Inter-District Variations in the Levels of Agricultural Development in Gujarat

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CERTIFICATE

This is to certify that the Dissertation entitled "Inter-District Variations in the Levels of Agricultural Development in Gujarat" submitted by Shri Ashoka Kumar Majhee, is to the best of my knowledge, a bonafide work and may be placed before the examiners for evaluation.

CHAIRMAN 14/7/86

SUPERVISOR

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In accomplishing this dissertation, my debts are many: Some are academic, some are personal. It is my duty to give them due place wh helped me in bringing this dissertation in this form.

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Ashoka Kumar Majhee

(ASHOKA KUMAR MAJHEE)

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PREFACE

The most important problem that is faced by the social scientist in India is that of regional imbalance in the pattern of development. In this study an attempt is being made to portray the levels of agricultural development in Gujarat. The study deals with regional variations in the levels and growth of agricultural developments taking all the districts as units of study, covering the triennium 1963-66 and 1977-80. The study consists of the following chapters.

The objective of study, a brief introductory study of review of literature, data base etc. have been spelled out in detail in the first chapter. Chapter two deals with the Economic background of the state under considerations. It examines the state's physiography, drainage, climatic conditions and soil- all of which provide the very foundation on which agricultural development depends. Chapter three discusses comprehensively the rationale of selection of indicators and the methodology involved in the agricultural development of Gujarat. Chapter four is divided into two sections. First section deals with inter-district variations in productivity level, and where as second section deals with intor-district

variations in yield levels. With respect to 18 crops only. In chapter five, the principal component analysis has been followed in order to identify the levels of agricultural development among the districts of Gujarat Chapter six deals with decomposition of agricultural output growth to know the role of area, yield, cropping pattern and also the interaction between yield and cropping pattern contributing the output growth. In chapter seven the determinants of agricultural development is found out through multiple regression analysis for 1963-66 and 1977-80 taking productivity as dependent variable and other independent variables, Chapter eight presents summary and Conclusion.

CHAPTER - I

1.1 India is predominantly an agricultural economy around seventy percent of working force is engaged in agriculture as per 1981 census. Despite this heavy dependence on agriculture, India has the lowest yield in the world for many important crops like wheat, rice, maize etc. This may be due to the traditional nature in Indian agriculture. Another important thing is that the level of agricultural development in India may be low because of the under utilisation or mis-utilization of the resources. Several authors have tried to define the nature of traditional agriculture, until some explained its nature in terms of economic attributes and some in terms of social attributes. Prof T.W. Schutz tries to explain the production behaviour of farmers bound by the traditional agriculture and also tries to find out the ways of transforming it. According to him, the traditional agriculture cannot be formulated rigorously in terms of cultural attributes, institutional arrangements, or technical properties of factors of production. Instead, he treats traditional agriculture on particular types of economic equilibriums arrived at a long period of time. He observes that in such type of agriculture the marginal rate of return is so low that the farmers have little

incentive to save and invest or work hard. As this state prevailed over a larger period of time the preference for acquiring and holding wealth remained constant for generation. The state of art of agriculture experienced no change and therefore the agricultural system attained a type of stationary equilibrium.

Agricultural backwardness has also been explained in terms of production relations. Some researchers are of the view that Indian agriculture is traditional because of the very pre-capitalist nature of the mode of production. The main features of this type of mode of production are (i) surplus extracted through extra economic coercion of unfree labour, (ii) Surplus appropriated directly without intervention of any market, (iii) Surplus dissipated in luxury consumption as well as in different unproductive investments, leaving the stock of productive capital unchanged and production in a cycle of simple (iv) Technology remains unchanged. According to Amit Bhaduri, the operation of semi-feudalism in Indian agriculture is a system of peasant economy characterised by share cropping, perpetual indebtedness of the small tenants, two modes of exploitation namely usury and landownership and lack of accessibility for the small tenants to the market. Even those who attribute the

backwardness of traditional agriculture to economic forces, believe that within the economic framework of traditional agriculture, there are less opportunities for the economic development. For example, in Schlutzian conception of traditional agriculture the rate of returns on traditional inputs like land, labour and capital are very low and risk is very high. This low rate of return does not provide sufficient incentive for investment in agriculture, while in Schoutzian traditional agriculture there is no scope for investment in traditional inputs and hence for production. Mellor visualised some scope for increase in agricultural output in traditional framework through increase in land area, irrigation schemes and limited use of inorganic fertilizer.

Again those who recognized the significance of production relation in agricultural development believe that even if some surplus is generated in traditional agriculture, because of the operation of 'pre-capitalistic' mode of production, the surplus generated would be diverted to luxury and unproductive purposes. And as the surplus is spent on unproductive activities, it results in decentralization or stagnation in agricultural development. In a peasant economy where factors of production, (land, labour, capital) interloand, the landlord

had no incentive to introduce yield increasing technology so long as landlords income from interest went down due to the increase in yield! It becomes clear that interlocked factor markets are constraint to agricultural development and maximum general idea becomes true.

1.2 The role of Agriculture in Economic development

In developing countries agriculture is the mainstay of the people. About 40 to 60 percent of the national income comes from agriculture while 50 to 80 percent of labour force is engaged in it. Thus agriculture has an important bearing in the pace of agricultural development. If one looks at the advanced industrialised nations thing were once predominantly agricultural economics. Economic historians have traced the various ways in which growth of agriculture, resulted in the subsequent establishment and expansion of manufacturing sector.[2] The role of agriculture in economic development can briefly be explained in the following ways. (i) Agriculture provides food grains to the growing population (ii) It supplies raw materials for industries (iii) it acts as a source of foreign exchange (iv) it supplies surplus labour to the manufacturing and other sectors.[3] Infact by

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1. Bhaduri, Amit: Production Condition in Indian Agriculture Under semifeudalism
2. Hayani Yujro and V.W Rattan, " Agricultural productivity Difference among countries", The American Economic Review, Vol IX, No 5, December 1970, p.895
3. F.Jonson and J.W.Mellor- "The role of Agriculture in Economic development" in Karl A fox and D.Gale Jonson(eds) Reading in the Economics of Agriculture (1970), p.360.

looking at the historical development of the industrialised nations, one can infer that the agricultural revolution preceeds the industrial revolution. So the rising agricultural productivity is must for the economic development. This rise in agricultural production is possible in two ways, (i) increasing the land under cultivation and intensity of cropping, (ii) increasing the yield levels. At present there is no scope to develop the Indian agriculture by increasing the area under cultivation. So the only alternative left is either to increase the intensity of cropping or the yield levels with the help of new technologies.

1.3. Statement of the Problem:

In India there are wide sectoral and spatial variations in levels of economic development. It is not only the different sectors of economy are at different levels of development, but for the same sector these levels very from one region to another. The variations in levels of economic development as well as spatial are more pronounced in the case of developing countries like India. Thus spatial dichotomy creates an adverse effect upon the overall agricultural development. These spatial variations in the levels of development exist within each state/region.[4]

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4. Bhalla (G.S) and Alagh (Y.K)- Performance of Indian agriculture, a district wise study.

An examination of the factors responsible for the variations among districts in the levels of development would provide an insight into the nature of the problems facing the agrarian economy in their proper perspective. So the objectives of the agricultural policies in developing economics are (i) increase in output (ii) reduction in regional disparities. While the output at the aggregate level has generally shown a positive response to policy makers. It is not uncommon to experience a trade off between two objectives, regional disparities to expand with agricultural development. This happened in the face of simplistic solutions recommended in various studies. Such studies often come up with results that attribute bulk of the disparity to differences in factor input i.g extent of irrigation, use of fertilizer, difference in crop composition, differences in factor endowments etc[5]

1.4 Objective of the Study:

The main objective of the study is to analyse the causes for the spatial variations among different districts of Gujarat. The levels of agricultural pattern in Gujarat are studied in terms of land productivity, the prevailing

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5. Preceding of the symposium on Regional Imbalances and and Economic Development with Special Reference to Agriculture. " Regional Disparity in Agricultural Production Relevance for policy". Indian Journal of Agricultural Economics, Vol XXIX June 1977,No.1

cropping pattern and some of the technological factors like irrigation, fertilizer and so on, at two points of time 1963-66 and 1977-80 on the district level. Further it is intended to examine if there are certain natural factors that have played an important role in the development process which has generated disparity within the region. For this the cross section variations in the productivity indicators like output per hectre and output per agricultural male workers have been explained with the help of technological and enviornmental factors(rainfall). Although the institutional factors are very crucial for agricultural development however they have not been taken into consideration for this study as the districtwise data for them is not available..

1.5 Data Base of the Study:

The present study is based on the data collected from secondary sources. In the present study area and output of 18 crops have been collected for all the nineteen districts of the state for two triemiums 1963-66, and 1977-80. The districtwise data of area and output of different crops for the first time period i.e 1963-64,1964-65 and 1965-66 have been collected from "Hand book of Basic Statistics, Gujarat state, 1965 and 1966 published by Bureau of

Economics and Statistics, Government of Gujarat for the first time period and for the second time period the data has been collected from season and crop report for the year 1977-78, 1978-79 and 1979-80. District wise data on male agricultural workers have been obtained from census of India 1961 and 1981. The data on consumption of fertilisers have been obtained from "Effective demand for fertilizers in India" prepared by W.B Bonde, G.O.I, New Delhi and Dorris D.Brown I.B.R.D, New Delhi for the first time period i.e 1963-66. The second period time i.e 1977-80 the data was collected from fertilizer statstics. Trienniem averages were taken for 1963-64, 1964-65 1965-66(sixtees and 1977-78 1978-79, 1979-80(eightiee) in order to account for the seasonal fluctuation in crop output which are a characteristics of the Indian agriculture.[6] For the related variables of area, fertilizer etc, except mechanisation, the same briennium method was adopted.

1.6 Choice of the time period

In this study the average area and output have been taken for the years 1963-66 and 1977-80. The choice was made because the triennium 1963-66 is a pre green revolution period where as the triennica 1977-80 is a post-green period

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6. Report on the second phase of the Jawaharlal Nehru University- Planning Commission Project on food Grains Growth- A district wise study by G.S.Bhalla- A.K.Alagh and S.S.Thind-R.K.Sharma, p.5.

when the new technology had been well established in Indian agriculture. So by taking at these two time periods, an inter temporal comparison can be made of the pre-green revolution and post green revolution situation.

CHAPTER II

ECONOMY OF GUJRAT

The state of Gujarat came into being with the bifurcation of the bilingual Bombay state in May 1960. Its bounderies are defined by the Arabian sea on the West, the state of Rajasthan on the north-east, Madhya Pradesh on the south east and Maharashtra on the South. Its performance after 60's is commendable and its economy is as strong as that of any developed state in India. The 1956 movement launched by people of Gujarat known as "Mahagujarat Movement" has not only resulted in getting them their own state but it has also helped in getting social and economic development for its people. The last 25 years have witnessed the fulfilment of the aspiration of the people of Gujarat. However, there still remained some areas of shortfalls and bottlenecks in its march for social and economic progress, because of several problems facing the state.

2.1 Physiography

"Gujarat is situated on the west coast of India between 20.1 and 24.7 degrees north latitude and 68.4 and 74.4 degrees east longitudes"[1]. State identities the following

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1. Hand book of Basic Statistics, Gujarat State 1969 to 76 by Bureau of Economics and Statistics, Government of Gujarat".

physiographic regions in Gujarat: The territories of the state fall into two broad natural regions: (i) the alluvial palin in the eastern half and (ii) the Kutch-Saurashtra peninsula to the west. The plain formed by the deposition of alluvium by the sabarmati and the Mahi which slops from north to south. The rivers Narmada and Tapti flow from east to west and conver towards the gulf of cambay. The southern most portion of these plains situated between the sea and western ghats. The rainfall is heavy in the southern extremity(120 to 200 cms) but declines to the minimum of 90 cms. The Ghats themselves have very high rainfall, a part of which is drained by numerous short rivers and steams, billowing into Arabian sea. The Aravali ranges run along the northern fringe of the state between these irregularly shaped hills are the alluvial valleys built up mainly by the Sabarmati and Mahi river. The effect of the monsoon declines as one moves northwords, the rainfall in the northern districts touching a low of 50 cms. The Saurashtra peninsula is connected with the mainland by a narrow shaped land. The relief is conspicous on account of low hills alternating with tiny alluvial basins.[2]

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2. O.H.K. Spate, A.T.A Lear mouth and B.H. Farmer, "India, Pakistan and Ceylon, the regions" Methuen and Co. Ltd, B.I., Publications 1972.

2.2 Drainage:

The mainland of Gujarat is largely an alluvial plain being the gift of rivers Sabarmati, Mahi, Narmada, Tapi, Rupin and Saraswati is surrounded in the east and north by a hilly region. Apart from several peaks and cliffs, which are part of the Aravalli system. Here are two masses of hills in the central and southern parts of the penninsula, giving rise to an almost perfect radial drainage pattern. The Raun of Kutch trying at the northern end is a vast expanse of tidal mud flats flecked with saline.

2.3 Climate and rainfall

The climate of Gujarat in the southern districts is moist, while the northern districts have the dry climate. The average rainfall in the state varies from 13" to 60" (33 to 152 centimeters). On the basis of the average annual rainfall, the state can be divided into four zones viz,
(1) South Gujarat covering Bulsar, Danges, Surat, Broach, Baroda, Pachmahals and Sabarkantha districts with the rainfall between 30" to 60"(76 to 152 centimetre). In some parts of the range the rainfall is around 75"(190 centimeters)
(2) North Gujarat covering Kaira, Ahmadabad, Gandhinagar Mahesana and Banaskantta districts with rainfall between 20" and 40"(51 and 102 centimeters).

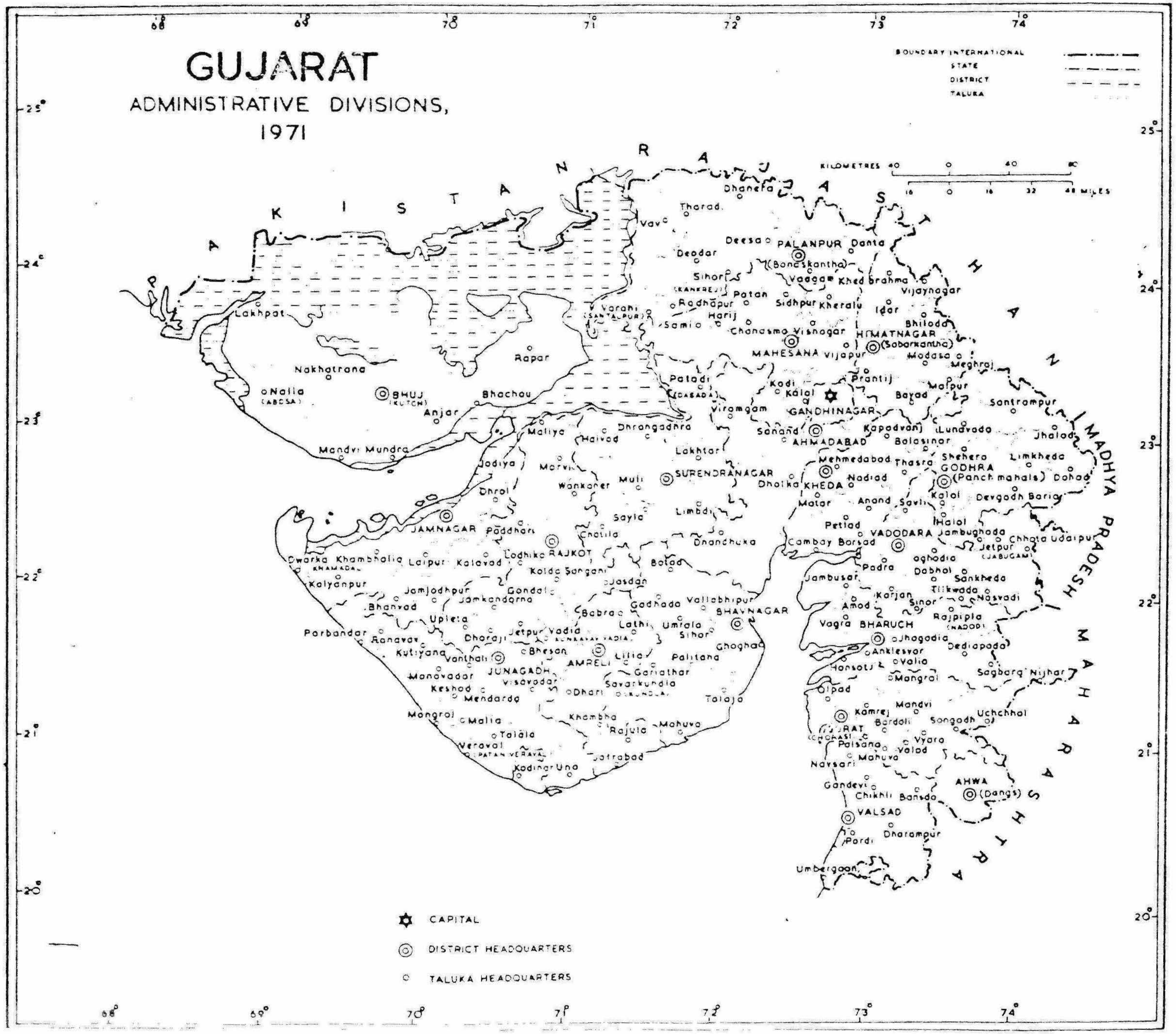
(3) Saurashtra covering six districts viz, Junagadh, Amereli, Bhavnagar, Rajkot, Jamnagar and Surendranagar. The rainfall here are around 25"(62 centimeters).
(4) Kutch with very low rainfall and evincing semi-desert conditions.

2.4 Soils

Geologically the basic complex of the state consists of volcanic rocks except the alluvial plains of north Gujarat and the western borders of the Saurashtra peninsula. Saurashtra regions is formed of Deccan lava sheets. Basically the soils are of a good quality. The northern parts of the state are dominated by sandy loams which owe their origin to the Indo-Gangetic alluvium. Saurashtra has medium black soils of basaltic origin. Alluvial soils are found all along the coast except some parts which are saline in nature The need for irrigation facilities is paramount. A little percentage of cropped area gets water from wells and tanks built through private efforts.

2.5 Administrative Set-up

According to 1971 census the state has an area of about 196 thousand square kilometers, which account for about 6 percent of the geographical area(3280 thousand square kilo meters) of the country. According to population census 1971 the population of the state was 267 lakhs persons of whom


GUJARAT
ADMINISTRATIVE DIVISIONS,
1971
BOUNDARY INTERNATIONAL
STATE
DISTRICT
TALUKA
KILOMETRES 40 0 40 80
16 0 16 32 48 MILES
P A K I S T A N
R A J A S T H A N
MADHYA PRADESH
M A H A R A S H T R A
Lakhpat
Nakhatrana
Nalia
(ABDSA)
BHUJ
(KUTCH)
Rapar
Bhachau
Anjar
Mandvi
Mundra
Varahi
(SANTALPUR)
Vav
Tharad
Dhanera
Deesa
PALANPUR
(Banaskantha)
Danta
Deodar
Sihori
(KANKREJ)
Vadgam
Khed brahma
Vijaynagar
Radhanpur
Patan
Sidhpur
Kheralu
Idar
Harij
Sami
Chanasma
Visnagar
HIMATNAGAR
(Sabarkantha)
Bhiloda
MAHESANA
Vijapur
Modasa
Meghraj
Patadi
(DASADA)
Kadi
Kalol
Prantij
Bayad
Malpur
Santrampur
Viramgam
GANDHINAGAR
Sanand
AHMADABAD
Kapadvanj
Lunavada
Balasinor
Jhalod
Maliya
Halvad
Dhrangadhra
Lakhtar
Mehmedabad
Thasra
Shehera
Limkheda
GODHRA
(Panch mahals)
Dohad
Jodiya
Morvi
Wankaner
Muli
SURENDRANAGAR
Dholka
KHEDA
Nadiad
Kalol
Devgadh Baria
Dhrol
Sayla
Limbdi
Matar
Anand
Savli
Halol
JAMNAGAR
Paddhari
Chotila
Dhandhuka
Petlad
Cambay
Borsad
VADODARA
Jambughoda
Chhota Udaipur
Jetpur
(JABUGAM)
Dwarka
Khambhalia
(KHAMADA)
Lalpur
Kalavad
Lodhika
RAJKOT
Kotda Sangani
Botad
Padra
Sankheda
Kalyanpur
Jamjodhpur
Gondal
Jamkandorna
Jasdan
Jambusar
Dabhoi
Tilkwada
Karjan
Sinor
Nasvadi
Bhanvad
Upleta
Babra
Gadhada
Vallabhipur
BHAVNAGAR
Amod
Rajpipla
(NADOD)
Porbandar
Ranavav
Dhoraji
Jetpur
Vadia
(KUNKAVAV VADIA)
Lathi
Umrala
Sihor
Vagra
BHARUCH
Jhagadia
Kutiyana
Vanthali
Bhesan
Lilia
Palitana
Ghogha
Anklesvar
Dediapada
Manavadar
JUNAGADH
AMRELI
Gariadhar
Hansot
Valia
Sagbara
Nijhar
Keshod
Visavadar
Dhari
Savarkundla
Mangrol
Mendarda
Talaja
Olpad
Mangrol
Malia
Khambha
Kamrej
Mandvi
Uchchhal
Talala
Rajula
Mahuva
SURAT
(CHORASI)
Bardoli
Songadh
Veraval
(PATAN VERAVAL)
Jafrabad
Palsana
Vyara
Valod
Kodinar
Una
Navsari
Mahuva
Gandevi
AHWA
(Dangs)
Chikhli
Bansda
VALSAD
Pardi
Dharampur
Umbergaon
CAPITAL
DISTRICT HEADQUARTERS
TALUKA HEADQUARTERS
68° 69° 70° 71° 72° 73° 74°
25° 24° 23° 22° 21° 20°

138 lakhs were males and 129 lakhs were females. The population of the state accounted for about 4.87 percent of the population of the country. The states has been divided into 19 administrative districts viz. Ahmedabad, Amereli, Kutch, Kheda(Kaira), Gandhinagar, Jamnagar, Junagadh, Dangs, Panchmahals, Banskantha, Broach, Bhanagar, Mehsana, Rajkot, Baroda, Bulsar, Sabarkantha, Surat and Surendranagar. The districts are further sub-divided into taliks, there being 184 taluks in the state with the establishment of the panchayat Raj in the state, district panchayat have been formed in all the districts. The average density of population of the state according to 1971 census was 136 per sq. km as against 178 persons per sq.km for all India. Districts having high density in population are Ahmedabad, Gandhinagar and Khida(Kaira) about 300 and above, per square kilometer. The lowest diensity (19 per sq.km) was recorded in Kutch.

According to 1971 census the districtwise distribution of urban population shows that Ahmedabad, Rajkot, Jamnagar Surat, Bhavnagar, Baroda, and Junagarh districts having proportion of urban population 66-86 percent 38.37 percnet 35.30 percent, 33.72 percent. 31.99 pefent respectively ranging from 32 to 67 percent as compared to the state average of 28 percent. The same type of structural shift is also

visible when one looks at the distribution of workers in the census of 1961 and 1981. The percentage of worker engaged in the primary sector has come down during the said period.

2.6 Economic Situation in Gujarat :

The economic performance of Gujarat can be observed very well in the following manner. The economy of Gujarat registered an annual growth rate of 3.3 percent during the period of 1960-70 as compared to growth rate of 3.2 percent per annum during the same period.for the Indian economy. The growth of the state's economy accelerated in the succeeding decade and attained the level of 4.6 percent(1970-80) as against the annual national growth rate of 3.7 percent in the corresponding period. During the recent years(1981-83) the state's economy has shown the average growth rate of 3.5 percent against the national growth of 3 percent. The percapita income of Gujarat has also shown a rise against the national income. The state's per capita income was Rs 2368 in 1982-83 against nationl percapita income of Rs 1868 in the same year. In respect of percapita income in current prices in 1982-83, Gujarat ranks fourth among the states of India. The first three are Punjab, Haryana and Maharashtra respectively with Rs 3502, Rs 2858 and Rs 2625.

The economy of Gujarat has also shown notable structural shifts. It has been observed that the contribution of the primary sector in the state income has decreased from about 42.4 percent in the triennium ending 1962-63 to about 34.4 percent in the triennium ending 1982-83. During the same period the shares of secondary and tertiary sectors have grown from 25 percent and 37.7 percent respectively. These structural shifts are the consequence of differential growth rates in various sectors of the economy. The annual growth rates of incomes originating in primary, secondary and tertiary sectors of the state were respectively 1.53 percent 3.9 percent and 3.29 percent during the first decade 1960 61 to 1969-79. The corresponding growth rate during the second decade 1970-71 to 1979-80 were 3.08 percent, 5.59 percent and 5.55 percent respectively. Thus through passage of time all the sectors have registered increase in growth rates. The growth of primary sector has been relatively slow. The marked rate in growth rates of sector is due to process of industrialisation taking place in the state Now Gujarat occupied the second rank in the country(next to Maharastra) in terms of per capital gross industrial output and number of industrial output.

State income of Gujarat

The state income at current prices originating from Gujarat was estimated at Rs 970 crores for the year 1965-66

However the provisional estimates for 1965-66 indicates a marginal decrease to the extent of Rs 1 crore as compared to the preceeding year. Though the secondary and teritiary sectors indicate an increasing trend, the income from agricultural and allied activities has been fluctuating as seen from the table 2.1. The table reveals that state domestic product originating from theprimary sector shows wide fluctuations in different years. This is due to the fact that agricultural output of the state mainly depends upon the monsoon as the irrigation facilities is not well developed in the state. Even then, the output of the total state domestic product, the contribution of this sector is the highest. The secondary and tertiary sectors show an increasing trend over all the years. This is clear from the table that the state domestic product at current prices in 1977-78 is estimated at Rs 4473 crores compared to Rs 4035 crores in 1976-77. In terms of constant prices(1970-71) The state domestic product increased from Rs 2459 crores in 1976-77 to Rs 2764 crores in 1977-78. The real increase in state domestic product during 1977-78 is mainly due to large increase in the domestic product from secondary sectors. The table also shows that in 1975-76 the real state domestic product has increased by about 26 percent (at 1970-71 prices) over the previous year of 1974-75 mainly due to the lower level of state domestic product in

Table 2.1

State domestic Product at current Prices (Rs in crores)

Items	1963-64	1964-65	1965-66	1969-70	1970-71	1971-72	1972-73
	(P)	(P)	(P)			(P)	(P)
1. SDP at factor cost	836	971	970	1784	2217	2181	2046
2. Agriculture, Forests logging and mining	401	524	486	770	1055	956	707
3. Mining, Quirying manufacturing and small enter prise	189	192	218	428	480	484	599
4. Burning Insurance, transport and commerce	123	127	133	246	277	307	327

Contd

Source- Hand Book of basic statistics, Gujrat state, 1965 and 1966, 1977-78, and 1969 to 76. Bureau of Economic and Statistics, Government of Gujrat, Gandhinagar.

Figures in the bracket one at nonstant (1970-71) Prices

* implies increase over the previous year at 1970-71 Prices

1973-74 (P)	1974-75 (P)	1975-76 (P)	1976-77 (P)	1977-78 (P)
3057	2999 (1877)	3584 (2360)	4035 (2459)	4473 (2588)
1418	1031	26.1%	3.9%	5.2%
701	898	-	-	-
368	444	-	-	-

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in 1974-75 which was a drought year, while in 1977-78 the state domestic product has increased by about 5.2 over the year 1976-77 mainly dée to higher increase in state domestic product originating from the secondary sector.

Labour Force

According to 1981 census, out of total population of 340 lakhs 127 lakhs were classified as workers and 2.13 lakhs were classified as non-workers. In other words the working population (including marginal workers) constituted 37.45 percent of the total population in the state as against 39.92 percent for all India. The number and percentage of workers according to the industrial classification as adopted in 1981 census are given in the following table.

Table 2.2

Industrial classification

Sr.No.	Workers			
	Gujarat		All India	
	Numbers	% of total workers	Numbers	% of total workers
1.Cultivators	4,114,744	34.46	92,522,836	41.58
2.Agricultural labours	2,350,195	21,340	55,499,704	24,94
3.Household industry,Manufacturing processing, servicing and repairs	267,280	2.43	7,710,920	3,46
4.Other workers*	4,113,718	38.71	66,783,115	30,01
5.Total workers	10,984,047	100.00	222,516,754	100.00

From the above table we can say that the proportion of agricultural workers is less in Gujarat compared to thatfor all India, whereas the proportion of workers engaged in manufacturing other than household industry trade and commerce a e higher in Gujarat than the corresponding figures for all India. The distribution of working population accordin to 1981 census by primary seccondary and teritary sectiors shows that larger proprotion of working population a.e engaged in seccondary and teritary sectors in Gujarat in comparision to all India. It is obvious that there is favourable industrial pattern in Gujarat in relation to all India.

Agricultural Situation in Gujarat

Pattern of land utilisation: Table 2.3 give the pattern of land utilisation in the state for the year 1960-64 to 1979-80. It is clear from the table that the pattern of land utilisation is affected by year to year fluctuation.

Note:

Other workers as shown in table 2.2 include (i) livestock, forestr., fishary, hunting, plantation, rochdas, and alkied (ii) mining and quarrying (iii) Manufacturing, processing serviceing and repairs by other than household industry (iv) construction (v) Trade and commerce (vi) Transport, storage and communication (vii) other services.

Table 2.3

Land utilisation in Gujrat

Area in '00 hectores

Sr. No.	Items	1963-64	1964-65	1965-66	1966-67	1967-68
1.	Reporting area landutilisation	185325	185325	185325	185325	185325
2.	Area under forest	15766	15791	16348	16263	16269
		(8.51)	(8.52)	(8.82)	(8.78)	(8.78)
3.	Net area sown	94129	96606	96883	97421	98017
		(50.79)	(52.13)	(52.28)	(52.57)	(52.89)
4.	Gross cropped area	98867	101339	101881	101995	104204
		(1.05)	(1.05)	(1.05)	(1.05)	(1.06)

Source:- Hand book of basic statistics, Gujrat state 1977-78 and 1969 to 1976. Bureau of Economics and statistics, Govt. of Gujrat, Gandhinagar.

Figures in the brackets are % to total reporting area and in case of Gross cropped area, the figures are in term of intensity of cropping.

1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
185716	188242	188128	188161	188124	188124
15910	15599	15731	15761	15674	15683
(8.57)	(8.29)	(8.36)	(8.38)	8.33)	8.34)
95919	24279	97130	97881	96022	97599
(51.65)	(150.08)	(51.63)	(51.88)	(51.04)	(51.88)
101818	100477	104919**	104793	102592	104923
(1.06)	(1.07)	(1.08)	(1.07)	(1.07)	(1.09)

(**) Cropped area in Dangoa districts included in forest

1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
188170	188163	188099	188164	188164	188164
18283	18892	19589	19621	19831	19767
(9.72)	(10.04)	(10.41)	(10.43)	(10.54)	(10.51)
82051	96474	95239	95424	95704	95724
(43.61)	(51.27)	(50.63)	(50.71)	(50.86)	(50.87)
88504	104991	103552	103887	104586	106053
(1.08)	(1.09)	(1.09)	(1.09)	(1.09)	(1.108)

Table 29 shows that out of the total reporting area of 188 lakh hectares in the state, about 95.2 lakh hectares or 50.63 percent of the total reporting area was under plough. In the year 1973-74 the area under plough was 97.5 lakh hectares which decreased to 82.1 lakh hectares in 1974-75. The total gross cropped area in the state decreased in 1974-75 to 89 lakh hectare from 105 lakh hectare in 1973-74. It again rose to 105 lakh hectare in 1975- 76 and decrease to 104 lakh hectares in 1976-77.

Area Sown and Production of Major Crops

In this section we shall study the trends in the out put of major crops. Here rice, wheat, jowar, bajri, tur and gram, the main food crops grown in the state are token into consideration. The main cash crops in the state care ground-nut, cotton and tabacco. The area and production of important crops from the year 1963-64 to 1977 80 are given in appendix 1. Between the years 1968-69 to 1975-76, the area under food grains was the highest in the year 1970-71(55.83 lakh hectares) and the lowest in the year 1974-75(38.18 lakh hectares).

The production of crops in Gujarat has continued to be affected by cyclic fluctuations in the weather conditions. In 1967-68, food grains production in the state was 35.61 lakh tonnes which was the highest recorded till then. Adverse monsoon conditions in 1968-69 affected the crop prospects and the foodgrains production in 1968-69 declined to 24.60 lakh tonns. In the year 1969-70, several parts of the state faced failure of monsoon. Never the less, the overall agricultural prospects in the state were considerably better than these prevailing in the preceeding year and the foodgrain production was 33.25 lakh tonns in 1969-70. In 1970-71, though there were heavy filods in the some parts of the state, the monsoon was very favourable to most of the areas in the state and as a result the production of food grains in the state reached a record level at 48.44 lakhs tonns. In the year 1971-72, the food grains production (41.24 lakh tonnes) was slightly lower than that in 1970-71 The year 1972-73 was a drought year, resulting in a decline in food grains production at about 22.14 lakh tonnes. However, due to the timely and satisfactory rainfall in the year 1973-74. The food grains production during the year rose to the level of 39.16 lakh tonns. But the state was again affected by severe drought conditions in the year 1974-75 and the food grain showed a steep decline with the output of the order of only 21.53 lakh tonns, being the lowest after 1960-61. With favourable monsoon season in the next year

the foodgrains production in 1975-76 is estimated at 45.20 lakh tonnes. In the year 1976-77, the monsoon in overall terms was favourable, although it was marked by damage to crops and destructions of property due to unexpected heavy ~~rain~~ rains consequent on the cyclonic depression which affected the crop prospects. As a result of the food grains products in the state declined to 39.50 lakh tonnes in the year 1976-77. In the year 1977-78 the behvaour of monsoon was somewhat erratic with heavy to very heavy rainfall in the district of central and northern Gujarat regions which affected the prospects of Khariff crops especially bajra in these areas. However, despite bajra crop the food grains production in the etate was about 38.93 lakhs tonns in the year 1977-78. The charges in area and production of principal crops during the year 1968-67 to 1976-77 can be seen from the table. The table aleo reveals that the total foodgrains production was higher in the year 1975-76 than that in the year 1976-77 and 1977-78. Though the total food grains production was lower in 1977-78. The production of rice, Wheat and Cotton was higher in 1977-78 than that in the previous years.

The productivity in 1977-78 was not adversely affected in the cases of important crops like Rice, Wheat and cotton. The yield rates for important crop of the etate given in the table 2.3.

From the table it is clear that rice and jowar have shown the highest productivity in the year 1975-76 since 1969-70. These type of severe fluctuations in the yield levels which affect the output of the respective crops may be also because of the lack of technological factor.

Out of the total gross cropped area of about 103.1 lakh hectares of area was under irrigation during 1972-73 Thus about 14.8 percent of the gross cropped area was irrigated in 1972-73 as against 12.2 percent in 1968-69 Similarly out of the total gross cropped area of about 104 lakh hectares in the state approximately 17.7 lakh hectares of area was under irrigation during 1976-77. Thus about 17.1 percent of gross cropped area was irrigated in 1976-77 as against 16.2 percent 1975-76. The following table gives the source wise irrigation regarding net area under irrigation.

Table 2.4

Sl.No.	Sources	Percentage of total net area irrigated 1970-71	1971-72	1972.73	1973-74	1974-75	75-76
1.	Govt.Canals	17.20	16.32	14.42	17.3	16.8	18.8
2.	Private canals	0.04	-	-	-	-	-
3.	Wells	79.02	79.34	81.30	79.9	80.8	78.6
4.	Tarus	2.71	2.86	2.65	1.8	1.5	1.7
5.	Others	1.03	1.44	1.43	1.0	0.9	0.9
		100.00	100.00	100.00	100.00	100.00	100.00

(_) = Nil

Source: Handbook ofbasic stastics , Gujarat State 1977 and 1978. Bereau of Economic and Statistics, Government of Gujarat, Gandhinagar.

The table 2.4 reveals that the main source of irrigation in Gujarat is wells and nearly 80% of irrigated land is accounted by well. Next important source of irrigation is government canals which accounts for about 19 percent of the net area irrigated by all source in 1975-76, (See Appendix 1(e).) .

Crop Pattern

Fertiliser, Mechanisation

The development of irrigation and increase of the cultivation, the use of fertiliser and mechnise has helped in the crops and has also affected the cropping pattern. The fertiliser consumption increased by 3.57 kilo gram per 1000 hectare from 1963-66 to 8.47 kg per 1000 hectare in

The state has a larger proportion of the crop area under non-food crops such as cotton, oilseeds, tobacco and fodder than all-India. Nearly three.fifths of the cropped area and under food grains(as aginst 77% in all India) However the dominance of coarse millets within the cereals group makes the pattern inferior from the point of view of value productivity.

From above discussion, Gujarat is essentially an agricultural state where 68.8% of the population is rural according to the census 1981. Judged from the angle of the nationl average, the agricultural productivity per acre as well as per engaged person is low. This is primarily due to low per acre yields and to some extent it is accounted for by the inferior crop pattern. The main objective of the study is to analyse the (a) inter-district variations in agriculturel development at two points of time viz 1963-66 and 1977-80(b) and causes of these variations in the state of Gujarat. An attempt is being made in the following chapters to decompose the growth of agricultural output in various components. The difference in the levels of agricultural development has also been studied for the two time periods by taking districts as units and using principal componants analysis. Finally the inter-district variations have also been analysed with the help of tabular and regression analysis.

CHAPTER III

Choice of the variable and methodology

In these studies of levels of agricultural development single variable is not adequate to reflect features which are not directly observable. In view of the variations in the levels of agricultural development and resources endowments in various regions, it is desirable to select variables which reflect the levels of activity and to examine them seperately in the space. It will help in the indentification of relative position of advanced and less advanced regions. Growth of agriculture depends upon a number of factors and these can be broadly grouped under three heads viz.(i) environmental (ii) technological (iii) infrastructural and institutional factors, although very important, has not been considered in the study because of the nature of the problem. Secondly the data pertaining to institutional factor at district level for all the districts in Gujarat is not available. Before coming to choice of indicators, it is better to draw a line of distinction between a variable and an indicator. An indicator viewed as a combination of matters of fact (data) and matters of relation(theory) on the other hand, can be constructed only through a correct sequence between

traditional and logical orders[1]. It is after an appropriate transformation of the variable, the indicators can be obtained within a theoritical format. For example the simple and common way of constructing indicators is to apply an appropriate denominator to the variable so that the influence of the non-essential factor is eliminated. When X and Y are two variables, b = Y/X can be conisered as an indicator only when the underlying fundtional form i.e Y = bx, has empirical validity in the given context.

The present study aims at explaining the variations in the agricultural development and the factors behind these variations in the state of Gujarat. Here agricultural productivity per hectare net sown area acts as proxy for the agricultural development. The composite agricultural productivity as the dependent variable and the rainfall, irrigation, agricultural labour, fertilizers as independent variables, have been taken for the purpose of analysis. In this chapter an attempt is being made to discuss the rationale behind the choice of dependent variable and independent variable. The following is the broad list of the variables:

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1. Kundu, A. Measurement in Urban process, Daniel Bell (1974-, p9) Chapter on choice of indicators page 30.

1. Productivity i.e Agricultural output/hectare of net sown area.
2. Effective land use defined as percentage of net sown area to the total reporting area
3. Intensity of croping i.e $\frac{\text{Gross area sown}}{\text{net area sown}}$
4. Intensity of irrigation i.e $\frac{\text{Gross area irrigated}}{\text{Net area irrigated}}$
5. Irrigation base = Net area irrigated/net area sown
6. Irrigation use = percentage of gross irrigated area to the gross area sown
7. Percentage of canal irrigated to the net area irrigated
8. Percentage of tank irrigated to the net area irrigated.
9. Percentage of area under well irrigation to net area irrigated.
10. Consumption of fertilizer per 1000 hectare of gross cropped area
11. Mechanization index
12. Proportion of area under non food grains to the gross cropped area.
13. Mean annual rainfall
14. Number of oil engine per thousand hectare of gross cropped area
15. Number of ~~oil~~ tractors ~~engine~~ per thousand hectare of gross cropped area.

16. Number of tractors per thousand hectare of gross cropped area.
17. Consumption of fertilizer per 1000 hectare of net sown area
18. Number of male workers per 1000 hectare of net sown area.
19. Number of tractors per 1000 sown area

Agricultural Productivity:

Productivity measurement is a controversial theme and any definition that one adopts is bound to meet with objections of one type or another. The term agricultural productivity is defined by different authors.[2] Some suggest that yield per hectare should be considered as the indicator of agricultural productivity and this is based on the limitation that it takes only land as the best one among the factors of production. Others suggest that the returns per unit of the scarce resource is to be the best representative of agricultural productivity. It was further argued that the average return per unit of the scarce resource does not depict the true picture and instead, the marginal returns per unit of the scarce ressurce

2. "Regional variation in Agricultural Development and productivity", Indian Journal of Agricultural Economics" Vol XIV, No.1, Jan-March 1964, pp 213-16.

should be considered. Inspite of these different approaches there is a wide agreement that productivity per hectare is best representative of agricultural productivity.

Productivity as an indicator is more useful as compared to total agricultral output because the effect of expansion of area on the total output is eliminated and one can compare the productivity defined as output per hectare of net sown area differs from region to region. Land being the scarce factor in India, this indicator happens to be an obvious choice. Increase in crop output per unit of land is an important indicator of development in agricultural sector.[3] In the present study the following 18 crops namely Rice, Wheat, Barley, Jowar, Bijri, Maize, Ragi, Gram, Jut, Sugar cane, chillies, potatoes, cotton, groundnut, sesamum rape and mustard, castor and tabacco have been considered The output per hectare is expressed on money terms at constant prices. To arrive at a total output figure and production per unit of land one must use price for the aggregation purpose as it is not advisable to add the physical production of different crops. So the total physical output is converted into money.value by taking price(farm harvest prices) and then the output per unit of land in

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3. Proceeding of sysmposium of "Regional imbalances and and Economic development" published in Indian Journal of Agricultrual Economics Vol.XXIX, No.1 June 1977.

money terms have been calculated for each district. So the difficulties of agfregation of different crops has been eliminated. This method with all its limiation has been widely used.[4]

As has already mentioned in the first chapter the time periods cosidered are 3 years of 60's(1963-66) and 3 years of 80's (1977-80). The productivity is measured in value terms per unit of net sown area. The value of output for each district has been arrived at by multiplying the output of each of the above mentioned 18 crops in 60's and 80's by respective triennium average of state farm harvest ~~previous~~ prices prevailing in 1977-80. Since the shape of the total cropped area covered by these 18 crops was different in each district, the value of the 18 crops output was inflated to get the total output corresponding to 100 percent of the cropped area in order to compare the districts. The value of output arrived at was then divided by net sown area of each of the district to give productivity figures. The underlying assumption in this method is that the productivity per hecatre on the area not covered by 18 crops equals the average productivity of the 18 crops.

4. Bhalla(G.S.) and Alagh(Y.K.) Performance of Indian agriculture, A districtwise study 1979.

Rainfall

The invironmental factors exercise its influence through variations in relief, soil. Climatic conditions like rainfall and temperature. Each elements of natural environment affects the growth of the crop output in its own way. In the present analysis mean annual rainfall are taken to capture the effects due to environmental factors.

"Indian agriculture is characterised by gamble in the monsoon". Indian agriculture is very much dependent on timely occurance of monsoon rain and the proper distribution of rainfall during the raining season. Hence rainfall is the most important factor that effect plant growth and crop production. Rainfall being a crucial variables there are many studies which relates it with ppdductivity. In this study the mean annual rainfall has been considered a proper variables. The hypothesis is that rainfall has a positive relation with productivity.

Irrigation:

Infrastructure plays an important role in agricultural development. Irrigation is the most important factor amongst these. Introduction of irrigation in new areas is also a very important technological change now recognised as the crucial factor in Indian agriculture. Even fertilizers and improved seed cannot give full results unless ~~there are~~ assured irrigation facilities are available.

Irrigation plays an important role in the agricultural development which helps in increasing the output by increasing the yield level. The importance of irrigation in agricultural sector crédent because of its dependence on the rain fall. So irrigation is the most crucial input in the adoption of new farm technology and hence in determining the level of productivity. It not only contributes directly to higher yields but also expands the possibilities for the use of modern inputs such as fertilizers and HYV seeds. S.K.Rao has pointed at that irrigation has become like a technological constraint in Indian agriculture and once this is removed the farmer tends to apply the inputs complementory to regular watering and adopt the cropping pattern that brings the high yield.[5]

While studying the effect of irrigation that factors which affects a span of all the components elements(area, yield, cropping pattern etc) of output growth is irrigation[6] It also helps in extending the gross cropped area by making it possible to use the same land more intensively or raising the intensity of cropping. The use of other inputs like fertilizer and improved seeds can be utilized which are more crucial for the increase in agricultural productivity

6 S.K.Rao: Intra-regional variations in Agricultural growth 1952-53 to 1964-65. A tentative analysis in relation to irrigation Economic and Political Weekly July,71,p.1337

7.B.S. Minhas and A.Vaidyanathan: In readings in agricultural development,Ed,by Permit Chaudury,p.1317

if there is a supply of assured irrigation. So irrigation leads to increased output in various ways: (a) Through enhancing yields from regular watering (b) Through change in crop-pattern in favour of high yielding crops (c) by allowing multiple cropping. Thus considering the inportance of irrigation, three indicators namely (i) irrigation Base (ii) Irrigation use (iii) intensity of irrigation have been chosen. Besides this a considerable importance has been given to the different sources of irrigation in Gujarat. The follow wing three indicators have been chosen to get an idea about the assured supply of water for the agricultural development(i) Percentage of canal irrigated area to the net area irrigated (ii) Percentage of well(including tube well) irrigated area to net area irrigated (iii) proportion of area irrigated by tanks to the net area irrigated. So difference in irrigation levels of idfferent area should explain significantly the inter-regional differences in productivity levels[7].

3. Technolonical factors:

The technological factors influence the pace of agricultural growth and it includes these measures which improve the agricultural rpduction and productivity. Technological changes in Indian agricultural means increase of productivity by the adoption of farming techniques developed through

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7. C.H. Hanumantha Rao, " Technological changes and distribution of G$_a$ins in Indian agriculture" The Macmillian company of India Limited, 1975

research. Use of fertilizer, pesticide, improved seeds and improved implements are example of such techniques. In this study fertiliser and mechanisation are taken us technological inputs.

Fertilizers

The increasing use of fertilizers could be one of the factors responsible for the increasing yield instability. Use of fertilisers is treated as a land augmentory innovation and represents the increasing case with which capital can be substituted for land as well as for labour. Expenditure in modern inputs like fertilizers can be expected to be greater under condition of high profitability and relative certainity of the yields. That is why fertilizers being used heavily in those regions where water supply is assured throughout the year.

Mechanization

Farm mechanisation in Indian agriculture is of recent origin. It was more pronounced in 1966 at the time of green revolution. Mechanisation in Indian agriculture includes tractors, power tiller and power thresher etc. We have also taken into consideration to arrive at a mechanisation index. Although these inputs to provide assured irrigation has been considered in the irrigation variable, the mechanisation has been considered as one of the factors to promote improvement to basic prductive relationship in agricul-

ture and thereby productivity. In India the need for mechanization has been suggested for two reasons. Firstly to promote the production efficiency and secondly to fill-up the gap of our power requirements. In the sphere of agricultural development mechanical innovations plays an important role side by side bio-chemical innovations(Chemical fertilisers, pesticides, HYV seeds). Biochemical innovattion are generally labour absorbing, land savings and neutral to scale of operation where as mechanical innovations are labour displacing and biased to scale. Again, while bio-chemical innovations call for a high dose of working capital, mechanical innovations need substantial capital investment. The introduction of this innovation has changed both quantum and composition of farm capital, on the one hand, and on the other increased the capital intensity of agricultural production in general.

Mechanisation influences the cropping pattern and helps in increasing crop intensity both of which increase land and labour productivity. For example, assured supply of water made through water lifting pumpsets, encourages

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8. G.K.Chadha, " Farm style and productivity reinsited" Some notes from recent experience of Punjab- Economic and Political Weekly Vol XIII, No 39,September 30,1978,page 87

the cultivation of the commercial crops and helps in taking double crop. The present study considers oil engine, electrical pumps and tractors to represent mechanisation, as complete data are available only for these three. These three implements are put together and expressed in an index called mechanisation index. The mechanisation index is worked out by using the division by mean method.

Firstly the data of these implements were standadardised by deciding the oil engines, electrical pumsets and tractors per 1000 hectares of green cropped area for each districts. Then the proportion of standard value to the mean for each implement was found out. By adding the proportion of these three types of implements avialable in a particular district, the mechanization index was obtained. (See appendix 11 and 12)

Cropping Intensity

Intensity of cropping is green cropped area i.e area under all the crops divided by net sown area. In other words the difference between the actual area planted i.e gross cropped area and the net operated area is a measure of cropping intensity or multiple cropping. The residual variation in grass cropped area after accounting

for the variation in operated area can be attributed to the factors contributory to cropping intensity as for example, irrigation type or quality of irrigation and the variations related with HYV technology. There may be areas in which tractorization has a limited role to play in promoting higher cropping intensity. In these area high yielding varieties and irrigation with be the real explanation for rising level of multiple cropping . So cropping intensity is also a factor responsible for differentials in agricultural productivity.

Methodology:

1. The growth rate of agricultural output area under crops and productivity has been worked out by the method to find out the compound growth rate. This has been calculated with the help of equation $Y = X(1+g)^n$

   Here 'Y' stands for current year indexes, 'x' stands for base year indices, 'g' stands for compound annual growth rate and 'n' stands for number of years.

2. Cross classification ~~labour~~ Tabular form and composit indice have been followed in order to indentify the levels of development by each district in Gujarat.

3. A Decomposition of growth of Agricultural output has been carried out to indentity the components responsible for it. The different com›onent which have been considered here are area, yield, cropping pattern and interaction.

4. To analyse the variations in agricultural productivity in Gujarat, the regression techniques along with the usual tests of significance has been used. The mean coefficient of variation will be used to interpret the regional variation in agricultural productivity.

CHAPTER IV

Inter-District Variations in Agricultural Development in Gujarat.

In this chapter an attempt is being made to study the spatial and temporal variations in the levels and growth of agriculture in state of Gujarat. These variations are studied by comparing districtwise productivity at two time periods 1963-66 and 1977-80. Also the growth pattern between these two periods is studied the levels of agricultural productivity have been defined as value of output per hectare. The factors that have been associated with productivity levels have also been analysed in detail for both the time periods while trying the growth of agriculture among the districts of Gujarat the important changes in the cropping pattern have also been studied.

SECTION I

Inter-district variations in productivity level

Here the main aim is to examine the inter-district variations in agricultural productivity defined as ptotal output in value terms per unit of net sown area. After identifying the high and low productivity districts in Gujarat an attempt is made to analyse the inter-district variations in productivity. Also growth pattern in area and productivity is studied

between the two time period 1963-66 to 1977-80. Here also the applied concreate statistical measures like coefficient of variations is used to see whether inter district variations in productivity levels have tended to narrow down ouer the past two decades or not. The districts have been classified into three groups according to the levels of productivity per hectare of net sown area, low(less than Rs 1000), Medium (Rs 1000-1500) and high (Rs 1550 and above)

Levels of agricultural productivity for 1963-66 to 1977-80

The following table shows the position of each district according to the level of productivity in three groups.

Table 4.I.1

Spatial distribution of districts by level of land productivity per net sown area

1963-66				1977-80		
Productivity level	category	District	No. of dist	Name of District		
Above Rs1550	High	Ahmedabad Baroda, Broach, Bulsar, Kairo Sabarkantta Surat, Junajarh	8	Bulsar, Gandhinagar Kaira, Mehsana Surat, Amereli Bhavnagar, Jamnagar, Janagarh Rajkot	10	
900-1550	Medium	Gandhinagar Mehsana, Panchamahal, Amereli, Bhavnagar, Jamnagar Surendranagar	8	Banskantta, Baroada, Sanys, Panchmahal Sabarkantta Kutch	6	
Less than 900	Low	Banskanth Banskanth, Kutch Sangs	3	Broach Ahmedabad Surendranagar	3	

The table reveals that in the initial time period there were three destricts showing the lowest productivity. On the other extreme there are eight districts i.e Ahmedabad, Baroda, Broach, Junajarh, Sabarkantta, Surat, Bulsar and Kaira which fall in the high productivity group as they were more than Rs 1550 per hectare. The remaining eight districts fall in the medium group. But in 1977-80 one finds that because of differential growth there is a shift to the group category of the districts. One finds that still there are three districts in the low productivity group but they are now Broach, Ahmedabad and Surendranagar. Earlier two of them were in the higest productivity range i.e above Rs 1550 per hectare. The district of Surendranagar was middle productivity districts. Whereas the districts which were losing the lowest productivity in the first period have moved in to the second group i.e they have become the middle productivity districts. The following table gives the clear picture of the inter-district variations in productivity level between the distsicts of Gujarat.

Table 4.I.2

Agricultural Productivity

Items	1963-66	1977-80
Range	1650-06	2369-01
Mean	1514-43	1715-79
S.D	451-57	757-42
Coefficient of variation	29-82	44-14
(i) Above mean	10	8
(ii) Below means	9	10

In 1963-66 land productivity for the state as a whole was Rs 1515/per hectare and as many as 8 districts showed productivity below the state's average. The productivity varied from Rs 819 for Banskantha to Rs 2522 for Baroda. The disparity of agricultural in terms of coefficients of variations is 29-82 percent as revealed from the above table. As compared to earlier period the inter-district variations in productivity levels are found to be quite high in 1977-80 The productivity per hectare net sown area varies between Rs 997 for Dangs to Rs 2948 for Junagarh. The coefficent of variations of agricultural productivity has increased and it stood at 44.14 percent in 1977-80. This shows that the disparity in terms of productivity per net sown area has tended to increase in the districts of Gujarat. From the above analysis we can conclude that:

(a) Eight districts which were in ghigh productivity group in 1963-66 we characterised by high levels of irrigation use and high levels of consumption of fertiliser(See appendix 4) All these districts are situated in the coastal area of Gujarat. Sources of irrigation through canals and wells by these districts are also high(See appendix 5). In 1977-80 the coastal districts of Junajarh, Rajkot, Amereli, Jamnagar, Bhabnagar and Surat have shown very high productivity level. The

notable feature is that the district of Ahmedabad which had a very high productivity in 1963-66 came down to low productivity in 1977-80 group. The same thing happened in case of Baroda from high to medium productivity group. Inspite of all the input consumption(fertilizer, irrigational base sources of irrigation, mechanical inputs) by these two districts, the productivity has gone down during this period. This low productivity is due to the severe foods and drought affected by these states during 1977-80 (b) the medium productivity districts also consume more fertiliser, mechanical inputs and levels of irrigation which are above state average. (c) Low productivity districts are characterised by low level of consumption of fertilizer, low level of irrigation base and low level of rainfall. The cropping pattern in these districts is characterised by high vlue crops like sugarcane, tabacco and groundnuts.

We have so far examined the inter-district differentials in productivity level in Gujarat. At this stage it would be meaningful to consolidate the picture emerging in each time period considered by us. Table 4.I.3 recoputalate the broad picture. It gives a clear picture about the districts ~~if these~~ which have remained constant, improved and declined. It would be more clear by the help of transition matrix showing

Table 4.1.3

Levels of agricultural productivity in Gujrat at district level for two time period.

Districts	1963-66	1977-80	Position in 1977-80 over 1963-66
1. Ahmedabad	H	L	D
2. Banaskantha	L	M	I
3. Baroda	H	M	D
4. Broach	H	L	D
5. Bulsar	H	H	C
6. Dangs	L	M	I
7. Gandhinagar	M	H	I
8. Kaira	H	H	C
9. Mahsana	M	H	I
10. Panchmahals	M	M	C
11. Sabarkantha	H	M	D
12. Surat	H	H	C
13. Amareli	M	H	I
14. Bhavnagar	M	H	I
15. Junagadh	H	H	C
16. Kutch	L	M	I
17. Jamnagar	M	H	I
18. Rajkot	M	H	I
19. Surendranagar	M	L	D

Note:- C = Constant H = High
D = Declined M = Medium
I = Improved L = Low

the mobility of districts on the basis of productivity level in Gujarat(see appendix No.6)

Cross-Classification of Districts by Productivity level and Growth rate

So far we have studied the inter-district variations in agricultural productivity in Gujarat and regionalised the economy of the state by levels of productivity. Here an attempt has been made to study the growth rate among districts having different productivity levels. In order to obtain a combined frequency distribution of productivity levels and growth rates, we have cross-classified the districts according to their productivity levels and growth rates. Two cross-classified tables have been prepared, one each for 1963-66 and 1972-80. Analysis have been made with the help of already explained three-fold classfication of productivity levels. In terms of growth rate, the following four fold classifications have been adopted.

Annual growth rate exceeding 3 per cent = High growth districts

Annual growth rate ranging between(1.5-3.0) percnet medium growth districts.

Annual growth ranging to 1.5 percent = low growth district

Annual growth below 0 percnet = Negative growth district

Cross Classification of Districts by 1963-66 productivity levels and growth rates between 1963-66 to 1977-80.

Table 4 I.4 shows the districts with high, medium, low and negative growth ra es and their productivity levels. There are six districts showing deceleration in productivity between 1963-66 and 1977-80 and only 13 districts with a positive growth rate of which, 5 show a growth rate above 3 percent per annum and the remaining eight below 3 percant per annum. The districts with growth rate above 3 percent, are Junagarh, Jamnagar, Bhavnagar and Banskantha. As has been already observed in 60's there are three districts having low productivity level i.e less than Rs 900 per hectare and another 8 had medium productivity. The remaining 8 had a high producitivity level. The disaggregation of these districts in terms of their growth rates gives the following pictures. Now looking at productivity levels and rate of growth simultaneously, one finds that out of the 3 low productivity districts, 2 districts show a low growth rate (0-1.5 percnet) per annum and one district(Banaskantha) shows a growth rate more than 3.0 per cent per annum. During this period here was no negative growth rate district in the low productivity group. However, two of the eight medium productivity districts and four of the eight high productivity districts experienced a negative growth rate

Table

Cross-classification of districts by 1963-66 Productivity level and growth rate over 1963-66 to 1977-80

Productivity category	Negative growth rate	Low growth rate 0-1.5	Medium growth rate 1.5 - 3.0	High growth rates 3.0	Total
Low Productivity (up to Rs.900 per hectar)	Nil	Dangas Kutch	Nil	Banaskantha	3
Medium Productivity (Rs.900-Rs.1500 per hectar)	Panchmahal Sundranagar	Nil	Gandhinagar Amreli Rajkot	Bhavnagar Jamnagar Mehsana	8
High Productivity (Rs.1550 or more per hectar)	Ahmedabad Baroda Broach Sabarkantha	Bulsar	Kaira Surat	Junagadh	8
Total	6	3	5	5	19

during 60's and 80's. The other three medium productivity districts(Gandhinagar, Amereli, Rajkot) grew at a rate between 1.5 and 3.0 percent and the remaining three districts (Mehsana, Bhavnagar, Jamnagar) had a high growth rate of about 3.0 percent per annum. As compared with low level districts, the performance of medium ones were better. If one looks at the growth pattern of 8 high productivity districts during this period, one finds that Junagarh district is the only one having a hgih rate of growth above 8 percent.

To sum-up during this period 6 districts have experienced a deceleration in their productivity levels. It is surprising that the proportion of districts with negative rate of growth was high in case of high and medium level of productivity districts , whereas low productivity districts seem to have shown relatively good performance. Out of 3 districts one districts(Banaskantta) has experienced a high growth rates of above 3 percent per annum

Cross-classification by 1977-80 productivity level and growth rates over 1963-66 to 1977-80

In table 4.I.5 the districts have been reclassified according to 1977-80 productivity levels and 1963-66 to 1977-80 growth rates. There are thirteen districts which have shown positive growth rate of which five districts in high

Table

Allotment of districts according to Productivity levels of 1977-80 and compound growth rate productivity.

Productivity category	Negative growth rate	Low growth rate 0-1.5	Medium growth rate 1.5-3.0	High growth rate 3.0	Total
Low Productivity (up to Rs.900 per hectare)	Broach Ahmedabad Surendranagar	Nil	Nil	Nil	3
Medium Productivity (Rs.900-Rs.1550 per hectare)	Baroda Panchmahals Sabarkantha	Dangas Kutch	Nil	Banaskantha	6
High Productivity (Rs.1550 or more per hectare)	Nil	Gulsar	Gandhinagar Kaira Surat Amareli Rajkot	Mehsana Bhavnagar Jamnagar Junagarh	10
Total	6	3	5	5	19

growth rate category, five districts in medium growth rate category and remainign three are in low growth rate category. Six districts have shown a regative growth in their productivity.

By looking at the cross classification one comes across interesting results that all three low productivity districts according to 1977-80 level are the districts which have experienced negative growth over the year 1963-66 to 1977-80 There are six medium productivity districts and three of them are the negatively growing districts, two have grown at a medium growth rate of 0 to 1.5 percent, The sixth district is Banskantta which has grown at a rate above 3.0 percent. However, non of the ten high productivity districts has experienced negative growth rate and only one growing at a rate of 0-1.5 percent, the five districts at a rate of 1.5 to 3.0 percent The remaining form high productivity districts i.e Mehsana, Bhavnagar, Jamnagar and Junagarh have been growing at a high rate above 3.0 percent.

SECTION II

Inter-District variations in yield levels

The levels and growth of productivity is very much dependent on the gains in yield of the different crops. Here it is intended to trace this pattern with average

yields defined as the total agricultural output per unit of grass cropped area covered by these 18 crops.

Levels of Development and Growth of Agriculture in Gujarat

As already explained the total value of agricultural output during both sixties and seventies have been obtained by calculating the value of the 18 crops at constant state average farm harvest prices for 1977-80(see appendix 7). During this period the total agricultural output ofthe state frew at a compound growth rate of 0.58 percent per annum(see appendix 8). The gross cropped area under 18 crops decreased from 8,688,168 hectare to 8,307,932 hectare is at an annual compund rate of-0.28 percent. But the total gross cropped area has shown an increase at the rate of 0.32 percent. So one can infer that the left out crops have become more important over the two periods.

Although yield per hectare increased at a rate of 0.86 percent from Rs 1437 to Rs 1616/hectare, however the labour productivity has decreased at an alarming rate of-6.36 percent. This shows that the growth of agriculture in Gujarat has not kept pace with the population growth and the situation had deteriated over the two decades. Inspite of the fact that the net sown area has decreased there is a marked increase in agricultural output. This increase in output is because of the improvement in productivity and intensity of cropping. At the district level, agricultural

output has registered an increase in all the districts except six districts namely Ahmedabad, Baroda, Broach, Panchmahals, Sabarkantha and Surendranagar. Needless to say that the major contribution to the increase in output was made by those districts where there has been increase in net sown area i.e Banskantha, Kaira, Mehsana, Amereli, Bhavnagar, Jamnagar, Junagarh and Rajkot.

In general, in all the districts of Gujarat where agricultural output has registered a positive growth, output increases are associated with increase in yields and not with the increase in area. For example the district of Mehsana, which has experienced a prominant increase in output has shown a negative growth in gross cropped area. This is clearly indicated by the highest growth rate of land yield(4.18) percent in Mehsana district due to increase in yield from Rs 1408/hectare to Rs 2467/hectare (see appendix) In case of district Broach, even if it shows a positive growth rate of 0.25 percent in gross cropped area, the output growth is negative(-7.52 percent) due to high negative growth rate in land yield by -7.36 percent.

Levels of agricultural development 1963-66

In order to know the levels of agricultural development in Gujarat, the spatial variations in yield and use of modern inputs have been taken into account for both the time period.

The average yield of the state in 1963-66 comes to be Rs1437/only and the spatial variations are noticeable. (See Appendix 13.) Out of the 19 districts of Gujarat,8 districts viz, Ahmedabad, Beroda, Broach, Bulser,Sabarkantha, Surat, Gunajash, Rajkot have recorded average yield above the state average. These districts account for the 43.18 percent of the net sown area of the state, 53.26 percent of the total state agricultural out put.

The districts having yield level above Rs1500/hectore have been designated as high yield districts,those which have yield levels,between Rs 1000-Rs 1,500 as medium yield districts and those with yield less than Rs 1,000 as low yield districts. As per yield is concerned, the districts of Gujarat categorised as below.

Table 4 . II.I

Yield level and districts in each category 1963-66

Range	Category	Districts
Above Rs 1,500	high	Ahmedabad,Bulsar, Kaira, Sabarkantha, Surat, Junagarh, Rajkot Baroda, Broach
Rs 1,000-Rs 1,5000	Medium	Gandhinagar, Mehsana Panchmahal, Amereli Bhavnagar, Jamnagar Surendranagar
Below Rs 1,000	Low	Banskantha, Dange,Kutch

The above table shows that during 60's most of the districts are concentrated in the category high and medium yield level categgry. These districts show high yield rate due to high input consumptio of Gujarat during this period In the district of Baroda, the percentage of net sown area to total area(69.37 percent) consumption of firetilizer per 1000 hectare of gross cropped area.(8.46 metric tons the proportion of area under non food grains(61.41 percent) and mechanisation index all are above state average. On the other hand intensity of cropping(102.92 percent), percentage of gross irrigated area to gross cropped area (5.10 percent) are below state average. The notable feature here is that the area irrigated more than once is completely absence as the intensity of irrigation remains just 100 percent. The district of Broach possesses a very high percentage of net sown area to total area(59.00) percentage. Gross irrigated area to gross cropped area is only 3.88 percent with 100.44 percent of intensity of cropping which is quite low. The mechanisation index is as low as 1.81 percent of this district. But these unfavourable conditions have been overcome by the indicators viz, consumption of fertilizers which is 3.85 metric tons per 1000 hectares of G.C.A (the corresponding figure for the state is 3.57 metric tons per 1000 hectares of G.C.A) and a fantastic high percentage (See Appendix 16) of area under non-food grains to grosscropped area 64.82 percent(the state average is only 49.75 percent).

In general practice the response to fertiliser to a great extent, depends on the assured supply of water and assured irrigation facilities would greatly prompt the farmer in adopting fertilizer practice. But these two districts are marked with high consumption of fertilisers with insignificant irrigation. This is due to fact that these two districts receive plenty of rainfall(average annual rainfall in the year 1963-66 are 868.7 mm and 875.mm respectively) where there is practically no need for irrigation. The agricultural economy of these two districts are dominated by cotton. Among the other districts viz, Ahmedabad, Bulsar, Kaira, Sabarkantha, Surat, Junagarh, and Rajkot, Kaira has the highest percentage of net sown area to total area(75.98 percentage) followed by Ahmedabad(71.83%), Sabarkantha (66.11%) Rajkot(66,10 6%), Surat(60.88%), Balsar(56.10%) Junagarh(54.42%) which are above state average. The intensity of cropping in these districts i.e Kaira with 107.04 percent. Junagarh 106.91 percent, Balsar 109.60 percent, Sabarkanth 106.94 is above the average of the state(10.03) while the intensity of cropping in Ahmedabad Surat, Rjakot is below the state average proportion of gross area irrigated is highest in Junagarh(15.67 percent) followed by Sabarkantta(12.22 percent), Ahmedabad(10.07 percent) is above the state average(9.02 percent), The

proportion of gross irrigated area to gross cropped area is much below the averages of the state and in the district of Balsar, Surat and Rajkot. Junagarh is the only district where intensity of irrigation(119.64 percent) is very high above the state average(103.24 percent). The intensity of irrigation is not so high in Ahmedabad(101.74 percent) Balsar(100 percent) Kaira(100.10 percent Sabarkantta(100 percent). Kaira occupies first position in the consumption of fertilizer per 1000 hectares of gross cropped area (10.57 metric tones) followed by Surat(8.49 metric tons) Junargarh(6.07 metric tons). Rajkot(5.51 metric tons) Ahmedabad(2.59 metric tons) and sabarnanta(1.06 metric tons). Mechanisation an agriculture is quite high in Kaira with an index of (5.69) which is much above the state average(3.00). The district of Surat with an index of (3.68) the district of Junnagar with an index of(3.66) Balar with(4.57) and Rajkot with(4.83) also enjoy position and above the state average. On the other hand, Ahmedabad and Sabarkantta are marked with a low mechanisation index of (2.65) and (2.72) respectively. Among these seven districts, Ahmedabad, Sabarkantta, Surat, Junagarh and Rajkot have a higher proportion of area under non-food grains to gross cropped area with 51.29 percent., 55.25 percent, 70.45% and 66.37% respectively(all above state

average) except Bulsar, Surat and Kaira.

The districts of Gandhinagar, Mehsan, Panchamahals Amereli, Bhavnagar, Jamnagar and Surendranagar fall in the category of medium yield rate ranging from Rs 1,000-Rs1,500 The intensity of cropping in Mehsana(109.12 percent), and Pancha-mahal (115.49%) is well above state average, followed by Gandhinagar (104.76 Percent) Amereli(101.49 percent), Bhavnagar(102.83 percent) Jamnagar (103.51 percent) where it is below state average. It is surprising that Panchamahal with such a medium yield rates is makrked with the highest intensity of cropping in the state, much higher than state average Likewise, the percentage of gross irrigated area is quite high in Mehsana while the districts belonging to same category have a low percentage of gross irrigated area to gross cropped area, i.e Gandhinagar, 11.35 percent, Panchmahal,2.26 percent, Amereli 7.00 percent. Bhavanagar 9.50 percent, Jamnagar 6.76 percent. Surendra nagar 4.68 percent. Irrigation intesity is very low in all the districts except surendranagar . The irrigation intensity is low in districts of Gandhinagar 100 percent, Mehsana 100.86 percent, Panchmahel 100 percent Amerali 100.94 percent Bhavnagr 101.23 percent, Junagarh 102.43,Surendranagar has recorded an itnesity of index ~~it irrigatbn~~ of 106.84 percent. Mechanisation index is low in the districts of Mehsana (2.86), Panchamahal(0.41) Bhavnagar(2.24), Surendrnagar (1.38) whereas Gandhinagar Amereli, Jamnagar recorded a high mechanisation index of 6.69, 3.44, 3.06 respectively which is much above the state average. The consumption of fertilizer of these districts is also much below the state average except

Amereli. In case of proportion of area under non-food grains to grose cropped area, Amereli, Bhavnagar, Jamnagar and Surendranagar fell well with 60.82 percent, 51.42 percent, 57.90 percent and 59.86 percent respectively. Though these four districts possess a high proportion of area under non-food grains, due to the poor application of other important inputs they find to occupy the category of medium yield level.

Yield level category

Banskantha, Dangs, Kutch have recorded a very low level of agricultural development during the period 1963-66 occupying the category of low yield level. The application of inputs is also quite low in these three districts. Banskantha occupies a place above state average with respect to percentage of net sown area to total area. The intensity of irrigation in the district of Kutch is 112.42 percent which is above the state average. In all other aspects these three districts occupy positions below the state average. Thus these three districts of Gujarat are characterised as the low yield districts and low input consuming districts during this period of 1963.66.

Levels of Agricultural development 1977-80

(See Appendix 14)

The yield level of Gujarat is Rs 1616 during this period. Out of 19 districts, 9 districts namely Balsar, Kaira, Mehsana, Surat, Mereli, Bhavnagar, Jamnagar, Junagarh and Rajkot stand above average yield of the state. The above average yield distacts account for 51.41 percent of the

net sown area of the state, 71.40 percent of the total state agricultural output and consume 64.93 percent of the total fertilizers and employ 60.68 percent of the total tractors, 67.07 percent of the pumsets, 71.96 percent of the total oil engines and account for 60.61 percent of gross irrigated area. From these figure it is quite evident that there is a large concentration of inputs in the high yield districts. Consequently they account for the larger proportion of output also.

On the base of yield level, the districts of Gujarat fall into the following categories during this period:

Table 4 II.2

Yield categories and districts in each category: 1977-80

Range	Category	Districts
Above Rs 1,500	High	Bhavnagar, Jamnagar, Rajkot Bulsar, Kaira, Mehsana, Amareli, Junagarh, Surat
Rs 1,000-Rs 1,500	Medium	Bansuantha, Gandhinagar Sabarkantha
Below Rs 1,000	Low	Ahmedabad, Broach, Dange Panchmahals, Kutch, Surendra nagar

If we compare yield level of 1977-80 all the districts have shown progress except Ahmedabad, Baroda, Broach, Panchmahals, Sabarkantha and Surendranagar with respect to yield level. THe districts of Baroda has stepped backward from high yield category to low. Similarly the districts of Broach has gone down from high yield level to low. The districts of Ahmedabad and Sabarkantha have lost their position from high level of yeild category to low. The district of Surendrabagar moved from Medium level to low yield level. All other districts have shown progress;

During this period, the districts of Junagarh and Surat occupy the dominant position with high yield rate i.e Rs 2698 and Rs 2545 respectively (For details see appendix 17). In these districts the percentage of net sown area to total area are 51.29 percent percent and 57.67 percent respectively which are above state average. In the districts of Junagarh, the proposition of gross irrigated area to gross cropped area is quite low(only 15.42 percent) The mechinisation index is only 5.30 which is much above the state average. The consumption of fertilizer per 1000 hectare of gross cropped area is 24.67 percent which is below state average. A high proportion of area under non-food grains to gross

cropped area(30.67 percent) is well ahead the state average as a result of which is shown a very high level of yield rate. Secondly Surat having a high proposition of net sown to gross irrigated area(28.23%), large consumption of fertilizers(54.27) metric tons per 100 hectare of gross cropped area), high mechanisation index 3.09, and low proposition of area under non food grains(15.55 per cent), it has attained a position above state average. The percentage of net sown area is above state average in Bulsar(57.05%, Kaira(74.19 percent) Mehsana(76.76percent) Amereli(73.09 percent). The district of Balsar, Kaira, and Mehsana are also marked with high intensity of cropping i,e 110.57 percent, 113.89 percent, 127.35 percent respectively. Mehsana is the first district with high intensity of cropping 127.35 percent. In case of Amereli, the intensity of cropping below the state average i.e. 104.60 percent. These three districts are also marked with intensity of irrigation above state average. The districts of Kaira and Mehsana are marked with high percentage of gross irrigated area to gross cropped area i.e 40.62 percent and 38.24 percent respectively. Whereas in the districts of Mehsana, the other inputs i.e fertilizer consumption and mechanization indexs are not high. In the districts of Kaira, due to high proportion of gross irrigated area, the mechanisation(4.73) and consumption of fertilizer(58.83 metric tons per 1000 hectare of G.C.A are also remarkably high. On the otherhand the proportion

of area under non-food grains(only 22.19 percent) is below the state average. In case of Bulsar and Amreli, low percentage of gross irrigated area is compensated with high mechanisation index. The consumption of fertiliserin case of Amreli(44.07 metric tons per 1000 gross cropped area) where as in case of Bulsar it is quite low(27.20 metric tons per 1000 hecteres of gross area) Some of these are compensated with high proportion of area under non-food grains to gross cropped area, as a result of which the yield rate is high.

The other high yield districts are Bhavnagar, Jamnagar and Rajkot. Rajkot surpasses the other districts of Gujarat in the consumption of fertilisers per 1000 hectare of gross cropped area(63.20 metric tons) and high proportion of area under non food-grains(31.36 percent). In mechanisation index it occupies the 4th place in the district. The intensity of irrigatio(106.68 percent), the cropping intensity(108.51 percent), the gross irrigated area to grosss cropped area (18.14 percent), are all below the state average. Jamenagar is the first district which occupies first place in the itensity of irrigation(138.19 percent) in Gujarat. It is associated with consumption of fertilizer(42.03 metric tons per thousand hectares of gross cropped area).The area under non food grains(31.34 percent) and net sown area(58.09 percent), [illegible] are above state average. In spite of these high inputs [illegible] associated with low gross irrigated area (16.50 percent) and mechanisation

62.66% of net sown area is associated with high consumption of fertilizer

index(2.68). Bhavnagar with (33.53 metric tons per 1000 hectares of gross cropped area) and mechanisation in agriculture is much below the state average. The proportion of gross irrigated area to gross cropped area (14.50) is not very high and is below the state average (19.61) percent, as a result of which the cropping intensity as low as 107.84 percent.

Banskantha, Baroda, Gandhinagar, Saberkantha fall in the category of medium yield level category. In Banaskantha district, the intensity of irrigation(105.72 percent) consumption of fertilizer per 1000 hectare of gross cropped area(9.47 metric tons) mechanisation index (2.03), proportion of area under non food grains(15.95 percent), all are below the state average. The intensity of cropping(117.23 percent) gross irrigated area(21.58 percent) and net sown area(67.52 percent) are above state average. Likewise the district of Baroda(consumption of fertiliser(43.80 metric tons nutrients per thousand hectare gross cropped area), and net sown area(69.28 percent) in all other inputs, its position is below the state average. In this district the propertion of area under non food grains is just above the state level. Similarly in case of Gandhinagar except proportion of area under non food grains(20.67 percent) all other inputs are above state

level. Here it can be inferred that in case of Gujarat the proposition of food grain occupies the dominat role in the inputs are above state average. But occupies low yield category due to physiographic condition of the district.

Ahmedabad, Broach, Dnage, Panchmahals, Kutch, Surendranagar, fall in the category of low yield level. All these districts are characteristic by low level of cropping intensity, low level of grose cropped area. Low level of fertiliser consumption and low level of mechani zation index, Kutch is the only dist-ict where the net sown aree is below the state average i.e 14.51 percent. The dist#ict of Ahmedabad having intensity of cropping (104.84 percent), grose irrigated area(16.55 percent) consumption of fertiliser(20.30 metric tons per 1000 hectares of gross cropped area) mechanisation index(2.97) proportion of area)mechanisation index(2.97), proportion of area under non food grain(18.26 percent) all are below state average. Only intensity of irrigation(118.86 percent) and net sown area(67.22 percent) above state average. In case of Broach intensity of cropping(100.78 percent) gross irrigated area(9.58 percent), intensity of irrigation 102.28 percent) fertiliser consumption(13.60 methic tons

per thousand hectares of gross cropped area) mechanisation index(1.71), area under non food grains(19.75 percent) all are below state average. The district of Dangs occupies a very low level in all the input use. In case of panchmahal except cropping intensity and net sown area, all are below average. These are gross cropped area(6.73 percent), intensity of irrigation(106.13 percent) fertiliser consumption (11.97 metric tons per thousand gross cropped area), mechanisation index(0.43 percent) and area under non food crops (7.33 percent). In the district level of Kutch only intensity of irrigation 126.66 percent above the state average. All other inputs are below state. Surendranagar is the district where except area under non-food grains all other inputs occupy very low position. In this district, cropping intensity(101.67 percent) gross irrigated area(10.12 percent), intensity of irrigation(103.03 percent), consumption of fertiliser(8.47 metric tons per thousand hectares of gross cropped area and mechanisation index(1.41), all are below the state average. So we can say that all those low level of input are resulted in low yield rate in these district.

Table 4. II.3

Yield as the Index of Agricultural Development : 1963-66

SlNo.	Items	1963-66
1.	Lowest figure	Rs 764/-
2.	Highest figure	Rs 245/-
3.	Range	Rs 1687/-
4.	Mean	Rs 1446.11
5.	S.D	429.57
6.	Co-efficient of variations	29.71
7.	Total number of districts	19
8.	No of districts mean	9
9.	No. of district below mean	10

Table 4.II.4

Yield as the index of agricultural development 1977-80

sl.No.	Items	1977-80
1.	Lowest figure	Rs 639 /-
2.	Highest figure	Rs 2545 /-
3.	Ranges	Rs 1907 /-
4.	Mean	Rs 1563.89 /-
5.	S.D.	660.61
6.	Coefficient of variation	42.24
7.	Total number of districts	19
8.	No. of districts above mean	9
9.	No. of districts below mean	10

From the above two tables it is clear that the disparities in the yield rate has increased over this period from 29-71 to 42.24. This implies that there might a wide variation in the levels of agricultural development in Gujarat.

Growth of Agriculture in Gujarat(With respect to 18 crops)

In this sector an attempt has been made to identify the variations in the growth rates of gross cropped area, value of output, Yield and between two time periods 1963 66 and 1977-80 among the districts of Gujarat. For the state as a whole though the gross cropped area(under 18 crops) has shown a negative growth of -0.28 percent per annum, the output grew at a compound annual rate of 0.58 percent and yield rate at 0.86 percent per annum. The labour productivity in very low in the state which grew at -6.36 percent per annum(see appendix 8). A bester idea of the growth pattern in agriculture can be obtained by analysing the district wise growth rates.

Growth of Gross Cropped area:

In general, though the gross cropped area of the state has shown a negative growth rate of -0.28 percent per annum, 11 districts of Gujarat namely Banskantha, Broach, Balsar, Dangs, Kaira, Amereli, Bhavnagar, Jamnagar, Junagarh

Kutch, Rajkot, having positive growth rate in gross cropping area 0.67 percent, 0.25 percent, 0.23 percent, 1.89 percent 0.37 percent, 0.19 percent, 0.26 percent, 0.18 percent 0.29 percent, 1.13 percent, o.26 percent respectively. In the remaining 8 districts there was a dicline in the gross cropped area over this period of time and the decline is quite significant in the district of Ahmedabad, Surat Surendranagar of Gujarat with-0.86 percent, 0.78 percent ,-1.40 percent respectively.

On the basis of growth rates of gross cropped area the districts of Gujarat are classified as follows:

Table 4.II.5

Growth rates of gross cropped area 1963-66 to 1977-80

Range	Category	District
Positve growth		
Above 1 percent	High	Kutch, Dangs
0-5-1 percent	Medium	Banskantha, Kaira
0-0-5 percent	Low	Broach, Bulsar
Negative growth(below 0)		Amereli, Bhavnaga Jamnagar, Junagarh Rajkot

Kutch which shows the highest rate of growth in gross cropped area due to extention of area by arable land. The another notable feature is that, during this period these

area under cotton and groundnut had increased from about 30 percent in 63-66 to to 50 percent in 1977-80.

Growth of Output:

The fact is that all the districts of Gujarat have shown an upward tren-d in the growth of output except six districts namely Ahmedabad, Baroda, Broach, Panchmahal, Sabarkantha and Surendranagar. These districts showing the the negative growths are Ahmedabad(-5.20 percent), Baroda (-5.70 percent), Broach(-7.52 percent) Pahchmahal(-2.18 percent), Sabarkantha(-3.12 percent) Surendnagar(-6.13 percent). The districts of Gandhinagar, Mehasana, Surat which have recorded negative growth in gross cropped area are all marked with positive growth in output and this fact definetely proves that productivity had played the major role in the growth of agricultural economy. In Gujarat this period is noted for increase in output largely on account of increase in yield per hectares but not by the increase in area. Though, in general, Gujarat experienced a positive growth rate of 0.58 percent per annum in the output Still the spatial variations in the growth of output are very much pronounced. Jamnagar has recorded the highest growth with an annual compound growth rate of 4.36 percent and holds the first rank in the growth of output, followed by Banaskantha

4.26 percent and Mehsana 3.57 percent and Junagarh 3.38 percent, Mehsana has actually experienced a decline in gross cropped area. Surat has shown a remarkable growth of output inspite of a negative growth rate of -0.78 percent in the gross cropped area and it also occupies a position above the state average. Ahmedabad, Baroda, Broach, Panch mahal, Sabarkantha and Surendranagar have occupied the last six places, all below average growth rate of the state. Amereli, Bhavnagar, Jamnagar, Junagarh, have shown a positve growth of output even inspite of very slow growth rate in gross cropped area. The districts having negative growth rate of output corresponding to negative gross cropped areas are Ahmedabad, Baroda, Panchamahals, Sabarkantha, and Surendranagar. In these districts output decreased by a greater rate due to greater fall in the yield rate . The general upward trend in the agricultural output in Gujarat over this period can be explained by technological quadrigaminous drive.

Depending upon the growth rates of agricultural output, the districts of Gujarat have been classified as follows:

Table 4.II .6

Growth rates of output 1963-66 to 1977-80

Range	Category	Districts
Above 3 percent	High	Banskantha, Mehsana, Amereli, Bhavnagar, Jamnagar, Jungarh
1-3 percent	Medium	Baisar, Surat, Kutch Rajkot, Danga, Kaira
0-1 percent	Low	Nil
Below	Negative	Ahmedabad, Baroad, Broach, Panchmahal, Sabarkanta, Surendra-nagar.

Cropping Pattern

The main feature of the cropping pattern in Gujarat is that the area under cash and food crops is almost equal. In 1963-66 about 50 percent of cropped area was under non-food crops of which about 23 percent was under groundnut and 21 percent of the area was under cotton. Among the food grains, Bajra and Jowar account for about 18 and 16 percent of the cropped area respectively for the state as a whole. However the variations in the cropping pattern among the districts are quite marked. In the year 1963-66 groundnut alone accounted for about 52 to 62 percent of the cropped area in the Saurastra region comprising of Jamnagar, Rajkot and Junajarh districts where as in Surendranagar, Baroda and Broach cotton is grown on about 45 to 60 percent of the cropped area. Tabacco is mainly grown in Kaira districts, which has about 13 percent of the cropped area under it. Apart from these cash crops, there are districts such as Mehsana, Banskantha, and Panchmahals where mainly food crops are grown, occuping about 75 to 90 percent of the cropped area.
The proportion of gross-cropped-area under each crop (see appendix 9)

An examination of the cropping pattern data(see appendix 8) indicates a considerable shift over time from Jowar and Bajra to cotton and groundnut crops. The

area under groundnut has increased from about 23 percent of the cropped area in 1963-66 to about 26 percent in 1977-80 for the state as a whole. In some districts, the area under groundnut has been to the extent of about 35 percent. For instance, in 1963-66 the area under ground nut was between 50 and 62 percent of the cropped area in Jamnagar, Rajkot and Junajarh, and it increased to between 57 and 72 percent in 1977-80. In these districts the proportion of the tottal cropped area under Jowar and Bajra for the same period decreased from 12 and 25 percent to 4 and 12 percent respectively. Similarly the cotton growing districts of Broach the area under cotton has decreased from about 60 percent in 1963-66 to about 45 percent in 1977-80. This decrease has led to increase in area under Jowar because in this period area under Jowar has increased from 17 percent to 24 percent. It shows that the major crops in Gujarat are region specific, so it becomes more important to look at the district level data.

The notable feature is that the area under Bajra which is the highest for any cereals which makes it the important food grops in the state. It accounts for about 35 percent of the total area under food grains. So the future prospects of increased grains production in the state is closely

linked with development of this crop. In Gujarat, high yielding varieties of several cereals crops were introduced as a part of country's programme for increased production. Amongest these, hybrid maize and sorghum, were introduced earlier than hybrid Bajra, however, these two did not spread fast enough to create a significant input on their production. Hybrid Bajra even though a late entrant in the field, was readily accepted and area thereunder increased rapidly.

In Gujarat, hybrid Bajra variety was first introduced in 1964-65 and in sucessive years coverage of area increased Thus the importance of this variety for increased production is implicit. Since Bajra contributes over a third of the food gains basket of the state, if green revolution has an impact in Gujarat, it is to be with reference to Bajra crop.

CHAPTER V

Level of Agricultural Development in Gujarat

In the previous chapter, we have tried to study the spatial and temporal variations in agricultural development on the basis of the variable that is land productivity and yield rate. Here an attempt is being made to consider more variables which are infact determinant of land products and to study the spatial and temporal variations. The crucial thing in such multivariate analysis is that, to construct a large number of variables into smaller one so that the micro units(districts of Gujarat) can be easily compared with each other. Various approaches have been suggested for this purposes, the most important of them is the construction of composite index for the each district.[1] The advantage of using this method is that it takes care of multicolinerity among the variables. In some cases where the values of the correlation matrix are higher and some cases are lower, the data shows a multi-dimensionality in the structure of the variables. In such cases the standard methods of factor analysis is to be used for working out more than one composite index. These composite indices are also known as factors or principal components.

1. Kundu(Amitabh): Measurement of Urban process, A study in regionalisation.

The most important problems in this method are :
(i) to remove biasness (ii) to give appropriate weightage. The weights in the first principal factor are directly dependent on the correlations, i.e the correlation of the variable the greater its weight. The limitations of this method is that it does not say about the contribution made by individual variable to the development process.

For constructing a composite index the technique of principal component analysis[2] has been adopted. The first principal compoent is a linear combination(weighed) of the standard score of the given variables. The weights used in this case are the elements of the eigin Vector corresponding to the highest eigin value of the correlation matrix R of the given variable. The eigin Vector used here is also normalized to the highest eigin value used. The percentage of variations explained by first principal component is measured by the ratio of the highest eigin value of R to n.

If P elements of an eigin Vector corresponding to an eigin value λ_i and normalised to unity, are multiplied and normalised to unity, are multiplied by $\sqrt{\lambda_i}$ they become the coefficient of correlations of the principal component with each of the 'p' variables. These coefficients of

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M.G.Kendall," The Geographical distribution of crop productivity in England", Journal of Royal statistical society, vol 102, 1939, pp.21-48

correlation are known as factor matrics. In other words it is called factor loadings. By the help of factor loadings of any principal component one can find out the variable having high correlations with that component. In orderto identify the dimensions along the spatial differentials in the agricultural development of Gujarat for the periods 1963-66 and 1977-80, the variable chosen here are

x_1 = land productivity per net sown area

x_2 = percentage of net sown area to the total area for land utilisation

x_3 = Intensity of cropping i.e $\frac{\text{Gross area sown}}{\text{Net area sown}}$

x_4 = Percentage of gross irrigated area to gross cropped area

x_5 = Intensity of irrigation i.e $\frac{\text{Gross area irrigated}}{\text{Net area irrigated}}$

x_6 = Percentage of area under well irrigated to net area irrigated

x_7 = Consumption of fertilizer per thousand hectares of gross cropped area

x_8 = Mechanization index

x_9 = Proportion of area under non-food grains to gross cropped area.

Statistical Model:

In the present study we are concerned with the variable which are related to agricultural development only, and the observations are the districts in the state of Gujarat. In order to explain the method, which we have adopted, let x_{ij} be the 'j' th observed variable relating to "i"th observation. Thus a particular Xij represent the scores assigned to the 'i'th district on 'j'th variable. The first principal component is that linear combination of weighted variables which explains the maximum of variance by definition

$$P_1 = a_{11} X_1 + a_{21} x_2 + \cdots + a_{n1} x_n$$

The measure of first principal component can also be written in the following way:

$$P_1 = \frac{\sum_{i=1}^{n} a_{ji} Z_j}{\lambda_1}$$

Where : a_{j1} (j = 1,2---n) are the factor loadings

Z_j = Standardised variable

λ_1 = eigin value (largest characteristic root)

The composite index for the agricultural development is nothing but the first principal component of the variables

The measure adopted is:

$$Z_{j1} = \sum_{j=1}^{n} a_{j1} \frac{X_{j1}}{\sigma x_j}$$

Z_{i1} = the compsite index of development of 'i' th district where 'i' denotes that this is the first principal component(the variable Z is not the same as in the previous equation). a_{j1} = Factor loadings on the first principal compohent Vector

X_{ji} = value of the X_j variable on 'i'th observation

S_{xj} = standard deviation on the X_j variable. Here we are using the general form of standardisation i.e $\frac{xji - \bar{x}i}{S_{xj}}$

Here we are not dividing the factor loadings by $\lambda 1$ because this is a constant.

Result of First Principal component

The whole set of data is normalised and the standardised data are taken for the computation of inter-correlation matrix.

The correlation matrix of indicators of agricultural development are given below in table 5.1 and 5.2

TABLE 5.1 INTER CORRELATION MATRIX. 1963-66

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9
x_1	1·0000	·3902	-04536	·07912	·27588	-00117	·5949	·3469	·6038
x_2		1.0000	·1736	·4239	·4418	·3969	·3467	·4293	·2931
x_3			1.0000	·28589	·2701	·1026	-·1191	·0783	·4403
x_4				1.0000	·4622	·4362	·1651	·5048	·1179
x_5					1.000	·7049	·2236	·3955	·4856
						1·0000	-·1142	·2011	·3504
							1·000	·4426	·4330
								1·000	·3947
									1·000

Table 4.2

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9
x_1	1.000	.3178	.2616	.4162	.2854	1520	.4344	.4580	.2284
x_2		1.000	.7670	.9971	.1319	-.0097	.3471	.9251	.4036
x_3			1.0000	.6191	. 3697	-.10451	.3752	.5956	.5017
x_4				1.0000	.2630	.0453	.5519	.6928	.2703
x_5					1.0000	.03510	.4075	.2838	.3761
x_6						1.0000	-.1359	.1377	.3338
x_7							10000	.6307	.9308
x_8								1.0000454540	
x_9									1.0000

In 1963-66 the matrix shows that the most of the variables are coassociated. During this period the significant correlation exists between consumption of fertilizer and productivity per net sown area(.5949) between intensity of irrigation and percentage of area under well irrigated to net area irrigated(.7049). The notable thing is that the variable numbers irrigation use(x_4) and intensity of cropping(x_3) do not have statistically significant correlation with other variables. This reveals that in Gujarat the irrigation use was not so developed and widespread during sixties(pre-green revolution period). This may be due to lack of adequate supply of water in the state. As a result this low level of irrigation use leads to lowering the cropping intensity in the state.

In 1979-80 an altogether different picture is seen than previous one. Here also most of the variables are coassociated. The correlation between percentage of net sown area and intensity of cropping is as high as(.7670) between productivity per net sown area(x_1) and consumption of fertilizer(x_7)(.4344) between productivity and mechanization (.4580) between percentage of net sown and irrigation use (.5971). Intensity of cropping and of irrigation use (.6191). However the variable percentage of area well irrigated to net area irrigated does

not have statistically significant correlation with other variables. This reveles that sources of irrigation through well(including tubewells) have gone down in Gujarat during this period. However given these two matrix by iteraction we derived the final factor loadings. In order to mitigate the differences in the units of measurement, the variables one standardized by dividing them with their respective standard diviations.

The index of agricultural development x in 1963-66 is given in equation 1, which is the first principal component of the variables $x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8$ and x_9

$X = .614x_1 + .715x_2 + .89x_3 + .608x_4 + .775x_5 + .558x_6 + .571x_7 + .712x_8 + .688x_9 \rightarrow 1$

The total variations explained by the first principal component is 39 percent. The agricultural development index X(in 1977-80) is given in the quation 2, which is the first principal component of the variable $x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9$. $X = .570x_1 + .739x_2 + .803x_3 + .811x_4 + .523x_5 + .035x_6 + .747x_7 + .835x_8 + .651x_9$ The total variations explained by the first principal component is 46 percent. The computed values of the composite index ofagricultural development for different districts in two time periods

are given in table 5.3 along with development classes of occurance. Here the standard deviation grouping technique is applied to derive development class such as High(H) Medium(M) and Low(L).

Table 5.3

Values of agricultural development indices and classes of their occurance

SlNo.	Districts	1063-66	1977-80
1.	Ahmedabad	.507337(M)	-.91325(L)
2.	Banskantha	-2.31563(L)	-1.55819(L)
3.	Baroda	2.79606(H)	.41289(M)
4.	Broach	1.12257(M)	-3.70128(L)
5.	Bulsar	-.47612(L)	-.19029(L)
6.	Dange	-11.24153(L)	-12.0002(L)
7.	Gandhinagar	1.65621(M)	5.64602(H)
8.	Kaira	3.18767(H)	5.26819(H)
9.	Mehasana	1.68804(M)	3.41277(H)
10.	Panchamahals	-3.78904(L)	-4.82041(L)
11.	Sabarkantha	1.60217(M)	3.56678(HO
12.	Surat	.56283(M)	1.50695(M)
13.	Amereli	1.89415(M)	1.57271(M)
14.	Bhavnagar	.33487(M)	-.29787(L)
15.	Jamnagar	-.18277(L)	2.58829(M)
16.	Junagarh	4.84812(H)	2.02546(M)
17.	Kutch	-3.69557(L)	-21557(L)
18.	Rajkot	2.11789(M)	2.78228(H)
19.	Surendrnagar	-61684(L)	-3,13629(L)

On the basis of agricultural development the districts are classified in the following table 5.4

Table 5.4

Position of the each district on the category of agricultural development indices.

Category	1963-66	No. of districts	1977-80	No.of Districts
High	Baroda, Kaira Junagarh	3	Gandhinagar Kaira, Mehsana, Sabarkantha, Rajkot	5
Medium	Ahmedabad, Broach Gandhinagar, Mehsana, Sabarkantha Surat, Amereli Bhavnagar, Rajkot	9	Baroda, Surat Amereli, Jamnagar, Junagarh Surat	6
Low	Banskantha, Bulsar Dangs, Panchmahals Jamnagar, Kutch, Surendranagar	7	Ahmedabad, Banskanth, Broach, Bulsar, Dangs, Panchmahals Bhavnagar, Kutch Surendranagar	9

It is clear from the above table that the pattern of agricultural development over the time period was not uniform, hence there resulted wide variations amongh the districts. Due to these wide variations, four districts agricultural regions engaged.

These regions can be represented as:

1. Advanced region comprising of Gandhinagar, Kaira, Mehsana, Sabarkantha and Rajkot districts
2. Developed region comprising of Baroda, Surat, Junagargh, Amereli and Jamnagar districts.
3. Underdeveloped region comprising of Ahmedabad Baroach, Bulsar and Bhavnagar districts
4. Problematic region comprising of Dangs, Panchmahal Kutch and Surendranagar districts.

The above delineated four regions are not only pepresenting the variation in agricultural development but they have also highlighted the continuity pattern of the spatial units and very interestingly all these regions are superimposed on the physico-cultural and agro-climatic regions of the state.

Hence the causes for such variations are very much linked with the topographical characteristics of the regions, soil fertility, status, climatic conditions, undergound water potential, and intensity of soil erosion. finally the impact of frequent drought on agricultural development is equally important.

The advanced regions consisting of the major characterised by uniform fertile alluvium, soil trace, having high

underground water potential where there is absolutely no soil erosion. This region has achieved the first order of agricultural development due to the above favourable factors.

The developed regions represent that part of Gujarat where soil fertility is high for agricultural development and to some extent the area is covered by Kakarpura irrigation networks. As compared to first region, the region is lagging behind due to the hazards of drought.

As far as the development is conerned, the remaining two agricultural regions are equally bad but the intensity of agrarian problems vary from one region to another. This region represents balack soil which is less fertile and deficient in plant nutrients. The underground water potential is meagre and it is not possible to meet the water requirement for present cropping pattern. Simultaneously the area is very much effected by moderate to severe soil erosion.

The problematic regions consist of hill ranges which belong to the main line of Arabali ranges along with some plains and valley laying between the hill ranges. Besides these hill ranges, certain extensive plateaus are there.

The soil type is exactly the same as the underdeveloped region, along with the occurence of black soil. There is no scope for the development of major irrigation projects and simultaneously the underground water potential is also very meagre. The area is severely affected by soil erosion. Besides these above factors, the other factors responsible for underdevelopment are traditional nature of cultivation, lack of irrigation facilities and present cultural practices of the state.

Another striking feature that emerges from our analysis is that the variation of agricultural development during this periods, is mainly reflected over the physicocultural environment of individual regions. As ammatter of fact, it is very much guided by natural factors. So the planning for better agricultural development is very much linked in controlling soil erosion on the one hand, and in tackling the drought phenomenon, on the other. In spite of good rainfall, some patches of underdeveloped regions are chronically affected by drought due to the cotton and groundnut cultivation only. The new agricultural practices for better development will certainly involve the adoption of a new cropping pattern on the basis of agro-climatic conditions and particularly with the emphasis on the efficient utilization of avilable water resources for irrigation purposes.

CHAPTER VI

Decomposition of Agricultural Output Growth

An attempt has been made to study the factors affecting the growth of agricultural output. The factors that have been considered here are area, yield, cropping pattern and interaction between yield and cropping pattern. Several factors affect the growth components. For example fertilizer use would influence the yield per unit of land, while crop-pattern may be influenced by the prices and returns. Irrigation while affecting both yield and crop-pattern would also increase area by increasing crop frequency. Here an attempt has been made to quantitatively measure the contribution of these different components to the aggregate increase in crop output.

The methodology used in determining the contribution of the component, in agricultural output growth is that of Minhas and Vaidyanathan[1].

A notational representation of the method used is as follows :

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1. B.S. Minhas and Vaidyanathan- Growth of Crop output in India, 1951-54 to 1958-61 in Reading in Indian agricultural development Edited by pramil Chaudhuri London, 1972, p.53

Crop	Weight	Proportion of area in year		Yield in year	
		0	t	0	t
C_1	W_1	C_{10}	C_{1t}	Y_{10}	Y_{11}
C_2	W_2	C_{20}	C_{2t}	Y_{20}	Y_{21}
C_3	W_3	C_{30}	C_{3t}	Y_{30}	Y_{3t}
C_n	W_n	C_{no}	C_{nt}	Y_{no}	Y_{nt}

The analysis is confined to 18 crops only. The C_i's W'_s are constant price weights assigned to different crops and consists of the farm harvest prices of the state. C_{io}'s and C_{it}'s and C_{it}'s are proportion of area occupied by different crops in year O and t. This represents the cropping pattern. Y_{io}'s and Y_{it}'s are base and final year yields. Triennium average have been used (1963-66, 1977-80) for C_{io}'s and C_{it}'s, W_i's and Y_{io}'s and Y_{it}'s

The symbols used for output and area are:

Ao = Gross cropped area in 1963-66

At = Gross cropped area in 1977-80

Po = Index of crop output in year 0

Pt = Index of crop output in year t

By definition

$$Po = Ao \sum_i W_i \; C_{io} \; Y_{io}$$

$$Pt = At \sum_i W_i \; C_{it} \; Y_{it}$$

Assuming that every addition in gross cropped area is as good as average hectare already under cultivation[2], the increase in crop production has been split into their component elements over the time period of the study.

The model as adopted in the exercise is as follows:

$$\frac{Pt - Po}{Po} = \frac{(At - Ao) \sum_i W_i \; C_{io} \; Y_{io}}{Po} + \frac{At \sum_i (W_i Y_{it} C_{io} - W_i Y_{io} C_{io})}{Po}$$

$$+ \frac{At \sum_i (W_i Y_{io} C_{it} - W_i Y_{io} C_{io})}{Po}$$

$$+ \frac{At \sum_i (W_i Y_{it} C_{it} + W_i Y_{io} C_{io} - W_i Y_{it} C_{io} - W_i Y_{io} C_{it})}{Po}$$

2. Minhas and Vaidyanathan op. cit, p.54.

The first term in right hand side of the equation represents the effect on crop output of changes in gross cropped area, in the absence of yield and crop pattern changes. The second term is the effect of yield changes in the absence of the area and crop pattern. The third term measures the contribution of cropping pattern in output growth. The fourth term measures the contribution of the interaction between the latter two elements; yield and cropping pattern.

Components of increase in output in Gujarat 1963-66 to 1977-80.

The relative contribution of component elements to the growth of crop output in different districts are presented in the following table. From the table 6.1 it is evident that spatial variations exist in the relative contribution of component elements to the growth of agricultural output.

Table 6.1

Relative contribution of different components to the growth of output in Gujarat and its districts: 1963-66 to 1977-80.

State/District	Percentage increase attributed				Total
	Area	Yield	Cropping pattern	Inter action	
Gujarat	-15.51 (-.0142)	-3.15 (-.0029)	15.84 (.0146)	102.82 (.0948)	100.00 (.0923)
1.Ahmadabad	20.37	82.93	.44	-3.72	100.00
		(-43.64)	(-.0023)	(.0196)	(-5263)
2.Banskantha	12.34	46.05	19.12	22.50	100.00
	(.1014)	(.3782)	(.1570)	(.1848)	(.8213)
3.Baroda	-4.07	-137.57	20.18	221.46	100.00
	(-.0178)	(-6012)	(.0882)	(.9678)	(.4370)
4.Broach	-6.25	114.71	19.24	-27.68	100.00
	(.0399)	(-7325)	(-1228)	(1767)	(-6386)
5.Bulsar	11.80	.47	101.09	-12.36	100.00
	(.0302)	(.0012)	(.2587)	(-0342)	(.2559)
6.Danges	69.11	24.80	-02	6.12	100.00
	(.3004)	(.1078)	(-0001)	(.0266)	(4347)
7.Gandhinagar	-10.91	66.87	-66.46	110.51	100.00
	(-0216)	(1324)	(.1316)	(.2188)	(1980)
8.Kaira	21.16	54.53	-2.97	27.29	100.00
	(.804)	(.2072)	(-0113)	(0113)	(.3800)
9.Mahsana	-29.73	26.00	69.08	34.66	100.00
	(-11698)	(.1485)	(3946)	(.1980)	(.5712)
10.Panchmahals	35.66	42.84	-38.07	59.57	100.00
	(-0740)	(-0389)	)0790)	(-1236)	(-2075)
11.Sabarkantha	14.01	98.01	-1.58	10.42	100.00
	(-0479)	(-3352)	(.0054)	(.0356)	(3420)
12.Surat	-25.82	-26.12	102.23	49.71	100.00
	(-1053)	(-.1065)	(.4169)	(.2027)	(.4075)
13.Amereli	5.06	80.93	35.27	-21.24	100.00
	(.0260)	(4158)	(.1812)	(-1091)	(5138)
14.Bhavnagar	5.81	128.68	29.28	-63.77	100.00
	(0385)	(.8530)	(.1941)	(-4227)	(.6629)
15.Jamnagar	2.81	62.75	24.29	10.14	100.00
	(.0228)	(.5097)	(.1973)	(.0234)	(.8123)
16.Junajarh	6.27	71.20	22.63	-29	100.00
	(.0406)	(.4465)	(.1419)	(-0018)	(6271)
17.Kutch	53.02	-11.89	143.61	-108.51	100.00
	(.1538)	(.0345)	(.4166)	(-.3148)	(.2901)
18. Rajkot	16.09 (.0323)	-16.89 (-.0339)	118.24 (.2373)	-17.44 (-.0350)	100.00 (.2007)
19. Surendranagar	30.40 (-.1796)	65.19 (-.3851)	-14.04 (.0831)	18.45 (-.1090)	100.00 (-.590)

The above table shows the results of additive decomposition scheme in different districts of Gujarat for the period 1933-66 to 1977-80. The relative contribution of different components to crop output growth differ from district to district. For the state as a whole, the component that has contributed the maximum for output growth is interaction between yeild and cropping pattern (102.82 percent), cropping pattern has contributed (15.83 percent), yield(-3.15 percent) and the area contribution is as low as(-15-51 percent). Districtwise, however, here are variations in the area contribution ranging from 5 percent for Amereli to 70 percent in the case of Dang's. The contribution of area was almost insignificant in many districts except Danges and Kutch where about 53 and 69 percent of growth in crop output could be attributed to this factor. One of the striking features of the output growth during this period has been the dominant influence of the interaction between yield and cropping pattern for the state as a whole. The districtwise classification according to ranges of contribution by area as follows

Table 6.2

Districtwise classification of contribution of area to output growth

Percentage contribution by area increase	Districts
Below 15	Banskantha, Baroda, Broach, Baleer, Gandhinagar, Mehsana, Sabarkantta, Surat, Amereli Bhavnagar, Jamnagar, Junajarh
15-30	Kaira, Rajkot, Ahmedabad
30-45	Panchmahals, Surendranagar
45-60	Kutch
60 and above	Dangs

While increase in area may occur due to explanation either in areable land or in double cropped area in Gujarat. But the influence of former has been negligible. For the state as a whole, the percentage of crop intenuity was 105.03 in 1963-66 and it became 109.68 in 1977-80, whereas the index of area shown decreased from 51.73 percent to 50.82 percent. This only shows that in influencing output growth during this period under study, the expansion in cultivated area had no major role to play.

Coming to the aspect of yield increase its contribution to the output-growth was about-3.15 percent for the state as a whole. Here again, the contribution of yield increase shows wide variations ranging from 12 percent in Kutch to 128 percent in Bhavnagar. Classification according to different ranges of contribution.

Table 6.3

Districtwise classification of contribution of Yield to Output Growth.

Percentage contribution by yield increase	Districts
Below 20	Kutch, Baroda, Bulsar, Surat Rajkot
20-40	Dangs, Mehsana
40-60	Banskantha, Kaira, Panchmahals
60-80	Gandhinagar, Amereli, Jamnagar Junajarh, Surendrnagar
80 and above	Ahmedabad, Broach, Sabarkantha Bhavnagar.

As regards the third factor of crop pattern, its contribution to output growth has been comparatively low than the interaction between yield and crop pattern. Its contribution to output-growth being only 16 percent for the state as a whiles; and, in, districts like Ahmedabad, Dange Gandhinagar, Kaira, Panchmahal, Sabarkantha, and Surendranagar this factor did not have any perceptible impact on

output-growth. The districts which followed the general state pattern as far as this particular factor is concerned have been Banskantha, Baroda, and Broach. However, in the case of some districts its influence has been more significant. Thus for, Mehsana, Bulsar, Surat, Rajkot and Kutch their relative contributions were between 70 to 140 percent while in the case of Amereli, Bhavnagar, Jamnagar and Junajarh it accounted for about 23 to 35 percent of output growth. The changes in crop pattern indicated by the area shifts from jowar and bajra to groundnut and cotton crops from 1963-66 to 1977-80 had been responsible for output growth in these districts. For the state as a while, the jowar and bajra had occupied about 16 and 18 percent of cropped area respectively during 1963-66. But the area under both crops decreased by about 4 percent during 1977-80. On the other hand, the area under groundnut and cotton increased from about 19 and 23 percent during 1963-66 to about 22 and 26 percent during 1977-80 respectively. In general, the increase in crea under groundnut c op was quite marked in the district of Gujarat during this period. In case of Jūnagarh and Amereli where the improvement in crop pattern had contributed about 23 to 35 percent to output growth respectively. The area under groundout had increased from 62 percent to 71 percent and from 52 percent to 60 percent respectively, shifted from

jowar and bajra crops. In Rajkot, Kutch, Bulsar and Surat the area had increased substantially in groundnut cotton and tabacco, as a result about more than 100 percent of output growth was explained by the changes in crop pattern.

The interaction between crop-pattern and yield had contributed 103 percent to output growth in Gujarat as a whole. It is about more than 100 percent to output growth in Baroda and Gandhinagar and about 20 to 50 per cent in Banskantha, Kaira, Mehsana, Surat, Jamnagar, and Surendranagar. The contribution made by other districts to output growth is insignificant. This indicates that the area had shifted towards crops giving higher yield and yield of area which was already under crop has also been increasing. With this result, the interaction between the crop-pattern change and yield level together explained output growth in a significant manner.

From the above analysis it is clear that area increase had negligible or insignificant contribution to output growth in Gujarat during the period 1963-66 to 1977-80 in all the districts except the Dangs, Kutch and Panchamahals. It is distressing to note that even the yield has not contributed much in the growth of output in Gujarat state. The third component of output growth is the crop-pattern which indicates that during this period 1963-66

1977-80 there were shifts of area from jowar and bajara to groundnut and cotton which are defenitely high yield crops in value terms. However there was an apparent tendency for area shift from groundnut to bajara crop in Ahmedabad Bhavnagar and Jamnagar districts. In Junagarh only the area increase in groundnut explained sunstantial portion of out-put growth

It will be more appropriate to look deeper into these shifts from low yielding food grains crops to high yielding non-food grain crops. An attempt is being made to study this phenomena with the help of table 6.4 which is giving the area, output and yield growth rates for the foodgrain and non food grain crops.

In Gujarat, the gross cropped area of the food grains has declined(see table) by -0.43 percent whereas the area under non-food grains decreases only at the rate of -0.19 percent. The district of Baroda(1.54 percent) Broach (3.15%) Bulsar(1.15 percent), Dnags(1.65 percent), Gandhinagar (0.09 percent), Kaira(0.98 percent), Sabarkantha(0.56 percent) and Surat(0.65 percent), all the other districts have registered a fall in the area of food grains. The negative frowth rate districts of Gujarat in food grain are ranging from- 0.18 percent in Ahmedabad to -2.73 percent in Jamnagar. In contrast to this the area under

TABLE 6.4

Cereals, Pulses, food grains and non-foodgrains

Percentage of compound annual growth rates of Area, out put and value yield etc.

Districts	Cereals			Pulses		
	Area	Out put	Value yield etc	Area	Out put	Value yield etc
1. Ahmedabad	-0.26	+2.76	+3.09	+3.45	+6.56	+2.95
2. Banaskantha	-0.28	+3.07	+3.63	+7.43	+9.76	+2.16
3. Baroda	+0.66	+3.68	+2.96	+6.18	+4.89	-1.26
4. Broach	+1.50	+2.89	+1.40	+11.87	+11.67	-0.26
5. Bulsar	+0.98	+2.29	+1.16	+2.19	+2.68	+0.45
6. Dangas	+1.63	+1.90	+0.26	+1.75	+2.39	+0.67
7. Gandhinagar	-0.17	+5.26	+5.35	+3.77	+12.03	+7.91
8. Kaira	+1.18	+5.35	+4.18	-1.58	-1.26	+0.39
9. Mahsana	-3.43	+4.58	+8.24	+2.45	+5.02	+2.46
10. Panchmahals	-0.17	-0.92	-0.83	-1.50	+0.67	+2.18
11. Sabarkantha	+0.57	+1.68	+1.18	+0.89	+5.63	+4.72
12. Surat	+0.36	+2.93	+2.63	+3.13	+2.32	-0.78
13. Amareli	-2.52	+4.27	+6.94	-5.43	-4.82	+0.74
14. Bhavnagar	-0.87	+3.86	+4.68	-5.76	-5.48	+0.38
15. Jamnagar	-2.77	+3.89	+6.76	-7.93	-11.74	-4.18
16. Junagadh	-2.98	+3.83	+6.98	-2.19	-4.93	-2.79
17. Kutch	-1.29	+4.58	+5.93	+3.24	+13.64	+10.06
18. Rajkot	-2.53	+5.76	+8.45	-0.38	+2.08	+2.43
19. Surendranagar	-1.92	-0.36	+1.67	+4.75	+4.67	-0.09
20. State	-0.62	3.62	1.53	3.15	3.68	0.58

Contd.

Foodgrains			Non-foodgrains		
Area	Out put	Value of yield	Area	Out put	Value of yield
-0.18	+2.90	+3.08	-1.57	-10.79	-9.45
-0.19	+3.19	+3.35	+5.25	+5.86	+0.59
+1.54	+3.95	+2.35	-1.26	-8.92	-7.78
+3.15	+4.95	+1.75	-.172	-12.67	-12.14
+1.15	+2.36	+1.18	-5.14	+0.18	+5.55
+1.65	+2.00	+0.37	+10.48	+10.53	+0.19
+0.09	+5.49	+5.5	-01.23	-1.52	-0.37
+0.98	+4.98	+3.92	-0.26	+0.10	+0.30
-3.27	+4.59	+8.06	+1.35	+1.92	+0.56
-0.25	-0.63	-0.36	-1.53	-4.51	-3.10
+0.56	+1.97	+1.45	-1.18	-6.56	-5.38
+0.65	+2.85	+2.27	-2.72	+1.69	+4.57
-2.56	+4.23	+6.95	+1.65	+2.76	+1.09
-0.87	+3.80	+4.67	+1.23	+1.96	+0.79
-2.78	+3.45	+6.33	+1.75	+4.35	+2.58
-2.91	+3.61	+6.71	+1.30	+3.54	+2.20
-1.28	+4.66	+5.97	+4.37	+0.98	-3.25
-2.50	+5.70	+8.42	+1.32	-12.83	-0.67
-1.80	-0.13	+1.76	-1.18	-7.23	-6.08
-0.43	3.58	4.50	-0.19	-0.95	-0.76

non food grains has grown at a compound annual growth rate of as much as 10.53 percent in Dangs districts. The district of Ahmadabad, Panchmhals, and Surendranagar have experienced negative growth in the area of both food grains and non good grains. On the otherhand, Dangs is the only district experienced positive growth in the area of both food and non-food grains. The districts of Banskantha Mehsana, Amereli, Bhavnagar, Jamnagar, Junajarh, Kutch and Rajkot have gained the area under nonefood grains at the cost of food grains. Within the foodgrains category, the state has experienced a drastic fall of -0.62 percent per annum in the area of cereals. Barring the districts of Baroda, Broach, Bulsar, Dangs, Kaira Sabarkantha and Surat in all other districts cereals have shown a negative growth ranging from -0.17 percent in Gandhinagar to -3.43 percent in Mehsan per annum. But as regards to Pulses except Kaira(-1.58 percent) Panchmahal(-1.50 percent), Amereli(-5.43 percent) Bhavnagar(-5.76 percent) Jamnagar(-7.93 percent) Junagarh(-2.19 percent) and Rajkot (-0.38 percent) all other districts have registered a positive growth of as much as 11.87 percent in Broach district. So it is quite clear that the fall in the area of food grains is mainly due to the decline in the area of cereals, where as area under pulses has increased over the period. Inspite of the negative growth in the

area of cereals the output of cereals has shown a positive growth rate of 3.62 percent per annum. Only Panchmahal and Surendranagar have shown negative growth rate- 0.92 percent and -0.36 percent respectively in the output of cereals. The maximum growth in output is seen in Rajkot which is marked with a positive growth rate of 5.76 percent. The increase in output of cereals may very well be explained by yield increase, using all modern inputs. As regards to pulses, due to the increase in area as well as yield , the output has grown at a positive compound annual growth rate of 3.68 percent in the state. Kutch has experienced a positive growth of 13.64 percent In case of Kaira(-1.26 percent), Amereli(-4.82 percent) Bhavnagar(-5.48 percent)Jamnagar(-11.74 percent) Junagarh (-4.93 percent) , the output has registered a negative growth. This may be due to fall in the area under pulses. It can be said that, it happened due to increase in overall yield figure by intensive cultivation of gram, tur, and other pulses, by extension area under cultivation and by increasing the yield with adoption of package of practices and supply of improved seeds.

By integrating cereals and pulses a different picture emerges in the spatial variations in the output of food grains. Almost all the districts have shown a positive

growth in the output of foodgrains, except panchmahals and Surendranagar which are marked by a sharp decline at a rate of - 0.63 percent and -0.13 respectively. It is worth mentioning that Mehsana, Amereli, Bhavnagar, Jam nagar, Junagarh, Kutch, Rajkot which have experienced a fall in gross cropped area, are marked with remarkable growth rates of 4.59 percent, 4.23 percent, 3.80 percnet 3.45 percnet 3.61 percent 4.66 percant and 5.70 percent respectively. But Baroda, Broach, Bulsar, Dangs with positive growth of area in food-grains have shown an output increase only at the rate of 3.95 percent, 4.95 percent, 2.36 percent, 2.00 percent respectively. This is naturally associated with high value yield of Mahsana, Amereli, Bhavnagar, Jamnagar, Jungarh, Kutch, and Rajkot Even in Surendranagar the output has decreased at a slower rate than that of the area as a result of yield invrease.

Out of 19 districts of Gujarat, 8 districts have shown negative growth rate of output in non-food grains As a result the output of non food grains in the state as a whole has decreased by a compound annual growth rate of -095 percent. The negative output growth rate districts are Ahmedabad(-10.79 percent), Baroda(-8.92 percent) Broach(-12.67 percent), Gandhinagar(-1.52 percent),

Panchmahals(-4.51 percent, Sabarkantha(-6.56 percent) Rajkot(-12.83 percent) and Surendranagar(-7.23 percent) The remaining districts of Banskantha, Bulsar, Dangs, Mehsara, Surat, Amereli, Bhavnagar, Jamnagar, Junagarh, Kutch have recorded extremely high growth in output. Inspite of decline in area under non-food grains, Bulsar, Kaira and Surat have attained positive growth in output at the rate of 0.18 percent, 0.10 percnet, 1.69 percent per annum respectively. This may be due to the introduction of cotton. Being a black cotton soil region of Gujarat three districts are included in the "Intensive cotton development programme" which was sponsored by the centre. It was implemented in the entire area under irrigated cotton in these districts. The programme aims at achieving a breakthrough in the average yield of cotton and stresses on varietal change and adoption of new agro-techniques.

The state has experienced an increase in yield of food grains at a compound annual growth rate of 4.50 percent over this period. If we analyse the districtwise growth rates, all the districts of Gujarat except Panchmahals have shown positive growth, ranging from 0.37 percnet(Dangs) to as much as 8.42 percent(Rajkot). The districts of Gandhinagar, Mehsana, Amereli, Jamnagar, Junagarh, Kutch and Rajkot occupy position above the state average whereas

the remaining districts are below state average with respect to value yield of food grains.

Within the food grains, yield rates of cereals show a positive growth in all the districts except Panchmahals The districts of Ahmedabad, Banskantha, Baroda, Gandhinagar, Kaira, Mehsana, Surat, Amereli, Bhavnagar, Jamnagar Junajarh, Kutch, Rajkot and Surendranagar have growth rates much above the state average of 1.53 percent. As regards to pulses, Baroda, Broach, Surat, Jamnagar, Junagarh and Surendranagar have shown negative growth in the yield rate. All other districts have positive growth and Kutch has been the highest growth at a rate of 10.06 percent per annum and next come Gandhinagar(7.91 percent) The yield rate of pulses on an average has grown at a compound annual growth rate of 0.58 percent in the state.

The yield rate of non-food grains has grown at an annual compound growth rate of-0.76 percent in Gujarat But if we look at the districts like Banskantha, Bulsar, Dangs, Kaira, Mehsana, Surat, Amereli, Bhavnagar, Jamnagar and Junajarh these have experienced positive growth in yield of non-food grains, whereas the other districts have shown negative growth.

CHAPTER VII

Determinants of Agricultural development in Gujarat:

In this chapter an attempt is made to study the determinants of regional disparties in agricultural development of the state of Gujarat. In a region, disparties in agriculture may be attributed to variations existing in following factors[1]:(i) natural endowment of the regions and (ii) The chemical level of farming practices Although there is a third factor, namely institutional which is very important and has its role to play inter-regional disparties however because of lack of data on district data on district level has not been taken into consideration in this study. A selective study of land use pattern, proportion of population engaged in agri-cultural activities and the availability of surface and ground water will give a broad idea of the natural endow-ment enjoyed by different regions. On the otherhand, the level of consumption of fertilizers and implements along with the improved modes of irrigation will show the technical level of farming practices in the various regions of the state. In this chapter analysis has been carried out with the help of stewise regression analysis in order to indentify the important factors which are

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responsible for variation in agricultural productivity.

Inter-District Variations: Regression analysis:

A stepwise regression is a special type of multiple regression analysis and it helps to locate the best possible set of explanatory variables which account for maximum variation. In this procedure, a series of intermediate regression equations are obtained. One for each addition of variable until all variables are added and the final regression equation is reached. The variables are added in order of their importance i.e in order of their power to explain the dependent variable(by seeing the changes in the value of R^{-2})It helps to see whether the new variable is worth including in the model ornot. It also helps us in keeping a watch over the changes in the values of the regression coefficicients and their standard error. The other important quality of this method is that it takes care of the famous problem of multicollienearity.

The inter-district variations in agricultural productivity are explained by selecting various combinations of explananatory variables over the districts of Gujarat. In general, the equation formats tried are

$$Y = \beta_0 + \beta_1 x_4 + \beta_2 x_6 + \beta_3 x_{13} + \beta_4 x_{17} + \beta_5 x_{18}$$

$$\beta_6 x_{19} + \beta_7 x_{20}$$

whereas Y = land productivity per net sown area

x_4 = intensity of cropping i.e($\frac{\text{Gross area sown}}{\text{Net sown area}}$)

x_6 = Intensity of irrigation i.e ($\frac{\text{Gross area irrigated}}{\text{Net area irrigated}}$)

x_{13} = Mean annual rain fall,

x_{17} = Irrigation Base : Net area irrigated/Net area sown

x_{18} = Consumption of fertilizer per 1000 hectares of of net sown area

x_{19} = Number of male workers per 1000 hectares of net sown area

x_{20} = Number of tractors per 1000 hectares of net sown area

β_o = Constant

β_1 to β_7 regression coefficient

The various combination of explanatory variables are tried. The reasons are:

Firstly, it is most unlikely that all the explanatory variables listed above, will be equally important in all the districts. Hence, its is not worthwhile to put all them in all equations. Instead, we formulated only a few equations, which are meaningful in explaining the variations in the dependent variable.

Secondly, even among the significant variables, it may not be advisable to use all of them in one single equation owing to the presence of multi-collinearity between the pairs of independent variables. Here we use stepwise regression procedure so that we can see the improvement is R^{-2} value at the end of every step. It gives us an idea in determining the relative importance of each of the variables included in the model. The various combination which we have tried are as folows:

$$Y = \beta_o + \beta_4 x_{17} + \beta_5 x_{18} + \beta_7 x_{20}$$

$$Y = \beta_o + \beta_1 x_4 + \beta_4 x_{17} + \beta_5 x_{18} + \beta_7 x_{20}$$

$$Y = \beta_o + \beta_2 x_6 + \beta_5 x_{18} + \beta_7 x_{20}$$

$$Y = \beta_o + \beta_4 x_{17} + \beta_5 x_{18} + \beta_6 x_{19} + \beta_7 x_{20}$$

$$Y = \beta_o + \beta_3 x_{13} + \beta_4 x_{17} + \beta_5 x_{18} + \beta_6 x_{19} + \beta_7 x_{20}$$

$$Y = \beta_o + \beta_3 x_{13} + \beta_5 x_{18} + \beta_7 x_{20}$$

$$Y = \beta_o + \beta_4 x_{13}$$

$$Y = \beta_o + \beta_3 x_{13} + \beta_4 x_{17} + \beta_5 x_{18} + \beta_7 x_{20}$$

$$Y = \beta_o + \beta_3 x_{13}$$

Here we would like to explain the variations in agricultural productivity over time by taking various

combinations of explanatory variables by taking linear functional relationship.

The correlation Matrix

The correlation matrix given in the apprendix reveals the association between the variables i.e between the dependent and independent variables and also amongst the independent variables. The correlation matrix for linear function shows that the associations of the value productivity is positive with all the variables in 1963-66. In case of 1977-80, the associations of the value productivity is positive with all the variables except mean annual rainfall. The results of the regression exercise are presented in the following table 7.1 .

Results of the stepwise regression analysis

The cross-section data of the 19 districts were tried in a stepwise regression for two points of time to explain variations in productivity levels. Here productivity per unit of net sown area(Y) was considered as a dependent variable and all others were considered independent variables. The results are given in the table 7.1 attached. It must be reminded that many of the variables explaining an economic phenomenon may be inter-correlated, which was also the case in this exercise as noted from the various zero order correlation matrices. Hence it was considered proper to undertake stepwise regression so that not only shifted variables are added in each step, but in the process,

those acquiring weak relationship are also removed. However, the posibility of some degree of correlation amongst the retained variables is not ruled out. An effort was made in which the high correlated variables were not fed together in the explanatory system. A clear example of theis is that irrigation level of net cultivated area and of total cropped area were not simultaneously fed. Similarly consumption of fertilizer per 1000 of net and gross cultivated area were tried seperetly. One would presume a high degree of correlation between the quantity of fertilizer consumed and levels of irrigation, but since the latter was one of the indices of the infra-structural development it was retained alongwith the former.

Table 7.1

Regression result of productivity levels of 1960's and 1070's

Equation No		R^2
1.	(i) $Y_{1960} = 1276.32 - 2.23x_{17} + 77.47x_{18} - 6.077x_{20}$ $(-.116) \quad (2.749) \quad (-.122)$	0.343 (2.615)
	(ii) $Y_{1960} = 1256.24 + 76.34\ x_{18}$ (2.974)	.342 (8.844)
	(i) $1980 = 846.29 + 46.746\ x_{17} + 12.125x_{18} - 2523.76x_{20}$ $(2.154) \quad (1.444) \quad (-1.558)$	.383 (3.106)
2.	(i) $Y_{1960} = 36.71 + 1199.53x_4 - 5.367x_{17} + 79.07x_{18}$ $(.441) \quad (-.257) \quad (2.709)$ -1.453 $(-.028)$	.352 (1.904)

(11) $Y1960 = 227.70 + 977.49x_4 + 77.44x_{18}$ .349
(.417) (2.928) (4.294)

(1) $Y19\ 1980 = 1085.28 - 327.95x_4 + 53.10x_{17} +$
(-.448) (2.009)

$13.88x_{18} - 2722.58x20$ .392
(1.462) (-1.581) (2.255)

(11) $Y1980 = 846.29 + 46.75x_{17} + 12.125x_{18} - 2523.77x_{20}$ .383
2.154 (1.444) (-1.56) (3.106)

3. (1) $Y1960 = 959.93 + 325.45x_6 + 71.97x_{18} - 6.94x_{20}$ .371
(.827) (2.586) (-.142) (2.958)

(11) $Y\ 1960 = 958.50 + 323.69x_6 + 71.285x_{18}$ .371
(.849) (2.684) (4.710)

(1) $Y\ 1980 = -23.10 + 1121.76x_6 + 14.28x_{18} - 173.48x_{20}$ .210 (1.327)

(11) $Y\ 1980 = 1163.56 + 15.71x_{18}$ .192
(2.009) (4.035)

4. (1) $Y\ 1960 = 1063.49 - 1.121x_{17} + 71.07x_{18} + .534x_{19} + 2.115x_{20}$ .392
(-.059) (2.476) (1.061) (.042) (2.259)

(11) $Y1960 = 1056.36 71.047x_{18} + .532x_{19}$ .392
(2.728) (1.145) (5.159)

(1) $Y\ 1980 = 472.57 - 48.77x_{17} + 14.726x_{18} + .716x_{19}$
(2.243) (1.500) (1.033)

.427
$-32.95.43x_{20}$ (2.607)
(-1.851)

5. (1) Y 1960 = 937.95 + 1.581x_{13} + 4.353x_{17} + 71.091x_{18}
(.849) (.214) (2.452)

.387x_{19} + 5.954x_{20} .424
(.721) (.117) (1.915)

(11) Y1960 = 968.48 + 1.444x_{13} + 726.68x_{18} + .387x_{19} .422
(.878) (2.784) (.779) (3.647)

(1) Y 1980 = 172.02 + 3.8880x_{13} + 53.93x_{17} + 16.319x_{18} +
(.883) (2.381) (1.727)

.232x_{19} - 3713.88x_{20} .459
(.261) (-2.001) (2.209)

(11) Y 1980 = 192.07 + 4.59x_{13} + 60.378x_{17} + 16.288x_{18} -
(1.374) (2.591) (1.784)

3635.58x_{20} .456
(-2.055) (2.935)

6. (1) Y 1960 = 1094.75 + 1.873x_{13} + 76.555x_{18} + .328x_{20} .398
(1.172) (2.879) (0.007) (3.310)

(11) Y 1960 = 1094.99 + 1.871x_{13} + 76.59x_{18} .398
(1.222) (3.027) (5.297)

(1) Y 1980 = 1056.79 + .906x_{13} + 17.15x_{18} - 225.18x_{20} .196
(.255) (1.600) (-.162) (1.218)

(11) Y 1980 = 1163.56 + 15.71x_{17} .192
(7.821) (4.035)

7. (1) Y 1960 = 1459.91 + 6.34x_{17} .005
(.291) (0.85)

(1) Y1980 = 1113.053 + 32.32 x_{17} .241
(2.325) (5.405)

8. (1) Y 1960 = 1041.74+2.014x_{13}+5.135x_{17} + 75.255x_{18}+ (.401)
(1.163) (.256) (2.696) (2.345)
1.687x_{20}
(.034)

(11) Y1060 = 1094.99 + 1.87x_{13}+76.59x_{18} (.398)
(1.222) (3.027) (5.297)

(1) Y 1980 = 192.07.07 + 4.589x_{13}+60.378.x_{17} + (.456)
(1.374) (2.591) (2.939)
16.288x_{18}- 3635.58x_{20}
(-2.55) (-2.055)

9. (1) Y 1960 = 1357.24 + 1.834x_{13} (.54
(.934) (.956)

(1) Y 1980 = 1773.52 -.537x_{13} .001
(-.152) (.023)

Note Figures in parentheses are the 't' values for regression coefficients and 'F' values incase of R^{-2}

The regression equations shows that, the overall productivity level in 1960's was positively and significantly affected by the usage of consumptio offertilizer and intensity of irrigation. Connectively through cropping

intensity and number of male workers also indicated a positive impact but with a relatively lower level of significance. Tractorisation comes with a negative sign in all the cases for 1970's. A scrutiny of data reveals that while some of the high productivity districts have lower number of tractors, where as the low productivity districts have a relatively higher number giving an overall increased relationship. In 1970's the productivity level was positively and significantly affected by irrigation base along with consumption of fertilizer having relatively lower level of significance. In 1960's a totally distorted figure is shown by variable x_{17}. In some cases it shows negative sign before infering mean annual raifall and in other cases having positive sign entering after mean annual rainfall along with consumption of fertilizer. From this it can be said that in 1960's the assured supply of irrigation depends on rainfall in the state of Gujarat. To overcome this problem, therefore, to choose the final equation(ii) it was thought proper to stop at point where the relative contribution made by R^{-2} is high. By doing so in some cases, the R^{-2} gets a little lowered but the extent of explanation lost is not of a high order.

Enviornment variables like mean annual rainfall had a negative impact on productivity level in 1970's. In 1970 also cropping intensity(x_4) responds in a negative fashion in the step regression. This is due to the correlation between irrigation base(61178), with fertilizer consumption (.39676), with tractorization(.37346), which are significant for 19 observation. Hence, although x_4 shows a positive relation with productivity levels in the correlation matrix, as soon as it enters after x_{18}(tractorisation), it brings forth an unexpected sign(see.eq.No.8) Therefore for the final equation(ii) only the first three steps were taken into consideration which explain 38 percent of the total variation in productivity levels in the state of Gujarat.

To further analysis it is seen that common characteristics like usage of fertilisers feature important being positively related top productivity level in all the cases for both time period. Mean annual rainfall has shown positive sign along with fertilizer consumption and levels of irrigation (in equation no 5 and 6) for both time period. It clearly specifies that districts where annual rainfall is high, the productivity finds to high. To overcome this problem, the model was re-run by taking

only x_{13} in equation. It is seen that it has positive sign with productivity in 60's and negative sign with 70's. It is clear that rainfall has minor role to play in the productivity determination reflected in the R^{-2}. The number of male workers engaged in agriculture has shown positive sign with productivity and marginal productivity of labour is positive. So labour acts as an important input in the production function.

From above analysis it can be said that irrigation base and, fertilizer consumption are significant throughout the period of analysis. One interesting thing to be noted that we are not in a position to say inter-district variations in productivity have been vanished completely. The reason is that the explanatory power of the model in almost all cases is very very low i.e even less than 50 percent. In the state as a whole irrigation base is found to an important variations in the productivity in 1970's. The consumption of fertiliser is the second important variable in explaining the differentials in productivity. It is interesting to note that during this post-green-revolution period due to the impact of package programme the agricultural development is not properly reflected. This is reflected in explanatry power of the regression model. The reason

are: (i) Variables chosen here may not be true representative of agricultural development in region of Gujarat. There are other variables which we have not taken into consideration due to lack of availability of data.(ii) The agricultural sector is not as developed as industrial sector in Gujarat Thus it can be summed up that the irrigation base and fertilizer consumption influence the productivity in Gujarat to a great extents out of total explanatory power of the model. (ii) At the same time most of the explanatory variables are not showing significant coefficients for the whole period of our analysis. The reason being, the districts in which, by and large, there is no noticeable change is traceable for some of their explanatory variables while some improvement in their productivity level had occured over our time.

CHAPTER VIII

Summary and Conclusion:

In India there are wide sectoral and spatial variations in the levels of economic development. It is not only that different sectors of [illegible] economy are at different levels of development but for the same sector these levels very from one region to another. The role of agricultural development is very crucial in determining economic development.

The main objective of this study was, to analyse the causes of spatical variations among different districts of Gujarat. The levels of agricultural pattern in all the nineteen districts of Gujarat are studied in terms of land productivity. Yield rates cropping pattern (18 crops) and some of the technological factors like irrigation, fertilizers, and mechanisation(tractors, oil engine, electrical pumpset). The time periods, covered in this study is triennium of 60's(1963-66) and 80's(1977-80) in order to make inter-temperal companion of pregreen revolution and post green revolution situation.

The output of each crop was evolutated at 77-80 face level constant state level prices for the respective crops. The inter-district variations in the levels of agricultural development is studied with the help of

productivity, growth rate and yield levels. The analytical scheme and methodology used in the present study are briefly as follows:

The productivity figures for each district were obtained first by calculating the yield levels for 18 crops covering between 80 to 85 percent of gross cropped area and then inflating these figures to cover the remaining cropped area. The underlying assumption is that the average yield for the uncovered crops is equal to the average yield of all the 18 crops included in the study and dividing this total output (inflate output) divided by net sown area. In this regard, an attempt is being made to study productivity levels of each of the districts to gain a bread idea of how a district in comparison with other districts, has been improving its levels of productivity over 1963-66 to 1977-80 It is also followed by the cross classification of districts according to their productivity levels and growth rates. Inter-district variations in the yield levels have been studied to know the growth of productivity levels for each district: various statistical levels for each district. Various statistical

tools such as compound growth rate coefficient of variations, principal compnent analysis a decomposition of agricultural output growth and multiple regression techniques have been used. The main findings of the study are as below: (Respect to produced level):

(i) Green revolution period(1963-66) represents higher productvity figures pregreen revolution era in all most all the districts of Gujarat.

(ii) Over this period, the districtw which are showing high productivity levels came from northern Gujarat region comprising of Bhavnagar, Jamnagar, Amereli and Junajerh Mehsana districts.

(iii) The ghiest productivity ir recordéd in Mehsana district followed by Junargarh districts.

(iv) There are three districts which are reporting low productivity (Dange, Kutch, Banskantta) over this period of our study remained underdeviaped in our productivity levels.

(A number of facts emerging from the yield levels are (i) the study shows that the total agricultural output of the state has increased inspite of decrease inspite of decrease of from 1963-66 to 1977-80. This temporakk variations clearly suggest that the yield level played a vital role to raise the agricultural production of the state.

(ii) Ot is quite evident that the large inputs use is mainly observed in high yield level districts. But the interesting point is that the increase in input over this period does not reflect proportionate increase in yield levels.

The statistical tools applied with coefficents of variation range S.D sho the inter-district variation in the productivity levels has been increased over this period at a higher level.

Cropping Pattern

In case of food grains, for the state as a whole inspite of decrease of -0.43 percent in the area under food grains, the output per shown a positive growth rate of 3.38 percent. The output increase in the food grains is mainly contributedy by the pulses and cereals. The output of pulses alone has shown a positive growth rate of 3.08 percent per annum followed by cereals 3.62 percent per annum. On the otherhand, non food grains have recorded an decrease in output at the rate of -0.95 percent per annum as a result of decrease in both area(-).19 percent) and productivity(-0.76 percent)

The regional(district-wise) variations in the growth of area under food grains and non-food grains is quite conspicuous. The regions namely Banskantha, Mehsana,

Amereli, Bhavnagar, Jamnagar,, Junajarh, Kutch and Rajkot have registered an increase in the area under non food grains while area under food-grains has shrunk over this period of time. But Ahmedabad, Panchmahal, Surendranagar have experienced negative growth in both food as well as non-food grains. Dang is the only district which as registered positive growth in the area under food grains as well non-food grains. The regions such as Baroda, Broach, Bulsar, Gandhinagar Kaira, Saberkantha, and Surat have registered a psitive growth in area of non food grains. It is interesting to note that except seven districts namely Baroda, Broach Bulsar, Dangs, Kaira, Saberkantha, Surat all other districts have shown a negative growth rate per annum. Among the districts which have shown negative growth rate of area under cereals such as Ahmedabad, Banskantta Gandhinagar, Mehsana, Kutch, Surendranagar have shown remarkable positive growth in pulse. So it may be very well inferred th t the fall in the area of food grains is due to the decline in the area of cereals only not pulses.

As regards output of food grains, except surendranagar and Panchmahal all districts have shown positive growth. It is note worthy that all the districts have

except Panchmahal the districts(Ahmedabad, Baroda, Gandhinagar, Mehsana Sabarkantha, Surat) which have shown negative growth rate in gross cropped area are marked with remarkable positive growth of output of food grains This is mainly due to the high yield level of these districts. If we disagregate foodgrains, the output of cereals has shown positive growth rate of 0.62 percent, inspite of a negative growth in the area. Only Panchmahals and Surendranagar have experienced a negative growth of -0.92 and -0.36 percent respectively in the output of cereals. The districts of Gandhinagar Kaira, Mehsana, Amerli, Kutch and Rajkot have shown a marked positive growth of output which is above 4% per annum. But as regards to pulses the positive growth rate of pulses as high as 13.64 percent in Kutch and out of 19 districts only five districts such as Kaira Amereli Bhavnagar, Jamnagar, Junajarh have recorded a decline in the output of pulses which also associated with the decline in area. Again, in the output of non-food grains, the districts namely Banaskantha, Dangs Amereli, Bhavnagar, Jamnagar, Junajarh have recorded high positive growth and the districts of Baroda, Ahmedabad, Broach, Panchmahals, Sabarkantha, Rajkot

and Surendranagar have sown extremely negative growth in output of non-food grains, have attained positive growth in output due to favourable climatic and soil condition suitable for the cultivation of cotton.

According to the yield levels of the food grains, all the districts of the state have sown positive growth except panchmahals. Among the foodgrains, pulses have shown negative growth in yield level only in six districts namely Baroda, Broach, Sabarkanth, Jamnagar, Junajarh and Surendranagar, while cereals show a positive growth in all the districts except Panchmahals. But as regards to non-food grains only Bulsar, Surat, Jamnagar, Junajarh are worth mentioning with high positive gwoth of 5.9 percent. 4.5 percent,2.5 percent and 2.2 percent respectively. In fact the districts of Ahmedabad, Baroda, Broach, Gandhinagar, Panchamahals, Sabarkantha, Kutch Rajkot and Surendranagar all have experienced negative growth in the productivity of non-food grains.

Looking at the exercise of principal component analysis we find that districts of Gandhinagar, Kaira Mehsana, Sabarkantha Jamnagar, and Rajkot have improved their agricultural development during this period.

Another notable features that over a period of time the general impression one gathers is that although the absolute index values for all the districts have increased thus reflecting a slight rise in the level of agricultural development in the districts, the relative position of the districts; districts, thgister any noticable change. In fact, the grouping of districts into the developed and less developed for 1963-66 is found to be valid for the next period as well with same marginal changes. To test this findings satistically, the spearman's coefficients of rank correlation between 1963-66 and 1977-80 has been calculated. The estimated coefficient is estimated to be 82. It is statistically significant. These coefficeat , confirm the findings over a period of 14 years no significant change has been effected in the ranking pattern.

An effort has been put to decompose this growth and various component like area, yield, cropping rather and interaction between yield cropping pattern.

The study shows that the component that has contributed the maximum is the interaction between yield and cropping pattern by 102.84 percent whereas cropping pattern has contributed 15.34 percent. Yield has contributed -3.15 percent, and area has contributed

-19.51 percent. One finds that wide spatial variations exists in the relative contribution of the componets to the growth of output among the different districts of Gujarat. In two districts namely Baroda and Gandhi nagar, the effect is due to interaction between yield and cropping patter. In all other districts the interaction effect is relatively insignificant. In case of cropping pattern only five districts namely Bulsar, Mehsana, Surat, Kutch and Rajkot played a dominant role. In case of area the districts of Dangs and Kutch contributed significant increases to output growth compared to other districts. The contribution of yield to output growth was more pronounced in the districts of Ahmedabad, Broach, Kaira, Sabarkantha, Amerreli. Bhavnagar, Jamnagar, Junajarh and Surendranagar. In a nutshell one can say that the spatial variations are greater in the relative contribution of area, yield, cropping pattern and interaction to the growth of output over this period among the districts of Gujarat.

Looking at the exercise on cross-section stepwise regression analysis one finds that in the sixties although the use of fertilizer and irrigation was very low, however, they turned out to be the crucial factors

for explaining the interdistrict variations in productivity Over the period i.e from pregreen revolution to post green revolution period one finds that the irrigation is the more prominent factor followed by fertilizer which explains the interdistrict variations.

Limitations of the Study:

As in this study using the secondary data one has to make many assumptions because of the paucity of the data in a distred form. So the major limitation is that of the procedure adopted for computing productivity figures for each districts of Gujarat. As pointed out earlier, the output for each district has been inflated keeping in view the proportion of area covered by 18 crops which accounts to around 80 to 85 percent to get out put corresponding to 100 percent of area and then to derive productivity variable by dividing this output by net sown area. This has an underlying questionable assumption that th yield levels of the left out crops are the same as the covered 18 crops. It was necessary to adopt this method to arrive at district wise comparable figures otherwise the output would have gien very inconsistent results.

Another limitation ofthe study is that, it does not take into account the institutional factor especially land utilisation patterns and tenancy structure, which are very crucial for the development and growth of agriculture in an economy especially the underdeveloped economies. Although some fragmenting data on these aspects are thrown up by NSS reports over different rounds however these are not available at the district level.

To sumup, the present study seeks to explain variations in productivity levels mainly interms of technological factors such as irrigation and fertilizer use, cropping intensity and cropping pattern.

Policy Measures:

From the study of spatial variations in the levels of agricultural development at district levels for the period 1977-80, some useful conclusions have been arrived at which may help to formulate the ways and means to remove the regional imbalances.

On the whole, the district level study reveals that Gujarat has not sifnificantly achieved the progress in agricultural sectors during this periods starting with the help of package technology of high yielding varieties of hybrid seeds(particularly hybrid varieties of Bajra)

the state achieved increase in the yield per hectare. Though the technology of high yielding vrieties and multiple cropping for further improvement in agriculture are now aimed at in the state but at the same time it should not be ignored that the state suffers from serious natural endowment defficient of rainfall and ensured irrigation whic is crucial for the adoption of new technology. Here for the state of Gujarat dry-farming technology seems to be the only way out.

On general we can say from the forging analysis that there exists regional imbalance in the agricultural development of the state of Gujarat. Therefore sincere efforts are needed to improve the situation. It is also true that the regional imbalances cannot be wiped out it is also true that these can be brought to minimum level. The fact of regional imbalances arises due to existing pattern of economic components, social traditions, human resources, geographical attributes and environmental changes.

Appendix - 1

Area in '000 Hectares
Outturn in '000 tonnes

Area and outturn of Principal crops in Gujrat

Sr.No.	Items	1963-64		1964-65		1965-66	
		Area	Outturn	Area	Outturn	Area	Outturn
1.	Rice	538	499	549	471	536	255
2.	Wheat	430	363	444	416	515	554
3.	Jowar	1566	428	1308	407	1292	338
4.	Bajri	1440	774	1483	888	1652	780
5.	All cereals	4455	2508	4263	2692	4484	2283
6.	All Pulses	475	192	475	188	425	133
7.	All Cereals*Pulses	4930	2700	4738	2880	4909	2416
8.	Cotton **	1743	1404	1846	1646	1751	1491
9.	Tobacco	82	77	91	90	82	75
10.	Groundnuts	1847	1267	2143	1647	2066	945

Contd.

(**) = Outturned of cotton in '000 bales of 170 Kgs each.

Source - Hand book of basic statistics and crop and season report of different year of Gujrat.

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1966-67		1967-68		1968-69		1969-70	
Area	Outturn	Area	Outturn	Area	Outturn	Area	Outturn
505	299	507	463	495	369	470	440
427	458	463	687	494	590	431	545
1388	365	1343	423	1359	335	1348	376
1775	864	1867	1239	1851	4773	2021	1346
4612	2282	4821	3356	4743	2342	4798	3201
427	132	529	204	437	118	447	146
5039	2413	5450	3560	5180	2460	5245	3347
1726	1488	1640	1604	1701	1547	1738	1739
91	86	94	100	87	92	97	105
1957	912	1942	1409	1875	865	1657	1040

Contd.

1970-71		1971-72		1972-73		1973-74	
Area	Outturn	Area	Outturn	Area	Outturn	Area	Outturn
511	631	516	560	487	856	443	472
641	974	525	808	375	555	538	836
1305	601	1096	447	1112	228	1203	530
2111	1799	1811	1520	1910	856	2149	1487
5087	4543	4446	3954	4372	2269	4850	3706
496	201	483	170	421	120	509	186
5583	4844	4929	4124	4793	2389	5360	3892
1745	1904	2204	2888	2148	1721	1991	1837
81	103	88	120	96	110	81	116
1778	1869	1971	1745	1949	379	1705	1341

Contd.

1974-75		1975-76		1976-77	
Area	Outturn	Area	Outturn	Area	Outturn
397	214	464	597	474	565
366	646	604	983	601	863
1028	321	1236	610	1106	643
1504	446	1845	1282	1415	1131
3828	1952	4738	4288	4968	3614
357	105	595	208	614	336
4185	2058	5329	4446	4777	3950
1746	1615	1859	1758	1856	1762
59	86	91	142	125	208
1614	485	1775	2190	2077	2074

Contd.

1977-78		1978-79		1979-80	
Area	Outturn	Area	Outturn	Area	Outturn
512	724	529	535	550	516
560	962	5352	119	643	116
1098	558	1083	577	1097	637
1383	967	1454	1553	1432	1366
4094	3540	4166	3682	4263	3977
590	292	408	346	714	371
4684	3833	4834	4226	4976	4349
19070	2037	1571	2101	1717	1786
126	192	122	154	125	181
2052	1831	2086	1786	2108	1846

Appendix 1(2)

Area in '00 Hectares

Area irrigated by different sources

Sr. No.	Items	1963-64	1964-65	1965-66	1966-67
1.	Govt. Canals (% of area under canals to net area irrigated)	968 (13.53)	1209 (13.68)	1393 (13.38)	1656 (16.29)
2.	Wells* (% of well irrigated to net area irrigated)	5711 (79.80)	6997 (79.18)	8625 (82.84)	8064 (79.32)
3.	Tanks (% of tank irrigated to net area irrigated)	183 (2.56)	326 (3.69)	296 (2.84)	325 (3.20)
4.	Total net area irrigated (% of net area irrigated to net sown area	7157 (7.60)	8837 (9.15)	10412 (10.75)	1016 (10.44)
5.	Gross area irrigated (% of Gross area irrigated to gross cropped area)	7406 (7.49)	9134 (9.01)	10722 (10.52)	10573 (10.37)
6.	Intensity of irrigation $\frac{(GAI)}{NAI}$	1.03	1.03	1.03	1.04

Contd -

* including tube wells

Source: Hand book of basic statistics Gujrat state, 1977 and 1978, Bureau of Economics and statistics Govt. of Gujrat, Gandhinagar.

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1967-68	1968-69	1969-70	1970-71	1971-72	1972-73
1981	1954	2058**	2358**	2303**	1934**
(17.80)	(16.99)	(17.03)	(17.20)	(16.36)	(14.42)
8861	9171	9617	10831	11165	10933
(78.17)	(79.75)	(79.58)	(79.01)	(79.34)	(81.50)
339	2735	297	372	402	355
(3.06)	(2.39)	(2.46)	(2.71)	(2.86)	(2.65)
11081	11499	12085	13708	14073	13414
(11.31)	(11.99)	(12.82)	(14.11)	(14.42)	(13.97)
11657	12409	13071	14939	15247	15212
(11.19)	(12.19)	13.01)	(14.24)	(14.55)	(14.83)
(1.05	1.08	1.08	1.09	1.09	1.03

** Including Panchyat Canals.

1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80
2425**	2266**	2844**	3043**	3268	3288	3451
(17.30)	(16.79)	(18.78)	(19.42)	(19.06)	(16.21)	(15.61)
11192	10909	1190	12227	13458	11870	15395
(79.85)	(80.81)	(78.58)	(78.02)	(78.48)	(66.64)	(79.66)
254	198	252	321	330	349	349
(1.81)	(1.47)	(1.66)	(2.05)	(1.92)	(1.96)	(1.81)
14016	13499	15144	15671	17149	17812	19326
(14.36)	(15.45)	(15.70)	(16.45)	(17.97)	(18.61)	(20.19)
15913	15232	17091	17741	19358	20204	22114
(15.17)	(17.21)	(16.28)	(17.13)	(18.63)	(19.32)	(20.85)
1.14	1.13	1.13	1.13	1.13	1.13	1.14

Appendix 2

Growth rate of Cultivated area, value of output and productivity levels in districts of Gujrat.

Districts	Growth rates		
	Area	Out put	Productivity
1. Ahmedabad	-0.54	-4.78	-4.26
2. Banaskantha	0.13	4.30	4.17
3. Baroda	-0.08	-5.60	-5.52
4. Broach	-0.38	-7.60	-7.24
5. Bulsar	-0.03	1.46	1.50
6. Dangas	0.00	0.75	.75
7. Gandhinagar	-0.64	1.47	2.12
8. Kaira	-0.20	2.01	2.21
9. Mahsana	0.02	5.84	5.82
10. Panchmahals	-0.12	-1.45	-1.33
11. Sabarkantha	-0.22	-2.92	-2.71
12. Surat	-0.87	2.11	3.01
13. Amareli	-0.16	2.87	3.03
14. Bhavnagar	-0.04	3.10	3.14
15. Jamnagar	0.60	5.29	4.67
16. Junagadh	0.37	3.79	3.41
17. Kutch	1.60	2.53	0.91
18. Rajkot	-0.11	1.42	1.53
19. Surendranagar	-0.50	-5.15	-4.76
20. Gujrat State	-0.004	1.01	1.01

Appendix 3

AGRICULTURAL PRODUCTIVITY FOR 60's and 80's (in Rupees)

DISTRICTS/State	1963-66	1977-80
1. Ahmedabad	1635	889
2. Bonskantha	819	1451
3. Baroda	2522	1139
4. Broach	2145	749
5. Bulsar	1871	2304
6. Dangs	898	997
7. Gandhinagar	1244	1670
8. Kaira	1749	2375
9. Mehsana	1367	3017
10. Panchmahals	1355	1123
11. Sabarkantha	1943	1322
12. Surat	1796	2720
13. Amereli	1537	2334
14. Bhabnagar	1230	1896
15. Jamnagar	1118	2118
16. Junagarh	1844	2948
17. Kutch	872	991
18. Rajkot	1545	1911
19. Surendra nagar	1283	648
Gujarat State	1515	1744

Appendix 4

Irrigation levels and usage of fertilizer and Mechanical in Puts (1960's and 1980's)

Districts/State	Net Area irrigated / Net sown area		Fertilizer/1000 Net sown area	
	1963-66	1977-80	1963-66	1977-80
1. Ahmedabad	10.16	14.60	2.66	21.28
2. Banaskantha	9.32	23.93	0.46	11.10
3. Baroda	5.25	19.31	8.71	45.54
4. Broach	3.87	9.44	3.87	13.71
5. Bulsar	6.27	14.48	0.00	30.08
6. Dangas	0.00	0.36	0.00	0.23
7. Gandhinagar	11.89	37.47	0.00	42.50
8. Kaira	12.42	37.38	11.31	67.00
9. Mahsana	22.59	41.20	1.96	28.44
10. Panchmahals	2.62	7.23	0.97	13.65
11. Sabarkantha	13.46	31.48	1.17	69.84
12. Surat	8.71	27.28	8.92	58.02
13. Amareli	7.04	9.54	4.92	46.10
14. Bhavnagar	9.66	15.25	4.01	36.16
15. Jamnagar	6.84	13.21	2.64	46.49
16. Junagadh	14.01	15.59	6.49	26.96
17. Kutch	7.09	8.18	0.23	33.64
18. Rajkot	7.89	18.45	5.62	68.58
19. Surendranagar	4.40	9.99	0.32	8.61
20. State	9.16	18.92	3.85	36.04

Contd.

Tractors/'1000 Net sown area		Oil engins/1000 Cultivate area		Electric (Pump sets/1000 Cultivate area	
1963-66	1972-80	1968-76	1979-80	1968-76	1979-80
0.39	0.24	6.31	19.97	1.53	5.18
0.04	0.22	4.01	20.15	0.10	1.57
0.46	0.18	3.46	9.26	1.99	4.79
0.43	0.18	3.55	8.96	0.42	1.89
0.60	0.27	7.47	16.98	3.67	6.88
0.00	0.00	0.41	-	-	-
0.82	0.30	19.15	37.29	4.23	24.59
1.07	0.62	6.76	13.89	3.46	5.47
0.25	0.23	15.45	24.17	1.22	3.97
0.06	0.01	2.30	6.56	0.09	0.84
0.31	0.44	17.26	57.21	0.52	5.59
0.68	0.30	4.43	15.26	2.21	6.41
8.67	0.04	16.27	62.96	0.62	5.27
0.17	0.09	12.90	46.03	0.90	4.71
0.18	0.06	21.92	59.39	0.88	3.02
0.26	0.05	32.04	98.78	3.18	10.84
0.12	0.07	6.39	15.97	1.36	3.74
0.20	0.16	19.42	74.19	3.17	7.44
0.20	0.03	5.77	29.43	0.42	1.76
0.34	0.16	11.17	35.40	-.46	4.61

(—) = nil

Attached to 4

Irrigation status in Gujrat state

Net Cropped Area irrifald as % of NSA

Districts	1963-66	1977-80	Source Wise irrigation 1963-66 Canal	Tank	Well	Others
1. Ahmedabad	10.16	14.60	33.31	9.71	56.97	.01
2. Banaskantha	9.32	23.93	0.00	0.91	99.07	.02
3. Baroda	5.25	19.31	7.73	16.64	70.45	5.18
4. Broach	3.87	9.44	2.83	3.21	91.68	2.28
5. Bulsar	6.27	14.48	16.06	28.15	51.98	3.81
6. Dangas	.00	.36	0.00	0.00	0.00	0.00
7. Gandhinagar	11.89	37.47	0.00	0.00	98.40	1.60
8. Kaira	12.42	37.38	29.67	1.99	67.61	0.73
9. Mahsana	22.59	41.20	1.26	0.59	86.50	11.65
10. Panchmahals	2.62	7.23	21.96	8.46	69.31	0.27
11. Sabarkantha	13.46	31.48	2.77	0.65	96.18	0.40
12. Surat	8.71	27.28	71.18	5.19	22.33	1.30
13. Amareli	7.04	9.54	6.50	0.65	92.83	0.02
14. Bhavnagar	9.66	15.25	12.76	0.44	85.84	0.96
15. Jamnagar	6.84	13.21	6.38	0.00	93.61	0.01
16. Junagadh	14.01	15.59	3.70	0.00	96.29	0.01
17. Kutch	7.09	8.10	15.93	1.86	81.78	0.43
18. Rajkot	7.89	18.45	24.69	3.75	71.31	0.25
19. Surendranagar	4.40	9.99	15.12	1.21	83.55	0.12

1977-80

Canal	Tank	Well	Others
36.42	2.41	60.18	0.99
7.34	0.51	91.09	1.06
1.80	3.61	93.38	1.21
22.36	1.30	72.32	4.02
46.43	7.60	44.31	1.66
00.00	0.00	100.00	0.00
0.00	0.00	100.00	0.00
31.93	1.86	66.09	0.12
1.96	2.43	95.60	0.01
31.84	13.72	50.82	3.62
6.30	0.52	93.14	0.04
71.98	2.02	25.36	0.64
10.95	0.49	88.55	0.01
33.53	3.81	62.65	0.01
7.01	0.00	92.98	0.01
4.70	0.00	95.29	0.01
20.19	0.00	79.80	0.01
20.16	2.46	76.69	0.69
13.54	0.00	86.44	0.02

Appendix 6

Transition matrix showing the mobility of productivity per Districts according to net coun area in Gujrat.

	Intiolsitution 1963-66	Low Productivity range	Medium Productivity range	High Productivity range
Low Productivity range	(3) Banaskantha, Dangas Kutch	(0)	(3) Banaskantha Kutch .1* Dangas	(0)
Medium Productivity range	(8) Gandhinagar Panchmahal Bhavnagar Surendranagar Mehsana Amareli Jamnagar Rajkot	(1) Surendranagar .13*	(1) Panchmahal .13*	(6) Gandhinagar Mehsana .74* Amareli Bhavnagar Jamnagar Rajkot
High Productivity range	(6) Ahmadabad Kaira Broach Bulsar Kaira Sabarkantha Surat Junagadh	(2) Ahmadabad .25* Broach	(2) Barode .25* Sabarkantha	(4) Bulsar Kaira .50* Surat Junagarh

Notes - Figures in the brackets are number of districts.
Figures with * is the Probability of transition.

Appendix 7

Annual average farm harvest prices (State average) prices are in rupees per quintal (per 100 kg).

Crops	1977-78	1978-79	1979-80	Triennial average 1977-80
1. Rice	109.23	123.95	123.02	118.73
2. Wheat	139.92	141.46	148.77	143.38
3. Barley	100.41	110.73	114.13	109.42
4. Jowar	112.73	112.56	130.03	118.44
5. Bajra	118.76	118.32	120.22	119.10
6. Maize	110.75	118.10	123.61	117.49
7. Ragi	98.90	113.41	99.33	103.21
8. Gram	189.73	218.84	261.88	223.48
9. Tur	297.71	296.10	292.07	295.29
10. Sugarcane	128.38	162.57	236.09	175.68
11. Chillies	736.88	860.20	888.53	828.54
12. Potatoes	83.01	80.74	92.29	85.35
13. Cotton	364.03	355.20	368.06	362.43
14. Groundnut	221.51	242.66	284.28	249.48
15. Sesamum	337.40	364.72	404.75	368.96
16. Rape and mustard	295.35	291.03	359.01	315.13
17. Castor	209.70	210.56	244.11	221.46
18. Tobacco	225.15	275.50	267.78	256.14

Appendix 8

Percentage compound annual growth rates of gross cropped area, output, yield rate

Districts	Out put	Gross cropped area	Yield rate
1. Ahmedabad	-5.20	-0.86	-4.26
2. Banskantha	4.26	0.67	3.54
3. Baroda	-5.70	-0.19	-5.58
4. Broach	-7.52	0.25	-7.36
5. Bulsar	1.48	0.23	1.19
6. Dangas	2.63	1.89	0.78
7. Gandhinagar	1.39	-0.17	1.49
8. Kaira	2.34	0.57	1.76
9. Mahsana	3.89	-0.48	4.18
10. Panchmahals	-2.18	-0.56	-1.42
11. Saberkantha	-3.12	-0.28	-2.74
12. Surat	1.98	-0.78	2.83
13. Amreli	3.76	0.19	3.52
14. Bhavnagar	3.17	0.26	2.79
15. Jamnagar	4.36	0.18	4 .148
16. Junagadh	3.58	0.29	3.249
17. Kutch	1.68	1.13	0.86
18. Rajkot	1.47	0.26	1.13
19. Surendranagar	-6.13	-0.69	-4.87
20. State	0.58	-0.28	0.86

Appendix 9

Cropping pattern for 1963-66

Districts	Rice (1)	Wheat (2)	Barley (3)	Jowar (4)	Bajra (5)	Maize (6)	Ragi (7)	Gram (8)	Tur (9)
1. Ahmedabad	5.99	18.91	0.11	16.05	9.53	0.01	0.13	0.61	0.50
2. Banskantha	0.35	5.35	0.11	20.12	60.24	1.70	0.08	0.30	0.28
3. Baroda	13.70	1.59	0.00	11.40	3.13	2.33	0.00	0.50	3.60
4. Broach	7.28	3.97	0.00	17.38	1.73	0.36	0.00	0.58	2.70
5. Bulsar	53.56	0.80	0.00	8.77	0.00	0.00	11.40	0.61	4.04
6. Dangee	29.71	0.00	0.00	0.84	0.00	1.34	55.26	0.64	10.52
7. Gandhinagar	1.93	4.60	0.00	14.78	39.72	0.00	0.00	0.00	2.03
8. Kaira	17.23	9.42	0.00	1.78	24.03	2.04	2.80	0.42	2.96
9. Mehsana	1.55	9.43	0.04	22.00	30.67	0.12	0.00	0.37	1.37
10. Panchmahals	25.42	3.56	0.30	2.71	4.12	27.43	3.37	8.82	2.07
11. Sabarkantha	7.11	6.09	0.00	4.54	9.33	14.76	0.11	1.24	1.37
12. Surat	16.56	3.30	0.03	25.46	0.45	0.08	1.60	0.90	4.15
13. Amreli	0.41	2.55	0.00	16.19	21.20	0.12	0.00	0.06	0.01
14. Bhavnagar	0.23	4.84	0.00	19.03	24.54	0.06	0.00	0.09	0.00
15. Jamnagar	0.28	3.80	0.00	24.52	13.06	0.04	0.00	0.38	0.00
16. Junagadh	1.21	4.82	0.00	12.13	10.08	0.14	0.00	0.88	0.00
17. Kutch	0.00	1.78	0.12	32.46	32.76	0.03	0.00	0.06	0.00
18. Rajkot	0.28	2.86	0.00	17.96	12.24	0.09	0.00	0.10	0.00
19. Surendranagar	0.10	3.30	0.00	19.66	17.54	0.00	0.00	0.41	0.00
20. State	6.22	6.86	0.05	15.99	17.55	2.77	0.76	0.89	1.06

Contd.

Sugarcane	Potatoes	Cotton	Ground nuts	Sesamum	Rape and mustard	Castor	Tobacco	Chillies	Total
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	
0.05	0.00	39.18	7.01	0.58	0.52	0.46	0.18	0.18	100.00
0.36	0.09	4.12	0.01	1.87	1.12	2.44	0.02	0.14	100.00
0.06	0.03	52.12	6.90	0.31	0.00	0.17	3.88	0.17	100.00
0.04	0.00	59.62	5.55	0.56	0.00	0.26	0.13	0.20	100.00
1.26	0.00	15.55	2.87	0.00	0.02	0.72	0.00	0.41	100.00
0.00	0.00	0.00	1.67	0.00	0.00	0.00	0.00	0.34	100.00
0.00	0.21	20.99	10.60	0.86	0.00	1.39	1.50	1.39	100.00
0.00	0.22	13.67	9.86	2.06	0.00	0.28	12.94	0.29	100.00
0.11	0.05	16.75	7.49	1.08	4.71	3.31	0.65	0.29	100.00
0.07	0.02	5.63	15.21	0.54	0.01	0.12	0.24	0.34	100.00
0.28	0.00	26.63	26.06	1.46	0.02	0.84	0.03	0.15	100.00
1.30	0.00	33.47	11.24	0.26	0.12	0.55	0.00	0.51	100.00
1.32	0.00	2.56	51.94	3.18	0.00	0.06	0.00	0.37	100.00
0.69	0.01	3.08	46.68	1.86	0.06	0.00	0.02	0.14	100.00
0.75	0.01	3.36	50.90	2.02	0.00	0.72	0.00	0.16	100.00
0.86	0.00	7.06	61.97	0.33	0.00	0.35	0.00	0.18	100.00
0.05	0.03	17.17	11.62	2.27	0.00	1.64	0.00	0.02	100.00
0.42	0.00	13.49	51.65	0.84	0.00	0.00	0.00	0.06	100.00
0.02	0.00	45.13	11.86	1.95	0.00	0.00	0.00	0.04	100.00
0.40	0.03	20.49	23.23	1.38	0.39	0.71	0.98	0.24	100.00

Appendix 10

Cropping Pattern for 1977-80

Districts	Rice (1)	Wheat (2)	Barley (3)	Jowar (4)	Bajra (5)	Maize (6)	Ragi (7)	Gram (8)	Tur (9)
1. Ahmedabad	10.44	19.47	0.13	12.33	12.14	0.05	0.08	1.15	0.86
2. Banaskantha	0.28	7.60	0.78	15.90	50.94	1.64	0.00	0.55	0.89
3. Baroda	11.52	2.48	0.00	13.58	3.39	4.69	0.24	0.50	9.37
4. Broach	4.99	5.13	0.00	23.65	1.56	0.97	0.06	0.34	13.25
5. Bulsar	59.98	2.51	0.00	11.13	0.00	0.00	10.60	0.84	5.25
6. Dangas	19.26	0.39	0.00	1.15	0.00	1.28	62.13	0.77	10.39
7. Gandhinagar	4.45	11.16	0.22	11.67	33.41	0.44	0.00	0.00	3.50
8. Kaira	20.21	11.13	0.00	1.27	26.15	2.33	1.13	0.33	2.17
9. Mahsana	2.25	16.36	0.79	23.12	44.00	0.14	0.00	1.10	1.85
10. Panchmahals	22.18	5.26	0.44	1.99	4.16	34.50	2.62	6.43	3.09
11. Sabarkantha	4.30	9.32	0.35	12.88	19.86	19.86	0.08	0.87	2.24
12. Surat	17.91	3.23	0.00	32.76	0.36	0.18	1.05	0.62	8.07
13. Amareli	0.15	3.76	0.00	9.80	13.45	0.36	0.00	0.03	0.00
14. Bhavnagar	0.44	4.34	0.00	17.11	19.77	0.10	0.00	0.04	0.00
15. Jamnagar	0.06	4.58	0.00	11.63	11.44	0.00	0.00	0.12	0.00
16. Junagadh	0 .48	5.83	0.00	4.26	7.27	0.12	0.00	0.62	0.00
17. Kutch	0.00	2.33	0.02	20.10	26.03	0.02	0.00	0.08	0.00
18. Rajkot	0.14	6.06	0.00	8.10	8.34	0.06	0.00	0.09	0.00
19. Surendranagar	0.06	3.25	0.00	18.73	15.73	0.00	0.00	0.95	0.00
20. State	6.39	7.04	0.17	13.15	17.13	3.61	0.68	0.82	2.31

Contd.

Sugarcane	Potatoes	Cotton	Ground nuts	Sesamum	Rape and mustard	Cogtom	Tobacco	Chillies	Total
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	
0.25	0.00	38.36	1.73	0.52	0.40	1.79	0.25	0.05	100.00
0.22	0.28	4.32	0.66	1.38	6.82	7.42	0.08	0.26	100-00
0.24	9.86	43.05	3.85	0.33	0.00	0.37	6.19	0.11	100-00
0.13	0.00	45.10	2.92	1.10	0.00	0.53	0.14	0.12	100.00
4.72	0.00	2.19	1.37	0.06	0.00	0.00	0.00	0.00	100.00
0.00	0.13	0.00	4.24	0.00	0.00	0.00	0.00	0.26	100.00
0.00	0.00	14.15	2.04	1.02	1.75	10.80	0.58	1.31	100.00
0.21	0.33	12.09	3.10	1.81	0.14	0.51	17.01	0.09	100.00
0.08	0.12	23.85	1.79	1.36	12.12	9.22	0.78	0.68	100.00
0.04	0.02	10.27	7.58	0.50	0.00	0.12	0.57	0.24	100.00
0.20	0.02	29.23	17.58	0.79	0.11	1.42	0.05	0.18	100.00
11.51	0.00	14.90	8.24	0.42	0.00	0.36	0.00	0.41	100.00
1.48	0.31	7.36	59.91	2.90	0.01	0.25	0.00	0.23	100.00
0.36	0.00	16.43	38.34	2.51	0.00	0.04	0.00	0.51	100.00
0.46	0.14	5.63	63.52	0.86	0.75	0.39	0.00	0.41	100.00
1.62	0.05	7.97	71.11	0.34	0.02	0.04	0.00	0.26	100.00
0.08	0.02	28.72	12.46	4.15	0.00	5.94	0.00	0.04	100.00
1.21	0.00	18.61	56.81	0.28	0.13	0.05	0.00	0.11	100.00
0.04	0.00	53.13	6.33	1.70	0.00	0.01	0.00	0.07	100.00
0.98	0.07	22.24	25.06	1.29	1.43	1.87	1.50	0.26	100.00

Appendix 11

Number of agricultural Machinery.

Districts	Tractors		Oil engines		Electric Pump sets	
	1964	1979	1964	1979	1964	1979
1. Ahmedabad	245	140	4024	12055	974	3128
2. Banaskantha	42	180	3517	19620	90	1530
3. Baroda	252	95	1930	5153	1109	2862
4. Broach	198	78	1534	3904	193	825
5. Bulsar	176	79	2413	5509	1184	2233
6. Dangas	-	1	15	18	-	2
7. Gandhinagar	43	9	1054	1310	233	864
8. Kaira	565	317	3804	6087	1947	3186
9. Mahsana	173	162	11631	21289	919	3493
10. Panchmahals	27	7	1278	3539	47	452
11. Saberkantha	138	192	8645	28189	262	2752
12. Surat	308	118	2087	6483	1043	2721
13. Amareli	274	20	8293	32349	317	2709
14. Bhavnagar	108	52	8179	30450	571	3116
15. Jamnagar	94	32	12302	39289	491	1971
16. Junagadh	147	30	109799	65678	1965	7208
17. Kutch	64	47	3446	10908	734	2556
18. Rajkot	266	116	14486	57904	2362	5810
19. Surendranagar	140	19	3991	19380	288	1159
20. State	3248	1528	112428	371114	14729	48377

Appendix 12

Mechanization Index (Division by Mean Method)

Districts	1960's Tractors	Oil Engines	Electric Pump sets	Index	1980's Tractors	Oil Engines	Electric Pump sets	Index
1. Ahmedabad	1.0987	0.585	0.968	2.65	1.406	0.616	0.946	2.97
2. Banaskantha	0.137	0.371	0.065	0.57	1.121	0.621	0.287	2.03
3. Baroda	1.291	0.321	1.263	2.88	1.036	0.286	0.875	2.197
4. Broach	1.234	0.310	0.267	1.81	1.085	0.276	0.346	1.71
5. Bulsar	1.557	0.692	2.325	4.57	1.473	0.523	1.258	3.25
6. Dange	-	0.038	-	0.04	-	-	-	-
7. Gandhinagar	2.231	1.774	2.684	6.69	1.552	1.149	4.495	7.20
8. Kaira	2.869	0.627	2.195	5.69	3.297	0.828	1.000	4.73
9. Mehsana	0.657	1.432	0.774	2.86	1.115	0.745	0.725	2.59
10. Panchmahals	0.140	0.213	0.053	0.41	0.079	0.202	0.153	0.43
11. Sabarkantha	0.789	1.599	0.332	2.72	2.364	1.763	1.021	5.15
12. Surat	1.866	0.4010	1.402	3.68	1.68	0.242	1.171	3.09
13. Amareli	1.537	1.507	0.394	3.44	0.236	1.941	0.964	3.14
14. Bhavnagar	0.477	1.195	0.571	2.240	0.499	1.419	0.861	2.76
15. Jamnagar	0.477	2.031	0.555	3.06	0.297	1.831	0.553	3.68
16. Junagadh	0.680	2.968	2.016	5.66	0.273	3.043	1.980	5.58
17. Kutch	0.340	0.592	0.863	1.80	0.418	0.492	0.684	1.594
18. Rajkot	1.020	1.799	2.008	4.83	0.903	2.287	1.361	4.55
19. Surendranagar	0.580	0.535	0.264	1.38	0.176	0.907	0.322	1.41
20. State								

Appendix 13

Gross cropped area, out put, Yield [illegible] for 1963-66

Districts	Gross cropped area (Hectare)	Out put in 000 Rupees	Yield per hectare in Rs.	Yield per hectare in Rs.
1. Ahmedabad	571367	889047	1556	4[illegible]2
2. Banaskantha	615099	469936	764	2[illegible]1
3. Baroda	481166	1179338	2451	[illegible]8
4. Broach	390239	830429	2128	[illegible]0
5. Bulsar	153532	270523	1762	1[illegible]7
6. Dangas	19967	17910	897	[illegible]
7. Gandhinagar	46700	55433	1187	2[illegible]
8. Kaira	465067	959919	1634	1[illegible]2
9. Mahsana	622167	779469	1408	[illegible]9
10. Panchmahals	496703	596540	1201	[illegible]
11. Sabarkantha	456833	806310	1765	[illegible]5
12. Surat	355085	607161	1710	[illegible]
13. Amreli	475666	656895	1381	1[illegible]6
14. Bhavnagar	585298	700016	1196	4[illegible]5
15. Jamnagar	536766	582391	1085	4[illegible]9
16. Junagadh	568500	980663	1725	4[illegible]5
17. Kutch	374767	321175	857	3[illegible]1
18. Rajkot	718100	1086485	1513	[illegible]39
19. Surendranagar	660966	842071	1274	[illegible]2
20. State	8593968	12484097	1437	[illegible]

Appendix 14

Gross cropped area, Out put, and yield for 1979-80

Districits	Crox cropped Area (Hectare)	Out put in '000 rupees	Yield per hectare in Rs.		Labour productivity per male workers in Rs.	Labour productivity (1981 in Rupees)
1. Ahmedabad	510126	432587	848	2008		1855
2. Banaskantha	677463	838022	1237	2199		2446
3. Baroda	472593	517962	1096	1506		1275
4. Broach	405827	297065	732	1344		1209
5. Bulsar	158163	329295	2082	1431		1279
6. Danges	25966	25836	995	1116		1016
7. Gandhinager	45691	66755	1461	2048		1904
8. Kaira	502461	1048134	2086	1502		1912
9. Mehsana	516496	1274196	2467	3441		3188
10. Panchmahals	459963	440645	985	1028		847
11. Saberkantha	434963	516736	1188	2204		1833
12. Surat	317694	808531	2545	3067		2550
13. Amereli	488030	1103924	2262	6842		5719
14. Bhavnager	607861	1069228	1759	5052		3833
15. Jamnager	549029	1050842	1914	6414		5380
16. Junagadh	591595	1596123	2698	5774		4878
17. Kutch	432391	405095	960	3193		2837
18. Rajkot	741297	1305424	1761	5900		4873
19. Surendranager	542229	345942	638	2219		2152
20. State	8470838	1342818	1616	1425		2592

Appendix 15

Cereals, Pulses, Food grains and non-foodgrains Area, Out Put and Yield per hectare Area in Hectares, Out Put in 000 Rupees, and Yield in Rupees.

Districts	Cereals 1963-66 Area	Out Put	Yield	1977-80 Area	Out Put	Yield
1. Ahmedabad	289800	187211	645	278764	274025	983
2. Banaskantha	540933	346738	614	522666	530506	1015
3. Baroda	154766	107408	694	169631	176756	1042
4. Broach	119866	88102	735	147564	131332	890
5. Bulsar	114433	162724	1422	133198	223107	1675
6. Dangas	17400	13793	792	21866	179521	821
7. Gandhinagar	23500	16859	580	28032	338071	1205
8. Kaira	257767	261876	278	312599	542359	1735
9. Mehsana	397067	354581	893	243065	662595	2726
10. Panchmahals	332362	306776	922	327265	269994	825
11. Sabarkantha	191533	159547	832	205799	201271	978
12. Surat	188633	182562	964	176264	244302	1386
13. Amareli	192699	123907	639	134265	220463	1642
14. Bhavnagar	284599	168149	590	253797	284253	1120
15. Jamnagar	223833	81699	364	152198	138500	910
16. Junagadh	161300	131943	818	106299	223547	2103
17. Kutch	251668	89342	354	209660	167518	799
18. Rajkot	240100	102043	424	168232	222907	1325
19. Surendranagar	268332	77548	289	204765	73715	360
20. State	4361701	2922339	670	4000533	4792639	1198

Contd.

Pulses

1963-66			1977-80		
Area	Out Put	Yield	Area	Out Put	Yield
6367	5692	894	10232	13793	1348
3566	3488	978	9733	12760	1311
20133	31206	1550	46632	60948	1307
11433	15343	1342	55166	71605	1298
7133	9901	1388	9633	14276	1482
2267	3301	1456	2900	4599	1586
950	443	466	1600	2165	1353
15667	22905	1462	12533	19288	1539
10833	10486	968	15199	20762	1366
54100	809302	1281	43766	75365	1722
11934	10048	842	13499	21625	1602
17933	27814	1551	27599	38280	1387
367	593	1615	167	297	1780
533	816	1531	233	373	1602
2033	5139	2528	633	8934	1412
5000	9140	1028	3666	2533	691
233	223	959	366	1341	3665
700	671	958	667	894	1340
2700	2832	1049	5166	5362	1038
169667	221755	1307	26043	366950	1409

Control,

Foodgrains

1963-66

Area	Output	Yield
296167	192903	651
544499	350226	643
174899	138614	793
131299	103445	788
121566	172625	1420
19667	17099	869
29450	17002	577
283434	284781	1005
407900	365067	895
386468	376078	973
203467	169595	834
186566	190376	1020
192866	123600	641
285532	168965	592
225866	86838	384
166300	137083	824
251901	89565	356
240800	102714	427
271032	80380	297
4531368	3144769	694

Area	Output	Yield
288991	287818	996
532399	543266	1020
216269	237704	1099
202730	202937	1001
142831	237383	1662
24766	22551	911
29632	35972	1214
325132	561617	1727
258264	683357	2646
371031	345359	931
219298	222896	1016
203863	282582	1386
134432	220760	1642
254030	284626	1120
152831	139394	912
109965	226080	2056
210026	168859	804
168899	223801	1325
209931	79077	377
4260966	5155769	1210

Contd.

Non-Foodgrains

Area	Out Put	Yield	Area	Out Put	Yield
276200	717446	2607	221130	144619	654
70600	132869	1882	145064	295060	2034
306267	1040695	3398	256330	279912	1092
258935	727089	2808	203097	98502	485
31966	90240	2823	15332	91885	5993
300	805	2682	1200	3282	2735
17250	38485	2231	14465	30796	2129
182933	475260	2598	177329	479320	2703
214267	414178	1933	258232	540480	2093
110235	206801	1876	88932	107608	1210
253366	638229	2519	215665	247368	1147
168499	416698	2473	113831	525785	4619
282800	596425	2109	353598	868083	2455
299766	530886	1771	353831	698816	1975
310900	495575	1594	396198	899766	2271
402200	843413	2097	481630	1369274	2843
122866	214893	1749	222365	245713	1105
477300	986102	2066	572398	1081126	1889
389934	761541	1953	332298	266503	802
4156800	9336173	2246	4046966	8158684	2016

Appendix 16

Indicators for the levels of Agricultural development 1963-66

District wise

Districts/State	x1	x2	x3	x4	x5	x6	x7
1. Ahmedabad	1593	4742	71.83	1.03	10.07	1.02	33.31
2. Banaskantha	764	2111	67.73	1.08	8.78	1.01	0.00
3. Baroda	2451	3948	69.37	1.03	5.10	1.00	7.73
4. Broach	2128	4390	59.00	1.00	3.88	1.01	2.83
5. Bulsar	1706	1387	56.10	1.10	5.71	1.00	16.06
6. Dangas	897	948	20.72	1.00	0.00	0.00	0.00
7. Gandhinagar	1188	2280	77.73	1.05	11.35	1.00	0.00
8. Kaira	1634	1979	75.98	1.07	11.61	1.00	29.67
9. Mehsana	1408	2829	75.37	1.09	20.87	1.01	1.26
10. Panchmahals	1201	1602	53.81	1.15	2.26	1.00	21.96
11. Sabarkantha	1765	4593	66.11	1.07	12.22	1.00	2.77
12. Surat	1710	28090	60.08	1.05	8.88	1.00	71.18
13. Amreli	1381	5663	78.24	1.01	7.00	1.01	6.50
14. Bhavnagar	1196	4025	66.58	1.03	9.50	1.01	12.76
15. Jamnagar	1085	4979	52.08	1.04	6.76	1.02	6.38
16. Junagadh	1725	4835	54.42	1.07	15.67	1.20	3.70
17. Kutch	857	3261	11.99	1.02	7.83	1.12	15.93
18. Rajkot	1513	6569	66.06	1.02	7.75	1.00	24.69
19. Surendranagar	1274	8332	67.43	1.03	4.68	1.07	15.12

Contd:

x1 = Yield rate x2 = Labour productivity
x3 = percentage of net soun area to total area for land utilisation
x4 = Intensity of cropping i.e. (gross area sown)
x5 = Percentage of gross irrigated area to gross cropped area.
x6 = Intensity of irigation gross area irrigated/Net area irrigated

x8	x9	x10	x11	x12	x13	x14
9.71	56.97	2.59	2.65	51.29	78.20	6.31
0.92	99.07	0.43	0.57	27.02	57.89	4.00
16.64	70.45	0.46	2.88	61.41	86.67	3.46
3.21	91.68	3.85	1.81	64.82	87.58	3.35
28.15	51.98	0.00	4.57	46.29	262.46	7.47
0.00	0.00	0.00	0.64	21.13	179.77	0.41
0.00	98.40	0.00	6.69	37.33	0.00	19.15
1.99	67.61	10.57	5.69	39.43	90.28	6.76
0.59	86.90	1.80	2.86	34.97	57.54	15.45
8.46	69.31	0.84	0.41	22.51	72.65	2.30
0.65	96.18	1.06	2.72	55.25	77.46	17.26
5.19	22.35	8.49	3.68	49.14	144.89	4.43
0.65	92.83	4.85	3.44	60.82	56.45	16.27
.44	86.84	3.90	2.24	51.42	57.38	12.90
0.00	93.61	2.55	3.06	57.90	37.52	21.92
0.00	96.29	6.07	5.66	70.45	91.33	32.64
1.86	82.76	0.23	1.80	39.31	81.33	6.39
3.75	71.31	5.51	4.63	66.37	58.20	19.42
1.21	83.55	0.32	1.38	59.86	50.80	5.77

control

x8 = Percentage of tank irrigated to net area irrigated
x9 = Percentage of area under well irrigation to net irrigated area
x10 = Consumption of fertilizers per 1000 hectares of gross cropped area
x11 = Mechanization Index.
x12 = Proposition of area under non-foodgrains to gross cropped area.
x13 = Mean annual rainfall.
x14 = Number of oil engine per thousand hectare of gross cropped area.

x15	x16	x17	x18	x19	x20	x21
0.38	257.00	10.16	2.66	263.78	0.39	1635.15
0.04	253.00	9.32	0.46	272.17	0.04	819.17
0.45	512.00	5.25	8.71	526.94	0.46	2522.47
0.43	413.00	3.87	3.87	414.81	0.43	2145.00
0.55	585.00	6.37	0.00	641.13	0.60	1871.22
0.00	489.00	0.00	0.00	489.89	0.00	898.24
0.78	663.00	11.89	0.00	694.55	0.82	1244.33
1.00	683.00	12.42	11.31	731.08	1.07	1749.42
0.23	366.00	22.59	1.96	399.37	0.25	1366.86
0.05	655.00	2.62	0.97	756.14	13.06	1354.97
0.28	394.00	13.46	1.17	422.69	0.31	1942.80
0.65	488.00	8.71	8.92	512.45	0.68	1795.79
8.54	248.00	7.04	4.92	251.72	8.67	1536.78
0.17	274.00	9.66	4.01	281.01	0.17	1229.95
0.17	208.00	6.84	2.64	215.30	0.18	1117.85
0.24	328.00	14.01	6.49	350.70	0.26	1843.75
0.12	172.00	7.09	0.23	175.04	0.12	872.41
0.20	222.00	7.89	5.62	226.61	0.20	1544.63
0.20	150.00	4.40	0.32	151.14	0.20	1283.32

x15 = Number of tractors per thousand hectare of gross cropped area.
x 16 = Number of male workers per 1000 hectare of gross cropped area.
x17 = Irrigation age Percentage of net soun area Net area irrigated/Net soun area irrigat
x18 = Consumption of fertilizer per 1000 hectares of net soun area.
x19 = Number of male workers per 1000 hectares of gross cropped area.
x20 = Number of tractors per 1000 hecatares net soun area
x21 = Land productivity per net soun area.

Appendix 17

Indicators for the level of agricultural development (1977-80) District wise

District/State	x1	x2	x3	x4	x5	x6
1. Ahmedabad	848	1855	67.22	1.05	16.55	1.99
2. Banaskantha	1237.	2446	67.52	1.17	21.58	1.06
3. Baroda	1096	1275	69.20	1.04	20.70	1.11
4. Broach	732	1209	55.40	1.01	9.58	1.02
5. Bulsar	2082	1279	67.05	1.11	15.61	1.19
6. Dangas	995	1016	30.00	1.05	2.06	1.00
7. Gandhinagar	1461	1904	73.55	1.55	38.45	1.18
8. Kaira	2086	1912	74.19	1.14	40.62	1.24
9. Mahsana	2467	3188	76.71	1.27	38.24	1.18
10. Panchmahals	985	847	53.46	1.14	6.73	1.06
11. Sabarkantha	1188	1833	60.58	1.12	31.93	1.13
12. Surat	2545	2550	51.29	1.07	28.23	1.11
13. Amareli	2262	5719	73.09	1.05	10.53	1.16
14. Bhavnagar	1759	3833	62.66	1.08	14.50	1.03
15. Jamnagar	1914	5380	58.09	1.11	16.50	1.38
16. Junagadh	2698	4878	57.67	1.09	15.42	1.08
17. Kutch	960	2837	14.51	1.03	9.94	1.27
18. Rajkot	1761	4873	64.54	1.09	18.14	1.07
19. Surendranagar	638	2152	62.00	1.02	10.12	1.03

Contd.

Here the variables x1 to x21 are same as defined in 1963-66

x2	x8	x9	x10	x11	x12	x13	x14
36.42	2.41	60.18	20.30	2.97	18.26	96.94	19.97
7.34	0.51	91.09	9.47	2.03	15.95	75.08	20.15
1.80	3.61	93.38	43.80	2.20	26.12	131.78	9.26
22.36	1.30	72.32	13.60	1.71	19.75	120.52	8.96
46.43	7.60	44.31	27.20	3.25	12.65	199.78	16.18
0.00	0.00	99.99	0.23	0.00	0.00	243.38	0.00
0.00	0.00	99.99	37.03	7.20	20.67	58.03	37.29
31.93	1.86	66.09	58.83	4.73	22.19	114.29	13.89
1.96	2.43	95.60	22.33	2.59	25.04	88.84	24.17
31.84	13.72	50.82	11.97	0.43	7.33	131.87	6.56
6.30	0.52	93.14	62.57	5.15	28.27	100.55	57.21
71.98	2.02	25.36	54.27	3.09	15.55	186.69	15.26
10.95	0.49	88.55	44.07	3.14	25.96	69.20	62.96
33.53	3.81	62.65	33.53	2.76	24.89	73.15	46.03
7.01	0.00	92.16	42.03	2.68	31.34	78.22	59.39
4.70	0.00	95.29	24.67	5.30	30.67	32.15	98.73
20.19	0.00	79.60	32.60	1.59	30.15	60.65	15.57
20.16	2.45	76.69	63.20	4.55	31.36	15.78	74.19
13.54	0.00	86.44	8.47	1.41	27.55	72.47	29.47

x15	x16	x17	x18	x19	x20	x21
0.23	386.00	14.60	21.28	404.66	0.24	888.80
0.19	352.00	23.93	11.10	412.68	0.22	1450.88
0.17	730.00	19.31	45.54	758.97	0.18	1139.08
0.18	564.00	9.44	15.71	568.30	0.18	748.59
0.24	794.00	14.48	30.08	877.97	0.27	2301.44
0.00	686.00	0.36	0.23	687.24	0.00	997.18
0.26	636.00	37.47	42.50	730.01	0.30	1670.08
0.54	941.00	37.38	67.00	1071.73	0.62	2375.69
0.13	454.00	41.20	78.44	578.17	0.23	3017.22
0.01	964.00	7.23	13.65	1099.21	0.01	1122.97
0.39	572.00	31.48	79.84	638.43	0.44	1322.35
0.28	746.00	27.28	80.02	797.57	0.30	2720.16
0.04	376.00	9.54	46.10	393.30	0.04	2333.78
0.08	422.00	15.25	36.16	455.07	.09	1896.46
0.05	300.00	13.21	46.49	331.87	0.06	2117.80
0.05	492.00	15.59	26.96	537.61	0.05	2948.16
0.07	209.00	8.10	33.64	215.64	0.07	990.82
0.15	343.00	18.45	68.58	372.20	.16	1910.58
0.03	244.00	9.99	8.61	248.00	0.03	648.21

Appendix IS

Indicators for agricultural development in the state of Gujarat.

Items	1963-66	1977-80
x_1	1437	1616
x_2	51.73	50.82
x_3	105.03	109.68
x_4	9.02	19.61
x_5	103.24	113.61
x_6	13.63	18.41
x_7	13.63	1.89
x_8	80.79	75.01
x_9	3.57	32.87
x_{10}	3.00	32.87
x_{11}	49.75	72.47

x_1 = Yield rate(in rupees)

x_2 = Percentage of net sown area to total reporting area

x_3 = Intensity of cropping i.e gross area sown/ Net area sown

x_4 = Percentage ofgross irrigated area to gross cropped area.

x_5 = Intensity of irrigation i.e $\frac{\text{Gross area irrigated}}{\text{Net area irrigated}}$

x_6 = Percentage of canal irrigated to net area irrigated.

x_7 = Percentage of tank irrigated to net area irrigated

x_8 = Percentage of area under well irrigated to net irrigated area.

x_9 = consumption of fertilizer per 1000 hectares of gross cropped area

x_{10} = Mechanization index

x_{11} = Progortion of area under non food grain to gross cropped area

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