton tract (in Region IV there is also rice but that is not considered in this chapter) and kharif jowar is equally important, together the two crops covering 60 and 80 per cent area in the basic table. For selected cultivators, these two crops do feature prominently in these regions but the two crops together cover 42 and 68 per cent area which is a somewhat lower coverage.

But by and large we may conclude that in each region major crops (among the 13 crops) have got a good area representation for the both the years in the cropping patterns of the selected farmers.

3.8 We have also to look at shares of regions within each given crop and this is especially relevant when we analyse the data on cropwise fertilizer use in the next chapter and arrive at estimates at the State level. We see that major regions are well represented for both the years for most of the crops as can be seen from Tables 3.10, 3.13 and 3.16. For crops with relatively small shares in total area, like tur, mung, udid, etc., the differences in regions' shares are a bit greater, but this is only to be expected. But we note a shift in regions' shares for sugarcane crop because as mentioned frequently, although it has a mere 2-3 per cent share of total area, it carries highest weightage in Maharashtra's agriculture and is a major fertilizer consumer.

For this crop of sugarcane, share of Region II is the highest (64 per cent) followed by Region I (20 per cent) and Region III (12 per cent) in the basic data but Tables 3.13 and 3.16 reveal that while for 1983-84 sample farmers the order is consistent (Region II-69 per cent, Region I 21 per cent) for 1984-85, the order is changed with Region III coming as second (Region I - 60 per cent, Region III 30 per cent) perhaps because of the larger representation Region III received in the augmented sample size in 1984-85. This shift is worth mentioning because as we shall see in the next chapter, sugarcane is a major consumer of fertilizers and although in both the years area under (harvested) sugarcane is nearly the same around 65 ha., this shift causes changes in per hectare use of fertilizer for the crop.

Before we close the chapter, let us have a very quick look at the irrigations in different regions based on sample farmers. From sample data analysed in the next chapter we have gross irrigated/gross cropped area ratios for the two years as follows:

Region	Gross irrigated/gross cropped area (%) 1983-84	1984-85
I	26.59	12.30
II	31.83	47.82
III	7.55	11.60
IV	7.59	29.15
All Regions	17.18	18.88

The drought-prone area of Region II is historically also the most irrigated as mentioned earlier but we also note that between the two years the proportions are different (in order as well as magnitude) and this would also contribute to the differences in the estimates of fertilizer use per hectare between the two years under consideration. Also noted is the fact that 'All regions' ratio of 17 and 19 per cent over two years is much higher than official data based (Season and Crop Report) ratio, for example, of 1980-83 triennium of 12.72 per cent (Table 2.3).

Table 3.1 : Agro-Climatic Zones in Maharashtra

Zone	Name	Rainfall	Soil	Crops	Area under 13 selected crops (hundred ha.)*
I	Very high rainfall zone with lateritic soils	2500-3000 mm.	Laterites and lateritic	rice, ragi and hill millets	112 (0.83)
II	Very high rainfall with non-lateritic soils	2250-3000 mm.	Non-lateritic loams of brown to red colour	"	8620 (6.39)
III	Ghat Zone + Transition A-reddish to r.brown soils + Transition B-greyish-black soils	Less than 2200 mm.	Mainly red to brown soils with varying depth and texture	rice, nagli, bajra, groundnut, cotton, jowar	8932 (6.62)
IV	Scarcity zone (Dhule Region)	500-700 mm.	Medium black calcareous soils formed from trap with varying depth and texture	kharif (except rice) cum rabi depending upon soil depth	22821 (16.92)
V	Scarcity zone (Pune Region)	"	"	Rabi, jowar, bajra	7511 (5.57)
VI	Scarcity zone (Sangli Region)	"	"	Kh., rabi jowar, bajra	2922 (2.17)
VII	Scarcity zone (Marathwada Region)	"	"	Bajra, Safflower, Cotton	

\* Based on the third column of Table 3.2

(contd.)



Table 3.1 : (Contd.)

1	2	3	4	5	6
VIII	Assured Rainfall zone (Western Maharashtra)	700-900 mm.	Medium-black calcareous	Kh., Rabi Jowar, cotton	9673 (7.17)
IX	Assured Rainfall zone (Marathwada Region)	700-900 mm.	"	"	26135 (19.38)
X	Assured Rainfall zone (Vidarbha)	"	"	"	17751 (13.16)
XI	Moderate to moderately high rainfall zone	900-1250 mm.	Brown to dark calcareous	Kharif crops all types	26850 (19.91)
XII	High rainfall zone	1250-1700 mm.	Yellowish-brown to red soils	All kharif with rice main	2545 (1.89)

Table 3.2 : Area under Selected Crops for various zones in Maharashtra (area in 100 ha.)

Zone Number	Total no. of Tehsils in the zone	Total area under the selected	Selected Crops												
			kh. Jawar	Rabi Jawar	Bajri	Ragi (nagli)	Cotton	Sugar-cane	Onion	Ground-nut	Sun-flower	Saf-flower	Tur	Mung	Udid
			1	2	3	4	5	6	7	8	9	10	11	12	13
I, II	47	1124	8	-	-	909	-	28	6	41	-	-	53	15	64
III	35	8620	1367	1830	1270	930	121	692	65	1654	-	-	201	103	387
IV	13	8932	1176	941	4003	164	374	305	209	1190	-	12	46	291	221
V	26	22821	903	14151	3319	4	547	1371	106	375	2	1289	507	211	36
VI	13	7511	1833	1938	2162	3	116	473	20	473	-	154	220	39	80
VII	8	2922	-	-	1181	-	234	121	7	112	27	486	383	236	135
VIII	16	9673	1377	2576	970	-	1736	111	28	727	9	156	378	536	1069
IX	29	26135	12166	-	2333	3	3615	319	18	819	131	1769	1751	2047	1164
X	15	17751	6514	-	216	-	7628	15	27	577	9	470	961	727	607
XI	25	26850	11331	-	174	-	10396	87	21	671	4	401	1900	1136	729
XII	8	2545	1842	-	1	-	126	-	8	15	-	-	172	51	330
		134884	38517	21436	15629	2013	24893	3522	515	6654	182	4737	6572	5392	4822

(Based on the official data for 1978-79 available at the MPAU)

Table 3.3 : Area Shares of Selected Crops in Various Zones in Maharashtra

Zone No.	Total no. of Tehsils in the zone	Selected Crops													
		Kh. Jawar	Rabi Jawar	Bajri	Ragi (nagli)	Cotton	Sugar cane	Onion	Ground nut	Sun-flower	Saf-flower	Tur	Mung	Udid	
I, II	47	100.00	0.71	0.00	0.00	80.88	0.00	2.49	0.53	3.65	0.00	0.00	4.72	1.33	5.69
III	35	100.00	15.86	21.24	14.73	10.79	1.40	8.03	0.75	19.19	0.00	0.00	2.33	1.19	4.49
IV	13	100.00	13.17	10.54	14.82	1.84	4.19	3.40	2.34	13.32	0.00	0.13	0.52	3.26	2.47
V	26	100.00	3.96	62.01	14.54	0.20	2.40	6.91	0.46	1.64	0.01	5.65	2.22	0.92	0.16
VI	13	100.00	24.40	25.80	28.78	0.04	1.54	6.30	0.27	6.30	0.00	2.05	2.93	0.52	1.07
VII	8	100.00	0.00	0.00	40.42	0.00	8.01	4.14	0.24	3.83	0.92	16.63	13.11	8.08	4.62
VIII	16	100.00	14.24	26.63	10.03	0.00	17.94	1.15	0.29	7.52	0.09	1.61	3.91	5.54	11.05
IX	29	100.00	46.55	0.00	8.93	0.01	13.83	1.22	0.07	3.13	0.50	6.77	6.70	7.83	4.45
X	15	100.00	36.70	0.00	1.22	0.00	42.97	0.08	0.15	3.25	0.05	2.65	5.41	4.10	3.42
XI	25	100.00	42.20	0.00	0.65	00.00	38.72	0.32	0.08	2.53	0.01	1.49	7.08	4.23	2.72
XII	8	100.00	72.38	0.00	0.04	0.00	4.95	0.00	0.31	0.59	0.00	0.00	6.76	2.00	12.97
All Zones	235	100.00	28.55	15.89	11.59	1.49	18.46	2.61	0.38	4.93	0.13	3.51	4.87	4.00	3.57

(Figures are percentages to the total area of selected crops)

**Table 3.4 : Percentage Area Shares of Various Zones in Maharashtra in Each Selected Crop**

Zone No.	Total No. of Tehsils in the zone	Selected Crops													Average
		Kh. Jowar	Rabi Jowar	Bajri	Ragi	Cotton	Sugar-cane	Onion	Ground-nut	Sun-flower	Saf-flower	Tur	Mung	Udid	
I, II	47	0.02	0.00	0.00	45.15	0.00	0.80	1.17	0.62	0.00	0.00	0.81	0.28	1.33	3.86
III	35	3.55	8.54	8.13	46.20	0.49	19.65	12.62	24.86	0.00	0.00	3.06	1.91	8.03	10.56
IV	13	3.05	4.39	25.60	8.15	1.50	8.66	40.58	17.88	0.00	0.25	0.70	5.40	4.58	9.29
V	26	2.34	66.01	21.24	0.20	2.20	38.92	20.58	5.64	1.10	27.21	7.71	3.91	0.75	15.22
VI	13	4.76	9.04	13.83	0.15	0.47	13.42	3.88	7.11	0.00	3.25	3.35	0.72	1.66	4.74
VII	8	0.00	0.00	7.56	0.00	0.94	3.44	1.36	1.68	14.84	10.26	5.83	4.38	2.80	4.08
VIII	16	3.58	12.02	6.21	0.00	6.97	3.15	5.44	10.93	4.95	3.29	5.75	9.94	22.17	7.26
IX	29	31.59	0.00	14.93	0.15	14.52	9.06	3.50	12.30	71.97	37.35	26.64	37.96	24.14	21.85
X	15	16.91	0.00	1.38	0.00	30.64	0.43	5.24	8.67	4.95	9.92	14.62	13.48	12.58	9.14
XI	25	29.42	0.00	1.11	0.00	41.76	2.47	4.08	10.08	2.19	8.47	28.91	21.07	15.12	12.67
XII	8	4.78	0.00	0.01	0.00	0.51	0.00	1.55	0.23	0.00	0.00	2.62	0.95	6.84	1.35
	235	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 3.5 : Production of Selected Crops for Various Zones in Maharashtra

(Prod. in 100 quintal)

Zone No.	Total No. of Tehsils in the zone	Selected Crops												
		Kh. Jawar	Rabi Jawar	Bajri	Ragi	Cotton (lint)	Sugar-cane (Gur)	Onion	Ground-nut	Sun-flower	Saf-flower	Tur	Mung	Udid
I+II	47	137	-	-	2727	1	2572	578	266	-	-	76	61	258
III	35	18291	8590	4618	2791	203	67272	8139	14337	4	-	1658	263	1404
IV	13	10431	5183	16880	492	492	33103	29913	7176	-	12	380	933	868
V	26	7454	56835	7927	11	2083	161187	13729	2766	13	1289	2253	432	95
VI	13	22537	9036	4819	10	366	50758	2221	3449	3	154	1941	117	230
VII	8	-	-	3160	-	273	9048	673	466	143	486	1637	775	436
VIII	16	17915	14880	5345	-	1920	10126	4000	4279	59	156	1863	2142	4476
IX	29	130577	-	8176	8	3987	23635	2162	3690	802	1769	8019	6787	3798
X	15	64889	-	967	-	4944	1152	2577	3008	43	470	6477	1392	1552
XI	25	91439	-	796	-	8628	6572	2357	3200	17	401	13013	2608	1577
XII	8	11893	-	2	-	113	-	1372	73	1	-	1020	90	792
		375563	94524	52690	6039	23010	365425	67421	42710	1085	4737	38437	15600	15486

(Based on the official data available at MPAU)



Table 3.7: Proportion of Centres to be allotted by Table 3.4 and the Actual Allotments in 1983-84 and 1984-85 to Different Zones

zone	Percentage by Table 3.4	1983-84		1984-85	
		No.of Centres	Percentage to total	No.of centres	Percentage to total
I, II	3.86	2	5.00	1	1.67
III	10.56	4	10.00	4	6.67
IV	9.29	4	10.00	4	6.67
V	15.22	5	12.50	10	16.67
VI	4.74	2	5.00	3	5.00
VII	4.08	2	5.00	1	1.67
VIII	7.26	2	5.00	4	6.67
IX	21.85	9	22.50	12	20.00
X	9.14	4	10.00	8	13.33
XI	12.67	5	12.50	12	20.00
XII	1.35	1	2.50	1	1.67
Total	100.00	40	100.00	60	100.00

**Table 3.8: Area under Selected Crops for Various Regions in Maharashtra (area in 100 ha.)**

Selected Crop	Region I	Region II	Region III	Region IV	All Regions
1. Kh.Jowar	1375	3912	20057	13173	38517
2. Rabi Jowar	1830	17030	2576	-	21436
3. Bajra	1270	10665	3519	175	15629
4. Ragi(Nagli)	1839	171	3	-	2013
5. Cotton	121	1271	12979	10522	24893
6. Sugarcane	720	2270	445	87	3522
7. Onion	71	342	73	29	515
8. Groundnut	1695	2150	2123	686	6654
9. Sunflower	-	29	149	4	182
10. Safflower	-	1941	2395	401	4737
11. Tur	254	1156	3090	2072	6572
12. Mung	118	777	3310	1187	5392
13. Udid	451	472	2840	1059	4822
<b>Total</b>	<b>9744</b>	<b>42186</b>	<b>53559</b>	<b>29395</b>	<b>134884</b>

(Based on data in Table 3.2)



Table 3.9 : Regionwise Cropping Pattern for the Selected Crops in Maharashtra

Selected crops	(Percentages)				
	Region I	Region II	Region III	Region IV	All Regions
1. Kh.Jowar	14.11	9.27	37.45	44.81	28.56
2. Rabi Jowar	18.78	40.37	4.81	-	15.90
3. Bajra	13.03	25.28	6.57	0.60	11.52
4. Ragi (Nagli)	18.87	0.41	0.01	-	1.49
5. Cotton	1.24	3.01	24.23	35.80	18.46
6. Sugarcane	7.39	5.38	0.83	0.30	2.61
7. Onion	0.73	0.81	0.14	0.10	0.38
8. Groundnut	17.40	5.10	3.96	2.33	4.93
9. Sunflower	-	0.07	0.28	0.01	0.13
10. Safflower	-	4.60	4.47	1.36	3.51
11. Tur	2.61	2.74	5.77	7.05	4.87
12. Mung	1.21	1.84	6.18	4.04	4.00
13. Udid	4.63	1.12	5.30	3.60	3.57
Total	100.00	100.00	100.00	100.00	100.00

(Based on Table 3.8)

Table 3.10 : Shares of Different Regions in Area  
of Each Selected Crop for Maharashtra

Selected crop	(Percentages)				All Regions
	Region I	Region II	Region III	Region IV	
1. Kh.Jowar	3.57	10.16	52.07	34.20	100.00
2. Rabi Jowar	8.54	79.44	12.02	-	100.00
3. Bajra	8.13	68.24	22.51	1.12	100.00
4. Ragi(Nagli)	91.36	8.49	0.15	-	100.00
5. Cotton	0.49	5.10	52.14	42.27	100.00
6. Sugarcane	20.44	64.46	12.63	2.47	100.00
7. Onion	13.79	66.41	14.17	5.63	100.00
8. Groundnut	25.47	32.31	31.91	10.31	100.00
9. Sunflower	-	15.93	81.87	2.20	100.00
10. Safflower	-	40.98	50.55	8.47	100.00
11. Tur	3.86	17.59	47.02	31.53	100.00
12. Mung	2.19	14.41	61.39	22.01	100.00
13. Udid	9.35	9.75	58.90	21.96	100.00
Total	7.22	31.28	39.71	21.79	100.00

(Based on Table 3.8)

Table 3.11: Area Under the Selected Crops For the 400 Selected Farmers for Different Regions (1983-84)

	(Area in ha.)				
	Region I	Region II	Region III	Region IV	All Regions
1. Kh. Jowar	6.21	21.68	180.87	88.69	296.44
2. Rabi Jowar	8.27	227.78	130.93	25.92	392.90
3. Bajra	18.14	171.98	84.32	11.50	285.94
4. Ragi	5.96	0.36	-	-	6.32
5. Cotton	-	12.48	200.71	91.23	304.42
6. Sugarcane	23.91	78.37	3.93	6.82	113.03*
7. Onion	7.41	11.33	0.75	-	19.49
8. Groundnut	11.83	18.11	28.57	6.92	65.43
9. Safflower	-	14.31	21.04	-	34.35
10. Tur	-	10.38	65.81	16.17	92.11
11. Mung	0.04	11.71	165.06	7.16	183.86
12. Udid	0.03	1.07	15.77	8.66	25.53
Total area	81.80	579.56	897.76	263.27	1819.82
No. of farmers	60	130	150	60	400

\* Sugarcane area includes both harvested - 65.89 ha. as well as standing - 47.14 ha.)

Details for sunflower not available.

Table 3.12 : Regionwise Cropping Pattern for Selected Crops in Percentages for Selected Farmers (1983-84)

	Region I	Region II	Region III	Region IV	All Regions
1. Kh.Jowar	7.59	3.74	20.15	33.69	16.29
2. Rabi Jowar	10.11	39.30	14.58	9.85	21.59
3. Bajra	22.18	29.67	9.39	4.37	15.71
4. Ragi	7.29	0.06	-	-	0.35
5. Cotton	-	2.15	22.36	34.65	16.73
6. Sugarcane	29.23	13.52	0.44	2.59	6.21
7. Onion	9.06	1.95	0.08	-	1.07
8. Groundnut	14.46	3.12	3.18	2.63	3.60
9. Safflower	-	2.47	2.34	-	1.89
10. Tur	-	1.79	7.33	6.14	5.06
11. Mung	0.05	2.02	18.39	2.72	10.10
12. Udid	0.04	0.18	1.76	3.29	1.40
Total	100.00	100.00	100.00	100.00	100.00

Table 3.13 : Shares of Different Regions in Areas of  
Each Selected Crop for 400 Selected Farmers  
(1983-84)

Crop	(Percentages)				All Regions
	Region I	Region II	Region III	Region IV	
1. Kh.Jowar	2.09	7.31	61.01	29.92	100.00
2. Rabi Jowar	2.10	57.97	33.32	6.60	100.00
3. Bajra	6.34	60.15	29.49	4.02	100.00
4. Ragi	94.30	5.70	-	-	100.00
5. Cotton	-	4.10	65.93	29.97	100.00
6. Sugarcane	21.15	69.34	3.48	6.03	100.00
7. Onion	38.02	58.13	3.85	-	100.00
8. Groundnut	18.08	27.68	43.66	10.58	100.00
9. Safflower	-	40.48	59.52	-	100.00
10. Tur	-	11.24	71.25	17.51	100.00
11. Mung	0.02	6.37	89.77	3.89	100.00
12. Udid	0.12	4.19	61.77	33.92	100.00
Total Area	4.49	31.80	49.26	14.45	100.00
Proportion of Farmers	15.00	32.50	37.50	15.00	100.00

Table 3.14 : Area Under Selected Crops for the 600 Selected Farmers for Different Regions (1984-85)

	(Area in ha.)				
	Region I	Region II	Region III	Region IV	All Regions
1. Kh.Jowar	14.93	45.07	301.94	149.41	511.35
2. Rabi Jowar	13.26	262.89	179.42	57.86	513.43
3. Bajra	11.49	104.34	82.97	3.51	202.71
4. Ragi	23.86	-	0.10	-	23.96
5. Cotton	1.95	14.28	253.39	200.92	470.54
6. Sugarcane	10.34	67.85	33.66	0.75	112.60*
7. Onion	0.30	14.04	2.00	0.10	16.44
8. Groundnut	15.19	20.85	24.78	4.93	65.75
9. Safflower	0.15	9.01	87.18	4.72	101.06
10. Tur	0.19	9.16	90.04	38.98	138.37
11. Mung	0.50	4.52	133.25	26.61	164.88
12. Udid	1.77	1.17	40.84	11.40	55.18
Total area	94.33	553.18	1229.57	499.19	2376.27
No.of Farmers	50	180	240	130	600

Details for Sunflower not available.

\* Sugarcane area includes both harvested - 65.26 ha. - as well as standing - 47.34 ha. cane).

**Table 3.15 : Regionwise Cropping Pattern for Selected Crops in Percentages for Selected Farmers (1984-85)**

	Region I	Region II	Region III	Region IV	All Regions
1. Kh. Jowar	15.83	8.15	24.56	29.93	21.52
2. Rabi Jowar	14.06	47.52	14.59	11.59	21.60
3. Bajra	12.60	18.86	6.75	0.70	8.53
4. Ragi	25.29	-	0.01	-	1.01
5. Cotton	2.07	2.58	20.61	40.25	19.80
6. Sugarcane	10.96	12.26	2.74	0.15	4.74
7. Onion	0.32	2.54	0.16	0.02	0.69
8. Groundnut	16.10	3.77	2.02	0.99	2.77
9. Safflower	0.16	1.63	7.09	0.94	4.25
10. Tur	0.20	1.66	7.32	7.81	5.83
11. Mung	0.53	0.82	10.84	5.33	6.94
12. Udid	1.88	0.21	3.32	2.28	2.32
Total	100.00	100.00	100.00	100.00	100.00

Table 3.16 : Shares of Different Regions in Areas of Each Selected Crop for 600 Selected Farmers in 1984-85

Crop	(Percentages)				
	Region I	Region II	Region III	Region IV	All Regions
1. Kh. Jowar	2.92	8.81	59.05	29.22	100.00
2. Rabi Jowar	2.58	51.20	34.95	11.27	100.00
3. Bajra	5.87	51.47	40.93	1.73	100.00
4. Ragi	99.58	-	0.42	-	100.00
5. Cotton	0.41	3.03	53.85	42.70	100.00
6. Sugarcane	9.18	60.26	29.89	0.67	100.00
7. Onion	1.82	85.40	12.16	0.61	100.00
8. Groundnut	23.10	31.71	37.69	7.50	100.00
9. Safflower	0.15	8.91	86.27	4.67	100.00
10. Tur	0.14	6.62	65.07	28.17	100.00
11. Mung	0.30	2.74	80.82	16.14	100.00
12. Udid	3.21	2.12	74.01	20.66	100.00
Total Area	3.97	23.28	51.74	21.01	100.00
Proportion of Farmers	8.33	30.00	40.00	21.67	100.00



## CHAPTER IV

### THE RESULTS

Before we start examining the results of the study, it is pertinent to clarify that the results for the two years are to be interpreted as two points of assessment - like two coordinates - which act as indicators of the state of affairs. We do not in any way 'combine' the two results but simply look at them as two points around which the 'true figure' is likely to lie. Only in the fertilizer consumption potential exercise in the last section of this chapter we 'combine' the results of the two years. We also recall that in 1983-84 foodgrains production had a minor peak while in 1984-85 production was 'normal'. Except for rabi jowar, major foodgrain crops had a relatively higher production in 1983-84. Sugarcane production was lower in both the years than 'normal' while cotton production was distinctly low in 1983-84 but 'normal' in 1984-85, etc., as mentioned at the end of Chapter II.

#### 4.1 Comparative Cropping Patterns

In the previous chapter we looked at the cropping pattern within the 13-crop aggregate on which attention is focussed. Here we again look at the cropping patterns but now we consider the entire cropping pattern of the selected farmers. This comparison is undertaken to see to what extent the State-level cropping pattern and the cropping pattern of the two years 1983-84 and 1984-85 for the selected farmers are comparable. If they are, then we would be justified in analysing sample data at the State-level in addition to the cropwise analysis.

In Table 4.1 we present cropping patterns for 15 crop items which now cover the entire gross cropped area. State-level cropping pattern based on official data for 'total' as

well as irrigated cropping are juxtaposed with the cropping patterns of the selected farmers for the two reference years. Official cropping patterns are based on 1980-83 triennium average and from the first column we see that previously excluded crops of paddy-wheat-gram now feature here along with a crop-item of 'others'. Official data reveals that paddy and wheat have 7 and 5 per cent shares of GGA and these crops find their rightful place with samples. For both the years cropping pattern of sample farmers (cols. 4 and 7) reveals that paddy is underrepresented (share being between 2 and 2.5 per cent) but wheat is 4 to 5 per cent, close to State-level percentage.

When we look at the list of crops, we are struck by the similarity of sample cropping patterns with that of the State, especially for 1983-84. Remarkable is the closeness of shares of kharif jowar, rabi jowar, cotton, groundnut and wheat. Thus even with a '13 crops on equal footing' approach in sampling, major crops are well represented. Only paddy (rice) is under-represented and bajra is over-represented. In 1984-85 with a bias towards Regions III and IV as explained in the previous chapter, kharif jowar has a high share of 17.51 per cent compared with State-level area share of 14.67 per cent but bajra has now a due share of 7 per cent. Thus in both the years cropping patterns are remarkably close to State cropping patterns and it should be worthwhile to look at results of sample farmers for individual crops as well as all crops together.

Irrigated cropping patterns are presented in columns 2, 5 and 8 of this Table. At the State-level, wheat (22 per cent of gross irrigated area), paddy (16 per cent), sugarcane (14 per cent) and rabi jowar (13 per cent) are important and these crops in sample also are important except paddy which has less than 2 per cent share of gross irrigated area (GIA) in both the years. Thus paddy is inadequately represented. Other departures occur in rather high share in GIA for rabi jowar and a reduced share for wheat in 1984-85 and this may be due to the upward shift in importance of Regions III and IV.

Looking at the last row of columns 3, 6 and 9 we see that gross irrigated/gross cropped proportion is higher for sample farmers, at 18 and 19 per cent for the two years compared to the 'official' ratio of 13 per cent as revealed for the triennium 1980-83. This fact was mentioned at the end of the previous chapter. This fact has to be kept in mind because as we shall see shortly, availability of irrigation is an important factor in fertilizer use and a relatively higher irrigation proportion in the sample would give us per hectare estimates on the higher side. The irrigation proportion is higher in the sample (for both the years) for nearly every important crop except paddy. At the State level 29 per cent of paddy is irrigated while in sample it is just 14 and 11 per cent in the two years. But rabi jowar (State level 10 per cent of crop area, sample 15 and 26 per cent), wheat (State level 53 per cent of crop area, sample 79 and 66 per cent) have distinctly higher proportions. For cotton in one year sample ratio is lower and in another higher than State-level ratio of 5 per cent. Component of 'others' has again higher ratios of 30 and 36 per cent for sample compared with State-level ratio of 14 per cent and 'others' is not a small component in cropping pattern, covering 19 per cent of GCA and 21 per cent of GIA at State-level. Thus on the whole, with a higher irrigation proportion for the sample, we are likely to get higher estimates of fertilizer use per hectare. But we also note that with under-representation of rice and over-representation of rabi jowar in the irrigated area, the extent of over estimation of fertilizer input per hectare would be reduced to some extent. This is because fertilizer use is relatively modest for rabi jowar even under irrigated conditions but that for rice is much higher as we shall see subsequently.

In the previous chapter we had looked at the area shares of regions for each given crop. With the addition of paddy, wheat, gram and 'others' to the list of crops, let us look at the regionwise shares of these four crop items. These come out as follows:

Area Shares of Regions for a Given Crop  
(Percentages) for the Selected Farmers

		Paddy	Wheat	Gram	Others	GCA
<u>1983-84</u>						
Region:	I	55.19	3.04	9.50	9.97	5.48
	II	5.89	31.92	39.02	41.04	31.30
	III	23.64	35.87	38.88	26.14	46.81
	IV	15.28	29.16	12.60	22.84	16.51
Total		100	100	100	100	100
<u>1984-85</u>						
Region	I	37.98	7.21	10.50	12.15	6.00
	II	3.54	29.42	34.59	34.76	23.67
	III	11.08	37.96	49.11	37.04	48.95
	IV	47.39	25.41	5.80	16.06	21.38
Total		100	100	100	100	100

Paddy areas are more sharply marked in Regions I and IV and 'others' has a more even distribution over regions in 1984-85 than in the previous year. But by and large, area distributions over regions are consistent over the two years.

#### 4.2 A Glance at Some Important Results

In this section we have a quick look at some of the ratios and averages to set the tone for subsequent discussion in detail. These 'ratios and averages' are set out in Table 4.

#### Gross Area Per Farm:

First two items in the Table indicate that 400 farms in 1983-84 covered 2190 ha. of GCA and 600 farms in 1984-85, in an independent sample, cover 2920 ha. of GCA. We have per farm GCA of 5.48 and 4.87 ha. for the two years respectively. What is the State level estimate of per farm area? According to the Agricultural Census 1976-77 average net sown area (NSA) per holding comes to 2.98 ha. (Epitome of Agriculture, Part II, p.279). Further, we know that Maharashtra has a somewhat poor

intensity of cropping. In fact official data reveals that for 5 years from 1974-75 to 1978-79 the intensity varied between 107.14 and 109.13 averaging to 108.28 over the 5 years. If we apply this intensity to 2.98 ha., we get per farm GCA of 3.23 ha. which is still below the sample averages of 5.48 and 4.87 mentioned above. When we recall the method of selection of farms, this excess can be explained. As mentioned earlier, size groups of holdings are so formed that for each centre each size group contains equal area when arranged by size groups and two farms selected from each, giving large sized farms equal representation when in fact the distribution of holdings by size is decidedly skew, with concentration on the left and a longer tail on the right. A similar exercise indicates that net irrigated area (NIA) per holding according to the Agricultural Census 1976-77 is .2314 ha., (Epitome of Agriculture, 1983-84, Part II, p.220). With irrigated cropping intensities varying between 119.89 and 124.80 over 1974-75 to 1978-79 giving average intensity of 122.42, per farm GIA comes to .2833 ha. per holding, by official statistics. Our sample per farm GIAs are much higher, at .941 and .919 ha., respectively. This higher average is again partly due to the weightage to high size holdings.

Shares of Irrigated and Dry Cropped Area  
and Levels of N/ha:

Irrigation ratios of 17 and 19 per cent (GIA/GCA) for selected farmers for two respective years are higher than ratios of about 13 per cent according to official statistics, a fact already mentioned. In rows 5, 6 and 7 of Table 4.2, the table under discussion, total consumption of fertilizers in terms of nutrients is presented while in rows 8 and 9 shares of irrigated crops and of rainfed crops in N consumption are set out. This reveals that over the two years 66 and 58 per cent of N was consumed on account of irrigated crops. This clearly brings out importance of irrigation. Sample irrigated area of 17-18 per cent is thus noted as consuming

around 60 per cent of N. The per gross hectare N-P-K use comes to 19-7-3 kg in 1983-84 and slightly higher level of 22-9-5 for 1983-84. Per gross irrigated hectare the N-P-K is much higher at 74-27-11 and 69-26-18 kg for the two years. Similar figures for rainfed area are obviously lower, being 8-3-2 and 12-6-2 kg for two respective years. Rows 10, 11 and 12 of the Table reveal this.

Share of irrigated crops in total N consumption of 66 and 58 per cent for the two years is consistent with estimates made by us, based on data of 1970-71 NSS Survey and 1976-77 Input Survey (which was part of Agricultural Census 1976-77), in a study undertaken at the Agro-Economic Research Centre of the Institute.\* (This will henceforth be referred to as the AGPM Study.) This study gives estimates of irrigated crops share in total N at 64 per cent (1970-71, data of NSS Survey) and 56 per cent (1976-77, data of Input Survey). Further, use of 19 and 22 kg. of N and 7 and 9 kg. of P per (gross) hectare (in Table 4.2) is also consistent with the State-level per hectare consumption of N, of 19 N and 7 P which was noted earlier (section 2.1, Chapter II) for the year 1983-84. It was also remarked that from 1980-83 triennium average of 14 N and 5 P, State-level consumption has risen significantly to 19 N, 7 P in 1983-84 and that for 1984-85 and 1986-87 years also, consumption per hectare was likely to remain high. Here for the selected farmers, the N and P are quite close to the State-level figures. One is again reminded of the fact that N per hectare of around 20 kg. is woefully below the national average of 30 kg. and the Punjab average of 101 kg. in 1983-84 (Table 2.2). Incidentally, we also note that for State-level

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\* Agricultural Growth and Potential in Maharashtra, (pp.161 and 180) a study by the author undertaken in the AER Centre of the Institute at the instance of the Planning Commission (Unpublished). In the present write-up, referred to as the AGPM Study.

data N:P ratio is around 2.5:1 for 1980-83 triennium as well as for the subsequent years and the sample data also has the ratio around 2.5:1 for both the years.

Use of N-P-K per ha. of irrigated area is 74-27-11 kg. and 69-26-18 kg. for the two years for the sample farmers. For rainfed area the use is much lower at 8-3-2 kg. and 12-6-2 kg. as mentioned in the preceding paragraph. Importance of irrigation is again underlined. Similar estimates made by us for 1970-71 and 1976-77, based on the NSS Survey and Input Survey data respectively, come to 23.36 kg. of N/irrigated ha and 1.69 kg. of N/rainfed ha (1970-71) and 44.74 kg. of N/irrigated ha and 5.79 kg. of N/rainfed ha (1976-77) (Agricultural growth and Potential in Maharashtra - AGPM Study, pp.162 and 180) which are consistent with rising in fertilizer use noted in section 2.1 of Chapter II.

#### Major Fertilizer Consuming Crops:

Although in terms of area major crops are rabi jowar, K. jowar and cotton (item 13 of Table 4.2), top consumer of fertilizer (N) is sugarcane with 25 to 40 per cent share in N. Kh. jowar and cotton come in next but their share in N almost same as area share (item 14). In one year wheat also features as a major consumer although its area share is just 5 per cent. What we must point out again and again is the place of sugarcane. With just 2 to 3 per cent share in GCA it consumes 25 to 40 per cent of N. We also note that rabi jowar, with its highest area share is conspicuous by its absence in the top consumers and in fact has a poor share of fertilizers in spite of some irrigation.

In the gross irrigated area, top three crops with irrigated area (item 15) are wheat, sugarcane and rabi jowar in 1983-84 and a slightly different order in 1984-85 but top irrigated consumer is again sugarcane (with 40 to 65 per cent share in N) followed by wheat and last is onion in first year and rabi jowar in another (item 16).

Among rainfed crops (also referred to as 'dry') rabi jowar, cotton and kharif jowar dominate in area but rabi jowar again does not feature in top three consumers. Cotton, Kh. jowar are followed by bajra in first year but by paddy in the second year among top unirrigated consumers (items 17 and 18).

Major Crops Treating Irrigated and Dry Parts Separately:

If we look at different crops with irrigated and unirrigated components as separate crops, the top 4 crops as consumers of N come out, not unexpectedly, as (item 19):

1983-84 : Irrigated sugarcane, dry cotton, irrigated wheat and dry Kh. jowar

1984-85 : Irrigated sugarcane, dry K. jowar, irrigated 'others', dry cotton.

We again realise that kh. jowar and cotton in spite of being unirrigated come out as big consumers and with the well-known nexus between irrigation and fertilizer use, one does not attribute this to just big area shares of these crops. In fact we have noted in Chapter 2 that kharif jowar is not only biggest supplier of foodgrains, but over the years largest additions are also on account of this crop and the production increases are due to area but more so due to productivity. (On the other hand it was also seen there that performance of cotton has been an up and down affair.) Whereas N per hectare of dry crops is 8 to 12 kg. (item 2), dry cotton and dry k. jowar have N between 15-19 kg. per hectare.

Irrigated wheat and irrigated 'others' have more than 10 per cent share in N with less than 5 per cent irrigated area share. Wheat of course has brought green revolution all over the country and in Maharashtra wherever conditions are suitable and irrigation available, the crop has prospered. 'Others' irrigated category features in 1984-85 mainly because in the fresh sample relatively higher coverage of 'fruits' - especially banana, grapes - has occurred in the sample of that year as we shall see later.



The average N-P-K levels are also noted for these crops. While sugarcane has requirements ranging from 250 kg. of N (Suru variety, most common) to 400 kg. of N (for Adsali, less common variety), actual consumption of N of 230-270 kg/ha appears adequate but dry kh. jowar and dry cotton, although standing out as major consumers, have rather low levels of use of 15 to 19 kg/ha., less than the recommended levels. Depending upon the availability of moisture, there appears to be some scope for greater use. Irrigated wheat has average use of 58 kg. of N/ha when recommended level is higher from 75 to over 100 kg. of N. In all this we remind ourselves that paddy has got under-representation in the sample. We are aware that next to wheat, green revolution has occurred in this crop and is grown where rainfall is high or irrigation assured, and in reality, the crop is likely to feature among important consumer of fertilizers. (We have also noted earlier that next to kharif jowar, it is rice and not rabi jowar or wheat, which is the main foodgrains supplier in Maharashtra and has had good growth over years.).

#### 4.3 Recommended Doses of N-P-K:

Before we go into further details, let us note the N-P-K requirements of crops. These are incorporated in Table 4.3(a) and 4.3(b). In Table 4.3(a) cropwise per hectare requirements are noted for irrigated and unirrigated components but without reference to regions. These requirements are found in the literature when one is talking of a crop for the State as a whole. This information is culled from official and other sources. In Table 4.3(b) the requirements are given for (i) irrigated or assured rainfall regions and (ii) unirrigated or uncertain rainfall regions. This table is based on the 'Agricultural Extension Service' (1982) in Marathi, by Prof. Salunkhe, (then) Vice Chancellor, Mahatma Phule Agricultural University, Rahuri and D.Sapre, Deputy Director,

Department of Agriculture, Pune. The authors are thus a combination of technical and official implementing agencies. Since moisture availability plays an important part in fertilizer use, this distinction in 4.3(b) is important. Both the tables give requirements for HYV at appropriate places. We also note that Table 4.3(b) is more detailed for sugarcane and cotton crops. For sugarcane we note that the 'Deccan Canal Region' (which is Region II of scarcity region in our analysis) has higher recommendations of N-P-K than the Konkan (roughly Region I in our analysis) and Vidarbha-Marathwada region (Regions III and IV in our analysis) requirements. Further, from this table it is clear that the highest requirement variety of 'Adsali' sugarcane is common in 'Deccan Canal Region' (Region II) only.

#### 4.4 Relative Importance of Different Crops:

##### A Closer Look

For the year 1983-84 six tables from Table 4.4 to 4.9 are presented where relative position of different crops is presented - for 'total' crops i.e. without separating rainfed and irrigated components (Tables 4.4 and 4.5) and for irrigated crops (Tables 4.6 and 4.7) and rainfed crops (Tables 4.8 and 4.9). Similarly from Table 4.10 to 4.15 information for 1984-85 is presented. One can visualize three groups of crops :

(i) those crops which reveal the nexus between irrigation and fertilizer use with fertilizer (N) share of these crops being much higher than area share. Foremost of these is the sugarcane crop with 2.3 per cent share in GCA but 25-40 per cent share in N. Others are wheat, paddy and gram. Even with inadequate representation of wheat and paddy (especially the latter) this fact of 'greater share in N than in area' is apparent for both the years. (ii) Second group is of crops with area and N shares 'nearly equal'. Here we have crops like Kharif jowar with 13 per cent area and 11 per cent N and 17 per cent area and 16 per cent N for the two years, cotton (14 per cent area and N in 1983-84 and 16 per cent area and

13 per cent N in 1984-85) and bajra. These crops are mostly rainfed (less than 4 per cent under irrigation), widely grown and the mere fact of keeping up N share with area share is something of an achievement for these crops. (iii) crops with N share much lower than area share - foremost of these, is rabi jowar with 18 per cent area share in both years but less than 5 per cent share in N. This most widely cultivated crop thus remains untouched by the green revolution. There are no successful HYV varieties which are responsive to fertilizers and traditional varieties really prevail for this crop. (There are of course, 'improved' varieties of rabi jowar of which the popular 'Maldandi 35-1' comes from the nineteen-thirties.) Apart from the fact that in rabi season there is problem of moisture, rabi jowar is taken mainly for family consumption and for its fodder. In fact, if we look at fodder value as per cent of grain value, this crop has the highest fodder value proportion for both the sample years, among the major foodgrains. For sample farmers while rabi jowar has fodder value of 59 and 64 per cent of grain value in 1983-84 and 1984-85, for other foodgrains these percentages can be set out as:

Fodder/value/grain value (percentages)

Crop	1983-84	1984-85
Paddy	10	17
K. jowar	37	39
Bajra	38	42
Wheat	3	6

Although for gross value of grain and fodder output (per ha) rabi jowar is only fourth among these five crops, it has per hectare value of fodder highest among these five foodgrain crops (value figures not presented here). Thus rabi jowar is taken for the fodder (which can sustain the livestock through summer) and quality grain from its non-HYV varieties, which receive low doses of fertilizers. (For rabi unirrigated

traditional jowar N-P-K recommended is 50-25-25 kg/ha in Table 4.3(a) and 25-12-0 by Table 4.3(b) for uncertain rainfall areas whereas the actual use of N for unirrigated jowar in both the years is less than 1 kg./ha.) Thus here is a crop waiting for the green revolution. Other crops in this group are tur, gram, mung, udid - i.e. pulses - and oilseeds like groundnut and safflower. All these are unirrigated and have N-P-K levels much below the recommended ones of modest 12.5-25-0 or 25-50-0. Only for tur and groundnut N-P-K are 5-3-1 and 13-8-3 in 1983-84 and 14-7-3 and 14-15-4 kg. in 1984-85. There is also lack of balance for these crops but more about this later. Pulses and oilseeds augment nitrogen in the soil and perhaps low-levels of fertilizer use are because of the wrong impression that those crops do not need them.

'Others' Category:

We have also a crop-head of 'others' which is of some importance. In 1983-84 it has 11 per cent area and 6 per cent N share and in 1984-85 13 per cent area share and 16 per cent N share. This category must contain sundry fodder crops along-with fruits, vegetables and onion. In fact onion is among the 13-crop aggregate on which attention is focussed in this study. But we had to add crops like paddy, wheat and gram to get a proper picture and we left out onion from the initial analysis and hence from these tables. But looking at the rather large component of 'others' (which includes onion) we had it hand-tabulated. It turns out that half the N of 'others' is due to onion (the crop being entirely irrigated) in 1983-84 but in 1984-85 fruits (especially banana, grapes crops which are entirely irrigated) dominate this category. The results for onion may be set out as :

Onion	Area (ha)	Kg. of nutrients		
		N	P	K
<u>1983-84</u> (per ha)	19.49	1205.97 (61.88)	916.45 (47.02)	138.35 (7.10)
<u>1984-85</u> (per ha)	16.44	600.80 (36.54)	428.80 (26.08)	213.60 (12.99)

Thus in 1983-84 onion covered half of N of 'others' category (17 per cent to be exact) but in 1984-85 it is about 6 per cent only. This one has to attribute to the zonewise different allocation of centres and to the sampling fluctuations. But this prompted us into looking for the crops that have shown large increase in N consumption in 1984-85. When we compared the 12 agro-climatic zones, we found that large consumption in 'others' was reported from zone 8 in 1984-85. It transpired that from zone 8 (which is Region III), 11 hectares of fruit crops (mainly banana) had about 3600 kg. of N - about 35 per cent of 'others' category where as in 1983-84 only negligible area was under fruits for the sample farmers. We do not go beyond this in this category of 'others'.

#### 4.5 Irrigated Crops

Tables 4.6, 4.7 for 1983-84 and Tables 4.12 and 4.13 for 1984-85 cover information of irrigated components of crops. While in Table 4.6 and 4.12 actual areas as well as levels of N-P-K are set out, Tables 4.7 and 4.13 present per cent shares in gross irrigated area (GIA) and in N, P, K, nutrients. We first note that N-P-K per irrigated hectare is 74-27-11 kg., (1983-84) and 69-26-18 kg. (1984-85) which are rather close and obviously much above either 'total' or rainfed categories (actually for rainfed category N-P-K levels in kg/ha are 8-3-2, and 12-6-2 for the two years). But whereas nutrient input for sugarcane has gone down, per hectare nutrient input for wheat and 'others' category is up in 1984-85. Reason for the decline for sugarcane, in N for example is due to the fact that in 1984-85 sample Region III of Marathwada-Vidarbha comes out as second in importance (unlike in 1983-84 when Region I was second-best) and in this eastern region of Maharashtra nutrient inputs requirements are traditionally low - see Table 4.3(b) - and actual nutrient inputs are even lower. Further, area of Adali sugarcane in the total sample is also much lower,

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although in both the years a constant area of around 65 hectares of harvested cane is covered. More about sugarcane crop later.

#### 4.6 Rainfed Crops

Looking at Tables 4.8, 4.9 for 1983-84 and Tables 4.14 and 4.15 for 1984-85 covering rainfed crops we are struck by the fact that kharif jowar and cotton - both widely grown crops together cover about 60 per cent of N followed by paddy or bajra. The recommended doses (which are always low for rainfed crops) indicate tremendous scope for increased fertilizer use. This includes rabi jowar, pulses and also kharif jowar and cotton. We have already noted the fact that rabi jowar - the most widely grown crop in the state - is by-passed by the green revolution and the comment on the high fodder content a few paragraphs before indicates that if an HYV of rabi jowar with equally good fodder (and quality grain) is developed, it is likely to be widely adopted. If this happens and the present meager level of fertilizer input not exceeding 1 kg. per hectare is increased to a respectable level, it would be a break through in Maharashtra's agriculture.

#### 4.7 Agro-Climatic Regions and Importance of Different Crops

Analysis similar to the one in preceding sections for different agro-climatic regions is contained in regionwise tables. These regionwise tables are incorporated in Appendix A; Appendix Tables A.2 to A.25 with Tables A.2 to A.13 for the year 1983-84 (three tables for each region) and Tables A.14 to A.25 for the year 1984-85. (Table A.1 gives names of talukas/districts in which centres are selected.) In the present chapter we present a summary table, Table 4.16, covering important features of the fertilizer use over regions. But let us recall again the compositions of Regions.

Region I : High rainfall zones of I, II and moderately high rainfall zone III covering Ghat zone and transition 1 and transition 2 areas.

Region II : Scarcity zone which covers Nasik region (Zone IV), Pune region (Zone V), Sangli region (Zone VI) and Marathwada region (Zone VII). But this region has traditionally better irrigation with a network of canals.

Region III : Assured Rainfall Zone : covering parts of Western Maharashtra (Zone VIII), Marathwada (Zone IX) and parts of Vidarbha (Zone X).

Region IV : Moderately high to high rainfall zone (Zone XI) and high rainfall zone (Zone XII).

Now let us examine Table 4.16, where regionwise summary of results is presented for the two years over 18 items. First of all we again recall that for 1983-84, sample of 400 farmers was selected over 40 centres while for 1984-85 a completely new sample of 600 farmers was taken from a new set of 60 centres in which Regions III and IV have a larger than 1983-84 coverage in terms of farmers and also in terms of their gross crop area (GCA). The biggest of the regions, Region III is 45 to 50 per cent - i.e. nearly half the total, and its share in gross irrigated area (GIA) improves from 20 per cent in 1983-84 to 30 per cent in 1984-85 while Region IV's share in GIA of sample reduces from 13 to 6 per cent. Region II, the scarcity or 'drought-prone' region has its share in GCA reduced from 31 to 24 per cent but its share in GIA increases from 58 to 60 per cent. Some of these facts were remarked upon from time to time but a quick recapitulation of the broad features would be helpful in comparing other results.

Apart from differences in estimates between the two years we note that Region III of assured rainfall is the biggest, followed by Region II of scarcity which is also the traditionally irrigated area. Region I of Konkan and Ghat has moderately high to high rainfall is the smallest (and here sample farm size is also small as it is a hilly region - item 3). It has some irrigation - 4 to 8 per cent of total

sample GIA - the smaller figure being for 1984-85. Region IV of Vidarbha and Marathwada of moderately high to high rainfall with irrigation share 6 to 13 per cent of GIA.

Region II, scarcity region, is the largest consumer of N between 36-46 per cent (36 per cent for the second year) share in total sample N, followed by 24-35 per cent share in N for Region III, the assured rainfall zone. Regions I and IV of higher rainfall have nearly equal shares in total N at 15 per cent in 1983-84 but 8 and 20 per cent respectively in 1984-85. Irrigated area plays a very high role in consumption of fertilizers in Region II with about 90 per cent of region's N being on account of irrigated area (and as has been remarked and as we would also find later in this analysis, sugarcane plays a big role in fertilizer consumption in this region affected by scarcity). In Table 4.2 of summary results for sample as a whole, it was seen that share of GIA in total N was 66 and 58 per cent over the two years. Here we see what a pronounced role irrigation plays in Region II.

It was also found that per ha. N-P-K came to 19-7-3 kg. and 22-9-5 kg. for the two years. Here in item 9, we see that the first two regions have much higher inputs than Regions III and IV for both the years. But Region I shows changes in many features due to changes in sugarcane area, total area, irrigated area etc., as commented upon. So let us concentrate on Regions II and III covering more than 70 per cent of GCA. The scarcity region of Region II has N-P-K/ha at 28-10-3 and 35-13-9 kg. compared to 10-5-2 and 16-8-3 kg. for Region III of assured rainfall over the two years. This is not surprising as Region II has relatively larger area under canal-well (and lift) irrigation. But when we come to the N-P-K/ha for rainfed (or dry) area, Region III of assured rainfall has 9-4-1 kg. and 9-5-2 kg. which are higher than 3-0-0 and 8-3-2 kg for Region II, the scarcity area (zeros here really mean less than 1/2 kg.). Thus N-P-K/ha is higher in assured rainfall



zone than in the scarcity zone, although we note that in 1984-85 the difference is less pronounced. If we look at the 'recommended doses of N-P-K' Tables 4.3(a) and (b) for even traditional varieties in unirrigated/uncertain rainfall areas N recommended is 25 and above (barring bajra but that too only in Table 4.3(b) with N requirement of 12 kg/ha). This takes us to an important conclusion : although there is a greater scope for fertilizer use in uncertain rainfall areas, in assured rainfall areas the scope is much much higher. In moderately high - high rainfall areas moisture is no constraint but even there N/ha is between 10-20 kg. over the two years which is small when we recall that for rice (paddy) HYV recommendations is over 100 kg. of N/ha and between 25-50 kg./ha for traditional varieties even by Table 4.3(b) which has rather conservative doses.

A look at N-P-K/ha for irrigated area, item 10, reveals that in the high-level fertilizer use of first two regions there is some reduction as the proportion of sugarcane area is less in the second year in these regions. In Region II for example, area under sugarcane reduces marginally from 43 hectares to 36 hectares but gross irrigated area increases by one and half times (see Appendix Tables A.2, A.3 and A.17 and A.18) so that sugarcane area component reduces from 19 to 11 per cent in GIA and with N/ha also reducing from 390 to 307 kg. N per ha of gross irrigated area reduces from 83 to 64 kg., over 1983-84 and 1984-85. Similar rates of Regions III and IV now show increases from 24 to 69 kg., because of more area under sugarcane and also a substantial increase in the 'others' component of irrigated crops where fruits like grapes, bananas requiring high fertilizer use get greater coverage in the second year. Thus one can see how inclusion/exclusion and proportions of crucial crops like sugarcane and to some extent of crops like grapes, bananas affect the estimates N-P-K use per hectare. This indicates that in any enquiry relating to

fertilizer use, these crops need to be handled on a special footing.

In item 12 in Table 4.16, the table under discussion, we have tried to look at the fertilizer use excluding sugarcane and the estimates over regions for gross cropped area in 12(i) are now low but more comparable but those for irrigated area in 12(ii) still fluctuate over the years. In 12(iii) we have then tried estimates for irrigated area excluding sugarcane and 'other crops', the latter having a significant component of fruits in 1984-85 as mentioned. The resultant estimates for irrigated area (excluding sugarcane and other crops) are closer together. In Region II of scarcity and Region III of assured rainfall, estimates of N/irrigated ha now range between 20 and 40 kg. This immediately appears as low because for irrigated area recommended N ranges between 50 and 120 kg/ha for the now remaining crops of kharif jowar, wheat, rice, rabi jowar etc., and a great scope for increased fertilizer use is indicated. In the other two regions (Regions I and IV) of higher rainfall, N/irrigated area without 'sugarcane and others' estimates are higher than Regions II and III, ranging between 35-65 kg/ha. Since moisture is no constraint, here too, if proper doses are given to crops like rice, fertilizer use can be extended. If we calculate similar N/ha rates for entire sample (i.e. at the state level) for irrigated area without sugarcane and 'others' then estimates come to 32 and 40 kg/ha for the two years. Surely with irrigation available, these levels are on the low side. Incidentally, we may mention that in Regions II and III N-P-K per rainfed ha. is lower than the overall in spite of having substantial kharif jowar (Region II) and kharif jowar and cotton (Region III) areas with relatively better use of N-P-K (as mentioned before and as will be seen when we take individual crops), because Region II has substantial rainfed rabi jowar while Region III has substantial pulses, both with poor N-P-K applications.

From items 13 to 18 in the table, we discuss prominent crops in terms of area and in terms of fertilizers (N) consumption. In item 13 we see that among top 3 crops, in terms of area rabi jowar, cotton and kharif jowar feature frequently in Region II, III and IV (as at the state level) but in Region I it is rice at the top. Among top fertilizer consumers sugarcane is prominent in first two regions while cotton or kharif jowar are at the top in third and fourth region, thus underlining the importance of these mostly rainfed crops as good consumers of fertilizers. (At the state level sugarcane is at the top followed by cotton/kharif jowar as seen earlier.) For irrigated crops, sugarcane, wheat, rabi jowar (especially in 1984-85) are important areawise (item 15) while top fertilizer consumers are sugarcane-wheat. Rabi jowar is a poor third and that too for only 1984-85. Among rainfed crops (items 17 and 18) in terms of area, rabi jowar, cotton, kharif jowar feature often (for Region I it is rice at the top) but among top fertilizer consumers rabi jowar is nearly absent and predictably, kharif jowar, cotton, bajra feature often. Bajra features mainly in Region II and we may mention that in Maharashtra; the green revolution really started with hybrid bajra and appearance of bajra as a major fertilizer consumer among dry crops is no surprise but even after an early start the introduction of hybrid variety is not vigorous after the crop started suffering from the soil-borne fungus "downy mildew" from 1971-72 to 1976-77, the worst year perhaps, being 1975-76, apart from the drought years of 1971-72, 1972-73.

The discussion in this section may be summed up as follows: The scarcity Region II, the second largest region in terms of area, has highest fertilizer (N) consumption of 35 to 40 per cent of state level consumption mostly on account of irrigation-sugarcane. Region III of assured rainfall - largest in area - comes next with 25 to 35 per cent

of consumption. The per hectare consumption of N for the farmer region (30 to 35 kg. of N) also exceeds the consumption for the latter (10 to 16 kg. of N) for the two years. For rainfed area, per hectare consumption for Region III with its assured rainfall is higher than that for the Scarcity Region II as one would expect but both are below 10 kg. of N per hectare. This shows that there is scope for increased use of fertilizers in scarcity region but more<sup>so</sup> in the assured rainfall region. Although both these regions have kharif jowar and/or cotton with their rather good levels of fertilizer use, scarcity region has large unirrigated rabi jowar area while assured rainfall region has large pulse area with their poor levels and hence the low levels for rainfed area. If we exclude sugarcane and 'others' (with their fruits component) level for irrigated area are more compact-within the range of 20 to 60 kg/ha and these are obviously low indicating greater scope of increased fertilizer use as even a seasonal irrigated crop of kharif or rabi jowar has a recommendation of 50 kg. of N per hectare.

#### 4.8 Individual Crops

Now we turn to important individual crops, Regionwise consumption levels for these crops are presented from Table 4.17 to 4.25. In these tables we would consider only N and P levels. This is for brevity and besides Maharashtra has soils which are generally rich in K so exclusion of K would not matter. In the Appendix Tables in Appendix A of course, detailed regionwise data are available.

##### Kharif Jowar:

It is already noted that this crop with area second only to rabi jowar, mostly rainfed, has been making large additions to the foodgrains production in the State and is the largest component of foodgrains. The increase in the production is partly due to area but mainly due to productivity (Chapter II, Table 2.6).

Although mostly rainfed, HYV introduction has played a significant part in the growth of this crop. HYV area has increased steadily over the years to 66 per cent by 1982-83 (Epitome of Agriculture, 1984-85, p.110) and this is the highest percentage achieved for any foodgrain. N-P-K/ha usage is estimated at 16-6-3 kg (1983-84) and 20-9-4 kg (1984-85) from our data and with less than 3 per cent/area under irrigation (sample estimates, official data estimates are even lower, see Table 2.5) this level of fertilizer use is an achievement.

By Tables 4.3(a) and (b) we have the recommended doses in kg/ha as:

Table 4.3(a)

Traditional : 50-25-25 (irrigated) 25-12.5-12.5 (dry)

HYV : 120-60-60 (irrigated) 60-30-30 (dry)

Table 4.3(b)

Traditional : 50-25-25 (irr/assured rainfall)

25-12.5-12.5 (dry or uncertain rainfall)

HYV : 75-62-62 (irr/assured rainfall)

25-12.5-12.5 (dry or uncertain rainfall)

In Table 4.17 regionwise area under kharif jowar along with N-P-K and N-P/ha are presented. From this table we see that for rainfed kharif jowar N does not exceed 25 kg and P does not exceed 13 kg but the average does not exceed 19-9 N-P/ha and thus there is a scope for increased use. But we see that between Region II of scarcity-uncertain rainfall and Region III of assured rainfall, N-P levels for the latter are only marginally higher in 1983-84 but actually lower in 1984-85 for our sample farmers. The assured rainfall region perhaps distinguishes itself by widespread cultivation of the crop (about 60 per cent of area, see Chapter II) and consequently large HYV areas rather than better levels of fertilizer use. This means that in assured rainfall areas there is considerable scope for increased fertilizer use if the

degree of confidence in HYV - fertilizer use reflects not only in widespread adoption but higher levels which are clearly permissible by the recommended doses. For irrigated kharif jowar we see that it is taken only in Region II in 1983-84 but in 1984-85 slightly higher areas in all the regions are noted and N-P in the latter year is 71-24 kg/ha whereas recommendations of N, for example, are 50 to 120 kg per hectare. Fertilizer use is clearly higher under irrigated conditions but with absolute area so small the reliability of estimates is not very great.

#### Rabi Jowar:

It is pointed out often that this is the most widely grown crop in the State covering about 18 per cent (1980-83 triennium) area but its production and productivity have stagnated over the years as noted in Chapter II. Among foodgrains, even with an area share of 26 per cent its production share is about 16 per cent only, with its stagnant productivity around 4.30 quintals/ha (productivity for kharif jowar is over 10 quintals/ha) as compared to the increased productivity of foodgrains over the years (i.e. 1967 to 1983) from 5 to 7 quintals per ha on account of crops like kharif jowar, rice, wheat, in fact in that order.

Although this crop has better irrigation (8 to 10 per cent over 1964-1983) hybrid-high yielding (together referred to by us as HYV) varieties have not made an impression on this crop - it is under 5 per cent till 1981-82 but 9 per cent in 1982-83 (Epitome of Agriculture, 1984-85, p.111). It is already pointed out by us that this crop has a fodder value with fodder content highest among foodgrains (see Section 4.4). In absolute terms also fodder value per hectare is highest among all foodgrains. The recommended doses N-P-K in kg/ha are as follows:



(Table 2.7, Chapter II). In fact over entire period of 1967-70 to 1980-83 production growth rate is mere 0.30 per cent p.a. with productivity rate of 2.20 being nullified by area growth rate of -1.86 per cent per annum. Really performance of this crop has been an up and down affair. The recommended doses of N-P-K in kg/ha are:

Table 4.3 (a)

<u>Traditional</u>	: 50-40-20 (irrigated)	25-20-10 (rainfed)
<u>HYV</u>	: 50-40-20 (irrigated)	25-20-10 (rainfed)

Table 4.3 (b)

<u>Traditional</u>	: 12-0-0 (irrig/assured rainfall area)	12-0-0 (rainfed/ uncertain rainfall)
<u>HYV</u>	: 50-37-25 (do)	N.A. (do)

In Table 4.3 (b) we see that HYV under uncertain rainfall draws no recommendation for fertilizer use. Perhaps the authors (see Section 4.3) do not recommend HYV without assured moisture conditions - an uncertainty causing indecision of many farmers in the drought-prone Region II, the main bajra area.

In Table 4.19 levels of N, P for bajra are set out under irrigated and rainfed conditions for various regions. By official data (Table 2.3 in Chapter II) only 2 to 3 per cent of bajra is taken under irrigated conditions but our sample has 10 per cent (1983-84) and 20 per cent (1984-85) area under irrigation (Tables 4.4 and 4.10). From the present table (Table 4.19) we see that irrigated bajra is almost wholly in Region II, the main bajra region. Region III also has substantial areas under bajra under rainfed conditions. For irrigated bajra N-P comes to 44-6 kg/ha and if we go by Table 4.3(a) recommendation for N-P of 50-40 kg/ha, P level is deficient but N appears satisfactory. For rainfed bajra, for total sample we get N, P estimates of 8-1 kg/ha (1983-84)



and 10-2 kg/ha (1984-85) which are below recommendation of 25-10 kg but close to 12-0 kg recommendation by Table 4.3(b). But we note a curious phenomenon : In 1983-84 as in 1984-85 we have substantial areas of rainfed bajra in Region II and Region III. In 1983-84 assured rainfall region of Region III has a N-P usage of 15-2 kg/ha and 6-0 kg/ha for Region II of scarcity-uncertain rainfall region but in 1984-85 while Region II (scarcity) has N-P 12-2 kg/ha, N-P for Region III is lower at 8-2 kg/ha. This may be due to the fact that 1984-85 different sample is taken from different villages (see Appendix Table A.1 and Chapter III) or perhaps if in a given year initial rains are satisfactory, subsequent uncertainty does not matter for a crop like bajra which can stand moisture stress.

Regarding the role of HYV, from Epitome of Agriculture, 1984-85 Part I, p.18, we see that between 1978-79 and 1981-82 percentage of HYV to total bajra area increases steadily from 18 to 38 per cent while for 1982-83 it is as high as 53.5 in 1982-83. This means HYV is not confined to irrigated part and rainfed HYV is also important. By Table 4.3(a) and 4.3(b) in assured rainfall areas HYV recommendation of 50-40 and 50-37 kg of N-P/ha there is considerable scope and perhaps a limited one in uncertain rainfall areas if we go by Table 4.3(b).

#### Cotton:

Now we come to a crop which is important as a fertilizer consumer in spite of being rainfed. It covers about 13 per cent of GCA, has only 2 to 5 per cent area under irrigation and disappointing production growth rates over 1967 to 1985 (Table 2.8, Chapter II). As regards HYV cotton, the per cent area under HYV increases steadily from 3 to 5 per cent over 1978-79 to 1982-83 (Epitome, 1984-85, p.27).

Our sample farmers also have about 15 per cent of GCA under cotton with 4 to 8 per cent under irrigation. We have the recommended doses as follows (N-P-K in kg/ha.).

Table 4.3 (a)

<u>Traditional</u>	: 100-50-50 (Irrigated)	30-50-25 (rainfed)
<u>HYV</u>	: 100-50-50 (Irrigated)	80-40-40 (rainfed)

Table 4.3 (b)

Hybrid-4 (irrigated)	100-50-50	Irrigated/ assured rainfall areas	No N-P-K mentioned for unirrigated uncertain rainfall area for Hybrid-4 and Varalaxmi
Hybrid-4 (rainfed)	50-25-25		
Varalaxmi (irrigated)	80-40-50	- do -	
Varalaxmi (rainfed)	50-25-25		
Desi	50-25-25	- do -	25-12-0 (uncertain rainfed)

We have on the other hand, three classifications in our sample data : Long staple (LS), Medium staple (MS) and Short staple (SS) apart from the irrigated-rainfed status. We presume that LS is mainly HYV, MS is a mix and SS mainly traditional varieties. In Table 4.20 and 4.21 data relating to 1983-84 and 1984-85 respectively are presented. It shows area and N under LS, MS and SS varieties. Fertilizer use is confined to Nitrogen (N) only, for brevity. Details are of course available in the detailed tables in the Appendix A.

We first note that cotton is mainly confined to Region III and Region IV. For LS irrigated cotton use of 56 kg N/ha is reported in 1983-84 and in 1984-85 it is 50 kg N/ha. The sample also indicates that LS is the dominant variety in irrigated cotton. Recommended dose (N) for HYV for Table 4.3(a) is 100 kg/ha and for 4.3(b) it is 80 kg/ha. There is great scope in increasing N input but we have to remind ourselves that official data suggests not much area under irrigated cotton and extending irrigation facilities to cotton would be equally important in increased fertilizer use. For rainfed cotton, N for LS variety is 31 kg (1983-84) and 23 kg (1984-85) per hectare. Even for Desi variety N recommendation for

irrigated or assured rainfall areas is 50 kg and there is clear scope for increasing fertilizer use. For MS and SS varieties for irrigated cotton N/ha is 12-16 kg (1983-84) and 24-30 kg (1984-85). Here also there is scope for higher use of N. But again absolute areas may not be high. For irrigated MS and SS N/ha for varies between 10 to 20 kg over the two years, much below 50 kg/ha for Desi variety in assured rainfall areas. As cotton is more or less confined to Regions III and IV where moisture is no constraint, fertilizer use can be easily increased, going by the recommended dosage. In the scarcity region of course, opportunities are limited unless irrigation is provided. But this appears difficult as sugarcane the next crop to be taken up, dominates agriculture in that area

#### Sugarcane:

Importance of sugarcane in Maharashtra's agriculture is frequently commented upon in this study. This crop taken entirely under irrigated conditions, covering not more than 3 per cent of GCA, is the top fertilizer consumer in the State covering between one-fourth and one-half of nutrient N (e.g. see Table 4.16). Over the period 1967 to 1982 it has a production growth rate of 6 per cent, comparable to wheat. This is mainly on account of area and only partly on account of productivity (Tables 2.5 and 2.8, Chapter II). By the ACPM Study (pp.235-236) (mentioned in Section 4.2) between 45 and 60 per cent of irrigation water is also consumed by this crop, which is very high indeed.

For the sample farmers also the coverage is between 2 and 3 per cent of GCA and consumes 42 per cent of N in 1983-84 and 23 per cent of N in 1984-85. It may be immediately remarked that the reduction is due to lesser proportion of GCA under sugarcane in 1984-85 as well as due to more area coverage under Region III in the entirely fresh sample of 1984-85 and this region having low N-P-K requirements than the

main Region II. For other crops, levels of fertilizer use in 1984-85 (especially in rabi jowar and 'others') were also generally higher. Nevertheless sugarcane is the top fertilizer consumer in both the years.

The recommended doses are available for Adsali, pre-seasonal and Suru varieties. Adsali is the longest-duration variety of one and half year (with high productivity). Pre-seasonal and Suru are yearly varieties but the former is sown early (September-October) while the latter, the most common variety, is sown in February. Doses are also mentioned for ratoon crop. From Table 4.3(a) we have (kg/ha) recommendations:

Suru	250-115-115
Pre-seasonal	340-170-170
Adsali	400-170-170
Ratoon	250-115-115

But Table 4.3(b) has rates for major sugarcane regions as follows (kg/ha):

Suru	:	1. Konkan Region : 150-110-110 (Konkan Part in Region I of our analysis)
		2. Deccan Canal Tract : 250-115-115 (Region II of our analysis)
		3. Vidarbha-Marathwada : 170-115-115 (Regions III and IV)
Pre-seasonal	:	2. Deccan Canal Tract : 340-170-170 (Not suited to Konkan)
		3. Vidarbha-Marathwada : 250-170-170
Adsali	:	2. Deccan Canal Tract : 400-170-170 (suited only to Region II)
Ratoon	:	1. Konkan Region : 150-110-110
		2. Deccan Canal Tract : 250-115-115
		3. Vidarbha-Marathwada : 170-115-115

In Table 4.22 we present regionwise level for 'planted and harvested' (PH) cane and for ratoon harvested (RH) cane.

We had also 'standing cane' as mentioned in Chapter III (Section 3.6) which we excluded from analysis as the crop is standing at the end of year (planted probably in February of that calendar year) and has yet to receive all its doses of fertilizers and hence is not suited for analysis. But we do not have separate analysis for 'Adsali' or pre-seasonal types and varieties as introducing them would have made the analysis cumbersome as we have to worry about standing cane, harvested cane, among harvested planted-harvested ratoon-harvested further regionwise peculiarities and the need for adequate area coverage to arrive at meaningful conclusions. Besides, pre-seasonal variety requirements are not much different from 'Suru' (exception N input for Region II) variety and Adsali being confined to Region II only, these sub-divisions were avoided and analysis is made for planted-harvested (PH) and ratoon-harvested (RH) categories only. In the present table (Table 4.22) we present N-P/ha for the two years for brevity (details of K are available in Appendix tables).

From this table we see that Regions I and II have high consumption of N between 300 and 390 kg/ha. The high consumption for Region I of Konkan area + ghat area and Transition I and Transition II area (see Table 3.1, Chapter III) is really on account of ghat zone and transition areas rather than Konkan proper where N (and P-K) recommendations are lower at 150 kg/ha. Thus for sugarcane crop Region I is not different than Deccan - Canal tract of Region II. For Regions III and IV, N ranges from 30 kg to 90 kg/ha. Here the use levels are obviously low and can be increased as even ratoon recommendations for Regions III and IV (i.e. Region 3(a) of Table 3(b)) are 170-115-115.

We also see that (last two columns) for both the years area is same at 45-46 hectares although GCA increased in 1984-85 with one and half times coverage. We also see that in Region I area reduced from 12.12 ha (1983-84) to 5.57 ha

(1984-85) whereas for Region III it increased from 3.88 ha (N at 70 kg/ha) in 1983-84 to 22.53 ha (Not 40 kg/ha) in 1984-85 and hence the overall rate reduced from 274 kg of N/ha to 231 kg N/ha over the two years. In Region II the N level is consistent around 300 kg/ha in the sample and with suru recommendation of 250 kg., pre-seasonal recommendation of 340 kg and Adsali recommendation of 400 kg of N/ha, actual average at 300 kg/ha is a good level and we also know that productivity is very high in Region II and much lower in Regions III and IV of Marathwada-Vidarbha. Looking at levels for planted-harvested (PH) and ratoon-harvested (RH) the former are higher by 60 to over 100 kg for N. For P there appears room for improvement as P recommended is between 115 kg to 170 kg whereas for 1984-85 it ranges from 40 to 123 kg over different regions. For Region II, the main PH component for 1983-84 P is indeed 171 kg/ha, at the upper limit among the recommended doses.

Thus by and large fertilizer use appears to be satisfactory for main sugarcane tract of Region II but the input has scope to increase in Regions III and IV of Marathwada and Vidarbha.

#### Groundnut

This important oilseed whose share in the State GCA has been steadily reducing over 1967-1983 (from 4.72 per cent in 1967-70 to 4.34 per cent in 1974-77 to 3.90 per cent in 1980-83 trienniums) has a poor performance in the State. It has a negligible irrigation component (which has increased steadily from 1 to 3 per cent of total groundnut area over 1967-1983) and the production of the crop has declined/stagnated with productivity growth rate (1.01 per cent per annum) getting neatly cancelled out by negative area growth rate (-1.11 per cent per annum, the Table 2.8) with overall negative production growth rate of -0.11 per cent per annum.

The productivity, it may be noted, has increased from 7 to 8 quintals (pods) over 1967-83.

Although there are successful new varieties, these are not 'HYV' varieties in the sense of fertilizer-responsive varieties like wheat, rice, etc., where yields are in multiples of local varieties. In fact, Epitome of Agriculture of the the Directorate of Agriculture (1984-85, Part I, p.29) does not give any data in the specified row under the title 'hybrid/high yielding variety area' below the total area under groundnut for years 1978-79 to 1982-83 - the years which are covered in that Epitome.

The recommended N-P-K/ha (in kg) are same in Tables 4.3(a) and 4.3(b):

25-50-0 Irrigated area Table 4.3(a), Irrigated or assured rainfall area Table 4.3(b)

12-25-0 Unirrigated area Table 4.3(a). Unirrigated or uncertain rainfall area Table 4.3(b).

In Table 4.23 we have presented N-P usage of fertilizers for various regions for the two years. Tables 4.4 and 4.10 reveal that we have 30 and 20 per cent groundnut area under irrigation for the two years for the sample farmers whereas at the State level it is only 3 per cent as noted above. For groundnut (irrigated and unirrigated components together) the N-P-K/ha in kg are 13-8-4 kg in 1983-84 and 14-15-4 kg in 1984-85 (see Tables 4.5 and 4.11). We see a pronounced imbalance for 1983-84 whereas in N-P of 14-15 kg.; a dose 15 kg of P is nowhere near twice the N in the recommended doses. From the present Table (Table 4.23) we see that groundnut is sizable (in the sample) in Regions III and II followed by Region I (from the Ghat and transition part) but irrigated component is consistently high in Region II, the traditionally irrigated drought-prone area. We see that for irrigated groundnut the imbalance in N-P is marked, being 17-7 kg of N-P per hectare in 1983-84 and 24-19 kg

in 1984-85. For rainfed component N-P are 11-9 kg/ha in 1983-84 and 12-14 kg/ha in 1984-85. The P dose is well below the norm of twice the N dose for irrigated area than the rainfed area. For the main Region III, for rainfed area, N dose appears satisfactory and P, while inadequate, the extent of inadequacy is not as marked as that for irrigated area.

What can be the possible reason for imbalance in N-P doses? Ignorance could be one reason but with irrigated groundnut being the more serious case, the possible reason could be speculated upon. For Maharashtra summer groundnut is dominant in the irrigated groundnut area. For example according to official statistics, in 1978-79 summer groundnut is 230 hundred hectares out of total 408 hundred hectares of irrigated groundnut at the state level, i.e. summer groundnut is over 56 per cent of irrigated groundnut (Season and Crop Report for 1978-79 by the Directorate of Agriculture, p.62). Now summer groundnut is often taken with a perennial crop like sugarcane when the latter is in its initial stages. With sugarcane being planted in February, a quick summer groundnut crop is possible before cane achieves a substantial height. But fertilizer doses of sugarcane are heavily in favour of N compared to P (in fact N is more than twice P) and after <sup>applying</sup> some rule of thumb in area allocation (and hence in N allocation) to groundnut within sugarcane, this fertilizer dose in favour N must be creating an imbalance in fertilizer application to irrigated groundnut. But we also admit that barring the main region of groundnut of Region III, doses are not only imbalanced but show fluctuations over the two years.

#### Rice (Paddy)

This is a crop which, although important in the State, was not included in sampling scheme of the thirteen crops as discussed in the previous chapter. Wheat and gram were the other two important crops left out. After the farmers were



selected with the focus on the thirteen listed crops, data for rice, wheat and gram were looked into as these crops are important to the State although Maharashtra's contribution in these may not be so important from the national point of view.

Rice covers over 7 per cent of State GCA and next to kharif jowar this is the crop that constitutes the foodgrains production of the State. By 1980-83 triennium averages, although it covers 10.76 per cent of foodgrains area, it accounts for 23 per cent foodgrains production (Table 2.3). Over 1967-83 it shows good and consistent growth rates of production (Table 2.8) and for this period it has a good production growth rate of 3.91 per cent, mostly on account of productivity gains, productivity growth rate being 2.94 per cent per annum. An intensive crop like rice has always higher productivity level than other foodgrains but apart from the high level, productivity has risen from 10 quintals/ha in 1967-70 to 15 quintals/ha in 1980-83 (Table 2.7). The absolute additions to rice production over years are second only to kharif jowar (Table 2.6).

For this crop which has one-fourth area under irrigation the recommended N-P-K doses in kg/ha are as follows:

Table 4.3(a) : 100-50-50 (irrigated)      50-25-0 (rainfed)

Table 4.3(b) : Traditional

50-25-25 (for irrigated and assured rainfall areas for acidic soils)

25-25-25 (for irrigated and assured rainfall areas, for other soils)

HYV      100-50-0 (irrigated and assured rainfall areas)

Summer  
Paddy      120-50-0

We have already commented that in our sample, paddy has inadequate representation in area - less than 2.5 per cent of GCA in both years as against the 7 per cent of GCA

by the official data. N-P for rice as a whole comes to 31-6 kg/ha in 1983-84 and 50-9 kg/ha in 1984-85 which appear close to 50 kg of N/ha recommended for traditional variety, (rice is taken only in high to very high rainfall areas so moisture is no constraint) but next to wheat and kharif jowar, HYV has made an impact for this crop and coverage of HYV area has been 57 per cent in 1978-79 and has increased to 62 per cent in 1982-83 (Epitome of Agriculture, 1984-85, Part I, p.15). For HYV, the recommendations of N-P are 100-50 kg/ha and 120-50 kg/ha. With 60 per cent area under HYV, there appears to be considerable scope for increased fertilizer use for this crop.

From Table 4.24 we see that irrigated rice is reported from Regions I, II and III in 1983-84 and Regions II, III and IV in 1984-85 with highest total sample area in any region being less than 4 hectares. However, it may be noted that rice region covers mainly Regions I and IV and irrigated rice mostly comes from Region IV, a fact which does not come out in the sample perhaps because this crop was not in the 13 crop aggregate on which sampling was based. From the table we see that for irrigated rice N-P usage comes to 79-44 kg/ha in 1983-84 and 50-9 kg/ha in 1984-85. With HYV area coverage of over 60 per cent in the State, there appears scope for increased use of fertilizers.

For unirrigated rice, in main areas of rice viz. Regions I and IV, N-P usage is 22-5 kg/ha in 1983-84 and 50-9 kg/ha in 1984-85. Here, of course, there is a considerable scope in fertilizer use because unirrigated rice is over three-fourth of rice area.

### Wheat

As mentioned before, hybrid variety and hence green revolution made its impact on Maharashtra through the widely grown bajra, a crop which later on received setbacks due to fungus-type disease. But HYV had made its impact through

wheat all over India and Maharashtra could not be an exception even though the crop is not very widely grown (5 per cent of GCA in 1980-83 triennium). In 1967-70 wheat was 4 per cent of GCA compared to 11 per cent area of bajra and productionwise, after kharif jowar, rabi jowar, rice it was bajra (production 635.5 thousand tonnes) followed by wheat (384.2 thousand tonnes). By 1974-77 triennium, wheat went ahead of bajra (wheat 955.3 thousand tonnes and bajra 603.2 thousand tonnes). But since that time wheat production stagnated and although wheat is still fourth largest supplier of foodgrains, its 1980-83 production is actually lower at 908 thousand tonnes while that of bajra, which showed modest increase, is at 661 thousand tonnes (Tables 2.4, 2.6).

For 1967-1983 period wheat has a production growth rate of 6.84 per cent per annum higher than any other foodgrain or any other crop for that matter, including sugarcane (growth rate 5.98 per cent per annum, see Table 2.6, last column). But if we consider 'recent' period of 1974-77 onwards, wheat has stagnated. Area under irrigated wheat, on the other hand, has been increasing steadily over the years from 239.7 thousand hectares in 1969-70 to 460.4 thousand hectares in 1974-77 to 575.8 thousand hectares in 1980-83. This shows clear preference of farmers to take the crop under irrigated conditions. The irrigated proportion of the crop has increased consistently from 29 per cent to 42 per cent to 53 per cent over the three trienniums mentioned (Table 2.5). If we look at the proportion of HYV area to total wheat area, in 1978-79 it is 81.8 per cent, decreasing to 77.5 per cent in 1982-83, but still remaining high (Epitome of Agriculture, 1984-85, Part I, p.113).

The recommended doses of fertilizers (N-P-K) for this crop in kg/ha are as follows:

<u>Table 4.3 (a)</u> : Tall HYV	75-50-50	(irrigated)
	40-20-0	(unirrigated)
Short HYV	120-60-50	(irrigated)

<u>Table 4.3 (b)</u> : Traditional	75-50-0	(irrigated/assured rainfall)
	25-25-0	(unirrigated/uncertain rainfall)
Tall HYV (Niphad)	75-50-50	(irrigated/assured rainfall)
Short HYV	120-60-50	(irrigated/assured rainfall)

The two recommendations do not differ much, but we may note that Table 4.3 (b) (for details of this Table see section 4.3) has no recommendation mentioned against HYV in uncertain rainfall. In Table 4.25 where sample estimates of fertilizer use on wheat for the two years are presented region-wise, we see that we have large areas of irrigated wheat reported from nearly all the regions and from main irrigated wheat regions of II, III and IV we see N around 70 kg/ha and P around 20 kg/ha. Tall HYV Niphad varieties are preferred in Maharashtra and 70-20 usage of N-P appears satisfactory. To the extent Short HYV varieties are taken, a higher dose would be needed. For unirrigated wheat (or unirrigated in uncertain rainfall areas) recommendations in N-P are from 25-25 to 40-20 kg/ha as mentioned above but from Table 4.26 we see that sample farmers are applying very low levels of N-P. For 1983-84 our estimate is 3-1 kg/ha and for 1984-85 it is 7-2 kg/ha, much below the minimum 25-25 kg/ha for N-P. Here is some scope to increase fertilizer use but we also see that farmers are not inclined to take unirrigated wheat, preferring to take the same under irrigated conditions.

#### Other Crops

##### Pulses

Under this, we have tur, mung (green gram), udid (black gram) and gram covered in our crop list. Barring gram, pulses are rarely taken under irrigated conditions. For the State, official statistics shows that total pulses area is 13 per cent of GCA (Table 2.3) and from our sample, we see

that these four pulses cover 15 per cent area in 1983-84 and 14 per cent area in 1984-85. Pulses account for 2 per cent of total N in 1983-84 and 5 per cent of total N in 1984-85. Regions III and IV cover main pulse area. For the entire sample we have N-P usage of 2-0 kg/ha for pulses in 1983-84 and 9-5 kg/ha in 1984-85 and this is well below 12.5-25 kg/ha, the minimum dose by Table 4.3(a). Apart from the dose being low, there is imbalance, with P being nowhere near twice N. Pulses are often taken as a mixed crop and it is possible that the imbalance may be due to this factor but ignorance and the belief that these nitrogen-fixing crops do not require fertilizers could also be important. In any case, there is scope for increased use of fertilizers.

#### Safflower

Area under groundnut is, by and large, declining over 1967-83 but area under safflower is rising consistently over this period (see Table 2.4). Its production is also rising, but area in fact is secondary reason for increased production, productivity showing considerable gains (Table 2.7 and 2.8). Compared to groundnut's area share of 13 per cent by official data, safflower's share is 4 per cent only.

In our sample, safflower has .58-.58 N-P in kg/ha in 1983-84 and 2.29-2 kg/ha in 1984-85 and these are extremely low and well below 25-50 N-P in kg/ha by Table 4.3(b).

#### Onion

Although onion is not included in the crops we analysed (although onion was in the 13-crop aggregate on which sampling is based) because of relatively small area coverage, we have in section 4.4 presented data of total area under onion in the two years and N-P-K usage for the sample farmers. In 1983-84 we get N-P usage as 62-47 kg/ha and in 1984-85 it is 37-26 kg/ha. Compared to 100-50 recommendation of Table 4.3(a) this is low, but it is comparable if we look

at Table 4.3(b) recommendation which is 50-50 of N-P in kg/ha. We refrain from saying whether or not there is a scope for increased use of fertilizers.

#### 4.9 Other Features:

We have also analysed data by size group of holdings and a quick examination of the classical size-inputs relation is attempted for the fertilizer input. Further, we also examine source of irrigation-fertilizer input relationship. These above mentioned aspects are analysed for only one year, viz., 1984-85 in which we had a bigger sample of 600 cultivators as against a sample of 400 cultivators in 1983-84. We may mention that the data were hand-tabulated for some reason and there are discrepancies in some of the aggregates mentioned so far. In such a large data, these discrepancies are only inevitable but these are not large and for our purpose the broad agreement is sufficient to warrant our conclusions.

#### Size of Farm and Fertilizer Use

In Table 4.26 and 4.27 data which bring out the relationship between cultivated area, net irrigated area and use of N and P nutrients are presented by size group of holdings. There is a difference, however, between 'size-groups' in Table 4.26 and 'size groups' in Table 4.27. In Table 4.26 the size groups are those that were adopted while sampling the cultivators. Going back to the sampling methodology we recall that after 60 centres were selected (each centre consisting of 1 to 3 villages) in each centre all the farmers were arranged according to their size of holding and five groups, each covering equal (i.e. fifth of total) area were formed and from each group, two cultivators selected making up ten cultivators in each centre. Now we have to remember that for each centre this procedure was adopted so that the actual class limits in terms of hectares of area of a size group (say size group 1) varied from centre

to centre and hence from zone to zone and region to region. A small farmer in group 1 in a given centre thus may have an area bigger than even the upper limit of a 'small' farmer of group 1 in another centre. We have already observed that in Konkan area (Region I) average size of a farm is small (2 ha in 1983-84 and 3.50 in 1984-85 compared to overall sample averages of 5.48 ha and 4.87 ha in the two years), Konkan being a hilly region, but the farms are intensively cultivated with a crop like rice. This can be contrasted with extensively cultivated cotton-kharif jowar tracts of Region III. In fact that upper limit of size group 1 varies from 0.66 ha to 4.71 ha and similarly limits of other classes vary from centre to centre. We have grouped farms by these size groups irrespective of the actual size of holding and thus farms in group 1 indicate that these are 'small' farms by the local standards - although across the zones they may vary considerably in size. In Table 4.27 we have farms classified by the usual size groups below 2 ha, 2-4 ha etc. and here size group is '1' for all the farms in the range 0-2 ha etc.

From Table 4.26 we see that along with increasing cultivated area, irrigated area keeps on increasing by the 'per farm' criterion. (Proportion of area irrigated however, is 20 per cent for size group 1 and 2 and then goes on reducing to 13 per cent in the highest size group.) Per farm use of N steadily increases from 46 kg to 183 kg over the five size groups. Per cultivated hectare usage of N, on the other hand, decreases steadily from 34 kg to 18 kg., indicating intensive nature of cultivation of small size farms - an observation true of many studies over the years. We note that proportion of irrigated area decreases over size groups and this is the reason for declining usage. Proportion of users of fertilizers (column 3) however increases from 65 to 85 per cent over the size groups with a minor deviation in size group 3 - possibly because irrigated area is same as in

size group 2 but cultivated area increases. Similar information for regions (aggregates only) is incorporated in Appendix Table A.26. The only observation we make from this Appendix table is that the proportion of users of fertilizers is smallest in Region II of scarcity - 70 per cent whereas in other regions it is 75 to 85 per cent. Further, within Region II again, proportion of users increases as size of farm increases. So two points regarding Region II emerge. In spite of the fact that this region is traditionally irrigated with a network of canals-wells, irrigation is not distributed widely (a fact apparent from the official data as well as our AGPM study referred to in Section 4.2) and hence proportion of users of fertilizers is small than other regions and further, within the size groups of holdings proportion of users increases with the size group. This must be leading to large inequalities in the region.

In Table 4.27 where size group intervals of areas are common across centres, zones, regions - i.e. the 'usual' way of classification of area being adopted, we see that number of farms more or less declined over the size groups. Number of users of fertilizers is 71 per cent (96 out of 176) for group 1 and for other groups it varies between 75 to 82 per cent. But the remarkable aspect of this table is that over size groups 2, 3 and 4 per farm irrigated area is almost constant - between 0.70 and 0.74 ha and so also is the per farm N for these three groups with the range being 111 to 113 kg. The first and fifth groups of course differ sharply with 0.30 ha and 1.26 ha of irrigated area and N per farm being 55 and 166 kg respectively. This again underlines the nexus between irrigation and fertilizer use and further, perhaps indicates that with common area class intervals local conditions get overlooked and heterogeneous entities are thrown together within a size-group with the results that even at 'per farm' level fertilizer use remains constant over



size groups of 2 to 4, 4 to 6 and 6 to 8 hectares. The classification adopted in Table 4.26 reflecting 'local conditions' is perhaps the more appropriate one, bringing out the contrasts between the 'size groups' with regard to levels of fertilizer use. The regionwise details are incorporated in Appendix Table A.27.

#### Source of Irrigation and Fertilizer Use

Six sources were considered for analysis—canal, well, canal and well, tubewell, tanks and 'others'. We found that for the sample farmers canal, well and 'others' are the main sources and we analysed the 1984-85 data for these three sources only, by hand tabulation. In Table 4.28 details of gross area irrigated through these sources are presented for size groups along with the fertilizer (N-P) use. Here we adopt size groups of Table 4.27 viz. below 2 ha, 2 to 4 ha etc. (and not the ones adopted in Table 4.26) as these are the conventional ones. The sourcewise irrigation was identified through the record of different crops and irrigated area under different crops leads us to gross rather than net irrigated area. We see here that gross irrigated area in this table comes to 533.18 ha whereas earlier we had gross irrigated area at 551.42 ha (Table 4.12) and the difference is due to exclusion of other sources and also due to the discrepancies between the computer analysis and hand tabulation. As mentioned above we decide to overlook this difference as the broad agreement suffices for our analysis.

We see that out of 533.18 ha of GIA, area covered by canal is 90.22 ha (17 per cent), by well irrigation 405.68 ha (76 per cent) and by other sources ('others') is 37.28 ha (7 per cent). The official statistics for the state indicates that of the net irrigated area, about 21 per cent is by canal, 16 per cent by tank, 57 per cent by wells and about 5 per cent

by other sources.\* In our sample also well irrigation dominates but in absence of sizable tank irrigation, well irrigation receives exaggerated share. From this table we see, that N/ha of irrigated area more or less declines for 'all sources together' as well as for canal, for wells and for 'others'. This is somewhat surprising. One would have thought that the big farmers would cultivate irrigated area as intensively as smaller farmers (with regard to fertilizers) even though per ha of net cultivated area (irrigated and dry together) fertilizer input declines over size groups as observed in Table 4.27. This cannot be attributed to the net-gross difference either, because as observed in Section 4.2 while discussing average irrigated area per farm, irrigation intensity is about 122, not much higher than overall intensity of cultivation of 108. Nor is this due to concentration of a particular source in smaller size farms. In fact canal-well-other sourcewise area distribution does not appear related to the size groups - to be specific, canal irrigation, the most potent or dependable source, does not appear related with the size group.

In fact our next observation relates to an interesting feature of this table that N/ha for canal irrigated area is actually much lower than N/ha for well irrigated area and this is true of nearly every size group (except first) and at the overall level N/ha is 42 kg for canal irrigated area whereas it is 77 kg for well irrigated area.

We could not leave this uninvestigated. Looking at the regionwise details (not presented here) we found that canal

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\* See the AGPM Study (p.207), mentioned in Section 4.2. The study looks at trienniums 1960-63, 1967-70, and 1973-74, 1974-75 for sourcewise irrigation. From 1975-76 the Directorate of Agriculture gives sourcewise irrigated area for two sources only, viz., surface and well irrigation.

irrigated area comes almost wholly from Region II (80.77 ha out of 90.22 ha) and so we looked into the cropping patterns of canal irrigated area and well irrigated area and fertilizer (N-P) levels for this region only. In Tables 4.29 and 4.30 cropping pattern of these two irrigation sources is presented along with N-P/ha. We see that rather surprisingly, sugarcane covers 13 per cent of well irrigated area whereas for canal it is just 6 per cent. The N/ha for sugarcane on canal is 336 kg whereas for well it is in fact lower at 302 kg., but with the higher area weightage, sugarcane 'contributes' 38 kg., in well irrigated area but only 20 kg in canal irrigated area to the overall (weighted) average of 70 and 44 kg of N in well and canal irrigated areas respectively. As levels of N and areas are all non-negative quantities, one can legitimately talk of 'contribution' of individual crops to 'overall' averages, ('contribution' of individual crops is its N/ha., weighted by the proportion of area under the crop). For canal irrigated area, major contributors are rabi jowar (N/ha 19.6 kg., area share 53.16 per cent, contributing 10 kg to overall average of 44 kg) bajra and wheat (contributions less than 6 kg of N in each case). For well irrigated area major contributors are 'others' (8.98 kg of N), wheat (8.14 kg of N), rabi jowar (8.09 kg of N) and bajra (5 kg of N) making up the overall average, along with sugarcane (38 kg of N), of 70 kg of N/ha. Thus we see that the difference in N/ha for canal and well irrigated area is due to these three to four crops.

Lower N/ha for canal irrigated area is surprising but we also know that even in canal tracts farmers prefer to irrigate their lands with well irrigation. With the proximity of canal, wells have ample water and farmers can irrigate high investment crops of sugarcane, fruits, wheat etc., as and when they wish to. Moreover cost of pumping water from wells is no consideration as the pumps are charged for electricity by their horse-power rather than actual electricity

consumption. In fact it was observed\* that in the main canal tract area irrigated by canal was actually declining. Farmers seem to prefer not to depend on outside agencies for irrigation although it is the existence of canals that makes the well irrigation possible. The P/ha for well irrigation is also higher than that for canal irrigation and we do not go further into the use of phosphatic fertilizers.

#### 4.10 Fertilizer (N) Consumption Potential

For this exercise we calculate 'existing levels' of fertilizer use of N for each crop and with the given recommended doses - of Tables 4.3(a) and 4.3(b) - make two estimates : a conservative estimate and a liberal estimate to determine the scope for fertilizer use. In these two tables we have slightly differing recommendations and in 4.3(b) we have separate rates for assured rainfall area and uncertain rainfall area and the overall level of recommendations are on the lower side. From these we pick up rates for HYV and traditional varieties (if significantly different) and among unirrigated part, separate rate for HYV and traditional variety (TV) under assured rainfall conditions and uncertain rainfall conditions.

Area under the crops data are taken for 1980-83 triennium average, from Table 2.3. Thus area data (irrigated-unirrigated separately) comes from the official statistics. Proportion of HYV area for major foodgrains is important and this percentage is taken from Epitome of Agriculture 1984-85, again an official data source.

From the sample data and from Tables 4.17 to 4.25 based on sample data, proportion of total crop area under Region II of uncertain rainfall (scarcity zone) is taken

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\* See Author's "Growth of Irrigation in Maharashtra (1960-61 to 1971-72)". Artha Vijnana, June 1979, Vol. XXI, No. 2, pp. 164-165. Also the AGPM Study, p. 220 with more data upto 1974-75.

(proportions of 1983-84 and 1984-85 averaged) and applied to state area under the crop to determine area under Region II and separate rates are applied, allowing for the uncertainty of rainfall. From the recommended rates we determine a low rate leading to the conservative estimate and a high rate leading to the liberal estimates of fertilizer consumption potential. 'Existing' levels, on the other hand, are obtained by applying separate rates for irrigated part and unirrigated part of various crops from sample data. (The rates for the two years are averaged.) In all these calculations we do not use even in 'liberal' estimate highest of recommended doses but a rate which is below the highest available rate generally by 10 per cent to 30 per cent. Thus the whole exercise is somewhat on the conservative side. This preference for relatively lower rates is due to various reasons. We are told that application of fertilizers depends upon climatic differences, soil differences, moisture availability, etc., and table of recommendations are presumably broad in nature. (On the other hand we have not come across in published literature or in media like radio television, differentiated doses for different agro-climatic zones.) Farmers are often exhorted to test their soil to determine nutrient deficiencies and hence to arrive at 'correct' doses. In fact we understand that soil testing should be done for different crops at different soil-depths. With all these qualifying statements taken along with the 'table of recommended doses' on top of 'moisture adequacy' condition, one feels that uncertainty is inherent in determining what is the 'right' dose and hence what is the 'scope' for further use of fertilizers. Clear evidence is of course in the actual use - levels obtained which are way below recommended ones and it would be prudent to use conservative estimates. We have incorporated the cropwise details of calculations in Appendix B. We again point out that 1980-83 triennium extent of irrigation is taken as constant and HYV

proportion of (and upto) 1982-83 from Epitome of Agriculture is also taken as constant. The exercise of calculations of fertilizer consumption potential is at 1980-83 'achieved' levels of irrigation and HYV levels and no assumptions are made regarding further growth of irrigated area or extended areas under HYV. This is another aspect of our conservative estimates. In the 'conservative' estimate we take from the available recommendations a rate which is modest 10-20 kg above the existing levels if these levels are well below the lowest dose recommended (and not necessarily even the lowest recommended dose). Thus we reiterate that our conservative as well as liberal estimates of potential are on the side of caution. So much so that for some crops (especially the irrigated crops) our 'conservative' estimate is close to or even below the existing levels.

The results are presented in Tables 4.31 to 4.33. The first two of these tables cover the irrigated components and the unirrigated components of crops respectively whereas the last table covers information for crops for the two components put together. From the last table (Table 4.33) we see that although the 'existing level' is 18.85 kg of N/ha of GCA the conservative estimate of potential is 29.61 kg of N/ha (incidentally, the all-India average is close to this figure for the period under consideration). The liberal estimate of potential is 41.21 kg/ha of GCA. This means that with moderate efforts it should be possible to raise the level from about 19 kg of N/ha to about 30 kg/ha of N. As a proportion, the existing level can be raised to one and a half times to two times. The main absolute additions seem feasible in kharif jowar, rabi jowar, rice and pulses. (We may point out here that in the overall exercise we have kept the 'others' category neutral as it is cumbersome to go by all its components.) Further, in potential as a proportion of the existing level, rabi jowar stands first.

In fact going by the recommended doses, one gets very high absolute additions also, but looking at the existing poor levels, we have opted for low conservative as well as liberal estimates for rabi jowar. (For more information see Appendix B). From the crops with greater potential, it is obvious that by our exercise the additions are really on account of unirrigated crops. Earlier two tables - Table 4.31 and 4.32 confirm this. Thus the additions required of about 220 thousand tonnes of N to reach the conservative potential have to come entirely from the unirrigated component. Similarly of the 450 thousand tonnes of additional N to reach the liberal estimate, nearly 420 thousand tonnes are to come from the unirrigated component by our exercise mainly from the crops already mentioned.

In the exercise regarding the irrigation factor, we have taken the irrigated area (and its distribution over crops) as unchanged. Further the levels assumed for potential calculation are only moderately higher because main sugarcane crop appears to receive adequate doses and we assume that with irrigation available, a farmer is not adverse to apply adequate fertilizers. With increased irrigation, better HYV adoption etc., the consumption level will be even higher. But no upward projections are made about these two crucial factors viz., irrigation and HYV adoption.

We have tried to cover all relevant factors - irrigation, reliability of rainfall, HYV adoption, etc., and fertilizer use potential appears quite feasible, given the caution with which we have done so. If these do not turn out as attainable, a significant change in the approach is necessary. If there are technical (agronomical, botanical) difficulties, these must be given due publicity and research should be directed in surmounting them. If our fertilizer recommendations are too broad or in other words ground conditions too

varied, more detailed areawise package of practices relating to fertilizer application need to be developed with due publicity. In popular media like radio and television this regional heterogeneity should find due mention in their programmes on agriculture.

Another significant aspect which cannot be overlooked is the fact of wide acceptance of the proposition that intensive use of chemical fertilizers has long term adverse effects. Farmers have in fact held such apprehensions since long. The corrective measures to prevent these should find adequate publicity so that these apprehensions are removed.



Table 4.1 : Comparison of Total and Irrigated Cropping Patterns of State with Cropping Patterns of Sample Farmers (Percentages)

Crop	1980-83 Official* data			1983-84 Sample data			1984-85 Sample data		
	Total cropping pattern	Irrigated cropping pattern	Proportion of each crop irrigated	Total cropping pattern	Irrigated cropping pattern	Proportion of each crop irrigated	Total cropping pattern	Irrigated cropping pattern	Proportion of each crop irrigated
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Kh.Jowar	14.67	1.31	1.13	13.53	1.99	2.52	17.51	3.16	3.41
2. R. Jowar	17.68	13.34	9.60	17.94	15.82	15.16	17.58	24.47	26.28
3. Bajra	7.97	1.96	3.13	13.05	7.65	10.07	6.94	7.04	19.14
4. Ragi	1.11	N.A.	N.A.	0.29	-	0.00	0.82	-	0.00
5. Cotton	13.21	5.30	5.30	13.00	2.95	3.64	16.10	6.99	8.20
6. S.Cane	1.77	13.89	100.00	3.01	17.51	100.00	2.24	11.83	100.00
7. G.Nut	3.90	1.11	3.62	2.99	6.02	34.63	2.25	2.39	20.05
8. Safflower	2.64	N.A.	N.A.	1.57	0.90	9.87	3.46	0.20	1.10
9. Tur	3.44	0.07	0.24	4.21	-	0.00	4.74	0.38	1.52
10. Mung	N.A.	N.A.	N.A.	8.39	-	00.00	5.65	0.43	1.44
11. Udid	N.A.	N.A.	N.A.	1.17	-	0.00	1.89	0.00	0.00
12. Paddy	7.44	15.64	28.86	2.16	1.84	14.58	2.40	1.41	11.09
13. Wheat	5.32	22.34	53.46	4.87	22.55	79.49	3.72	12.98	65.95
14. Gram	2.18	3.71	21.63	1.73	3.43	33.96	1.46	3.58	46.41
15. Others	18.67	21.33	14.53	11.19	19.35	29.73	13.24	25.12	35.83
Gross Area	100.00	100.00	12.72	100.00	100.00	17.18	100.00	100.00	18.88

\* From Epitome of Agri, also see Table 2.3. Mung, Udid mostly unirrigated.

Table 4.2 : Some of the Important Features of the Selected Farmers for 1983-84 and 1984-85

Feature	1983-84	1984-85
1. No. of farmers (No.)	400	600
2. Gross Cropped Area GCA (ha.)	2190	2920 (GCA per farm (ha) 5.48 (1983-84) 4.87 (1984-85))
3. Gross Irrigated Area GIA (ha.)	376	551 (GIA per farm (ha) .941 (1983-84) .919 (1984-85))
4. Gross Irri./Gross Cropped (%)	17.18	18.88
5. Fertilizer consumption N-Kg.	42698	65731
6. " " P-Kg.	16346	27539
7. " " K-Kg.	7069	15573
8. Share of GIA in N (%)	65.55	58.07
9. Share of Rainfed area in N(%)	34.45	41.93
10. N-P-K per ha of GCA (kg.)	19-7-3	22-9-5
11. N-P-K per ha of GIA	74-27-11	69-26-18
12. N-P-K per ha of Rainfed (kg.)	8-3-2	12-6-2
13. Top three crops with largest area shares in GCA (shares in brackets) (%)	R.Jowar (18) Cotton (14) K.Jowar (13)	R.Jowar (18) K.Jowar (17) Cotton (16)
14. Top three crops with largest shares in nutrient N (Shares in brackets)	S.Cane (42) Cotton (14) Wheat (12)	S.Cane (23) K.Jowar (16) Cotton (13)
15. Top three crops with largest shares in GIA (shares in brackets)(%)	Wheat (23) S.Cane (18) R.Jowar (16)	R.Jowar (24) Wheat (13) S.Cane (12)
16. Top three irri.crops in GIA with largest shares in N (shares in brackets) (%)	S.Cane (65) Wheat (17) Onion (4)	S.Cane (40) Wheat (13) R.Jowar (9)

(Continue)

Table 4.2 : (Continued)

Feature	1983-84	1984-85
17. Top three rainfed crops with largest shares in rainfed area (shares in bracket) (%)	R.Jowar (18) Cotton (16) K.Jowar (16)	K.Jowar (21) Cotton (18) R.Jowar (16)
18. Top three crops in rainfed area with highest shares in N (shares in bracket) (%)	Cotton (37) K.Jowar (30) Bajra (15)	K.Jowar (33) Cotton (26) Paddy (11)
19. Treating irr. and dry components of crop as separate crops, top 4 crops with largest share in N		
i) Crop (with N share %) Irr. S.Cane(42)	Irr. S.Cane (23)	
% share in GCA	3.01	2.23
Kg. of N-P-K/ha.	275-99-43	231-90-80
ii) Crop (with N shares%) Dry Cotton(13)	Dry K.Jowar(14)	
% share in GCA	13.39	16.91
Kg. of N-P-K/ha.	19-10-4	19-8-4
iii) Crop (with N shares%) Irr.Wheat (11)	Irr.Others(14)	
% share in GCA	3.87	4.74
Kg. of N-P-K/ha.	58-18-8	66-32-19
iv) Crop (with N shares %) Dry K.Jowar(10)	Dry Cotton (11)	
% share in GCA	13.19	14.79
Kg. of N-P-K/ha.	15-6-3	17-9-4

Table 4.3(a) : Recommended Fertilizer Doses for Some Important Crops

(Nutrients/ha. in kg.)

Crop		Irrigated			Unirrigated		
		N	P	K	N	P	K
1. K.Jowar	TV	50	25	25	25	12.5	12.5
	HYV	120	60	60	60	30	30
2. R.Jowar	TV	60	30	30	50	25	25
	HYV	120	60	60	60	30	30
3. Bajra	TV	50	40	20	25	20	10
	HYV	50	40	20	25	20	10
4. Ragi	TV	-	-	-	25	20	10
5. Cotton	TV	100	50	50	50	50	25
	HYV	100	50	50	80	40	40
6. S.Cane	Suru	250	115	115	-	-	-
	Pre-seasonal	340	170	170	-	-	-
	Adsali	400	170	170	-	-	-
	Ratoon	250	115	115	-	-	-
7. G. nut	TV	25	50	-	12	25	-
8. Safflower	TV	50	-	-	25	-	-
9. Tur	TV	25	50	-	25	50	-
10. Mung	TV	25	50	-	12.5	25	-
11. Udid	TV	25	50	-	12.5	25	-
12. Paddy	-	100	50	50	50	25	-
13. Wheat	Tall HYV	75	50	50	40	20	-
	Short HYV	120	60	50	-	-	-
14. Gram	TV	26	50	-	N.A.	N.A.	N.A.
15. Onion	TV	100	50	50	-	-	-

(Collected from different sources. Under unirrigated conditions often a remark like 'with assumed rainfall' is also added. Sometimes whether a given recommendation is for irr. or unirrig. part is not mentioned.)

TV : Traditional Variety

Table 4.3(b) : Recommended Fertilizer Doses for Irrigated/  
Assured Rainfall Areas and for Unirrigated/  
Uncertain Rainfall Areas\*

Crop	(Nutrients kg/ha)					
	Irrigated/ Assured rain- fall areas			Unirrigated/ Uncertain rainfall areas		
	N	P	K	N	P	K
1. K.Jowar TV	50	25	-	25	12	-
HYV	75	62	62	-	-	-
2. R.Jowar TV	50	25	-	25	12	-
HYV	125	75	62	75	62	62
3. Bajra TV	12	-	-	12	-	-
HYV	50	37	25	-	-	-
4. Ragi TV	12	12	25	-	-	-
5. Cotton TV (Desi)	50	25	25	25	12	-
Varal axmi-Irri.	80	40	40	-	-	-
Hybrid - 4-Irr.	100	50	50	-	-	-
Hybrid - 4-Dry	50	25	25	-	-	-
6. S.Cane <u>Suru</u> - Konkan	150	110	110	-	-	-
Deccan Canal Tract	250	115	115	-	-	-
Vidarbha-Marathwada	170	115	115	-	-	-
<u>Pre-Seasonal-Deccan Canal</u>	340	170	170	-	-	-
Vidarbha-Marathwada	250	170	170	-	-	-
<u>Adsali</u> - Deccan Canal	400	170	170	-	-	-
<u>Ratoon</u> - Konkan	150	110	110	-	-	-
D. Canal	250	115	115	-	-	-
Vid-M'wada	170	115	115	-	-	-
7. G.Nut TV	25	50	-	12	25	-
8. Safflower TV	60	30	-	25	50	25
9. Tur TV	25	50 to 75	-	-	-	-

(Contd.)

Table 4.3(b) : Contd.

Crop	Irrigated/ Assured rain- fall areas			Unirrigated/ Uncertain rainfall areas		
	N	P	K	N	P	K
10. Mung TV	25	75	-	15 to 20	40 to 50	-
11. Udid TV	25	75	-	"	"	"
12. Paddy TV - Acidic Soils	50	25	25	-	-	-
- Other soils	25	25	25	-	-	-
HYV	100	50	-			
- Summer	120	50	-			
13. Wheat TV	75	50	-	25	25	-
HYV - Niphad (Tall)	75	50	50	-	-	-
HYV Mexican	120	50	50	-	-	-
14. Gram - TV	25	50 to 75	-	-	-	-
15. Onion TV	50	50	20	-	-	-

Source : Agricultural Extension Service (1982) by Prof. D. Salunkhe, V.C., Mahatma Phule Agril. Univ., D. Sapre, Deputy Director, Deptt. of Agri., Pune, Mahatma Phule Agri. Uni., (pp.119-122).

Table 4.4 : Cropping Pattern and Consumption of N of Selected Farmers (1983-84)

Crop	Area (ha)	%	N (Kg)	%	N/ha (Kg)	% of crop area under irri- gation
1. Kh.Jowar	296.44	13.53	4635.94	10.86	15.64	2.52
2. R.Jowar	392.90	17.94	241.20	0.56	0.61	15.16
3. Bajra	285.94	13.05	3131.36	7.33	10.95	10.07
4. Ragi	6.32	0.29	77.55	0.18	12.27	0.00
5. Cotton	304.42	13.90	5851.25	13.70	19.22	3.64
6. S.Cane*	65.89	3.01	18091.15	42.37	274.57	100.00
7. G.Nut	65.43	2.99	860.75	2.02	13.15	34.63
8. Safflower	34.35	1.57	20.00	0.05	0.58	9.87
9. Tur	92.11	4.21	461.00	1.08	5.00	0.00
10. Mung	183.86	8.39	220.00	0.51	1.20	0.00
11. Udid	25.53	1.17	28.38	0.07	1.11	0.00
12. Paddy	47.33	2.16	1455.15	3.41	30.71	14.58
13. Wheat	106.77	4.87	4969.31	11.64	46.54	79.49
14. Gram	38.01	1.73	90.40	0.21	2.38	33.96
15. Others	245.02	11.19	2564.67	6.01	10.47	29.73
G.C.A.	2190.37	100.00	42698.11	100.00	19.49	17.18

\* Harvested area.

Table 4.5 : Consumption of P and K Nutrients and N, P, K per hectare for 400 Selected Farmers (1983-84)

Crop	Area (ha)	%	P (kg)	%	K (kg)	%	(Kg. per hectare)		
							N*	P	K
1. K.Jowar	296.44	13.53	1731.80	10.59	990.75	14.01	15.64	5.84	3.34
2. R.Jowar	392.90	17.94	127.50	0.73	58.10	0.82	0.61	0.32	0.14
3. Bajra	285.94	13.05	330.75	2.02	220.25	3.11	10.95	1.16	0.77
4. Ragi	6.32	0.29	77.55	0.47	18.75	0.26	12.27	12.27	2.97
5. Cotton	304.42	13.90	3136.36	19.19	1158.50	16.53	19.22	10.30	3.84
6. S.Cane	65.89	3.01	6493.87	39.73	2858.87	40.44	274.57	98.56	43.39
7. G.nut	65.43	2.99	543.75	3.33	243.00	3.44	13.15	8.31	3.71
8. Safflower	34.35	1.57	20.00	0.12	-	0.00	0.58	0.58	0.00
9. Tur	92.11	4.21	287.00	1.76	119.00	1.68	5.00	3.12	1.29
10. Mung	183.86	8.39	15.00	0.09	15.00	0.21	1.20	0.08	0.08
11. Udid	25.53	1.17	35.00	0.21	15.00	0.21	1.11	1.37	0.59
12. Paddy	47.38	2.16	298.65	1.83	184.45	2.61	30.71	6.30	3.89
13. Wheat	106.77	4.87	1535.50	9.39	694.91	9.83	46.54	14.38	6.51
14. Gram	38.01	1.73	31.10	0.19	20.50	0.29	2.38	0.81	0.54
15. Others	245.02	11.19	1682.34	10.29	462.32	6.54	10.47	6.87	1.89
G.C.A.	2190.37	100.00	16346.17	100.00	7069.40	100.00	19.49	7.46	3.23



Table 4.6 : Cropwise Area under Irrigation and Fertilizer Consumption for Selected Farmers (1983-84)

(Nutrients in Kg.)

Crop	Area (ha.)	N	P	K	Per hectare		
					N	P	K
1. Kh.Jowar	7.48	2221.70	27.50	7.00	29.64	3.68	0.93
2. R.Jowar	59.56	62.00	7.50	5.10	1.04	0.13	0.08
3. Bajra	28.79	928.85	70.00	30.00	32.26	2.43	1.04
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	6.05	341.20	125.00	50.00	56.40	20.66	8.26
6. Cotton-MS	1.24	20.00	13.50	7.50	16.13	10.89	6.05
7. Cotton-SS	3.80	36.50	27.00	15.00	12.24	7.10	3.95
8. S.Cane (PH)	24.18	8349.55	3513.85	1440.85	345.31	143.32	59.59
9. S.Cane(RH)	41.71	9741.60	2980.02	1413.02	233.55	71.45	34.00
10. G.Nut	22.66	391.30	158.50	37.50	17.27	6.99	1.65
11. Safflower	3.39	-	-	-	-	-	-
12. Tur	-	-	-	-	-	-	-
13. Mung	-	-	-	-	-	-	-
14. Udid	-	-	-	-	-	-	-
15. Paddy	6.91	545.95	100.75	90.75	79.01	14.58	13.13
16. Wheat	84.87	4895.31	1507.60	684.91	57.68	17.76	8.07
17. Gram	12.91	38.90	30.60	20.00	6.89	2.37	1.55
18. Others	72.85	2355.23	1596.99	427.72	72.33	21.92	5.87
Gross Irr. Area	376.40	27988.09	10158.81	4234.35	74.36	26.99	11.25

PH and RH are planted and ratoon harvested S.Cane crops respectively.  
For cotton, LS, MS, SS mean long staple and short staple varieties respectively.)

Table 4.7 : Shares of Crops in Irrigated Area and in N,P,K of Irrigated Crops for Selected Farmers (1983-84)

(Percentages)

Crop	Share in Gross Irrigated Area	Shares in		
		N	P	K
1. K.Jowar	1.99	0.79	0.27	0.17
2. R.Jowar	15.82	0.22	0.07	0.12
3. Bajra	7.65	3.32	0.69	0.71
4. Ragi	-	-	-	-
5. Cotton - LS	1.61	1.22	1.23	1.18
6. Cotton - MS	0.33	0.07	0.13	0.18
7. Cotton - SS	1.01	0.17	0.27	0.35
8. S.Cane (PH)	6.42	29.83	34.59	34.03
9. S.Cane (RH)	11.08	34.81	29.33	33.49
10. G.Nut	6.02	1.40	1.56	0.89
11. Safflower	0.90	-	-	-
12. Tur	-	-	-	-
13. Mung	-	-	-	-
14. Udid	-	-	-	-
15. Paddy	1.84	1.95	0.99	2.14
16. Wheat	22.55	17.49	14.84	16.18
17. Gram	3.43	0.32	0.30	0.47
18. Others	19.35	8.41	15.72	10.10
Gross Irr.Area	100.00	100.00	100.00	100.00

(PH and RH are planted and ratoon harvested S.cane crops respectively. For cotton, LS, MS, SS mean long staple, medium staple and short staple varieties respectively.)

**Table 4.8 :** Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers (1983-84)

(Nutrients in Kg.)

Crop	Area (ha)	N	P	K	Per hectare		
					N	P	K
1. Kh.Jowar	288.96	4414.24	1704.30	983.75	15.28	5.90	3.40
2. R.Jowar	333.34	179.20	120.00	53.00	0.54	0.36	0.16
3. Bajra	257.15	2202.51	260.75	190.25	8.56	1.01	0.74
4. Ragi	6.32	77.55	77.55	18.75	12.27	12.27	2.97
5. Cotton-LS	55.06	1725.00	609.50	412.50	31.33	11.07	7.49
6. Cotton-MS	103.34	1090.80	814.86	296.00	10.56	7.88	2.86
7. Cotton-SS	134.93	2627.75	1546.50	387.50	19.47	11.46	2.87
8. S.Cane(PH)	-	-	-	-	-	-	-
9. S.Cane(RH)	-	-	-	-	-	-	-
10. G.Nut	42.77	469.45	385.25	205.50	10.98	9.01	4.80
11. Safflower	30.96	20.00	20.00	0.00	0.65	0.65	0.00
12. Tur	92.11	461.00	287.00	119.00	5.00	3.11	1.29
13. Mung	183.86	220.00	15.00	15.00	1.20	0.08	0.08
14. Udid	25.53	28.38	35.00	15.00	1.11	1.37	0.59
15. Paddy	40.47	909.20	197.90	93.70	22.47	4.89	2.31
16. Wheat	21.90	74.00	27.90	10.00	3.38	1.27	0.46
17. Gram	25.10	1.50	0.50	0.50	0.06	0.02	0.02
18. Others	172.17	209.44	85.35	34.60	1.22	0.49	0.20
Total rainfed	1813.97	14710.02	6187.36	2835.05	8.11	3.41	1.56

(Sugarcane is hundred per cent irrigated. For Cotton, LS, MS and SS mean long, medium and short varieties respectively).

Table 4.9 : Shares of Crops in Rainfed Area and in N,P,K of Rainfed Crops for Selected Farmers (1983-84)

(Percentages)

Crop	Share in Rainfed Area	Share in		
		N	P	K
1. Kh. Jowar	15.93	30.01	27.54	34.70
2. R.Jowar	18.38	1.22	1.94	1.87
3. Bajra	14.18	14.97	4.21	6.71
4. Ragi	0.35	0.53	1.25	0.66
5. Cotton-LS	3.04	11.73	9.85	14.55
6. Cotton-MS	5.70	7.41	13.17	10.44
7. Cotton-SS	7.44	17.86	24.99	13.67
8. S.Cane (PH)	-	-	-	-
9. S.Cane (RH)	-	-	-	-
10. G.nut	2.36	3.19	6.23	7.25
11. Safflower	1.71	0.14	0.32	-
12. Tur	5.08	3.13	4.64	4.20
13. Mung	10.14	1.50	0.24	0.53
14. Udid	1.41	0.19	0.57	0.53
15. Paddy	2.23	6.18	3.20	3.30
16. Wheat	1.21	0.50	0.45	0.35
17. Gram	1.38	0.01	0.01	0.02
18. Others	9.49	1.42	1.38	1.22
Gross Rainfed Area	100	100	100	100

(Sugarcane is entirely irrigated. For cotton, LS, MS and SS long, medium and short staple varieties respectively.)

Table 4.10 : Cropping Pattern and Consumption of N of Selected Farmers (1984-85)

Crop	Area (ha.)	%	N(kg.)	%	N/ha (kg.)	% of crop area under irrigation
1. Kh.Jowar	511.35	17.51	10476.65	15.94	20.49	3.41
2. R.Jowar	513.43	17.58	3570.60	5.43	6.95	26.28
33. Bajra	202.71	6.94	3420.07	5.20	16.87	19.14
4. Ragi	23.96	0.82	211.82	0.32	8.84	0.00
5. Cotton	470.54	16.10	8839.48	13.45	18.79	8.20
6. S.Cane*	65.26	2.24	15082.65	22.85	231.12	100.00
7. G.nut	65.75	2.25	949.15	1.44	14.44	20.05
8. Safflower	101.06	3.46	230.95	0.35	2.29	1.10
9. Tur	133.37	4.74	1985.98	3.02	14.35	1.52
10. Mung	164.38	5.65	995.40	1.52	6.04	1.44
11. Udid	55.18	1.89	397.34	0.61	7.20	-
12. Paddy	70.24	2.40	3511.86	5.34	50.00	11.09
13. Wheat	108.57	3.72	5313.10	8.08	48.89	65.95
14. Gram	42.56	1.46	290.95	0.44	6.84	46.41
15. Others	386.61	13.24	10460.01	15.91	27.06	35.83
G.C.A.	2920.47	100.00	65731.01	100.00	22.51	18.88

\*Harvested Area.

Table 4.11 : Consumption of P and K Nutrients and N,P,K per Hectare for 600 Selected Farmers (1984-85)

Crop	Area (ha.)	%	P(kg)	%	K(kg)	%	Kg. per hectares		
							N*	P	K
1. K.Jowar	511.35	17.51	4500.39	16.34	2183.15	14.02	20.49	8.80	4.27
2. R.Jowar	513.43	17.58	1043.45	3.79	494.95	3.18	6.95	2.04	0.97
3. Bajra	202.71	6.94	587.00	2.13	341.00	2.19	16.87	2.90	1.68
4. Ragi	23.96	0.82	178.50	0.65	178.50	1.15	8.84	7.45	7.45
5. Cotton	470.54	16.10	4744.80	17.23	1739.15	11.17	18.79	10.08	3.70
6. S.Cane	65.26	2.24	5885.75	21.37	5218.95	33.51	221.12	90.19	79.97
7. G.Nut	65.75	2.25	1001.30	3.64	295.25	1.90	14.44	15.23	4.49
8. Safflower	101.06	3.46	202.50	0.74	80.50	0.52	2.29	2.00	0.80
9. Tur	138.37	4.74	986.60	3.58	420.00	2.70	14.35	7.13	3.05
10. Mung	164.88	5.65	641.90	2.33	172.60	1.11	6.04	3.89	1.05
11. Udid	55.18	1.89	351.75	1.28	112.40	0.72	7.20	6.37	2.04
12. Paddy	70.24	2.40	643.30	2.35	427.30	2.74	50.00	9.23	6.08
13. Wheat	108.57	3.72	1500.70	5.45	892.70	5.73	48.89	13.32	8.22
14. Gram	42.56	1.46	64.40	0.23	46.00	0.30	6.84	1.51	1.08
15. Others	336.61	13.24	5201.99	18.89	2970.70	19.08	27.06	13.46	7.68
G.C.A.	2920.47	100	27539.33	100	15573.15	100	22.51	9.43	5.33

Table 4.12 : Cropwise Area under Irrigation and Fertilizer Consumption for Selected Farmers (1984-85)

(Nutrients in Kg.)

Crop	Area (ha)	N	P	K	Per hectare		
					N	N	K
1. Kh.Jowar	17.44	1240.50	421.50	279.50	71.13	24.17	16.03
2. R.Jowar	134.94	3272.80	824.25	396.25	24.25	6.11	2.94
3. Bajra	38.80	1718.75	236.00	143.00	44.30	6.08	3.69
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	23.63	1178.00	624.50	113.00	49.85	26.43	4.78
6. Cotton-MS	11.89	225.80	95.50	39.50	24.88	8.03	3.32
7. Cotton-SS	3.03	86.00	86.00	48.00	28.38	28.38	15.84
8. S.Cane (PH)	37.62	9754.60	3557.50	3095.25	259.29	94.56	82.28
9. S.Cane (RH)	27.64	5328.05	2328.25	2123.70	192.77	84.23	76.83
10. G.Nut	13.18	319.10	254.10	62.25	24.21	19.28	4.72
11. Safflower	1.11	22.25	10.50	10.50	20.04	9.46	9.46
12. Tur	2.11	47.76	22.50	12.50	22.63	10.66	5.92
13. Mung	2.37	17.00	17.00	9.00	7.17	7.17	3.80
14. Udid	-	-	-	-	-	-	-
15. Paddy	7.79	388.00	66.40	27.00	49.81	8.52	3.47
16. Wheat	71.60	5045.45	1436.70	864.70	70.47	20.07	12.08
17. Gram	19.75	260.95	57.40	45.00	13.21	2.91	2.28
18. Others	138.52	9194.49	4373.14	2655.75	66.38	31.57	19.17
Gross Irr. Crop	551.42	38169.50	14411.24	9924.90	69.22	26.13	18.00

(PH and RH are planted and ratoon harvested S.Cane Crops respectively. For cotton, LS, MS, SS mean long staple, medium staple and short staple varieties respectively.)

Table 4.13 : Shares of Crops in Irrigated Area and in N,P,K of Irrigated Crops for Selected Farmers (1984-85)

Crop	Share in Gross Irr. Area	(Percentages)		
		N	P	K
1. Kh.Jowar	3.16	3.25	2.92	2.82
2. R.Jowar	24.47	8.57	5.72	3.99
3. Bajra	7.40	4.50	1.64	1.44
4. Ragi	-	-	-	-
5. Cotton-LS	4.28	3.09	4.33	1.14
6. Cotton-MS	2.16	0.77	0.66	0.40
7. Cotton-SS	0.55	0.23	0.60	0.48
8. S.Cane (PH)	6.82	25.56	24.69	31.19
9. S.Cane (RH)	5.01	13.96	16.16	21.40
10. G.nut	2.39	0.84	1.76	0.63
11. Safflower	0.20	0.06	0.07	0.11
12. Tur	0.38	0.13	0.16	0.12
13. Mung	0.43	0.04	0.12	0.09
14. Udid	-	-	-	-
15. Paddy	1.41	1.02	0.46	0.27
16. Wheat	12.98	13.22	9.97	8.71
17. Gram	3.58	0.68	0.40	0.45
18. Others	25.12	24.09	30.34	26.76
Gross Irr.Area	100	100	100	100

(PH and RH are planted and ratoon harvested S.cane crops respectively. For Cotton, LS, MS, SS mean long staple, medium staple and short staple varieties respectively.)



Table 4.14 : Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers (1984-85)

(Nutrients in Kg.)

Crop	Area (ha)	N	P	K	Per hectare		
					N	P	K
1. Kh.Jowar	493.91	9236.15	4078.89	1903.65	18.70	8.26	3.85
2. R.Jowar	378.49	297.80	219.20	98.70	0.79	0.58	0.26
3. Bajra	163.91	1701.32	351.00	198.00	10.38	2.14	1.21
4. Ragi	23.96	211.82	178.50	178.50	8.84	7.45	7.45
5. Cotton-LS	98.92	2274.15	1389.65	434.05	23.08	14.10	4.91
6. Cotton-MS	222.62	2914.78	1409.50	502.50	13.09	6.33	2.26
7. Cotton-SS	110.45	2090.75	1139.65	552.10	18.93	10.32	5.00
8. S.Cane(I)	-	-	-	-	-	-	-
9. S.Cane(RH)	-	-	-	-	-	-	-
10. G.Nut	52.57	630.05	747.20	233.00	11.98	14.21	4.43
11. Safflower	99.95	208.70	192.00	70.00	2.09	1.92	0.70
12. Tur	136.26	1938.22	964.10	407.50	14.22	7.08	2.99
13. Mung	162.51	978.40	624.90	163.60	6.02	3.85	1.01
14. Udid	55.18	397.34	351.75	112.40	7.20	6.37	2.04
15. Paddy	62.45	3123.86	581.90	400.30	50.02	9.32	6.41
16. Wheat	36.97	262.65	64.00	28.00	7.10	1.73	0.76
17. Gram	22.81	30.00	7.00	1.00	1.32	0.31	0.04
18. Others	248.09	1265.52	828.85	314.95	5.10	3.34	1.27
Total rainfed	2369.05	27561.51	13128.09	5648.25	11.64	5.54	2.38

(Sugarcane is hundred per cent irrigated crop. For cotton, LS, MS and SS mean long, medium and short varieties respectively.)

Table 4.15: Shares of Crops in Rainfed Area and in N,P,K of Rainfed Crops for Selected Farmers (1984-85)

Crop	Share in Rainfed Area	(Percentages)		
		Share in N	Share in P	Share in K
1. K.Jowar	20.85	33.51	31.07	33.70
2. R.Jowar	15.98	1.08	1.67	1.75
3. Bajra	6.92	6.17	2.67	3.50
4. Ragi	1.01	0.77	1.36	3.16
5. Cotton-LS	4.18	8.25	10.58	8.57
6. Cotton-MS	9.40	10.58	10.74	8.90
7. Cotton-SS	4.66	7.59	8.68	9.77
8. Sugarcane (RH)	-	-	-	-
9. Sugarbeet (RH)	-	-	-	-
10. G.nut	2.22	2.28	5.69	4.12
11. Safflower	4.22	0.76	1.46	1.24
12. Tur	5.75	7.03	7.34	7.21
13. Mung	6.86	3.55	4.76	2.90
14. Udid	2.33	1.44	2.68	1.99
15. Paddy	2.64	11.33	4.43	7.09
16. Wheat	1.56	0.95	0.49	0.50
17. Gram	0.96	0.11	0.05	0.02
18. Others	10.47	4.59	6.31	5.58
Gross Rainfed Area	100	100	100	100

(Sugarcane is entirely irrigated. For cotton, LS, MS, SS mean long, medium and short staple varieties respectively.)

Table 4.16 : Some of the Important Features of Selected Farmers Over Different Regions

(Area in ha., Nutrients in kg.)

Feature	1983-84				1984-85			
	Region I	Region II	Region III	Region IV	Region I	Region II	Region III	Region IV
1. Selected Farmers(No.)	60	130	150	60	50	180	240	130
2. Gross Cropped Area-GCA	120.05	635.63	1025.30	361.79	175.20	691.22	1429.53	624.52
% share of Region (state=100)	(5.48)	(31.30)	(46.81)	(16.52)	(6.00)	(23.67)	(48.95)	(21.38)
3. Per Farm GCA	2.00	5.27	6.83	6.03	3.50	3.84	5.96	4.80
4. Gross Irr. Area(GIA)	31.92	218.24	77.41	49.19	21.55	330.51	165.88	33.48
% share of Region (state=100)	(8.48)	(57.98)	(20.57)	(13.06)	(3.91)	(59.94)	(30.08)	(6.07)
5. Per Farm GIA	0.53	1.68	0.52	0.82	0.43	1.83	0.69	0.26
6. GIA/GCA%	26.59	31.83	7.55	13.60	12.30	47.82	11.60	5.36
7. Consumption of N	6744.86	19429.70	10343.65	6179.90	5311.16	23996.82	23165.72	13257.31
% Share of Region (State=100)	(15.80)	(45.50)	(24.22)	(14.47)	(8.08)	(36.51)	(35.24)	(20.17)
8. % Share of GIA in N within each region	85.98	93.07	17.77	36.69	43.00	87.47	49.16	26.45
9. N-P-K/ha. of GCA	56-17-11	28-10-3	10-5-2	17-8-5	30-9-8	35-13-9	16-8-3	21-9-5
10. N-P-K/ha. of GIA	182-56-34	83-30-10	24-11-3	46-21-12	106-37-36	64-23-17	69-27-16	105-47-30
11. N-P-K/ha. of rainfed area	11-3-1	3-0-0	9-4-1	13-5-4	20-5-4	8-3-2	9-5-2	17-7-4

(Contd.)

Table 4.16 : (Contd.)

Feature	1983-84				1984-85			
	Region I	Region II	Region III	Region IV	Region I	Region II	Region III	Region IV
12. Excluding Sugarcane								
i) N-P-K/ha of GCA	19-3-2	10-3-1	10-5-2	17-7-5	21-5-5	20-7-3	15-7-3	21-9-5
ii) N-P-K/ha of GI Excl.S.Cane & Others	54-28-4	30-3-3	21-11-3	48-21-11	36-16-10	33-11-5	65-24-15	102-46-30
iii) N-P-K/ha.of GIa	61-14-10	29-5-2	22-10-3	55-20-6	33-13-9	37-8-5	40-16-5	65-26-13
13. Top 3 Crops with largest shares in Region's GCA (% shares in brackets)	Rice (26) Bajra(18) S.Cane(12)	R.Jowar(33) Bajra(25) S.Cane( 6)	Cotton (20) K.Jowar(18) Mung (16)	Cotton(25) K.Jowar(25) Wheat ( 9)	Rice(15) Ragi(14) G.Nut(9)	R.Jowar(38) Bajra (15) K.Jowar( 7)	K.Jowar(21) Cotton (18) R.Jowar(13)	Cotton(32) K.Jowar(24) R.Jowar( 9)
14. Top 3 Crops with largest share (% in brackets) in N	S.Cane(70) Rice (14) Wheat ( 2)	S.Cane(66) Wheat (12) K.Jowar(2)	Cotton (31) K.Jowar(29) Bajra (12)	Cotton(41) Wheat (25) K.Jowar(19)	Rice(41) S.Cane(32) K.Jowar(4)	S.Cane (47) Bajra (10) R.Jowar(10)	K.Jowar(23) Cotton (18) S.Cane(9)	Cotton (28) K.Jowar(27) Tur (11)
15. Top 3 Irr.Crops with largest share (% in brackets) in GIa	S.Cane (28) Wheat ( 3) Rice ( 2)	S.Cane(20) R.Jowar(19) Wheat (15)	Wheat (37) R.Jowar(23) G.Nut ( 7)	Wheat (44) Cotton (14) S.Cane(13)	S.Cane(26) Wheat (22) Bajra (11)	R.Jowar(31) S.Cane(11) Bajra(10)	R.Jowar(18) Cotton (16) Wheat (15)	Wheat (35) Cotton (24) G.Nut ( 7)

Contd.

Table 4.16 : (Contd.)

	1983-84				1984-85			
	Region I	Region II	Region III	Region IV	Region I	Region II	Region III	Region IV
16. Top 3 Irr. Crops with largest share (% in brackets) in N for GIA	S. Cane(82)	S. Cane(71)	Wheat (57)	Wheat (66)	S. Cane(75)	S. Cane(53)	S. Cane(18)	Wheat (23)
	Rice ( 5)	Wheat (12)	S. Cane(15)	Cotton (14)	Wheat ( 7)	Wheat (11)	Wheat (15)	Cotton(13)
	Wheat ( 2)	Bajra ( 5)	G. Nut (14)	S. Cane ( 8)	Bajra ( 1)	R. Jowar(11)	R. Jowar( 8)	G. nut ( 6)
17. Top 3 dry crops with largest share	Rice (27)	R. Jowar(40)	Cotton(21)	K. Jowar(28)	Rice (17)	R. Jowar(44)	K. Jowar(23)	Cotton(33)
	Bajra (21)	Bajra (31)	K. Jowar(19)	Cotton (27)	Ragi (16)	Bajra (20)	Cotton (18)	K. Jowar (25)
	G. nut (13)	K. Jowar(3)	Mung (17)	Tur ( 5)	G. Nut (10)	K. Jowar(11)	R. Jowar(12)	R. Jowar(10)
18. Top 3 dry crops with largest share (% in brackets) in N for total dry area	Rice (73)	Bajra (63)	Cotton(36)	Cotton (58)	Rice (71)	K. Jowar(31)	K. Jowar(39)	K. Jowar(36)
	Ragi ( 8)	K. Jowar(16)	K. Jowar(35)	K. Jowar(30)	Bajra ( 8)	Bajra (28)	Cotton (29)	Cotton (34)
	K. Jowar(8)	R. Jowar( 9)	Bajra(15)	Rice ( 3)	K. Jowar(7)	Cotton(17)	Mung ( 6)	Tur (14)

Table 4.17 : Levels of N P for Kharif Jowar Over Regions for Selected Farmers

(Area in ha., nutrients in kg.)

	Irrigated					Unirrigated				
	Area	N	P	N/ha	P/ha	Area	N	P	N/ha	P/ha
<u>1983-84</u>										
Region I	-	-	-	-	-	6.21	75.90	-	12.22	-
Region II	7.48	221.70	27.50	29.64	3.68	14.20	218.55	50.00	15.39	3.52
Region III	-	-	-	-	-	180.87	2955.79	1187.30	16.34	6.56
Region IV	-	-	-	-	-	88.69	1164.00	467.00	13.12	5.27
Total	7.48	221.70	27.50	29.64	3.68	288.96	4414.24	1704.30	15.28	5.90
<u>1984-85</u>										
Region I	00.64	-	-	-	-	10.25	218.75	33.75	15.31	2.36
Region II	6.51	514.50	199.00	79.03	30.57	38.56	945.00	487.00	24.51	12.63
Region III	9.44	662.00	204.50	70.13	21.66	292.50	4585.85	2242.05	15.68	7.67
Region IV	0.85	64.00	18.00	75.29	21.18	148.56	3486.55	1316.09	23.47	8.86
Total	17.44	1240.50	421.50	71.13	24.17	493.91	9236.15	4078.89	18.70	8.26

Table 4.18 : Levels of N P for Rabi Jowar Over Regions for Selected Farmers

(Area in ha., nutrients in kg.)

	Irrigated					Unirrigated				
	Area	N	P	N/ha	P/ha	Area	N	P	N/ha	P/ha
<u>1983-84</u>										
Region I	0.69	-	-	-	-	7.58	-	-	-	-
Region II	40.65	56.60	2.10	1.39	0.05	187.13	116.20	57.00	0.62	0.30
Region III	17.77	-	-	-	-	113.16	63.00	63.00	0.56	0.56
Region IV	0.45	5.40	5.40	12.00	12.00	25.47	-	-	-	-
Total	59.56	62.00	7.50	1.04	0.13	333.34	179.20	120.00	0.54	0.36
<u>1984-85</u>										
Region I	0.42	-	-	-	-	12.84	3.70	3.70	0.29	0.29
Region II	104.08	2382.80	400.75	22.89	3.85	158.81	34.00	-	0.21	-
Region III	30.44	890.00	423.50	29.24	13.91	148.98	163.10	187.50	1.09	1.26
Region IV	-	-	-	-	-	57.86	97.00	28.00	1.68	0.48
Total	134.94	3272.80	824.25	24.25	6.11	378.49	297.80	219.20	0.79	0.58

Table 4.19 : Levels of N.P. for Bajra Over Regions for Selected Farmers

(Area in ha., nutrients in kg.)

	Irrigated					Unirrigated				
	Area	N	P	N/ha	P/ha	Area	N	P	N/ha	P/ha
<u>1983-84</u>										
Region I	-	-	-	-	-	18.14	15.00	5.00	0.83	0.28
Region II	28.79	928.85	70.00	32.26	2.43	143.19	845.01	28.50	5.90	0.20
Region III	-	-	-	-	-	84.32	1285.50	170.25	15.25	2.02
Region IV	-	-	-	-	-	-	-	-	-	-
Total	28.79	928.85	70.00	32.26	2.43	257.15	2202.51	260.75	8.56	1.01
<u>1984-85</u>										
Region I	2.39	69.00	33.00	28.87	13.81	9.50	247.00	63.00	26.00	6.63
Region II	32.61	1603.75	203.00	49.18	6.23	71.73	843.02	126.50	11.75	1.76
Region III	3.80	46.00	-	12.11	-	79.17	609.30	159.50	7.70	2.01
Region IV	-	-	-	-	-	3.51	2.00	2.00	0.57	0.57
Total	38.80	1718.75	236.00	44.30	6.08	163.91	1701.32	351.00	10.38	2.14



Table 4.20 : Levels of N for Cotton Over Regions for Selected Farmers (1983-84)

(Area in ha. N in kg.)

	Area			N			N/ha		
	LS	MS	SS	LS	MS	SS	LS	MS	SS
<u>Irrigated</u>									
Region I	-	-	-	-	-	-	-	-	-
Region II	0.35	-	2.20	24.20	-	-	69.14	-	-
Region III	0.60	0.60	0.60	66.00	-	9.00	110.00	-	15.00
Region IV	5.10	0.64	1.00	251.00	20.00	37.50	49.22	31.25	37.50
Total	6.05	1.24	3.30	341.20	20.00	46.50	56.40	16.13	12.24
<u>Unirrigated</u>									
Region I	-	-	-	-	-	-	-	-	-
Region II	-	-	9.93	-	-	70.50	-	-	7.10
Region III	20.56	70.63	107.72	336.00	607.30	2158.55	16.34	8.60	20.04
Region IV	34.50	32.71	17.28	1389.00	483.50	398.70	40.26	14.78	23.07
Total	55.06	103.34	134.93	1725.00	1090.80	2627.75	31.33	10.56	19.47

LS = Long Staple

MS = Medium Staple

SS = Short Staple

Table 4.21 : Levels of N for Cotton Over Regions for Selected Farmers (1984-85)

(Area in ha., N in kg.)

	Area			N			N/ha		
	LS	MS	SS	LS	MS	SS	LS	MS	SS
<u>Irrigated</u>									
Region I	1.95	-	-	121.00	-	-	62.05	-	-
Region II	0.80	1.85	-	136.00	114.50	-	170.00	61.89	-
Region III	15.81	7.06	3.03	474.00	164.80	86.00	29.98	23.34	28.38
Region IV	5.07	2.98	-	447.00	16.50	-	88.17	5.54	-
Total	23.63	11.89	3.03	1178.00	295.30	86.00	29.85	24.88	28.38
<u>Unirrigated</u>									
Region I	-	-	-	-	-	-	-	-	-
Region II	-	-	11.63	-	-	515.40	-	-	44.32
Region III	20.24	135.49	71.76	517.00	1514.50	1419.90	25.54	11.18	19.79
Region IV	78.68	87.13	27.06	1757.15	1400.28	155.45	22.33	16.07	5.74
Total	98.92	222.62	110.45	2274.15	2914.78	2090.75	23.08	13.09	18.93

LS = Long Staple, MS = Medium Staple, SS = Short Staple

Table 4.22 : Levels of N and P for Sugarcane (PH - Planted harvested, RH - Ratoon harvested)  
(Area in ha, Nutrients in kg.)

	Area		PH		RH		PH		RH		Overall	
	PH	RH	N	P	N	P	N/ha	P/ha	N/ha	P/ha	Area	N/ha
<u>1983-84</u>												
Region I	3.02	9.10	1206.95	248.75	3524.80	973.52	399.65	82.37	387.74	106.98	12.12	390.41
Region II	18.51	25.01	7019.80	3171.50	5874.80	1899.50	379.24	171.34	234.90	75.95	43.52	296.29
Region III	-	3.88	-	-	274.00	62.00	-	-	70.62	15.98	3.88	70.62
Region IV	2.65	3.72	122.30	93.60	63.00	45.00	46.34	35.32	18.28	12.10	6.37	29.95
Total	24.18	41.71	8349.55	3513.85	9741.60	2980.02	345.31	143.32	233.55	71.45	65.89	274.57
<u>1984-85</u>												
Region I	2.03	3.54	642.75	196.25	1059.05	350.75	316.63	96.67	299.17	99.08	5.57	305.53
Region II	22.99	13.42	7598.95	2837.75	3577.00	1438.50	330.53	123.43	266.54	107.19	36.41	306.95
Region III	11.85	10.68	1358.90	469.50	692.00	539.00	113.83	39.62	64.79	50.47	22.53	90.59
Region IV	0.75	-	164.00	54.00	-	-	218.67	72.00	-	-	0.75	218.67
Total	37.62	27.64	9754.60	3557.50	5328.05	2328.25	259.29	94.56	192.77	84.23	65.26	231.12

Table 4.23 : Levels of N, P for Groundnut over Regions for Selected Farmers

(Area in ha., nutrients in kg.)

	Irrigated					Unirrigated				
	Area	N	P	N/ha	P/ha	Area	N	P	N/ha	P/ha
<u>1983-84</u>										
Region I	0.50	-	-	-	-	11.33	27.60	-	2.44	-
Region II	12.63	95.30	27.50	7.55	2.18	5.48	27.85	14.50	5.08	2.65
Region III	7.13	254.00	112.00	35.62	15.70	21.44	382.00	321.75	17.82	15.00
Region IV	2.40	42.00	19.00	17.50	5.92	4.52	32.00	49.00	7.08	10.84
Total	22.66	391.30	158.50	17.27	6.99	42.77	469.45	385.25	10.98	9.01
<u>1984-85</u>										
Region I	0.50	-	24.00	-	48.00	14.69	174.00	178.00	11.84	12.12
Region II	8.98	87.50	121.00	9.74	13.47	11.87	75.25	169.00	6.34	14.24
Region III	1.48	15.00	3.50	10.14	2.36	23.30	368.30	383.70	15.81	16.47
Region IV	2.22	216.60	105.60	97.57	47.57	2.71	12.50	16.50	4.61	6.09
Total	13.18	319.10	254.10	24.21	19.28	52.57	630.05	747.20	11.98	14.21

Table 4.24 : Levels of N,P for Rice over Regions for Selected Farmers

(Area in ha, nutrients in kg.)

	Irrigated					Unirrigated				
	Area	N	P	N/ha	P/ha	Area	N	P	N/ha	P/ha
<u>1983-84</u>										
Region I	2.47	296.50	67.50	120.04	27.33	23.68	690.80	177.40	29.17	7.49
Region II	1.94	221.95	5.75	114.41	2.96	0.85	46.00	-	54.12	-
Region III	2.50	27.50	27.50	11.00	11.00	8.70	39.00	20.50	4.76	2.50
Region IV	-	-	-	-	-	7.24	133.40	-	18.43	-
Total	6.91	545.95	100.75	79.01	14.58	40.47	909.20	197.90	22.47	4.89
<u>1984-85</u>										
Region I	-	-	-	-	-	26.68	2154.59	331.50	80.76	12.43
Region II	2.49	129.00	2.40	51.81	0.96	-	-	-	-	-
Region III	3.75	122.00	19.00	32.53	5.07	4.03	8.00	8.00	1.99	1.99
Region IV	1.55	137.00	45.00	88.39	29.00	31.74	961.27	242.40	30.29	7.64
Total	7.79	388.00	66.40	49.81	8.52	62.45	3123.86	581.90	50.02	9.32

Table 4.25 : Levels of N,P for Wheat over Regions for Selected Farmers

(Area in ha, nutrients in kg.)

	Irrigated					Unirrigated				
	Area	N	P	N/ha	P/ha	Area	N	P	N/ha	P/ha
<u>1983-84</u>										
Region I	2.94	115.10	30.00	39.15	10.20	0.31	-	-	-	-
Region II	31.71	2239.21	454.90	70.62	14.35	2.37	-	-	-	-
Region III	28.48	1050.90	508.00	36.90	17.84	9.82	10.00	10.00	1.02	1.02
Region IV	21.74	1490.10	514.70	68.54	23.68	9.40	64.00	18.00	6.81	1.91
Total	84.87	4895.31	1507.60	57.68	17.76	21.90	74.00	28.00	3.38	1.27
<u>1984-85</u>										
Region I	4.73	166.65	42.75	35.23	9.04	2.10	-	-	-	-
Region II	30.94	2403.20	637.45	77.67	20.60	1.00	-	-	-	-
Region III	24.33	1667.40	451.00	68.53	18.95	16.88	153.00	46.00	9.06	2.73
Region IV	11.60	308.20	295.50	69.67	25.47	15.99	109.65	18.00	6.86	1.13
Total	71.60	5045.45	1436.70	70.47	20.07	36.97	262.65	64.00	7.10	1.73

Table 4.26 : Cultivated Area, Irrigated Area and N and P Consumption by Size Group\* of Holdings (1984-85)-I  
(Area in hectares, Nutrients in kg.)

Size group	No. of farms	No. of users of fertilizers	Cultivated area	Irrigated area	N	P	Per Farm				Per cult. ha.	
							Cultivated area	Irrigated area	N	P	N	P
1	120	79	162.79	33.70	5508.39	1905.83	1.36	0.28	45.90	15.88	33.83	11.70
2	120	95	336.91	67.21	10597.61	4052.00	2.81	0.56	88.31	33.77	31.45	12.03
3	120	88	507.62	66.48	12679.55	4881.46	4.23	0.55	105.66	40.68	24.98	9.62
4	120	102	764.03	103.58	14256.54	6285.00	6.37	0.86	118.80	52.37	18.66	8.23
5	120	101	1243.77	159.85	21901.28	9465.11	10.36	1.33	182.51	78.88	17.61	7.61
Overall	600	465	3015.12	430.82	64943.37	26539.40	5.02	0.72	108.24	44.31	21.54	8.82

1\* The size groups here are as they were obtained at each centre, representing equal area in each size group in that centre.

Hence farmers in size group 1 represent all smallest one-fifth of farmers in each centre. The actual ranges thus vary from centre to centre and hence from zone to zone, region to region, etc.

2 For other details, see Section 4.9.

Table 4.27 : Cultivated Area, Irrigated Area and N and P Consumption by Size Group of Holdings  
(1984-85)-II

(Area in ha., Nutrients in kg)

Size group (ha)	No. of Farms	No. of users of fertilizers	Cultivated area	Irrigated area	N	P	Per farm				Per Cult. ha.	
							Cultivated area	Irrigated area	N	P	N	P
Upto 2	136	96	175.57	41.30	7538.87	2734.19	1.29	0.30	55.43	20.10	42.94	15.57
2 - 4	171	137	507.70	120.40	19401.64	7093.75	2.97	0.70	113.46	41.48	38.21	13.97
4 - 6	110	87	549.95	77.71	11864.49	4456.05	5.00	0.71	107.86	40.51	21.57	8.10
6 - 8	77	58	528.65	57.25	8516.43	4441.21	6.87	0.74	110.60	57.68	16.11	8.40
Above 8	106	87	1253.25	134.16	17621.94	7864.20	11.65	1.26	166.24	74.19	14.06	6.27
Overall	600	465	3015.12	430.82	64943.27	26589.40	5.02	0.72	108.24	44.31	21.54	8.82

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Note: Discussion in Section 4.9 may be referred to for this table.



Table 4.28 : Sourcewise Gross Irrigated Area and Intensity of Fertilizer Use for Different Size Groups (1984-85)

(Cross Area in ha,  
Nutrients in kg.)

Size group (ha)	Farm	Farms with irrigation	Canal			Well			Others			Total		
			Gross irrigated area	N/ha	P/ha	Gross irrigated area	N/ha	F/ha	Gross irrigated area	N/ha	F/ha	Gross cropped area	N/ha	P/ha
0-2	136	53	4.13	100.22	22.88	44.98	83.37	30.99	4.84	113.48	21.17	53.95	87.36	29.49
0-4	171	75	24.22	52.54	13.01	113.84	95.28	34.58	9.81	131.49	33.32	147.87	90.68	30.96
4-6	110	40	22.41	48.32	9.77	65.26	80.33	26.05	5.94	45.56	2.53	93.61	70.46	20.66
6-8	76	29	7.70	18.57	14.03	70.04	62.50	30.52	-	-	-	77.74	58.15	28.89
8 and above	107	47	31.76	27.87	10.64	111.56	63.71	25.76	16.69	20.04	4.95	160.01	52.04	20.59
Total	600	244	90.22	42.09	11.91	405.68	77.21	29.68	37.28	65.56	14.13	533.18	70.46	25.59

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Table 4.29 : Cropping Pattern on Canal Irrigated Area and Fertilizer Use in Region II (1984-85)

(Area in ha, Nutrients in kg)

Crop	Area	%	N	%	P	%
1. Kh. Jowar Per ha.	1.40	1.73	92.00 (65.71)	2.59	-	-
2. R. Jowar Per ha.	42.94	53.16	843.50 (19.64)	23.74	64.75 (1.51)	6.62
3. Bajra Per ha.	9.78	12.11	458.55 (46.88)	12.91	7.50 (0.77)	0.77
4. S. Cane Per ha.	4.87	6.03	1636.00 (335.93)	46.05	695.50 (142.81)	71.11
5. Groundnut Per ha.	7.47	9.25	5.00 (0.66)	0.14	61.00 (8.17)	6.24
6. Safflower Per ha.	0.20	0.25	3.00 (15.00)	0.08	3.00 (15.00)	0.31
7. Tur	0.20	0.25	-	-	-	-
8. Rice Per ha.	1.01	1.25	57.50 (56.93)	1.62	-	-
9. Wheat Per ha.	4.54	5.62	39 6.10 (87.24)	11.15	78.50 (17.29)	8.03
10. Gram per ha.	6.2	7.68	49.75 (8.02)	1.40	3.75 (0.60)	0.38
11. Others Per ha.	2.16	2.67	11.50 (5.32)	0.32	64.00 (29.63)	6.54
Gross Irr. Area per ha.	80.77	100.00	3552.90 (43.99)	100.00	978.00 (12.11)	100.00

(No area under ragi, cotton, mung, udid reported).

Table 4.30: Cropping Pattern on Well Irrigated Area and Fertilizer Use in Region II (1984-85)

(Area in ha, Nutrients in kg)

Crop	Area	%	N	%	P	%
1. Kh.Jowar Per ha.	4.46	1.82	399.50 (89.57)	2.32	199.00 (44.62)	3.02
2. R.Jowar Per ha.	59.18	24.13	1493.30 (25.23)	8.69	336.00 (5.68)	5.10
3. Bajra Per ha.	22.38	9.13	1122.20 (50.14)	6.53	195.50 (8.73)	2.97
4. Cotton Per ha.	2.65	1.08	250.50 (94.55)	1.46	95.00 (35.84)	1.44
5. S.Cane Per ha.	31.14	12.70	9394.95 (301.70)	54.66	3551.25 (114.04)	53.94
6. Groundnut Per ha.	1.51	0.62	82.50 (54.63)	0.48	60.00 (39.73)	0.91
7. Safflower Per ha.	0.91	0.37	19.25 (21.15)	0.11	7.50 (8.24)	0.11
8. Tur Per ha.	0.30	0.12	0.46 (1.53)	0.00	-	-
9. Mung	1.15	0.47	-	-	-	-
10. Rice Per ha.	1.48	0.60	71.50 (48.31)	0.42	2.40 (1.62)	0.04
11. Wheat Per ha.	25.95	10.58	1995.60 (76.90)	11.61	558.95 (21.54)	8.49
12. Gram Per ha.	8.07	3.29	157.15 (19.47)	0.91	6.50 (0.80)	0.10
13. Others Per ha.	86.05	35.09	2202.24 (25.59)	12.81	1572.19 (18.27)	23.88
Gross Irr. Area per ha.	245.23	100.00	17139.15 (70.09)	100.00	6584.29 (26.85)	100.00

(No area under ragi & udid. Figures in brackets are nutrients/ha).

Table 4.31: Fertilizer (N) Consumption Potential for the Irrigated Component in the State

(Area in thousand ha, level and potential in thousand kg)

Crop	State Area	Existing level	Potential		(4)/(3)	(5)/(3)
			Conservative estimate	Liberal estimate		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. K.Jowar	33.7	1697.97	1735.55	2352.30	1.02	1.39
2. R.Jowar	343.9	4350.34	14361.20	18102.80	3.30	4.16
3. Bajra	50.5	1933.14	1045.40	2020.00	0.54	1.04
4. Ragi	-					
5. Cotton	136.6	5375.84	7046.20	9778.40	1.31	1.82
6. S.Cane	358.0	90516.72	81925.68	98257.56	0.91	1.08
7. G.nut	28.6	593.16	286.00	572.00	0.48	0.96
8. Safflower	-					
9. Pulses	97.3	559.47	973.00	1459.50	1.74	2.61
10. Rice	403.4	25932.99	24607.50	31142.60	0.95	1.20
11. Wheat	575.8	36894.38	34548.00	40306.00	0.94	1.09
12. Others	549.9	27137.56	27137.56	27137.56	1.00	1.00
Total	2577.7	195041.57	193666.09	231128.72	0.99	1.18

(For details see Section 4.10 and Appendix B)

Table 4.32 : Fertilizer (N) Consumption Potential for the Unirrigated Component in the State

(Area in thousand ha., level and potential in thousand kg)

Crop (1)	State (2)	Existing level (3)	Potential		(4)/(3) (6)	(5)/(3) (7)
			Conservative estimate (4)	Liberal estimate (5)		
1. K.Jowar	2938.3	49921.72	145748.65	198268.40	2.92	3.97
2. R.Jowar	3237.1	2152.67	60755.40	102030.20	28.22	47.40
3. Bajra	1563.5	14806.34	24046.60	46992.60	1.62	3.17
4. Ragi	224.0	2367.68	2240.00	4480.00	0.95	1.89
5. Cotton	2540.4	45400.09	52603.95	83139.25	1.16	1.83
6. S.Cane	-	-	-	-	-	-
7. G.nut	762.4	8752.35	7084.52	13899.30	0.81	1.59
8. Safflower	536.0	761.00	5360.00	10720.00	7.04	14.08
9. Pulses	2612.7	15023.03	26127.00	39190.50	1.74	2.61
10. Rice	1098.6	39813.26	67014.50	84811.80	1.68	2.13
11. Wheat	501.2	2626.29	10024.00	15036.00	3.82	5.72
12. Others	1667.1	5268.04	5268.04	5268.04	1.00	1.00
Total	17681.3	186392.47	406272.66	603836.09	2.17	3.23

(For details see Section 4.10 and Appendix B)

Table 4.33 : Fertilizer (N) Consumption Potential in the State

(Area in thousand ha., level and potential in thousand kg)

Crop	State	Existing level	Potential		(4)/(3)	(5)/(3)
			Conservative estimate	Liberal estimate	(6)	(7)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. K.Jowar	2972	51619.69	147484.20	200620.70	2.86	3.89
2. R.Jowar	3581	6503.01	75116.60	120133.00	11.55	18.47
3. Bajra	1614	16739.48	25092.00	49012.60	1.50	2.93
4. Ragi	224	2367.68	2240.00	4480.00	0.95	1.89
5. Cotton	2677	50775.93	59650.15	92917.65	1.17	1.83
6. S.Cane	358	90516.72	81925.68	98257.56	0.91	1.08
7. G.nut	791	9345.51	7370.52	14471.30	0.79	1.55
8. Safflower	536	761.00	5360.00	10720.00	7.04	14.09
9. Pulses	2710	15582.50	27100.00	40650.00	1.74	2.61
10. Rice	1502	65796.25	91622.00	115954.40	1.39	1.76
11. Wheat	1077	39520.67	44572.00	55342.00	1.13	1.40
12. Others	2217	32405.60	32405.60	32405.60	1.00	1.00
Total	20259	331934.04	599938.75	834964.81	1.57	2.19

(For details see section 4.10 and Appendix B)

## CHAPTER V

### SUMMARY AND CONCLUSION

5.1 Introduction of irrigation and adoption of high yielding varieties seeds are two main features of the green revolution. These varieties are fertilizer responsive and thus application of chemical fertilizers also becomes another inevitable feature of this green revolution. The present study deals with the use-levels of fertilizers in Maharashtra. Although the Department of Agriculture publishes huge data on agriculture in the state, these relate to cropping pattern, irrigated cropping pattern, production and productivity of various crops etc., incorporated in the annual Season and Crop Reports and similar data with some additional information on agriculture put out in the newly introduced (annual) Epitome of Agriculture. In the last mentioned publication we have consumption in the State by the three nutrients N, P and K over the years. More data on fertilizer use can also be found in the fertilizer Statistics published by the Fertilizer Association of India in which even districtwise nutrient consumption is available. But cropwise data on levels of fertilizer use are not available and these are important for planned growth of agriculture. There are various ad-hoc studies at different times in 1970-71 and 1976-77, the former being a part of 26th round of NSS and the latter as part of Agricultural Census 1976-77 (Report on Input Survey). (Sections 1.1 to 1.3)

The present study attempts to find out cropwise use levels for 1983-84 and 1984-85 based on state-wide Samples of 400 cultivators in 1983-84 and 600 cultivators in 1984-85. The data of these samples are made available to us by the Comprehensive Scheme for Studying the Cost

of Cultivation of Principal Crops Unit located at the Mahatma Phule Agricultural University, Rahuri and the cooperation extended by the Director and the Field Officer of the Centre is gratefully acknowledged. The Cost Accounting method was adopted by the Centre for data collection and from the enormous data collected we confine ourselves to data on fertilizer use only, keeping in view the objective and the cost and time constraints on us. We also take responsibility for the errors of omission and commission in analysing these data. (Section 1.4)

5.2 We look at the background relating to fertilizer use in the State so that this study relating to 1983-84 and 1984-85 finds a proper perspective for its results. Since 1960-61 the consumption of fertilizer is increasing steadily over the years. For example, consumption of nutrients N and P has increased from 12 thousand and 5 thousand tonnes in 1960-61 to 398 thousand and 159 thousand tonnes respectively by the year 1986-87. Per hectare of gross cropped area, input of N for example has increased from 1.13 kg/ha (average triennium 1961-64) to 14.51 kg/ha (average 1980-83). Thus although growth rate of fertilizer (N) consumption is high around 15 per cent per annum, in absolute terms even in 1980-83 the average of 14.51 kg of N/ha is woefully below the national average of over 30 kg/ha and nowhere near Punjab's average of over 100 kg of N/ha. One of the obvious reasons is low extent of irrigation (around 13 p.c. of gross cropped area) and the proverbial drought-proneness of the State (Sections 2.1 and 2.2).

A quick look at the agricultural performance reveals that foodgrains production increased at an annual



compound growth rate of 3.09 per cent between 1967-70 and 1980-83 while population between 1971 and 1981 increased at the rate of 1.78 p.c.p.<sup>a</sup>. Looking at absolute additions in foodgrains, kharif jowar, rice and wheat appear the major contributors in that order. Appearance of kharif jowar is truly remarkable as it is almost entirely unirrigated while rice has some and wheat considerable irrigation. Obvious lack of success is in rabi jowar which has the largest area share. Over years its productivity has remained low around 3 to 4 quintals whereas kharif jowar, rice and wheat have good increases in productivity. Among other crops cotton and groundnut are important in terms of area but over years the former has an up and down performance while the latter shows clear decline. But one must mention sugarcane crop which in terms of area is insignificant (less than 2 to 3 per cent) but is entirely irrigated with a very high irrigation water requirement. It has a good growth rate in production over the years claiming about half the irrigation water. Importance of sugarcane is revealed by the fact that in the agricultural production index sugarcane draws the highest weight of about 22 per cent with the next highest weight of 11.52 per cent being for rice-sugarcane is thus truly the 'prima donna' of Maharashtra's agriculture. As regards the two years under consideration viz., 1983-84 and 1984-85, these appear normal or at least not abnormal. Foodgrains production in these two years is neither exceptionally high nor exceptionally low although there is a minor peak in 1983-84 with a figure of 10.95 million tonnes but the 10 million mark was also crossed in 1977-78, 1979-80 and 1981-82. All important cereals and pulses have a higher

production in 1983-84 than the one in 1984-85 except for rabi jowar which has a higher production in 1984-85. By and large, foodgrains production is about normal in both the years.

Among non-foodgrains crops sugarcane production is lower in both the years around 26.5 million tonnes, somewhat below the 1980-83 average of over 30 million tonnes (but 1985-86 figure is even lower than 26.5 million tonnes). Similarly comparing 1983-84 and 1984-85 levels with 1980-83 triennium average, we find that production of cotton in 1983-84 is decidedly low but 1984-85 is normal; for groundnut, production level in both the years is consistently higher than 1980-83 average. But these we may accept as 'near-normal' considering overall setbacks in 1985-86 for cereals, sugarcane and groundnut (but not cotton). (Sections 2.3 to 2.5).

5.3 The methodology of selection of sample adopted by the Cost of Cultivation Scheme at Mahatma Phule Agricultural University (MPAU) may be summarised as follows: officially there are nine agro-climatic zones in the State. The Cost of Cultivation Scheme considers these in more detail into twelve zones and the sample is to be spread over these twelve zones. Thirteen crops are to be covered. They are : kharif jowar, rabi jowar, bajra, ragi, cotton, sugarcane, onion, groundnut, sunflower, safflower, tur, mung and udid (henceforth referred to as the '13-crop aggregate'). These do not cover some prominent crops like rice, wheat and gram possibly because Maharashtra is not a big producer in the national context. (In the analysis of data of course we include those three crops). The agro-climate zones cut

across district (and taluka) boundaries and hence the Department of Agriculture specially compiled the 13-crop aggregate cropping pattern to form a basis for the selection of sample. The 13-crop aggregate has areawise major crops (like kharif jowar, rabi jowar, cotton) as well as minor crops (like onion, sugarcane, sunflower, ragi etc.). To ensure adequate area coverage the sampling scheme tries to give equal importance to these crops. Area proportion of a given zone in each crop is first calculated and these proportions (which are now free of actual physical area) for that zone are averaged across the 13 crops to have 'mean percentage share' for that zone. Number of centres are allotted to each zone in proportion to these mean percentage shares. Forty centres are thus selected for 1983-84 and sixty for 1984-85. Each centre has a cluster of one to three villages from which 10 farmers are selected spread over the size groups of holdings. The sample size is thus of 400 farmers in 1983-84 and an augmented size of 600 farmers in 1984-85. Within a centre all the farmers are listed, arranged by the size of their holdings. The total area of the centre is then divided into five groups with each group covering equal area (and naturally unequal number of farmers). From each group 2 farmers are selected making 10 farmers per centre. The size of holding class ranges thus differ from centre to centre according to local conditions. (Sections 3.1 to 3.4)

5.4 Although the twelve agro-climatic zones get representations in the sample, we have for the purpose of this study grouped these zones into four 'regions' to avoid the analysis being cumbersome and because over the regions

we have relatively sharper differences in agro-climatic characteristics and hence in the fertilizer use levels. These four regions with their share of the 13 crop aggregate (this aggregate is referred to as 'basic' data in this section. The data were specially compiled zonewise by the Department of Agriculture and mentioned above), are as follows :

- Region I : High rainfall region in W. Maharashtra comprising (agro-climatic) zones I, II and III. Covers 7.22 per cent of 13-crop state aggregate area.
- Region II : Scarcity region covering zones IV, V, VI and VII forms 31.22 per cent of the 13-crop state area. This region has traditionally irrigated area with net-work of canals-wells.
- Region III : Assured rainfall region covering zones VIII, IX and X. Forms 39.71 per cent of 13 crop state aggregate. Covers parts of Vidarbha, Maharashtra and Jalgaon District.
- Region IV : High rainfall region of Eastern Maharashtra - most of vidarbha and small portion of Marathwada. Accounts for 21.79 per cent of State 13-crop area.

It will be soon later on that the regions have similar shares of the gross cropped area of selected cultivators with Region III of assured rainfall getting larger share in both the years. Thus in spite of the 'crops on equal footing' method of sampling, regionwise representation is adequate. Further if we look at the 13-crop aggregate 'basic data' and the cropping pattern of the selected farmers, we see that by and large shares of crops within 13-crop aggregate are of similar magnitudes. In the 'basic' data however, we have kharif jowar area about twice rabi jowar area whereas in the official data

rabi jowar area always exceeds kharif jowar area and the sample, too, reflects the correct state of affairs with rabi jowar of the selected farmers exceeding their kharif jowar area. Thus the flaw in the basic data has not affected the sample.

The regional cropping patterns based on selected farmers' cropping pattern are also representative of the regional cropping patterns based on basic data, especially for major crops in both the years. (Section 3.5 to 3.7).

5.5 One must also see how shares of regions within a given crop based on 'basic data' compare with the shares based on sample data. It is seen that major regions are well represented. For small crops like tur, mung, udid the differences between regions are rather exaggerated in the sample data. For sugarcane one sees that region-wise shares in 1983-84 for sample data are close to those in 'basic' data but in 1984-85 Region III comes out as the second largest instead of Region I and this merits mention because of the outstanding nature of this crop, affecting overall estimates of fertilizer consumption as is seen in the analysis of data (Section 3.8).

5.6 Before we come to the analysis of results, it should be mentioned that for cropwise analysis we have added crops of rice, wheat, gram and 'others' category so that all important crops and whole of gross cropped area is covered. But in this cropwise analysis sunflower with its very small area is not covered while onion is not included in various tables but only broad results given for the same reason.

When we compare the cropping pattern now over the entire gross cropped area of selected farmers with the State cropping pattern, we see remarkable close agreement in both the years although rice (crop not in 13-crop aggregate) is under-represented and bajra is over-represented. In the irrigated cropping pattern important (areawise) irrigated crops appear in the same order in sample data as in official data except for rice which has inadequate representation. Proportion of gross irrigated area to gross cropped area is also higher at 18 and 19 per cent in the two years compared to 'official' ratio at 13 per cent for 1980-83 triannium. Nearly for every crop, proportion of area irrigated in the sample is higher than the official data based proportion

Analysis of fertilizer consumption reveals that irrigated crops account for 66 and 58 per cent of nutrient N in the two years respectively although irrigation covers only 18-19 per cent of sample gross cropped area. Per hectare N-P-K for the gross cropped area (GCA) comes to 19-7-3 kg and 22-9-5 kg respectively in the two years. Per gross irrigated hectare it is as high as 74-27-11 69-26-18 kg over the two years. For rainfed area, levels are very low at 8-3-2 and 12-6-2 kg/ha for the two years.

Top fertilizer consuming crops are sugarcane with its 25 to 40 per cent share in total N (but only 2-3 per cent area share) followed by kharif jowar and cotton with around 15 per cent shares in N - same as their area shares. In the sample, top three irrigated crops are wheat, sugarcane and rabi jowar but top consumer is again sugarcane with 65 and 40 per cent shares in N of irrigated crops. Among the rainfed crops, rabi jowar, cotton and kharif jowar dominate

in area but in N consumption rabi jowar is absent. Among top (rainfed) N consumers cotton and kh.jowar are followed by bajra or rice (and not rabi jowar). Notable aspect is that cotton and kharif jowar each with 16 to 18 per cent area share, has around 30 per cent share of N for each and thus stand out as important fertilizer consumers. Treating irrigated and unirrigated components as separate crops we can list major fertilizer (N) consuming crops as :

Crop	Year	% share in GCA	% share in N	N-P-K/ha (kg)
Irr. S. Cane	1983-84	3.01	42	275-99-43
	1984-85	2.23	23	231-90-80
Dry Cotton	1983-84	13.39	13	19-10-4
	1984-85	14.79	11	17-9-4
Dry K. Jowar	1983-84	13.19	10	15-6-3
	1984-85	16.91	14	19-8-4
Irr. Wheat	1983-84	3.87	11	58-8-8
All Irrigated	1983-84	17.18	66	74-27-11
	1984-85	18.88	58	69-26-18
All Dry Crops	1983-84	82.82	34	8-3-2
	1984-85	81.12	42	12-6-2

We note the dominance of irrigated crops of sugarcane and to some extent of wheat. Rainfed kharif jowar and cotton find prominence even in this rather exclusive list and their levels of fertilizer use are higher than other dry crops. But there is a scope for fertilizer use especially for kharif jowar when we realize that most of the area comes from assured rainfall and high rainfall zones where N can go as high as 50-75 kg/ha, from the actual levels of 15-20 kg/ha (Sections 4.1 and 4.2).

5.7 To be able to compare use-levels of fertilizers with the recommended doses, two tables of recommended doses are presented. In the first table recommended doses for different crops separately for irrigated and unirrigated components are presented. These are the doses one finds in the literature when one is talking about Maharashtra as a whole. These are taken from various sources, the main source being the doses recommended by the Department of Agriculture and supplied to the Cost of Cultivation Scheme at the MPAU. In the popular media like radio and television also similar levels are mentioned. The second table of doses is not only more detailed for crops like sugarcane but it has separate doses for irrigated or assured rainfall regions and for uncertain rainfall regions. As rainfall is uncertain in large parts of Maharashtra, This distinction assumes importance and tempers our assessment of the disparity between the actual levels and recommended levels. The data of these recommended doses are taken from 'Agricultural Extension Service' (1989) in Marathi, by Prof. Salunkhe (then) Vice Chancellor, MPAU Rahuri and D. Sapre, Dy. Director, Department of Agriculture, Pune (Section 4.3).

5.8 The relative importance of cross as fertilizer consumers in the State can be realized by making three groups : (i) crops which reveal the nexus between irrigation and fertilizer consumption i.e. crops that have fertilizer (N) share easily exceeding the area share (ii) crops with area and fertilizer share of similar magnitudes and (iii) crops with fertilizer share well below the area share. In the first group we have pre-eminently sugarcane (3 per cent of GCA, 25-40 per cent of N), followed by wheat and rice.



In the second we have kharif jowar, cotton and bajra with the first two being major crops in terms of area also.

In the third group is rabi jowar, tur, mung, udid and oilseeds like groundnut and safflower. Pulses and oilseeds have not only low levels but the required balance between N and P is also absent with dominating N instead of P. In this third group, rabi jowar is the major crop - in fact covering largest area of GCA - but a very poor consumer of fertilizer. Its fodder value is as much as 60 per cent of its grain value and in fact per hectare fodder value is higher than other cereals like kharif jowar, paddy etc. HYV varieties of rabi jowar are not very popular probably because their fodder is not as plentiful and of similar quality and with the dominance of local improved varieties, fertilizer use levels are extremely low. Other small crops like onion, banana and grapes which get included in 'others' would fall in the first category as they are entirely irrigated with high fertilizer levels.

If we look at the irrigated component of crops we see that N-P-K/ha of irrigated area is 74-27-11 kg (1983-84) and 69-26-18 kg (1984-85) which are close and obviously higher than 8-3-2 and 12-6-2 kg/ha for the unirrigated crops for the two years. For the unirrigated component, kharif jowar and cotton are the main fertilizer consuming crops followed by rice and bajra. The main rainfed crop of rabi jowar has N less than 1 kg/ha and introduction of HYV with good fodder would be a break-through in Maharashtra's agriculture (Sections 4.5 and 4.6).

5.9 For examining differences between the regions we concentrate on the two biggest of the four. First is the

assured rainfall area of Region III with a coverage of nearly half the sample GCA and second is the drought prone Region II with its 25 to 30 per cent coverage of GCA. It is this Region II which is the largest consumer of N, accounting for 35-45 per cent share in the total N, as this region has about 60 per cent of the gross irrigated area and includes the sugarcane belt. As much as 90 per cent of Region II's consumption of N is on account of irrigated area. Region III, on the other hand, has 25 to 35 per cent share in total N with its 20 to 30 per cent share in State irrigated area.

Scarcity Region II has N-P-K/ha at 28-10-3 and 35-13-9 kg and for assured rainfall Region III these levels are lower at 10-5-2 and 16-8-3 kg for the two selected years. The effect of irrigation is apparent here. For the unirrigated crops however, Region III has N-P-K/ha at 9-4-1 kg and 9-5-2 kg compared to 3-0-0 and 8-3-2 kg for Region II for the two years. Effect of assured rainfall comes out but it should obviously be more pronounced. One can safely say that although there is a scope for increased fertilizer use in uncertain rainfall areas (Region II) the scope is even higher in assured rainfall areas. In the other two regions of moderately high and high rainfall area (Region I and IV) availability of moisture is no constraint and yet N/ha is low between 10 to 20 kg and here too there is great scope for increased use as even traditional varieties of rice (a crop dominant in these regions) have recommended doses of about 100 kg/ha.

Sugarcane and fruits like banana and grapes among 'other crops' have high fertilizer levels (over 300 kg of N/ha) and if we exclude these from the irrigated area

N/ha of irrigated area comes down from 60-75 kg to 32-40 kg and surely these remaining crops have rather low levels compared to the recommended doses for irrigated crops which often exceed 50 kg/ha. One reason is that among irrigated crops, rabi jowar is a major crop but fertilizer use (N) is around 20 kg/ha only as the green revolution has failed to touch this important crop (Section 4.7).

5.10 When one tries to take a cropwise view one can see the situation as follows :

Kharif jowar, the second largest crop in terms of area but first as supplier of foodgrains is mostly un-irrigated. By official data 66 per cent of the crop area is under HYV and barring wheat, this is highest among foodgrains. Although recommended doses for this unirrigated crop vary between 12 to 50 kg of N/ha for traditional variety (TV) and between 25 to 60 for HYV and even 75 kg/ha for assured rainfall areas, for no region the average exceeds 25 kg/ha and the overall average is in fact 19 kg of N/ha. As pointed out in the preceding sections, important aspect to note is that per hectare levels are not much different between those in the scarcity Region II and the assured rainfall Region III as the latter are only marginally higher where the use of fertilizer is perhaps more widespread. Thus there is a tremendous scope for increased fertilizer use in Region III and to a lesser extent in Region II. The existing levels are of course higher than those for rainfed area as a whole which are 9 and 12 kg/ha only, for the two years.

In case of Rabi Jowar, this crop with largest area is only the third biggest supplier of foodgrains after kharif jowar and rice. Although the crop has some irrigation (8 to 10 per cent), HYV has not made an impact on this

crop and its productivity has remained around 4.30 quintals/ha over the years. For the main unirrigated component the recommended dose is between 25 and 75 kg of N/ha depending on whether it is HYV or TV. But the average N by our sample is less than 1 kg/ha and this is indeed very low.

Large rabi jowar areas are obtained in Region II and Region III but in both the regions the levels are equally low so the assured rainfall condition does not seem to be exploited. The fodder dimension is relevant and if HYV varieties with good fodder content are developed, the HYV area proportion may improve from the dismal official 5 per cent estimate. Bajra with 8 per cent coverage of GCA and last among the big suppliers of foodgrains in the state showed initial promise but after 1971-72, the crop suffered from soil borne disease of downy mildew and its performance is modest. Over the years production is almost stagnant with area decreases cancelling productivity gains. This is mostly an unirrigated crop specially suited to drought-prone areas and the recommended doses for traditional variety are from 12 to 25 kg of N/ha while for HYV they are about 50 kg/ha. The actual levels are 8 to 10 kg/ha for the two years and these are modest, especially when official HYV coverage is estimated at 40 to 50 per cent. The crop area is divided between Regions II and III but the level obtained (for the two years) do not indicate that assured rainfall region has a distinctly higher level - in fact in one year it is lower. But in either case it does not exceed 15 kg of N/ha while State average does not exceed 10 kg/ha in either year.

Cotton is a major non-foodgrains crop in terms of area. By official statistics, it covers 13 per cent of GCA and is mostly unirrigated with less than five per cent

crop area being irrigated. Its production performance over years has been an up and down affair. Percentage area under HYV is 3 to 5 per cent, by official data. Cotton is mainly confined to Regions III and IV and for these regions there is no moisture problem. Medium staple (MS) and short staple (SS) varieties under unirrigated conditions receive 10 to 20 kg of N/ha which is well below 50 kg/ha recommended for desi variety in assured rainfall areas. This indicates scope for increased fertilizer use but one must admit that the existing levels of 10 to 20 kg of N/ha are above 9 to 12 kg/ha for unirrigated crops as a whole, and this crop along with kharif jowar is a major fertilizer consumer among the unirrigated crops.

For irrigated cotton, long-staple varieties dominate and 50 to 55 kg of N/ha are the use-levels which are high but the recommended doses are even higher at 80 to 100 kg/ha. Sugarcane is the most important crop in the state and even with 2-3 per cent share in GCA, consumes 25 to 40 per cent of N with per hectare levels over 300 kg/ha. Over the years its production growth rate is 6 per cent p.a. and this is indeed high but it is on account of area. The Adkali crop has high requirement of 400 kg of N/ha followed by pre-seasonal crop with 340 kg/ha and 'suru' with 250 kg/ha. Although we do not have the area break-up by these varieties we know that Adkali is confined to Region II (and to some extent Region I) where the other two types are also taken. For Vidarbha Marathwada - Region III and IV - for the popular suru preseasonal varieties requirements of N are lower at 250 kg/ha (preseasonal) and 170 kg/ha (suru). Considering all this, N levels of 300 to 400 kg/ha for

Region I and II (the latter being the most important region) are satisfactory but for Region III and IV the existing levels of 30 to 90 kg/ha are low compared to 170 kg/ha recommendations. But the overall rate of 274 kg of N/ha in 1983-84 and 231 kg/ha in 1984-85 appear satisfactory. Thus for main tract of Region II the fertilizer use appears satisfactory but indicates scope for further use in Regions III and IV.

Groundnut is the most important oilseed but the crop is not fairing well over the years with area declining from 5 to about 4 per cent of GCA, cancelling modest gains in productivity resulting in stagnation - decline over 1967-83 period. Productivity growth rate of 1.01 per cent p.a. gets neutralised by area growth rate of -1.11 per cent p.a. Primary reason for this appears to be lack of HYV varieties. Although there are improved varieties, the Epitome of Agriculture has no acreage under 'hybrid high yielding variety area'. The recommended N-P-K are 25-50-0 and 12-25-0 for irrigated/assured rainfall area and unirrigated area respectively. For sample farmers, N-P are 11-9 kg/ha in 1983-84 and 12-15 kg/ha in 1984-85 which are deficient in P but the imbalance is even more marked for irrigated groundnut. Since half the irrigated groundnut is summer groundnut, it may be that the crop is taken on sugarcane field when cane is in its initial stages and N dominates so that we get N-P level for irrigated groundnut at 17-7 kg/ha and 24-19 kg/ha respectively which is not only below 25-50 recommendation but there is considerable imbalance with P being highly inadequate.

Among the crops not included in the 13-crop list (on which sampling is based) are rice, wheat and gram for

which we have analysed data collected from the selected farmers. Rice which is fourth largest among foodgrains in terms of area (7 per cent of GCA by official statistics) is the second largest supplier of foodgrains and over 1967-83 the productivity has increased from 10 to 15 quintals/ha with production growth rate being 3.9. per cent p.a. In the sample it has only 2 per cent of GCA representation and the main regions of Region I and IV are not consistently represented over the two years. For irrigated component N-P level is 79-14 kg/ha and 50-9 kg/ha for the two years (by official data 25 per cent of crop area is irrigated) and the recommended doses are 100-50 kg/ha for HYV-irrigated or assured rainfall areas and 50-25 kg/ha for TV irrigated or rainfed. With 60 per cent area under HYV, there must be considerable area under HYV-irrigated and hence scope for increased fertilizer use exists. For unirrigated component, we have N-P usages at 22-5 kg/ha in 1983-84 and 50-9 kg/ha in 1984-85. Again there appears scope as there must be substantial HYV area in this component. Wheat, which is fifth in terms of area among foodgrains, (5 per cent of GCA) is the third largest supplier and has good production growth rates of 6.84 per cent p.a., highest among foodgrains over 1967-83 but in comparatively recent period of 1977 onwards, the crop appears to be stagnating. Proportion of HYV is very high, between 75 to 80 per cent by official statistics and the proportion of irrigated is constantly increasing with 53 per cent area being irrigated in 1980-83 triennium. For irrigated HYV or TV, N-P of 75-50 kg/ha is recommended for tall variety and 120-60 kg/ha for short variety. For selected farmers, we get N-P levels around 70-20 kg/ha

which appear satisfactory as tall varieties are likely to dominate. For unirrigated wheat 25-25 and 40-20 are the recommended N-P levels and the sample estimates are quite low at 3-1 kg/ha and 7-2 kg/ha in the two years so for unirrigated wheat use-levels can be increased. For pulses including gram, N-P usage is 2-0 kg/ha and 9-5 kg/ha in 1983-84 and 1984-85 which is not only below recommended 12.5-25 kg/ha but there is imbalance with N dominating instead of P. This may be due to the pulses being taken as a mixed crop. But if the imbalance is due to ignorance, it should be removed. Among other crops, onion is important and in fact is included in the 13-crop aggregate on which sampling is based. For 1983-84 we get N-P usage at 62-47 kg/ha and for 1984-85 it is 37-26 kg/ha. By Table 4.3(b) the recommended level is 50-50 kg/ha and observed levels appear satisfactory but by Table 4.3(a) recommendation is 100-50 kg/ha and the observed levels are low. It is difficult to assess the scope for further use of fertilizer for this crop (Section 4.8).

5.11 For the purpose of examining relationship between size of farm and levels of fertilizer use, 1984-85 data of 600 cultivators were considered. The classical size-inputs inverse relation also emerges true for size-fertilizer input relationship. Classifying data by size of cultivated area by intervals of upto 2 hectares, 2 to 4 hectares, 4 to 6 hectares, 6 to 8 hectares and final interval above 8 hectares, we see that per farm N and P increase from 55-20 kg/ha to 166-74 kg/ha over the size groups but per cultivated hectare N-P goes down from 43-16 kg/ha to 14-6 kg/ha and the inverse relation is quite apparent. Number of users of fertilizers among farmers is 77 per cent at overall level and fluctuates



over size-groups between 71 and 82 per cent. As for irrigation, per farm irrigated area increases from 0.30 ha for first size group to 1.26 ha for the highest size-group but percentage of area irrigated decreases over size groups from 23 to 11 per cent. If we look at the sources of irrigation, canal, well and other are the main sources in our sample with wells covering 76 per cent and canal 17 per cent area.

There are two-three interesting aspects that attract our attention. Firstly, although per farm irrigated area increases over size groups, distribution of sources of irrigation do not appear related with size groups and specifically distribution of canal irrigated area is not biased in favour of big farms. Secondly, size and level of fertilizer use on irrigated area are also inversely related like size-fertilizer relationship. That is, per hectare of (gross) irrigated hectare, N use decreases from 87 kg to 52 kg over the size groups. This is somewhat surprising. One would have expected this comparatively scarce source of irrigation to be better exploited by bigger farmers with their better resource position, education and awareness of the utility of fertilizer input. This inverse relationship is apparent for canal irrigated as well as well irrigated area. The third interesting aspect of irrigation is that for canal area N/ha is actually lower than that for the well-irrigated area. The level of N/ha for the two respective sources are 42 kg and 77 kg respectively. This merits further investigation. A closer look reveals that most of the canal area in the sample is in Region II of uncertain rainfall (81 out of 90 ha) and we can safely

concentrate our attention on this region. An analysis for this region's sourcewise levels of fertilizer use reveals that N per ha of canal irrigated area is lower at 44 kg/ha than 70 kg/ha for well irrigated area because only 6 per cent of canal irrigated area is under sugarcane and 53 per cent under low fertilizer consuming rabi jowar but under well irrigation 13 per cent is under sugarcane, the major fertilizer consuming crop and only 25 per cent under rabi jowar but 35 per cent under 'others' in which one has fruits like banana, grapes with very high fertilizer requirement. Thus farmers prefer to take high-input high-cost crops under well irrigation than canal irrigation because then irrigation can be given as and when required. Further wells are in the vicinity of canals, water-table is high and with electricity charges for pump-set being on horse-power basis (rather than actual electricity consumption) fuel costs do not go up in proportion. This phenomenon is in consonance with earlier studies at the AERC in the Institute in which it was observed that area irrigated under canals stagnated or declined over years (Section 4.9).

5.12 With a fertilizer consumption potential exercise we wind up the analysis. Official area data of irrigated and unirrigated crops are taken for the triennium 1980-83 and from the available recommended doses two doses are chosen—a 'conservative' dose and a 'liberal' dose - to arrive at consumption potential. Due consideration is given to uncertain rainfall conditions or assured rainfall conditions, to irrigation status and to HYV or traditional variety, wherever possible. Even the 'liberal' dose, and hence the estimate of potential, errs on the side

of caution because we are aware that recommended doses are presumably broad in nature. We are told that application of fertilizers depends upon climatic differences, soil differences, moisture availability, etc., and in fact individual farmers are exhorted to test their soil for nutrient contents so that a correct dose can be given and in fact farmers are asked to test their soils at different depths for different crops. Thus there are various factors influencing correct dosage and it would be proper to be cautious in such an exercise. With this we find that the existing level of N of 18.85 kg/ha can be raised to 29.61 kg/ha by the 'conservative' estimate by moderate efforts and with special efforts one can reach level of 41.21 kg/ha of GCA. That is, the existing level can be raised to one-and-half times to two times. This should be possible with existing irrigation and HYV adoption. (Additional irrigation and HYV coverage would raise these levels even further.) Main absolute additions appear feasible in kharif jowar, rabi jowar, rice and pulses. In the irrigated component, further scope does not appear substantial because levels are already satisfactory (for main consumer sugarcane, they appear quite close to recommended doses) and because our 'liberal' estimate is also on the cautious side. In the conservative estimate of the potential, additions of about 220 thousand tonnes come wholly from unirrigated component while in the liberal estimates, 90 per cent of additions of 450 thousand tonnes come from the unirrigated component. (Section 4.10 and Appendix B).

### 5.13 Conclusion

In Maharashtra consumption of fertilizer nutrients is increasing over the last 20-25 years at an annual

compound growth rate of about 10 per cent. But initial levels being rather low, by 1983-84 nutrient N has reached a level of about 20 kg. per hectare of gross cropped area which is well below the national average at about 30 kg/ha and nowhere near the Punjab average of over 100 kg/ha. Maharashtra has poor irrigation, about 12 per cent of cropped area being irrigated and this percentage is not expected to exceed 30, considering the water-resources in the State. Limited as the scope may be for fertilizer use, with fertilizer use being an integral part of the green revolution it is imperative to find out existing levels of use over different crops, different regions and under irrigated or rainfed conditions. For this purpose data provided by the Cost of Cultivation Scheme located at Mahatma Phule Agricultural University for 400 cultivators in 1983-84 and 600 cultivators in 1984-85 distributed over different agro-climatic zones are analysed. Irrigation dominates with 60 per cent of N being accounted by irrigation and per (gross) irrigated hectare 70 kg are used while for unirrigated area this level is around 10 kg. The analysis indicates that there is considerable scope for increased fertilizer use in case of rabi jowar, the largest grown crop of the State. It is known for its fodder content and if HYV varieties with good fodder content are popularized, the present low level of less than 1 kg of N/ha for the main rainfed part of this crop can easily be increased and it will be a breakthrough in Maharashtra's agriculture. Kharif jowar has shown good progress over the years in spite of being unirrigated and the HYV coverage is excellent and compared to unirrigated crops as a whole, kharif jowar has much better level of fertilizer input of 15 to 20 kg/ha of N and in fact

kharif jowar is an example of successful use of fertilizer even under unirrigated conditions. However, actual levels per hectare do not differ much between uncertain rainfall region and the assured rainfall region although for the latter the recommended levels are much higher. As most of kharif jowar comes from assured rainfall area, there appears to be a great scope for increased fertilizer use and hence increasing production still further. Levels of use for unirrigated cotton are also higher than unirrigated crops as a whole but production appears to fluctuate over years. The reason could be poor HYV coverage of about 20 per cent only. Better HYV coverage in this crop covering 12 per cent of gross cropped area would also be an achievement. Rice has done well in production over the years but wheat appears to stagnate although half the latter crop is irrigated and fertilizer levels appear satisfactory for the irrigated part. Unirrigated wheat has poor levels. But more distressing is the fact that pulses and oilseeds, both mostly unirrigated, have poor levels compared with the recommended doses. Although these recommended doses themselves are low, proper use of fertilizers would help in reducing the prevalent shortages. In both pulses and oilseeds absence of HYV varieties appears to be a constraint. If this is broken, higher output levels would not be difficult to reach.

That introduction of irrigation would be quite effective need not be stressed again as it is so obvious and this resource forms an integral part of exploiting new technology in agriculture. But for this crucial resource also, classical inverse size-input relationship holds true with N input per (gross) irrigated hectare

reducing over size groups. This means bigger farmers are not able to exploit this scarce resource as effectively as the smaller ones even with their better resource position. This may be worth looking into.

But the unirrigated crops predominate in the State and for these, even the recommended lower levels are not attained. An exercise in fertilizer consumption potential reveals that if one assumes only modest increases in existing levels (modest as compared to the recommended ones) then the level can be raised to one-and-a-half times the present level and with greater effort, twice the present level of consumption could be reached. Most of it is feasible on account of unirrigated crops of rabi jowar, kharif jowar, pulses, safflower, etc. But for this, HYV varieties have to be successful for rabi jowar, pulses and safflower. On the other hand if recommended levels are broad and there are many qualifying restrictions of severe nature along with recommendations with respect to soil condition, moisture condition, and balance of organic matter and chemical fertilizer etc., varying significantly over regions then one has to conclude that conditions on the ground are so different as to make the recommendations (often mentioned in popular media like radio and television) almost meaningless and efforts need to be made to arrive at proper doses under different conditions obtained in the State. These detailed recommendations of doses should receive due publicity. Otherwise fertilizer use will remain restricted to the irrigated area and there will be severe restrictions on the production potential of the State.

A P P E N D I X - A

**Table A.1:** Table Showing Distribution of Centres over Various Talukas for 1983-84 (40 centres) and 1984-85 (60 centres)

(One centre selected in each taluka)

Agro-Climatic Zone	District	Name of Taluka	
		1983-84	1984-85
I & II : High Rainfall Zone	Ratnagiri	Chiplun	Rajapur
	Raigad	Roha	-
III : Ghat Zone with Transition 1 and 2	Kolhapur	Shahuwadi	Panhala
	Pune	Khed	-
		Ambegaon	-
	Satara	Karad	Satara
	Dhule	-	Nandurbar
	Nasik	-	Dindori
(I, II and III zones from Region I in our analysis)			
IV : Scarcity Zone Nasik Region	Nasik	Baglan	Baglan
		Sinnar	-
		Malegaon	-
		Chandwad	-
	Dhule	-	Sindkheda
		-	Dhule
	Jalgaon	-	Amalner
V : Scarcity Zone Pune Region	Pune	Dhond	Dhond
		-	Baramati
		-	Indapur
	Ahmednagar	Nevasa	Nevasa
		Rahuri	Ahmednagar
		-	Sangamner
		-	Pathardi
Solapur	Barsi	Pandharpur	
	Sangola	Madhe	
	-	Malshiras	
VI : Scarcity Zone Sangli Region	Sangli	Walwa	Kavathe
	Satara	Khandala	Mahankal
			Phaltan
			Khatav
VII : Scarcity Zone Marathwada Region	Aurangabad	Paithan	
		Vaijapur	
	Bhir	-	Patoda
(IV, V, VI, VII zones from Region II in our analysis)			

Contd...



Table A.1 : (Continued)

Agro-Climatic Zone	District	Name of Taluka	
		1983-84	1984-85
VIII : Assured Rainfall Zone Western Maharashtra	Jalgaon	Parola	Chopada-1 Chopada-2 Edalabad
	Dhule	Shirpur	-
	Solapur	-	N. Solapur
IX : Assured Rainfall Zone Marathwada	Osmanabad	Ahmedpur Tuljapur	Umarga
	Bhir	Bhir	Bhir
	Parbhani	Majalgaon Gangakhed	
	Nanded	Pathri Kandhar	Kandhar Mukhed Deghar
	Latur		Nilanga Udgir Latur
	Jalna	Partur Jalna	Partur Bhokardan
	Aurangabad		Sillod Aurangabad
X : Assured Rainfall Zone Vidarbha	Akola	Balapur	Mangrulpur Murtijapur Akola Balapur
	Buldhana	Malkapur Khamgaon	Malkapur Mehkar Chikhali
	Amravati	Chandur	Amravati
(Zones VIII, IX, X make Region III)			
XI : Moderate to Moderately High Rainfall Zone	Nanded	Nanded	Bhokar
	Yeotmal	Mahagaon Digraj	Yeotmal Wani Kelapur Pusad
	Nagpur	Katol	Saoner
	Wardha	Arvi	Arvi Wardha
	Parbhani		Basmat
	Akola		Washim
	Chandrapur		Warara Rajura
XII : High Rainfall	Nagpur	Umrer	Umrer
(Zones XI and XII make Region IV in our analysis)			

**Table A.2 : Cropping Pattern and Consumption of N of Selected Farmers - Region I - (1983-84)**

Crop	Area (ha.)	%	N	%	N/ha (kg.)	% of crop area under irrigation
1. Kh. Jowar	6.21	5.17	75.90	1.13	12.22	-
2. R. Jowar	8.27	6.89	-	-	-	8.34
3. Bajra	18.14	15.11	15.00	0.22	0.83	-
4. Ragi	5.96	4.96	77.55	1.15	13.01	-
5. Cotton	-	-	-	-	-	-
6. S. Cane*	12.12	10.10	4731.75	70.15	390.41	100.00
7. G. Nut	11.83	9.85	27.60	0.41	2.33	4.23
8. Safflower	-	-	-	-	-	-
9. Tur	-	-	-	-	-	-
10. Mung	0.04	0.03	-	-	-	-
11. Udid	0.03	0.02	-	-	-	-
12. Paddy	26.15	21.78	987.30	14.64	37.76	9.45
13. Wheat	3.25	2.72	115.10	1.70	35.42	90.46
14. Gram	3.61	3.01	-	-	-	3.60
15. Others	24.44	20.36	714.66	10.60	29.24	53.48
G.C.A.	120.05	100.00	6744.86	100.00	56.18	26.59

\*Harvested area

**Table A.3 : Cropwise Area under Irrigation and Fertilizer Consumption for Selected Farmers -  
Region I, - (1983-84)**

Crop	Area (ha.)	N	P	K	(Nutrients in Kg.)		
					Per hectare		
					N	P	K
1. Kh. Jowar	-	-	-	-	-	-	-
2. R. Jowar	0.69	-	-	-	-	-	-
3. Bajra	-	-	-	-	-	-	-
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	-	-	-	-	-	-	-
6. Cotton-MS	-	-	-	-	-	-	-
7. Cotton-SS	-	-	-	-	-	-	-
8. S. cane (PH)	3.02	1206.95	248.75	238.75	399.65	82.37	79.06
9. S. cane (RH)	9.10	3524.80	973.52	923.52	387.34	106.98	101.49
10. G. nut	0.50	-	-	-	-	-	-
11. Safflower	-	-	-	-	-	-	-
12. Tur	-	-	-	-	-	-	-
13. Mung	-	-	-	-	-	-	-
14. Udid	-	-	-	-	-	-	-
15. Paddy	2.47	296.50	67.50	67.50	120.04	27.33	27.33
16. Wheat	2.94	115.10	30.00	-	39.15	10.20	-
17. Gram	0.13	-	-	-	-	-	-
18. Others	13.07	656.20	457.30	12.30	50.21	34.99	00.94
<b>Gross Irr. Crop</b>	<b>31.92</b>	<b>5799.55</b>	<b>1777.07</b>	<b>1242.07</b>	<b>181.69</b>	<b>55.67</b>	<b>33.91</b>

(PH and RH are planted and ratoon harvested S. cane crops respectively.)  
For cotton, LS, MS, SS mean long staple, medium staple and short staple varieties respectively.

Table A.4 : Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers -  
Region I - (1983-84)

(Nutrients in Kg.)

Crop	Area (ha.)	N	P	K	Per hectare		
					N	P	K
1. Kh. Jowar	6.21	75.90	-	-	12.22	-	-
2. R. Jowar	7.58	-	-	-	-	-	-
3. Bajra	18.14	15.00	5.00	5.00	0.83	0.28	0.28
4. Ragi	5.96	77.55	77.55	18.75	13.01	13.01	3.15
5. Cotton-LS	-	-	-	-	-	-	-
6. Cotton-MS	-	-	-	-	-	-	-
7. Cotton-SS	-	-	-	-	-	-	-
8. S. cane (PH)	-	-	-	-	-	-	-
9. S. cane (RH)	-	-	-	-	-	-	-
10. G.nut	11.33	27.60	-	-	2.44	-	-
11. Safflower	-	-	-	-	-	-	-
12. Tur	-	-	-	-	-	-	-
13. Mung	0.04	-	-	-	-	-	-
14. Udid	0.03	-	-	-	-	-	-
15. Paddy	23.68	690.80	177.40	73.20	29.17	7.49	3.09
16. Wheat	0.31	-	-	-	-	-	-
17. Gram	3.48	-	-	-	-	-	-
18. Others	11.37	58.46	35.00	-	5.14	3.08	-
<b>Total rainfed</b>	<b>88.13</b>	<b>945.31</b>	<b>294.95</b>	<b>96.95</b>	<b>10.73</b>	<b>3.45</b>	<b>1.10</b>

(Sugarcane is hundred per cent irrigated. For cotton, LS, MS and SS mean long, medium and short varieties respectively.)

**Table A.5 : Cropping Pattern and Consumption of N of Selected Farmers (1983-84) in Region II**

Crop	Area	%	N (kg)	%	N/ha	% of crop area under irrigation
1. Kh. Jowar	21.68	3.16	440.25	2.27	20.31	34.50
2. R. Jowar	227.78	33.22	172.80	0.89	0.76	17.85
3. Bajra	171.98	25.08	1773.86	9.12	10.31	16.74
4. Ragi	0.36	0.05	-	-	-	-
5. Cotton	12.48	1.83	94.70	0.49	7.59	20.43
6. S. cane*	43.52	6.35	12894.60	66.37	296.29	100.00
7. G. nut	18.11	2.64	123.15	0.63	6.80	69.74
8. Safflower	14.31	2.09	-	-	-	1.82
9. Tur	10.38	1.51	-	-	-	0.29
10. Mung	11.71	1.71	15.00	0.08	1.28	0.94
11. Udid	1.07	0.16	1.38	0.01	1.29	-
12. Paddy	2.79	0.41	267.95	1.38	96.04	69.53
13. Wheat	34.08	4.97	2239.21	11.52	65.70	93.05
14. Gram	14.83	2.16	56.60	0.29	3.82	39.78
15. Others	100.55	14.66	1350.20	6.95	13.43	42.44
G.C.A.	685.63	100.00	19429.70	100.00	28.34	31.83

\* Harvested area

**Table A.6 : Cropwise Area under Irrigation and Fertilizer Consumption for Selected Farmers (1983-84) in Region II**

Crop	Area	(Nutrients in kg.)					
		N	P	K	N	P	K
		(per hectare)					
1. Kh.jowar	7.48	221.70	27.50	7.00	29.64	3.68	0.94
2. R. jowar	40.65	56.60	2.10	2.10	1.39	0.05	0.05
3. Bajra	28.79	928.85	70.00	30.00	32.26	2.43	1.04
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	0.35	24.20	15.00	-	69.14	42.86	-
6. Cotton-MS	-	-	-	-	-	-	-
7. Cotton-SS	2.20	-	-	-	-	-	-
8. S.cane (PH)	18.51	7019.80	3171.50	1148.50	379.24	171.34	62.05
9. S.cane (RH)	25.01	5874.80	1899.50	469.50	234.90	75.95	18.77
10. G.nut	12.63	95.30	27.50	7.50	7.55	2.18	0.59
11. Safflower	0.26	-	-	-	-	-	-
12. Tur	0.03	-	-	-	-	-	-
13. Mung	0.11	-	-	-	-	-	-
14. Udid	-	-	-	-	-	-	-
15. Paddy	1.94	221.95	5.75	3.75	114.41	2.96	1.93
16. Wheat	31.71	2239.21	454.90	207.90	70.62	14.35	6.56
17. Gram	5.90	55.10	-	-	9.34	-	-
18. Others	42.67	1345.62	825.75	314.35	31.54	19.35	7.37
Gross Irri.Crop	218.24	18083.13	6499.50	2190.60	82.86	29.78	10.04

(PH and RH are planted and ratoon harvested s.cane crops respectively.  
For cotton, LS, MS, SS mean long staple, medium staple and short staple varieties respectively.)

**Table A.7 : Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers  
(1983-84) in Region II**

Crop	Area	(Nutrients in kg.)					
		N	P	K	N	P (per hectare)	K
1. Kh. Jowar	14.20	218.55	50.00	47.25	15.39	3.52	3.33
2. R. Jowar	187.13	116.20	57.00	17.00	0.62	0.30	0.09
3. Bajra	143.19	845.01	28.50	28.50	5.90	0.20	0.20
4. Ragi	0.36	-	-	-	-	-	-
5. Cotton-LS	-	-	-	-	-	-	-
6. Cotton-MS	-	-	-	-	-	-	-
7. Cotton-SS	9.93	70.50	47.50	47.50	7.10	4.78	4.78
8. S. cane (PH)	-	-	-	-	-	-	-
9. S. cane (RH)	-	-	-	-	-	-	-
10. G. nut	5.48	27.85	14.50	3.75	5.08	2.65	0.68
11. Safflower	14.05	-	-	-	-	-	-
12. Tur	10.35	-	-	-	-	-	-
13. Mung	11.60	15.00	15.00	15.00	1.29	1.29	1.29
14. Udid	1.07	1.38	-	-	1.29	-	-
15. Paddy	0.85	46.00	-	-	54.12	-	-
16. Wheat	2.37	-	-	-	-	-	-
17. Gram	8.93	1.50	0.50	0.50	0.17	0.06	0.06
18. Others	57.88	4.58	2.85	0.10	0.08	0.05	0.002
<b>Total rainfed</b>	<b>467.39</b>	<b>1346.57</b>	<b>215.85</b>	<b>159.60</b>	<b>2.88</b>	<b>0.46</b>	<b>0.34</b>

(Sugarcane is hundred per cent irrigated. For cotton, LS, MS and SS mean long, medium and short varieties respectively.)

Table A.8 : Cropping Pattern and Consumption of N of Selected Farmers (1983-84) in Region III

Crop	Area (ha)	%	N (kg)	%	N/ha	% of crop area under irrigation
1. Kh. Jowar	180.87	17.64	2955.79	28.58	16.34	-
2. R. Jowar	130.93	12.77	63.00	00.61	0.48	13.57
3. Bajra	84.32	8.22	1285.50	12.43	15.25	-
4. Ragi	-	-	-	-	-	-
5. Cotton	200.71	19.58	3176.85	30.71	15.83	0.90
6. S. cane*	3.88	0.38	274.00	2.65	70.62	100.00
7. G. nut	28.57	2.79	636.00	6.15	22.26	24.96
8. Safflower	21.04	2.05	20.00	0.19	0.95	14.88
9. Tur	65.81	6.42	434.00	4.20	6.59	-
10. Mung	165.06	16.10	205.00	1.98	1.24	-
11. Udid	15.77	1.54	-	-	-	-
12. Paddy	11.20	1.09	66.50	0.64	6.21	23.36
13. Wheat	38.30	3.74	1060.90	10.26	27.70	74.36
14. Gram	14.78	1.43	3.20	0.03	0.22	29.97
15. Others	64.06	6.25	162.91	1.57	2.54	12.94
G.C.A.	1025.30	100.00	10343.65	100.00	10.09	7.55

\* Harvested area



**Table A.9 : Cropwise Area under Irrigation and Fertilizer Consumption for Selected Farmers (1983-84) in Region III**

Crop	Area (ha)	(Nutrients in kg.)					
		N	P	K	N	P (per hectare)	K
1. Kh. Jowar	-	-	-	-	-	-	-
2. R. Jowar	17.77	-	-	-	-	-	-
3. Bajra	-	-	-	-	-	-	-
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	0.60	66.00	20.00	-	110.00	33.33	-
6. Cotton-MS	0.60	-	-	-	-	-	-
7. Cotton-SS	0.60	9.00	9.00	5.00	15.00	15.00	8.33
8. S. cane (PH)	-	-	-	-	-	-	-
9. S. cane (RH)	3.88	274.00	62.00	-	70.62	15.98	-
10. G. nut	7.13	254.00	112.00	-	35.62	15.70	-
11. Safflower	3.13	-	-	-	-	-	-
12. Tur	-	-	-	-	-	-	-
13. Mung	-	-	-	-	-	-	-
14. Udid	-	-	-	-	-	-	-
15. Paddy	2.50	27.50	27.50	19.50	11.00	11.00	7.80
16. Wheat	28.48	1050.90	508.00	166.00	36.90	17.84	5.83
17. Gram	4.43	3.20	-	-	-	-	-
18. Others	8.29	153.41	117.94	41.07	18.50	14.23	4.95
Gross Irr. Crop	77.41	1838.01	856.44	231.57	23.74	11.06	2.99

(PH and RH are planted and ratoon harvested. S. cane crops respectively. For cotton, LS, MS and SS mean long staple, medium staple and short staple varieties respectively.)

**Table A.10 : Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers (1983-84) in Region III.**

Crop	Area (ha)	(Nutrients in kg.)					
		N	P	K	N	P	K
		(per hectare)					
1. Kh. Jowar	180.87	2955.79	1187.30	535.50	16.34	6.56	2.96
2. R. Jowar	113.16	63.00	63.00	35.00	0.56	0.56	0.31
3. Bajra	84.32	1285.50	170.25	111.75	15.25	2.02	1.33
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	20.56	336.00	94.50	62.50	16.34	4.60	3.04
6. Cotton-MS	70.63	607.30	492.36	93.50	8.60	6.97	1.32
7. Cotton-SS	107.72	2158.55	1328.00	245.00	20.04	12.33	2.27
8. S. cane (PH)	-	-	-	-	-	-	-
9. S. cane (RH)	-	-	-	-	-	-	-
10. G. nut	21.44	382.00	321.75	196.75	17.82	15.00	9.18
11. Safflower	17.91	20.00	20.00	-	1.12	1.12	-
12. Tur	65.81	434.00	260.00	104.00	6.59	3.95	1.58
13. Mung	165.06	205.00	-	-	1.24	-	-
14. Udid	15.77	-	-	-	-	-	-
15. Paddy	8.70	39.00	20.50	20.50	4.76	2.50	2.50
16. Wheat	9.82	10.00	10.00	-	1.02	1.02	-
17. Gram	10.35	-	-	-	-	-	-
18. Others	55.77	9.50	9.50	9.50	0.17	0.17	0.17
<b>Total rainfed</b>	<b>947.89</b>	<b>8505.64</b>	<b>3977.16</b>	<b>1414.00</b>	<b>8.97</b>	<b>4.20</b>	<b>1.49</b>

(Sugarcane is hundred per cent irrigated. For cotton, LS, MS and SS mean long, medium and short varieties respectively.)

**Table A.11 : Cropping Pattern and Consumption of N of Selected Farmers (1983-84) in Region IV**

Crop	Area (ha.)	%	N (Kg.)	%	N/ha (Kg.)	% of crop area under irrigation
1. Kh.Jowar	88.69	24.52	1164.00	18.84	13.12	-
2. R.Jowar	25.92	7.16	5.40	0.09	0.21	1.74
3. Bajra	11.50	3.18	57.00	0.92	4.96	-
4. Ragi	-	-	-	-	-	-
5. Cotton	91.23	25.22	2579.70	41.74	28.28	7.39
6. S.cane*	6.37	1.76	190.80	3.09	29.95	100.00
7. G.nut	6.92	1.91	74.00	1.20	10.69	34.68
8. Safflower	-	-	-	-	-	-
9. Tur	16.17	4.47	27.00	0.44	1.67	1.36
10. Mung	7.16	1.98	-	-	-	-
11. Udid	8.66	2.39	27.00	0.44	3.12	-
12. Paddy	7.24	2.00	133.40	2.15	18.43	-
13. Wheat	31.14	8.61	1554.10	25.15	49.91	69.81
14. Gram	4.79	1.32	30.60	0.49	6.39	51.15
15. Others	55.97	15.48	336.90	5.45	6.02	15.76
G.C.A.	361.76	100.00	6179.90	100.00	17.08	7.59

\* Harvested area

**Table A.12 : Cropwise Area under Irrigation and Fertilizer Consumption for Selected Farmers (1983-84) in Region IV**

Crop	Area (ha.)	(Nutrients in Kg.)					
		N	P	K	N	P	K
		(Per hectare)					
1. Kh. Jowar	-	-	-	-	-	-	-
2. R. Jowar	0.45	5.40	5.40	3.00	12.00	12.00	6.67
3. Bajra	-	-	-	-	-	-	-
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	5.10	251.00	90.00	50.00	49.22	17.65	9.80
6. Cotton-MS	0.64	20.00	13.50	7.50	31.25	21.09	11.72
7. Cotton-SS	1.00	37.50	18.00	10.00	37.50	18.00	10.00
8. S. cane (PH)	2.65	122.80	93.60	53.60	46.34	35.32	20.23
9. S. cane (RH)	3.72	68.00	45.00	25.00	18.28	12.10	6.72
10. G.nut	2.40	42.00	19.00	30.00	17.50	7.92	12.50
11. Safflower	-	-	-	-	-	-	-
12. Tur	0.22	-	-	-	-	-	-
13. Mung	-	-	-	-	-	-	-
14. Udid	-	-	-	-	-	-	-
15. Paddy	-	-	-	-	-	-	-
16. Wheat	21.74	1490.10	514.70	311.01	68.54	23.68	14.31
17. Gram	2.45	30.60	30.60	20.00	12.49	12.49	8.16
18. Others	8.82	200.00	196.00	60.00	22.68	22.22	6.80
<b>Gross Irr. Crop</b>	<b>49.19</b>	<b>2267.40</b>	<b>1025.80</b>	<b>570.11</b>	<b>46.09</b>	<b>20.85</b>	<b>11.59</b>

(PH and RH are planted and ratoon harvested S. cane crops respectively. For cotton, LS, MS, SS mean long staple, medium staple and short staple varieties respectively.)

**Table A.13 : Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers (1983-84) in Region IV**

Crop	Area (ha.)	(Nutrients in Kg.)					
		N	P	K	Per Hectare		
					N	P	K
1. Kh. Jowar	88.69	1164.00	467.00	401.00	13.12	5.27	4.52
2. R. Jowar	25.47	-	-	-	-	-	-
3. Bajra	11.50	57.00	57.00	45.00	4.96	4.96	3.91
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	34.50	1389.00	515.00	350.00	40.26	14.93	10.14
6. Cotton-MS	32.71	483.50	322.50	202.50	14.78	9.86	6.19
7. Cotton-SS	17.28	398.70	171.00	95.00	23.07	9.90	5.50
8. S. cane (PH)	-	-	-	-	-	-	-
9. S. cane (RH)	-	-	-	-	-	-	-
10. G. nut	4.52	32.00	49.00	5.00	7.08	10.84	1.11
11. Safflower	-	-	-	-	-	-	-
12. Tur	15.95	27.00	27.00	15.00	1.69	1.69	0.94
13. Mung	7.16	-	-	-	-	-	-
14. Udid	8.66	27.00	35.00	15.00	3.12	4.04	1.73
15. Paddy	7.24	133.40	-	-	18.43	-	-
16. Wheat	9.40	64.00	18.00	10.00	6.81	1.91	1.06
17. Gram	2.34	-	-	-	-	-	-
18. Others	47.15	136.90	38.00	25.00	2.90	0.81	0.53
<b>Total Rainfed</b>	<b>312.57</b>	<b>3912.50</b>	<b>1699.50</b>	<b>1163.50</b>	<b>12.52</b>	<b>5.44</b>	<b>3.72</b>

(Sugarcane is hundred percent irrigated. For cotton, LS, MS and SS mean long, medium and short varieties respectively.)

**Table A.14 : Cropping Pattern and Consumption of N of Selected Farmers (1984-85) Region I**

Crop	Area (ha.)	%	N (kg.)	%	N/ha (kg.)	% of crop area under irrigation
1. Kh. Jowar	14.93	8.52	218.75	4.12	14.65	4.29
2. R. Jowar	13.26	7.57	3.70	0.07	0.28	3.17
3. Bajra	11.89	6.78	316.00	5.95	26.58	20.10
4. Ragi	23.86	13.62	211.82	3.98	8.88	-
5. Cotton	1.95	1.11	121.00	2.28	62.05	100.00
6. S. cane*	5.57	3.18	1701.80	32.04	305.53	100.00
7. G. nut	15.19	8.67	174.00	3.28	11.45	-
8. Safflower	0.15	0.09	-	-	-	-
9. Tur	0.19	0.11	-	-	-	-
10. Mung	0.50	0.29	-	-	-	-
11. Udid	1.77	1.01	-	-	-	-
12. Paddy	26.68	15.23	2154.59	40.57	80.76	--
13. Wheat	7.83	4.47	166.65	3.14	21.28	60.41
14. Gram	4.47	2.55	3.75	0.07	0.84	6.26
15. Others	46.96	26.80	239.10	4.50	5.09	10.80
G.C.A.	175.20	100.00	5311.16	100.00	30.31	12.30

\* Harvested area

**Table A.15 : Cropwise Area under Irrigation and Fertilizer Consumption for selected Farmers (1984-85) in Region I**

Crop	Area (ha)	(Nutrients in Kg.)					
		N	P	K	Per hectare		
					N	P	K
1. Kh. Jowar	0.64	-	-	-	-	-	-
2. R. Jowar	0.42	-	-	-	-	-	-
3. Bajra	2.39	69.00	33.00	25.00	28.87	13.81	10.46
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	1.95	121.00	40.50	22.50	62.05	20.77	11.54
6. Cotton-MS	-	-	-	-	-	-	-
7. Cotton-SS	-	-	-	-	-	-	-
8. S. cane (PH)	2.03	642.75	196.25	277.25	316.63	96.67	136.58
9. S. cane (RH)	3.54	1059.05	350.75	344.70	299.17	99.08	97.37
10. G. nut	0.50	-	24.00	-	-	-	-
11. Safflower	-	-	-	-	-	-	-
12. Tur	-	-	-	-	-	-	-
13. Mung	-	-	-	-	-	-	-
14. Udid	-	-	-	-	-	-	-
15. Paddy	-	-	-	-	-	-	-
16. Wheat	4.73	166.65	42.75	38.75	35.23	9.04	8.19
17. Gram	0.28	3.75	3.75	3.75	13.39	13.39	13.39
18. Others	5.07	222.00	108.00	60.00	43.79	21.30	11.83
<b>Gross Irr. Crop</b>	<b>21.55</b>	<b>2284.20</b>	<b>799.00</b>	<b>771.95</b>	<b>106.00</b>	<b>37.08</b>	<b>35.82</b>

(PH and RH are planted and ratoon harvested s. cane crops respectively. For cotton, LS, MS, SS mean long staple, medium staple and short staple varieties respectively.)

**Table A.16 : Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers (1984-85) in Region I**

(Nutrients in Kg.)

Crop	Area (ha)	N	P	K	Per hectare		
					N	P	K
1. Kh. Jowar	14.29	218.75	33.75	7.75	15.31	2.36	0.54
2. R. Jowar	12.84	3.70	3.70	3.70	0.29	0.29	0.29
3. Bajra	9.50	247.00	63.00	35.00	26.00	6.63	3.68
4. Ragi	23.86	211.82	178.50	178.50	8.88	7.48	7.48
5. Cotton-LS	-	-	-	-	-	-	-
6. Cotton-MS	-	-	-	-	-	-	-
7. Cotton-SS	-	-	-	-	-	-	-
8. S. cane (PH)	-	-	-	-	-	-	-
9. S. cane (RH)	-	-	-	-	-	-	-
10. G. nut	14.69	174.00	178.00	76.00	11.84	12.12	5.17
11. Safflower	0.15	-	-	-	-	-	-
12. Tur	0.19	-	-	-	-	-	-
13. Mung	0.50	-	-	-	-	-	-
14. Udid	1.77	-	-	-	-	-	-
15. Paddy	26.68	2154.59	331.50	331.50	80.76	12.43	12.43
16. Wheat	3.10	-	-	-	-	-	-
17. Gram	4.19	-	-	-	-	-	-
18. Others	41.89	17.10	-	-	0.41	-	-
<b>Total rainfed</b>	<b>153.65</b>	<b>3026.96</b>	<b>788.45</b>	<b>632.45</b>	<b>19.70</b>	<b>5.13</b>	<b>4.12</b>

(Sugarcane is hundred per cent irrigated. For cotton LS, MS and SS mean long, medium and short varieties respectively.)



**Table A.17 : Cropping Pattern and Consumption of N of Selected Farmers (1984-85) in Region II**

Crop	Area (ha.)	%	N (kg.)	%	N/ha (kg.)	% of crop area under irrigation
1. Kh. Jowar	45.07	6.52	1459.50	6.08	32.38	14.44
2. R. Jowar	262.89	38.03	2416.80	10.08	9.19	39.59
3. Bajra	104.34	15.09	2446.77	10.20	23.45	31.25
4. Ragi	-	-	-	-	-	-
5. Cotton	14.28	2.07	765.90	3.19	53.63	18.56
6. S. cane*	36.41	5.27	11175.95	46.57	306.95	100.00
7. G. nut	20.85	3.02	162.75	0.68	7.81	43.07
8. Safflower	9.01	1.30	38.85	0.16	4.31	12.32
9. Tur	9.16	1.33	0.46	Negligible	0.05	5.46
10. Mung	4.52	0.65	151.80	0.63	33.58	25.44
11. Udid	1.17	0.17	-	-	-	-
12. Paddy	2.49	0.36	129.00	0.54	51.81	100.00
13. Wheat	31.94	4.62	2403.20	10.01	75.24	96.87
14. Gram	14.72	2.13	206.90	0.86	14.06	96.94
15. Others	134.37	19.44	2638.94	11.00	19.64	66.09
G.C.A.	691.22	100.00	23996.82	100.00	34.72	47.82

\* Harvested area

**Table A.18 : Cropwise Area under Irrigation and Fertilizer Consumption for Selected Farmers  
(1984-85) in Region II**

Crop	Area (ha)	N	P	K	(Nutrients in Kg.)		
					Per hectare		
					N	P	K
1. Kh. Jowar	6.51	514.50	199.00	161.00	79.03	30.57	24.73
2. R. Jowar	104.08	2382.80	400.75	280.75	22.89	3.85	2.70
3. Bajra	32.61	1603.75	203.00	118.00	49.18	6.23	3.62
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	0.80	136.00	53.00	7.50	170.00	66.25	9.38
6. Cotton-MS	1.85	114.50	42.00	18.00	61.89	22.70	9.73
7. Cotton-SS	-	-	-	-	-	-	-
8. S. cane (PH)	22.99	7598.95	2837.75	2658.50	330.53	123.43	115.64
9. S. cane (RH)	13.42	3577.00	1438.50	1456.00	266.54	107.19	108.49
10. G. nut	8.98	87.50	121.00	41.00	9.74	13.47	4.57
11. Safflower	1.11	22.25	10.50	10.50	20.05	9.46	9.46
12. Tur	0.50	0.46	-	-	0.92	-	-
13. Mung	1.15	-	-	-	-	-	-
14. Udid	-	-	-	-	-	-	-
15. Paddy	2.49	129.00	2.40	-	51.81	0.96	-
16. Wheat	30.94	2403.20	637.45	405.45	77.67	20.60	13.10
17. Gram	14.27	206.90	10.25	10.25	14.50	0.72	0.72
18. Others	88.81	2213.74	1636.19	410.00	24.93	18.42	4.62
<b>Gross Irr. Crop</b>	<b>330.51</b>	<b>20990.55</b>	<b>7591.79</b>	<b>5576.95</b>	<b>63.51</b>	<b>22.97</b>	<b>16.87</b>

(PH and RH are planted and ratoon harvested s. cane crops respectively. For cotton, LS, MS, SS mean long staple, medium staple and short staple varieties respectively.)

**Table A.19 : Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers  
(1984-85) in Region II**

Crop	Area (ha.)	(Nutrients in Kg.)					
		N	P	K	Per hectare		
					N	P	K
1. Kh. Jowar	38.56	945.00	487.00	317.00	24.51	12.63	8.22
2. R. Jowar	158.81	34.00	-	-	0.21	-	-
3. Bajra	81.73	843.02	126.50	40.50	11.75	1.76	0.56
4. Ragi	-	-	-	-	-	-	-
5. Cotton-LS	-	-	-	-	-	-	-
6. Cotton-MS	-	-	-	-	-	-	-
7. Cotton-SS	11.63	515.40	312.20	100.00	44.32	26.84	8.60
8. S. cane (PH)	-	-	-	-	-	-	-
9. S. cane (RH)	-	-	-	-	-	-	-
10. G. nut	11.87	75.25	169.00	79.00	6.34	14.24	6.66
11. Safflower	7.90	16.60	-	-	2.10	-	-
12. Tur	8.66	-	-	-	-	-	-
13. Mung	3.37	151.80	-	-	45.04	-	-
14. Udid	1.17	-	-	-	-	-	-
15. Paddy	-	-	-	-	-	-	-
16. Wheat	1.00	-	-	-	-	-	-
17. Gram	0.45	-	-	-	-	-	-
18. Others	45.56	425.20	152.25	38.25	9.33	3.34	0.84
<b>Total rainfed</b>	<b>360.71</b>	<b>3006.27</b>	<b>1246.95</b>	<b>574.75</b>	<b>8.33</b>	<b>3.46</b>	<b>1.59</b>

(Sugarcane is hundred per cent irrigated. For cotton, LS, MS, SS mean long, medium and short varieties respectively.)

Table A.20 : Cropping Pattern and Consumption of N of Selected Farmers (1984-85) in Region III

Crop	Area (ha.)	%	N (Kg.)	%	N/ha (Kg.)	% of crop area under irrigation
1. Kh. Jowar	301.94	21.12	5247.85	22.65	17.38	3.13
2. R. Jowar	179.42	12.56	1053.10	4.55	5.87	16.97
3. Bajra	82.97	5.80	655.30	2.83	7.90	4.58
4. Ragi	0.10	0.01	-	-	-	-
5. Cotton	253.39	17.72	4176.20	18.03	16.48	10.22
6. S. cane*	22.53	1.58	2040.90	8.81	90.59	100.00
7. G. nut	24.78	1.73	383.30	1.65	15.87	5.97
8. Safflower	87.18	6.10	192.10	0.83	2.20	-
9. Tur	90.04	6.30	568.90	2.46	6.32	0.90
10. Mung	133.25	9.32	702.50	3.03	5.27	0.92
11. Udid	40.84	2.86	371.00	1.60	9.08	-
12. Paddy	7.78	0.54	130.00	0.56	16.71	48.20
13. Wheat	41.21	2.88	1820.40	7.86	44.17	59.04
14. Gram	20.90	1.46	60.90	0.26	2.91	18.13
15. Others	143.20	10.02	5763.27	24.88	40.25	26.81
G.C.A.	1429.53	100.00	23165.72	100.00	16.20	11.60

\* Harvested area

Table A.21 : Cropwise Area under Irrigation and Fertilizer Consumption for Selected Farmers  
(1984-85) in Region III

Crop	Area (ha.)	(Nutrients in kg.)					
		N	P	K	N	P	K
		(per hectare)					
1. Kh. Jowar	9.44	662.00	204.50	108.50	70.13	21.66	11.49
2. R. Jowar	30.44	890.00	423.50	115.50	29.24	13.91	3.79
3. Bajra	3.80	46.00	-	-	12.11	-	-
4. Ragi	-	-	-	-	-	-	-
5. Cotton - LS	15.81	474.00	336.00	20.00	29.98	21.25	1.27
6. Cotton - MS	7.06	164.80	49.00	19.00	23.34	6.94	2.69
7. Cotton - SS	3.03	86.00	86.00	48.00	28.38	23.38	15.84
8. S.cane (PH)	11.85	1348.90	469.50	129.50	113.83	39.62	10.93
9. S.cane (RH)	10.68	692.00	539.00	323.00	64.79	50.47	30.24
10. G.nut	1.48	15.00	3.50	1.25	10.14	2.36	0.84
11. Safflower	-	-	-	-	-	-	-
12. Tur	0.81	27.30	13.50	7.50	33.70	16.67	9.26
13. Mung	1.22	17.00	17.00	9.00	13.93	13.93	7.38
14. Udid	-	-	-	-	-	-	-
15. Paddy	3.75	122.00	19.00	2.00	32.53	5.07	0.53
16. Wheat	24.33	1667.40	461.00	217.00	68.53	18.95	8.92
17. Gram	3.79	32.90	26.00	22.00	8.68	6.86	5.80
18. Others	38.39	5143.15	1811.25	1556.25	133.97	47.18	40.54
Gross Irr. crop	165.88	11388.45	4458.75	2578.50	68.65	26.88	15.54

(PH and RH are planted and ratoon harvested S.cane crops respectively. For cotton LS, MS, SS mean long staple, medium staple and short staple varieties respectively).

**Table A.22 : Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers (1984-85)**  
in Region III

Crop	Area (ha.)	(Nutrients in kg.)					
		N	P	K	N	P	K
		(per hectare)					
1. Kh. Jowar	292.50	4585.85	2242.05	875.25	15.68	7.67	3.00
2. R. Jowar	143.98	163.10	187.50	79.00	1.09	1.26	0.53
3. Bajra	79.17	609.30	159.50	121.50	7.70	2.01	1.53
4. Ragi	0.10	-	-	-	-	-	-
5. Cotton - LS	20.24	517.00	304.00	60.00	25.54	15.02	2.96
6. Cotton - MS	135.49	1514.50	738.50	139.50	11.18	5.45	1.03
7. Cotton - SS	71.76	1419.90	756.00	350.10	19.79	10.54	4.88
8. S.cane (PH)	-	-	-	-	-	-	-
9. S.cane (RH)	-	-	-	-	-	-	-
10. G.nut	23.30	368.30	383.70	67.50	15.81	16.47	2.90
11. Safflower	87.18	192.10	192.00	70.00	2.20	2.20	0.80
12. Tur	89.23	541.60	375.00	90.00	6.07	4.20	1.01
13. Mung	132.03	685.50	526.00	123.00	5.19	3.98	0.93
14. Udid	40.84	371.00	331.50	101.50	9.08	3.12	2.49
15. Paddy	4.03	8.00	8.00	-	1.99	1.99	-
16. Wheat	16.88	153.00	46.00	13.00	9.06	2.73	1.07
17. Gram	17.11	29.00	5.00	-	1.64	0.29	-
18. Others	104.81	620.12	582.00	232.70	5.92	5.55	2.22
<b>Total rainfed</b>	<b>1263.65</b>	<b>11777.27</b>	<b>6836.75</b>	<b>2329.05</b>	<b>9.32</b>	<b>5.41</b>	<b>1.84</b>

(Sugarcane is hundred per cent irrigated. For cotton LS, MS, and SS means long, medium and short varieties respectively).

**Table A.23 : Cropping Pattern and Consumption of N of Selected Farmers (1984-85) in Region IV**

Crop	Area (ha.)	%	N (kg.)	%	N/ha (kg.)	% of crop area under ir- rigation
1. Kh.Jowar	149.41	23.92	3550.55	26.78	23.76	0.57
2. R.Jowar	57.86	9.26	97.00	0.73	1.68	-
3. Bajra	3.51	0.56	2.00	0.01	0.57	-
4. Ragi	-	-	-	-	-	-
5. Cotton	200.92	32.17	3776.38	28.49	18.80	4.01
6. S.cane*	0.75	0.12	164.00	1.24	218.67	100.00
7. G.nut	4.93	0.79	229.10	1.73	46.47	45.03
8. Safflower	4.72	0.76	-	-	-	-
9. Tur	38.98	6.24	1416.62	10.69	36.34	2.05
10. Mung	26.61	4.26	141.10	1.06	5.30	-
11. Udid	11.40	1.83	26.34	0.20	2.31	-
12. Paddy	33.29	5.33	1098.27	8.28	32.99	4.66
13. Wheat	27.59	4.42	917.85	6.92	33.27	42.04
14. Gram	2.47	0.40	19.40	0.15	7.85	57.09
15. Others	62.08	9.94	1818.70	13.72	29.30	10.07
G.C.A.	624.52	100.00	13257.31	100.00	21.23	29.15

\* Harvested area

**Table A.24 : Cropwise Area under Irrigation and Fertilizer Consumption for Selected Farmers (1984-85) in Region IV.**

Crop	Area (ha.)	(Nutrients in kg.)					
		N	P	K	N	P	K
		(per hectare)					
1. Kh. Jowar	0.35	64.00	18.00	10.00	75.29	21.13	11.76
2. R. Jowar	-	-	-	-	-	-	-
3. Bajra	-	-	-	-	-	-	-
4. Ragi	-	-	-	-	-	-	-
5. Cotton - LS	5.07	447.00	195.00	63.00	83.17	33.46	12.43
6. Cotton - MS	2.93	16.50	4.50	2.50	5.54	1.51	0.34
7. Cotton - SS	-	-	-	-	-	-	-
8. S.cane (PH)	0.75	164.00	54.00	30.00	213.67	72.00	40.00
9. S.cane (RH)	-	-	-	-	-	-	-
10. G.nut	2.22	216.60	105.60	20.00	97.57	47.57	9.01
11. Safflower	-	-	-	-	-	-	-
12. Tur	0.30	20.00	9.00	5.00	25.00	11.25	6.25
13. Mung	-	-	-	-	-	-	-
14. Udid	-	-	-	-	-	-	-
15. Paddy	1.55	137.00	45.00	25.00	83.39	29.03	16.13
16. Wheat	11.60	803.20	295.50	203.50	69.67	25.47	17.54
17. Gram	1.41	17.40	17.40	9.00	12.34	12.34	6.38
18. Others	6.25	1615.60	817.70	629.50	253.50	130.33	100.72
<b>Gross Irr.Crop</b>	<b>33.48</b>	<b>3506.30</b>	<b>1561.70</b>	<b>997.50</b>	<b>104.73</b>	<b>46.65</b>	<b>29.79</b>

(PH and RH are planted and ratoon harvested s.cane crops respectively. For cotton LS, MS, SS mean long staple, medium staple and short staple varieties respectively).



Table A.25 : Cropwise Rainfed Area and Fertilizer Consumption for Selected Farmers (1934-85) in Region IV.

Crop	Area (ha.)	(Nutrients in kg.)					
		N	P	K	N	P	K
		(per hectare)					
1. Kh. Jowar	148.56	3486.55	1316.09	702.65	23.47	8.36	4.73
2. R. Jowar	57.86	97.00	23.00	16.00	1.63	0.43	0.23
3. Bajra	3.51	2.00	2.00	1.00	0.57	0.57	0.23
4. Ragi	-	-	-	-	-	-	-
5. Cotton - LS	73.68	1757.15	1085.65	424.05	22.33	13.80	5.39
6. Cotton - MS	87.13	1400.23	671.00	363.00	16.07	7.70	4.17
7. Cotton - SS	27.06	155.45	71.45	102.00	5.74	2.64	3.77
8. S.cane (PH)	-	-	-	-	-	-	-
9. S.cane (RH)	-	-	-	-	-	-	-
10. G.nut	2.71	12.50	16.50	10.50	4.61	6.09	3.87
11. Safflower	4.72	-	-	-	-	-	-
12. Tur	33.18	1396.62	589.10	317.50	36.58	15.43	3.32
13. Mung	26.61	141.10	93.90	40.60	5.30	3.72	1.53
14. Udid	11.40	26.34	20.25	10.90	2.31	1.78	0.96
15. Paddy	31.74	961.27	242.40	68.80	30.29	7.64	2.17
16. Wheat	15.99	109.65	13.00	10.00	6.86	1.13	0.63
17. Gram	1.06	2.00	2.00	1.00	1.89	1.89	0.94
18. Others	55.83	203.10	94.60	44.00	3.64	1.69	0.79
Total rainfed	591.04	9751.01	4255.94	2112.00	16.50	7.20	3.57

(Sugarcane is hundred per cent irrigated. For cotton LS, MS and SS mean long, medium and short varieties respectively).

**Table A.26 : Consumption of N and P by Size Groups of Holdings in Different Regions - 1984-85 - I**

Re- gion	Size group	Total area (ha)	Irriga- ted area (ha)	N (kg)	P (kg)	Farms	Users
I	1	13.13	0.70	721.98	164.75	10	7
	2	29.20	1.49	760.19	186.25	10	8
	3	40.90	1.70	965.30	279.50	10	9
	4	68.76	3.54	1281.15	459.25	10	8
	5	109.14	5.37	1500.94	497.70	10	10
		261.13	12.80	5229.56	1587.45	50	42
II	1	41.19	21.63	2829.38	789.38	36	23
	2	85.75	34.52	3970.52	1278.15	36	24
	3	134.33	44.96	4677.70	1737.51	36	22
	4	199.05	60.64	5560.27	2134.75	36	28
	5	318.50	93.35	6757.74	2548.96	36	29
		778.82	255.10	23795.61	8488.75	180	126
III	1	69.32	7.53	1081.41	555.91	48	29
	2	140.31	27.21	4002.30	1789.90	48	41
	3	217.57	15.92	5063.90	1890.30	48	37
	4	323.86	32.64	4052.72	2278.00	48	42
	5	539.51	50.48	8081.55	4046.35	48	38
		1290.57	133.78	22281.88	10560.46	240	187
IV	1	39.15	3.84	875.62	395.79	26	20
	2	81.65	3.99	1864.60	797.70	26	22
	3	114.82	3.90	1972.65	974.15	26	20
	4	172.36	6.76	3362.40	1413.00	26	24
	5	276.62	10.65	5561.05	2372.10	26	24
		684.60	29.14	13636.32	5952.74	130	110
Maha- rash- tra	1	162.79	33.70	5508.39	1905.83	120	79
	2	336.91	69.21	10597.61	4052.00	120	95

(Refer Table No. 4.26)

**Note :** Refer to the discussion in Section 4.9 for details.

**Table A.27 : Consumption of N and P by Size Groups of Holdings in Different Regions - 1984-85 - II**

Region	Size group (ha)	Total area (ha)	Irrigated area (ha)	N (kg)	P (kg)	Farms	Users
I	0 to 2	19.58	4.23	1756.63	440.00	17	14
	2 to 4	36.74	4.05	1785.20	558.70	13	12
	4 to 6	19.41	1.08	451.89	68.25	4	4
	6 to 8	57.02	1.29	820.05	384.75	8	6
	8 & above	128.38	2.15	415.79	135.75	8	6
	<b>Total</b>	<b>261.13</b>	<b>12.80</b>	<b>5229.56</b>	<b>1587.45</b>	<b>50</b>	<b>42</b>
II	0 to 2	63.84	29.37	4017.15	1398.78	50	35
	2 to 4	177.14	73.69	7811.60	2760.16	60	44
	4 to 6	139.54	55.30	5595.15	1791.35	28	18
	6 to 8	123.45	27.20	2176.51	704.16	18	10
	8 & above	274.85	69.54	4195.20	1834.30	24	19
	<b>Total</b>	<b>778.82</b>	<b>255.10</b>	<b>23795.61</b>	<b>8488.75</b>	<b>180</b>	<b>126</b>
III	0 to 2	65.52	5.30	1171.41	634.91	48	32
	2 to 4	181.97	33.33	6972.80	2504.90	61	49
	4 to 6	240.65	18.53	3317.20	1573.80	48	40
	6 to 8	251.67	22.80	2940.42	1990.50	36	30
	8 & above	550.76	53.82	7880.05	3856.35	47	36
	<b>Total</b>	<b>1290.57</b>	<b>133.78</b>	<b>22281.88</b>	<b>10560.46</b>	<b>240</b>	<b>187</b>
IV	0 to 2	26.63	2.40	593.68	260.50	21	15
	2 to 4	111.85	9.33	2832.04	1269.99	37	32
	4 to 6	150.35	2.80	2500.25	1022.65	30	25
	6 to 8	96.51	5.96	2579.45	1361.80	14	12
	8 & above	299.26	8.65	5130.90	2037.80	28	26
	<b>Total</b>	<b>684.60</b>	<b>29.14</b>	<b>13636.32</b>	<b>5952.74</b>	<b>130</b>	<b>110</b>

**Note :** Refer to the discussion in Section 4.9 for details.

A P P E N D I X - B

## APPENDIX B

### DETAILS OF FERTILIZER (N) CONSUMPTION POTENTIAL ESTIMATION

It may be pointed out, as discussed in Section 4.10, the basics of these estimates are :

(1) Official data based 1980-83 triennium average areas under crops and irrigated areas under crops are taken.

(2) This potential estimation exercise is confined to N nutrient only, for brevity. From recommended doses of crops from Tables 4.3(a) and 4.3(b), a lower dose and a higher dose (the latter always lower than the highest of recommended doses) of each crop is externally determined with irrigated-unirrigated parts distinguished and among the unirrigated part assured rainfall and uncertain rainfall region further distinguished and with the consideration to HYV proportion. HYV proportion itself is taken from Epitome of Agriculture 1984-85, Part I.

(3) From these rates a 'conservative' and 'liberal' estimate is made for each crop.

(4) These are set against the 'existing level'. The existing level itself is calculated from averaging 1983-84 and 1984-85 cropwise actual rates separately for irrigated and unirrigated parts based on sample data and applied to areas in (1) above.

Below we try to explain the arithmetic of potential estimation for each crop.

#### B.1) Kharif Jowar

From official data (average 1980-83 triennium)

Area : 2972 Thousand hectares (TH) \*

Irrigated Area : 33.7 TH

Rainfed Area : 2938.3 TH

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\* Abbreviations used are : TH : Thousand hectares, TKG : Thousand kilograms, i.e. a tonne, TV : Traditional varieties.

i) Irrigated Kharif Jowar

Epitome of Agriculture 1984-85 gives 66 per cent of kharif jowar under HYV for 1982-83. Applying the same :

Irr. HYV area : 22.242 THx(60 kg/ha low rate,  
80 kg/ha high rate)

Irr. TV area : 11.458 TH x (35 kg/ha low rate,  
50 kg/ha high rate)

gives Irrigated Area Potential :

For HYV

Conservative estimate - 1334.52 Tkg.

Liberal estimate - 1779.4 Tkg.

For TV

Conservative estimate - 401.03 Tkg.

Liberal estimate : 572.9 Tkg.

Total irrigated : 1735.55 Tkg. Conservative

K. jowar potential  
2352.30 Tkg. Liberal

'Existing' level for irr.k. jowar :

33.7 TH area x 50.385 kg = 1697.97 Tkg. 'existing' level,

50.385 is average of 1983-84 and 1984-85 rates of 29.64 kg/ha

and 71.13 kg/ha (from Table 4.17). These estimates taken

to Table 4.31.

ii) Unirrigated kharif jowar

2938.3 TH area. Of this area 6.35 per cent area i.e.

186.73 TH is in Region II of scarcity-uncertain rainfall

(6.35 per cent is average percentage of 1983-84 and 1984-85 from Table 4.17).

Region II K. jowar : 186.73 TH

Assured rainfall area : 2751.57 TH (residual unirrigated).

Overall HYV area is 66 per cent. For Region II we take only 33 per cent as with moisture stress it is likely to be smaller while for remaining unirrigated area we use 66 per cent as proportion under HYV.

Region II HYV area : 61.62 TH doses of N : 25 lower,  
50 higher

Region II TV area : 125.11 TH doses of N: 20 lower,  
25 higher

Assured rainfall HYV area : 1816.04 TH doses of N : 60 lower,  
80 higher

Assured rainfall TV area : 935.53 TH doses of N : 30 lower,  
50 higher

Hence Region II estimate : 4,042.7 Tkg Conservative,  
6,208.7 Tkg. Liberal

Assured rainfall estimate : 141,705.95 Tkg Conservative,  
192,059.70 Tkg Liberal

Unirrigated rabi jowar :

Conservative estimate : 145,748.65 Tkg.

Liberal estimate : 198,268.70 Tkg.

Existing level : 49,921.72 Tkg.

These estimates taken to Table 4.32.

(Existing level : 2938.3 TH area x 16.99 kg/ha rate where  
rate is average of 15.28 kg and 18.70 kg rates for the two  
years.)

This gives from (i) and (ii) components.

K. Jowar : Potential estimate : Conservative : 147,484.20 Tkg  
Liberal : 200,620.70 Tkg  
Existing level: 51,619.69 Tkg

These estimates taken to Table 4.33.

Rates per ha applied - based on Tables 4.3(a) and 4.3(b) are :

Irrigated/Assured rainfall HYV : 60 kg lower,  
80 kg higher

TV : 35 kg lower,  
50 kg higher

Unirrigated/Uncertain rainfall : HYV : 25 kg lower,  
50 kg higher

TV : 20 kg lower,  
25 kg higher

Lower estimate used for conservative and higher for liberal  
potential estimates.

## B.2) Rabi Jowar

Total official data area : 3581 TH

Irrigated : 343.9 TH

Unirrigated : 3237.1 TH

HYV area by Epitome of Agriculture : 8.8 per cent

i) Irrigated rabi jowar

Irr. HYV : 30.26 TH at doses (kg) : 60 lower, 80 higher

TV : 313.64 TH at doses (kg): 40 lower, 50 higher

This gives : Conservative estimate : 14,361.20 TkgLiberal estimate : 18,102.80 Tkgagainst existing level estimate : 4,350.33 Tkg

for irrigated part, taken to Table 4.31.

Existing level obtained by multiplying area 12.65 TH by dose of 12.65 kg/ha. The dose is average of 1.04 and 24.25 kg in Table 4.18.

ii) Unirrigated rabi jowar

Total area : 3237.1 TH

Region II has 49.05 per cent of area (Average 56.14 per cent and 41.96 per cent from Table 4.18) i.e. 1587.80 TH.

Of this HYV area is put at 4.4 per cent, half the official HYV area estimate for rabi jowar, because this is low and uncertain rainfall area :

a) Reg.II HYV area : 70.00 TH at doses (kg) : 30 lower, 40 higher

TV area : 1517.80 TH at doses (kg): 15 lower, 20 higher

Assured rainfall unirrigated area (Non-Region II), 1649.30 TH with break-up given by 8.8 per cent under HYV :

b) Assured rainfall HYV area : 145.13 TH at doses (kg) : 40 lower, 60 higher

TV area : 1504.16 TH at doses (kg): 20 lower, 40 higher

Region II unirrigated estimate : Conservative : 24,867 Tkg

Liberal : 33,156 Tkg  
from a)

Assured rainfall unirri. estimate : Conservative : 35,684.4 Tkg

Liberal : 68,874.2 Tkg  
from b)

This gives :

Unirrigated component potential estimate :

Conservative : 60,755.4 TkgLiberal : 102,030.20 Tkg



against level of estimate existing : 2,152.7 Tkg, these three estimates are taken to Table 4.32. The existing level obtained by using area 3237.1 TH multiplied by existing rate of 0.665 kg/ha. (Average of 0.54 and 0.79 ha in Table 4.18).

From (i) and (ii) we finally obtain

Rabi jowar N consumption potential :

Conservative : 75,116.6 Tkg

Liberal : 120,133.0 Tkg

Existing : 6,503.0 Tkg, taken to Table 4.33

The doses used are (in kg) :

Irrigated/Assured rainfall HYV : 60 lower, 80 higher  
TV : 40 lower, 50 higher

Unirrigated/Uncertain rainfall : HYV : 30 lower, 40 higher  
TV : 15 lower, 20 higher

### B.3) Bajra

Official data 1980-83 Av. area : 1,614 TH

Irrigated: 50.5 TH

Unirrigated: 1,563.5 TH

HYV percentage area for 1982-83 by Epitome of Agri. : 53.5 p.c.

#### i) Irrigated Component

HYV area at 53.5 p.c. = 27.02 TH at doses 30 lower 40 higher

TV area = 23.48 TH at doses 10 lower 40 higher

Irrigated N potential : Conservative : 1,045.4 Tkg

Liberal : 2,020.0 Tkg

Existing : 1,933.1 Tkg

These are taken to Table 4.31.

Existing level being area 50.5 TH with average dose of 38.28 kg/ha (average of 32.26 and 44.30 kg doses of 1983-84 and 1984-85).

The existing level appears satisfactory compared with our cautious estimates of about one thousand and two thousand Tkg.

#### ii) Unirrigated Component

Area : 1563.5 TH

From Table 4.18 Region II (Scarcity) has 49.72 per cent area.

Region II area : 777.37 TH

Of this HYV : 207.95 TH (Half of overall percentage 53.5 i.e. 26.75 per cent applied).

TV : 569.42 TH

But both HYV and TV doses assessed at modest 10 lower and 20 kg higher.

Region II potential N : Conservative : 7,773.70 Tkg

Liberal : 15,547.40 Tkg

Unirrigated but assured rainfall area: 786.13 TH

Of this HYV : 420.58 TH (53.5 per cent) at doses  
(30 lower 40 higher)

TV : 365.55 TH (53.5 per cent) at doses  
(30 lower 40 higher)

Gives potential estimates for

Unirrigated assured rainfall areas : Conservative: 16,272.90 Tkg

Liberal : 31,445.20 Tkg

.. For unirrigated bajra as a whole potential estimates are :

Conservative : 24,066.60 Tkg

Liberal : 46,992.60 Tkg

Existing level : 14,806.34 Tkg, taken to Table 4.32.

Existing level obtained by multiplying 1563.5 TH by dose of 9.47 kg/ha (Average of 8.56 and 10.38 kg/ha rates based on Table 4.19).

From (i) and (ii)

Bajra N Consumption potential estimates :

Conservative : 25,092.0 Tkg

Liberal : 49,012.6 Tkg

Existing level : 16,739.48 Tkg, taken to Table 4.33.

Doses (kg/ha) used are :

Irrigated area or ) HYV : 30 lower 40 higher  
Assured rainfall area ) TV : 10 lower 40 higher

Unirrigated uncertain ) HYV : 10 lower 20 higher  
rainfall area ) TV : 10 lower 20 higher

B.4 Cotton

Doses : In recommended doses for irrigated cotton, Tables 4.3(a) and 4.3(b) give the following N/ha:

TV : 100 kg Table 4.3 (a)

Desi : 50 kg Table 4.3(b)

Varalaxmi : 80 kg Table 4.3(b)

Hybrid4 : 100 kg Table 4.3(b)

From this we fix following doses for our calculation :

Long Staple (LS) Irrigated Cotton : 60 lower, 80 kg higher dose.

Medium Staple (MS) and Short Staple (SS) Irrigated Cotton : 40 lower, 60 kg higher dose.

Both these are modest contrasted with the recommendations.

For unirrigated cotton we have recommendations as :

Varalaxmi in assured rainfall 30 kg (4.3-b)

Hybrid-4 in assured rainfall 50 kg (4.3-b)

Unirrigated TV : 50 kg (4.3-a)

Desi : 25 kg (4.3-b)

From these we fix rates as :

Assured-unirrigated L.S.Cotton : 25 lower, 45 higher dose

- M.S., S.S. Cotton : 20 lower, 30 kg. higher dose.

In uncertain rainfall region, sample has (average of 1983-84 and 1984-85) just 3 per cent of area. (Official data also indicates that this proportion is quite low.) This region's estimates, for whatever area, are made by using 10 lower and 20 kg higher dose. By and large, both our doses are cautious.

Potential Estimation

Total Cotton Area by official data : 2677 TH

Irrigated : 136.6 TH

Unirrigated : 2540.4 TH

i) Irrigated Cotton

Proportion of L.S. in total is 57.92 per cent. (Average of 54.55 and 67.29 per cent over the two years.)

∴ L.S. area is 79.12 TH at 60 and 80 kg/ha

M.S. and S.S. area is 57.48 TH at 40 and 60 kg/ha

gives Conservative estimate : 7,046.2 Tkg

Liberal estimate : 9,778.4 Tkg

against Existing level : 5,375.8 Tkg, taken to Table 4.31.

Existing level obtained by applying to L.S. area of 79.12 TH sample average input of 53.125 kg/ha and M.S. and S.S. area at average 20.40 kg/ha.

ii) Unirrigated Cotton

Area : 2540.4 TH

Of this, Region II has just 3.03 per cent (Tables 4.20,4.21) area i.e. 76.97 TH and for this area with rates of 10 lower and 20 kg higher, we have Conservative : 769.7 Tkg

Liberal : 1539.4 Tkg.

For assured rainfall unirrigated cotton,

Area : 2463.49 TH (Total unirrigated - Region II unirrigated area)

Of this L.S. area estimate 513.13 TH

M.S.,S.S. area estimate 1950.30 TH

Based on L.S. percentage unirrigated area of 20.83 per cent (average of 1983-84 and 1984-85 percentages in Tables 4.20, 4.21). With rates for L.S. 25 lower, and 45 kg higher and for M.S. and S.S. area with 20 lower and 25 kg higher dose we have for LS : Conservative 12,828.25 Tkg.

Liberal 23,090.80 Tkg

M.S. and S.S. : Conservative 39,006.00 Tkg

Liberal 58,509.00 Tkg

Together with Region II unirrigated area N consumption estimates we get :

Potential estimate for unirrigated cotton :

Conservative : 52,603.95 Tkg

Liberal : 83,139.25 Tkg

Existing level : 45,400 Tkg taken to Table 4.32.

The existing level being the result of unirrigated area of 2540.4 TH and average 1983-84 and 1984-85 dose of 15.51 kg

obtained from sample data (Tables 4.20 and 4.21).

iii) Putting together irrigated and unirrigated components, we have estimates for cotton as :

Conservative : 59,650.15 Tkg

Liberal : 92,917.65 Tkg

Existing level : 50,775.93 Tkg, taken to Table 4.33.

### B.5 Sugarcane

We consider, for potential estimation that Regions I and II have the characteristics of 'Deccan canal tract'. We include Region I because sugarcane is taken really in ghats and transition rather than in Konkan area. High N utilisation by sample farmers in Region I justifies this combining with Region II, the Deccan canal tract.

Recommended doses and selected doses of N :

For Regions I and II we have N recommendations for types :

Adsali	: 400 kg/ha
Pre-Seasonal	: 340 kg/ha
Suru and all ratoon types	: 250 kg/ha.

We assume Adsali area to be 30 per cent of cane area in Regions I, II and fix lower and higher doses at 340 and 370 kg/ha.

For Pre-seasonal and Suru-ratoon we fix doses at 220 lower and 280 kg/ha higher (with area 70 per cent of total sugarcane area). With these weights average rates come out as 256 lower and 307 higher dose of kg/ha.

For Regions III and IV we have N recommendations as :

Pre-seasonal	: 250 kg/ha
Suru	: 170 kg/ha
Ratoon	: 170 kg/ha

(No Adsali in these regions.)

We select 150 and 180 kg/ha as lower and higher N doses.

In selecting these doses we have relied on Table 4.3(b) rather than 4.3(a) as the former has separate recommendations for

Deccan canal tract and for Vidarbha-Marathwada area. Thus our dose selection is on the cautious side.

Estimation : Sugarcane is entirely irrigated and the State area by official statistics (1980-83) triennium is :

Area	: 358 TH
Regions I and II	: 266.28 TH
Regions III and IV	: 91.72 TH

The division into regions is obtained on the basis that 74.38 per cent of sample area comes from Regions I and II. Based on 1983-84 and 1984-85 coverages in Table 4.22.

Potential Estimation :

Regions I and II area estimated at 256 lower and 307 upper dose. Regions III and IV area estimated at 150 lower and 180 upper dose.

Giving up potential estimates for all regions together :

<u>Conservative</u>	: 81,925.68 Tkg
<u>Liberal</u>	: 98,257.56 Tkg

against existing level : 90,516.72 Tkg, taken to Tables 4.32 and 4.33.

The existing level obtained by using total area of 358 Th and average (of 1983-84 and 1984-85 doses by sample farmers) dose 252.84 kg/ha from based on Table 4.22.

Existing level appears rather satisfactory because reported doses in Regions I and II are themselves very high and because we do not know exact compositions of total acreage by adsali, pre-seasonal, suru, etc., we have just two categories planted-harvested and ratoon-harvested. It is also well known that especially in Regions I and II farmers tend to over-irrigate the crop and thus they also may be using very high N doses.

#### B.6 Groundnut

Recommended doses are : 25 kg of N/ha for irrigated/assured rainfall areas and 12 kg for unirrigated-uncertain

rainfall areas. If we fix 10 lower and 20 kg higher dose for irrigated/assured rainfall areas and 6 lower and 10 kg higher dose for uncertain rainfall areas, then Table 4.23 indicates that the existing doses are not far from these and hence potential may not be substantially higher. But as mentioned in the discussion of that table in Chapter IV, the quarrel is really with the P nutrient and its actual use is nowhere twice the level of N. Since our exercise is related to N, we carry it out for N so that total picture can emerge.

Groundnut area by Official data	:	791 TH
Irrigated area	:	28.6 TH
Unirrigated area	:	762.4 TH

i) Irrigated Component :

28.6 TH area at 10 lower and 20 higher dose gives

Conservative estimate : 286 Tkg

Liberal estimate : 572 Tkg

Existing level : 593.16 Tkg, taken to Table 4.31.

(28.6 TH at av. sample rate 20.74 kg/ha to obtain existing level).

ii) Unirrigated Component

Of the unirrigated area of 762.4 TH

Region II has 17.69 per cent area (based on the two years, Table 4.23)

∴ Region II area : 134.87 TH (at 6 lower and 10 higher dose)

Remaining area : 627.53 TH (at 10 lower, 20 higher dose)

gives for total unirrigated area

Conservative Estimate : 7,084.52 Tkg

Liberal Estimate : 13,899.30 Tkg

against Existing level : 8,752.35 Tkg, taken to Table 4.32.

The existing level obtained by using average rate of 11.48 kg/ha (Table 4.23 based) and area of 762.4 TH.

iii) Taking (i) and (ii) together, we have for groundnut :

N-Potential Conservative : 7,370.52 Tkg

Liberal : 14,471.30 Tkg

Existing Level: 9,345.51 Tkg, taken to

Table 4.33.

The existing level is in the middle of the two estimates.

#### B.7 Safflower

Recommended doses : Tables 4.3(a) and 4.3(b) indicate that for irrigated/assured rainfall areas N-dose 50 to 60 kg/ha and for unirrigated-uncertain rainfall areas 25 kg/ha. But we do not have up-to-date area under irrigated safflower (which is presumably small, e.g., in 1978-79 only 13 hundred ha were irrigated out of 4858 hundred hectares). We adopt 10 as lower and 20 kg/ha as upper rate for the whole crop. Thus we err on the side of caution.

Official data area : 536 TH at 10 lower and 20 higher dose gives

Conservative Estimate : 5,360 Tkg

Liberal Estimate : 10,720 Tkg

Existing Level : 761 Tkg, taken to Tables

4.32 and 4.33.

The existing level being obtained on the basis of area 536 TH at 1.42 Kg/ha (average of 0.56 and 2.28 kg/ha rates for 1983-84, 1984-85 of sample farmers).

#### B.8 Rice

It is mentioned all along that rice is under-represented as it is not in the 13-crop aggregate on which the sample is based. Irrigated area, by official data, is mainly in Vidarbha but in our sample it is more or less evenly spread.

#### N-Doses

From Tables 4.3(a) and 4.3(b) we fix the following doses:

HYV : 80 lower, 100 kg/ha higher dose

TV : 30 lower, 40 kg/ha higher dose.

Since rice is taken in high rainfall areas or entirely with



irrigation in other areas, we do not make irrigated and un-irrigated area distinction.

By official data, area is 1502 TH.

(Of this irrigated 403.4 TH but the fact is not made use of here.) HYV area by official data (Epitome, 1984-85) is 62 per cent in 1982-83.

∴ HYV area estimate : 931.24 TH at doses 80 100 kg/ha

TV area estimate : 570.76 TH at doses 30-40 kg/ha.

gives us Conservative Estimate : 91,622.0 Tkg

Liberal Estimate : 115,954.4 Tkg

Existing level : 65,796.2 Tkg

To obtain the last mentioned estimate we have used sample (1983-84 and 1984-85) average estimates of 64.41 kg/ha for irrigated area and 36.24 kg/ha for unirrigated rice. (Here we have to use irrigated-unirrigated distinction as HYV area is not available). Estimates for 403.4 TH taken to Table 4.31, of remaining area taken to Table 4.32 and total to Table 4.33.

## B.9 Wheat

### N-Doses

Looking at Tables 4.3(a) and 4.3(b) we see that for irrigated wheat recommendation is between 75 kg and 120 kg/ha, the former being for tall variety.

For unirrigated wheat, dose is between 25 and 40 kg/ha. Although from Epitome of Agriculture we also know that HYV is 77.5 per cent (1982-83) of total wheat area, for dose fixation we may take only two categories irrigated and un-irrigated with irrigated related to HYV.

We decide on doses as :

Irrigated wheat 60-70 kg/ha

Unirrigated wheat 20-30 kg/ha

Area : Official data (1980-83 triennium average) : 1077 TH.

Irrigated : 575.8 TH

Unirrigated : 501.2 TH

With the decided lower and higher doses, we get for all wheat :

Conservative estimate : 44,572.0 Tkg  
 Liberal estimate : 55,342.0 Tkg  
 Existing level : 39,520.67 Tkg, taken to Table 4.33.

The last estimate being the result of irrigated wheat of 575.8 TH at sample average rate of 64.075 kg/ha and unirrigated wheat of 501.2 TH at sample average rate of 5.24 kg/ha.

Estimate made for irrigated wheat taken to Table 4.31 and those for unirrigated wheat taken to Table 4.32.

#### B.10 Pulses

From Tables 4.3(a) and 4.3(b) we decide upon the following rate for all pulses : 10-15 kg of N/ha. In the sample we have tur, mung, urid and gram and although Epitome of Agriculture does not give data except for tur and gram we have Season and Crop Report of say 1978-79 where these data are available and where we see that these four pulses cover 75 per cent of area under pulses. We ignore the irrigated pulses (which form a very small proportion anyway - 830 hundred ha out of 28,009 hundred ha in 1978-79) as a separate component and treat all pulse area as unirrigated - this is in keeping with our cautious approach.

Official data : Total pulses area : 2710 TH (1930-83 average).

At 10 lower and 15 kg/ha higher rates,

Conservative estimate : 27,100 Tkg  
 Liberal estimate : 40,650 Tkg  
 Existing level : 15,528 Tkg, taken to Tables

4.32 and 4.33.

The last mentioned level based on 2710 TH area at sample average of 5.75 kg/ha.

#### B.11 Ragi

Ragi is the sample occurs mainly in Regions I and is unirrigated. By official statistics also we can ignore irrigated component (In 1978-79 one out of over two thousand in terms

of hundred hectares).

From Table 4.3 (a) we have 25 kg/ha of N for irrigated ragi. Fixing 10 as lower and 20 kg as upper dose, we have with official data based area of 224 TH.

Conservative estimate : 2,240 Tkg

Liberal estimate : 4,480 Tkg

Existing level : 2,367.68 Tkg, taken to Tables

4.32 and 4.33.

The last estimate based on area 224 TH and sample average dose of 12.30 kg (1983-84) and 8.84 kg (1984-85) at 10.57 kg/ha.

#### B.12 Other Crops

For other crops we do not decide lower and upper doses. Instead whatever average dose we obtain from the sample data (for irrigated and unirrigated components separately) we apply to official 'other irrigated area' and 'other unirrigated area' and get just one estimate which helps us in completing the picture. Since 'others' is a catch-all category we think it proper to use just the existing levels and applying these to official area data. We thus 'neutralise' 'other crops' category.

Thus from sample data (Tables 4.6 and 4.12), we get average dose of N for 'other irrigated area' at 49.35 kg/ha. Average being average of two sample years. For 'other unirrigated area' the average dose comes to 3.16 kg/ha. From official data we find that 'other irrigated area' is 549.90 TH and 'other unirrigated area' is 1667.10 TH and hence we get state-level estimates of 27,137.56 Tkg and 5,268.04 Tkg for 'other irrigated' and 'other unirrigated area'.

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