AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
BATCH #20

1. SUBJECT CLASSIFICATION

A. PRIMARY: Agriculture — AE30-0000-G635

B. SECONDARY: Development--India

2. TITLE AND SUBTITLE
India's agricultural progress in the 1950's and 1960's

3. AUTHOR(S)
Hendrix,W.E.; Giri,R.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1970	151p.	ARC IN630.954.H498b

7. REFERENCE ORGANIZATION NAME AND ADDRESS
USDA/ERS

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

9. ABSTRACT

10. CONTROL NUMBER
PN-RAB-116

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Data
India
Sector analysis

13. PROJECT NUMBER

14. CONTRACT NUMBER
PASA RA-2-00 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

India's Agricultural Progress in the

1950's and 1960's

by

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NEW DELHI

Printed by courtesy of United States Agency for International Development
at the Arcee Press, New Delhi, India

Preface

This report has been prepared as one phase of a cooperative research project on "Factors Associated with Changes and Differences in Agricultural Output and Productivity in India" conducted under a Memorandum of Understanding between the Ministry of Food, Agriculture, Community Development and Cooperation, Government of India, the Economic Research Service, United States Department of Agriculture and the United States Agency for International Development. India is one of seven developing countries in which the Economic Research Service has carried on somewhat comparable eountry studies for the U.S. Agency for International Deuelopment. The other countries are Brazil, Colombia, Greece, Mexico, Nigeria and Taiwan.

The project has been conducted under the direction of Shri R. Giri, Directorate of Economics and Statistics, Ministry of Food, Agriculture, Community Development and Cooperation, Government of India and Dr. William E. Hendrix, Economic Research Service, United States Department of Agriculture. They have been assisted by Dr. B. Sen and Shri R. Natarajan, United States Agency for International Development and Shri Sham Joshi, Directorate of Economics and Statistics. Analysis of data on district growth rates of crop output area and productivity was programmed for electronic computor operations by Shri D.L. Ralhan and Shri D.K. Bahl of the Institute of Agricultural Research Statistics.

In finalizing this report, the authors have also benefitted from suggestions from several economists and statisticians in Government Departments, Universities, and research organizations in India and from those of the United States Department of Agriculture and the United States Agency for International Development.

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CHAPTER 1

Introduction

...at the stroke of the midnight hours...
India will awake to life and freedom [56]

—**Jawaharlal Nehru**
August, 14 1947

Scope and Purposes of Study

When India became a free, sovereign nation in 1947, agriculture was the main source of livelihood for about three fourths of its 350 million people. Hence, the performance of agriculture in the ensuing years is one appropriate measure of fulfillment of the hopes of its people then so eloquently expressed by its first Prime Minister. The record of these years provides also an experience basis for evaluating the key ideas that have served as the guiding and organizing principles of India's recent agricultural development efforts. Moreover, because India is a highly diverse country, it is one in which such ideas can be examined under a wide variety of underlying physical, social, economic and institutional conditions.

This report presents main finding from an economic analysis of India's agricultural production growth since its Independence. Its purposes are to indicate rates of growth in agricultural production in India, its states and districts; to identify and assess the importance of major physical, social, economic and institutional factors contributing to or impeding this progress; and to indicate implications of these findings for the Nation's agricultural production potentials and their resource and policy requirements.

The General Setting in India 1947

India is the world's seventh largest nation in land area and its second largest in population. Its current population of 540 million people is larger than that of either the whole Western Hemisphere or of Europe outside the USSR.

At Independence, India was composed of a loosely knit mosaic of states formed out of what had formerly been British provinces and 540 princely or "native" states. The latter differed widely in size, autonomy, and governing patterns. While exhibiting large extremes of wealth, most of its people lived in severe

poverty. Its per capita income and literacy and educational levels were among the lowest in the world. Its schools, agricultural research and educational facilities, roads, electric, power, input supply industries, credit institutions and other infrastructures essential to agricultural progress were at a low level of development [50].

India had been predominantly an agricultural region throughout its known history [83]. In 1947, roughly 75 percent of its population of 350 million people depended on agriculture as their main source of employment and livelihood. Most of these lived in villages composed of farmers, herdsmen, agricultural laborers, land owners, money landers, artisians, traders, and other service workers including village officials, teachers and religious leaders in a variety and number making each village a highly self-contained unit of social and economic organization [81].

For centuries the dominant concern of India's masses had centered on the problems of sheer physical survival of families and villages as well as of individuals. Severe droughts and floods had recurred frequently throughout its history, resulting in wide-spread famine and starvation for large numbers of people. Epidemics of smallpox, cholera, typhoid and other dread diseases had been common, sometimes virtually depopulating whole villages and regions. In earlier centuries, many parts of India had repeatedly suffered the revages of war brought on by both foreign invaders and internal rivals. Age-old concern with these and other problems of survival had left a deep imprint upon the whole life outlook of the masses of India's people—upon their hopes, expectations, fears, and group loyalties as well as upon their institutions, beliefs and values.

At Independence, India's agriculture, except for a few small enclaves producing export crops like tea and spices, was highly traditional in three important respects. (1) It was prescientific—carried on mainly with kinds of inputs that had changed little for many generations. (2) It was premarket—carried on mainly for internal village consumption plus enough to pay taxes often in kind. (Marketing by farmers was limited to the small residuals above their household needs left after their payments in kind to village laborers. money-lenders, officials, artisian and others contributing to their agricultnral output and to the maintenance and continuity of village life). (3) As a correlative of its self-sufficiency, agriculture was also pre-market in that custom, tradition and authority had long been important sources of allocative and distributive directive *vis-a-vis* the directives of a large market economy [33, 40 and 84].

Most of India's rural people lived in villages where each person's role in the village economy had long been based on birth, some born to be cultivators, and others, to be laborers, carpenters, blacksmiths, masons, traders, cloth or leather makers, household servants, sweepers, and so on as required to make highly (although never wholly) self-contained village units of social and economic organization. The activities of each were related to those of others, instead of through normal market processes, an intricate system of reciprocal relationships obligations, rights. duties, rewards and depen, dence—long embedded in custom reinforced to a marked extent by ideological considerations [80].

India's agriculture had long been highly static not alone in technology and organization but also in its aggregative level of production [77]. Its volume of foodgrain production had varied little from one decade to another during the first half of the twentieth century. Its per capita output of all agricultural commodities had been declining for more than two decades (figure 1).

Moreover, in 1947, India had yet to develop (a) economical sources of supply and distribution systems for modern farm inputs ; (b) a rapidly growing nonfarm sector as a market or demand basis for sustained increases in production beyond those needed to meet farmer's consumption needs; (c) modern transport and marketing facilities and services needed for linking farmers more closely to nonfarm markets; and (d) strong research, education, extension, credit, and other institutions of the kinds required for a rapidly growing and highly dynamic agriculture [82].

Its principal asset capable of sparking the beginning of sustained economic progress consisted of its relatively small body of well-educated leaders dedicated to this objective. Most of these were closely associated with government but some were in educational, trade, manufacturing and professional fields. These leaders were keenly aware of the Nation's economic backwardness and of the need to increase its per capita output and levels of living and to eradicate its widespread poverty.

Tenure and Indebtedness

India's agriculture at the time of Independence was organized around 70 million cultivating units. Most of these had fewer than 5 acres of cropland. Many were crop share tenants paying half or more of their output as rent and taxes under semifeudal tenure systems. Its system of land tenure consisted of three main kinds based upon land revenue collection practices. These were (1) the *zamindari* or landlord tenure where one person or a few joint owners were responsible to the State for collecting the land revenue on the whole estates; (2) the *mahalwari* or joint-village tenure where the village land was held by co-sharing farmers or village communities, whose members were jointly and severally liable for the land tax; and (3) the *ryotwari* or peasant proprietors tenure where each individual holder was directly responsible for payment [50].

Zamindari and community system predominated in Bengal, Bihar, Punjab, the Central Province (now comprising much of Madhya Pradesh) and the United Province (now comprising Uttar Pradesh). The ryotwari system was, however, dominant in Assam, Madras (which now comprises parts of Mysore, Kerala, and Andhra Pradesh) and Bombay (which now comprises mainly Maharashtra) provinces.

Most of the area under zamindari and mahalwari tenure, comprising nearly two thirds of the land under cultivation in British India, was tilled by tenants as were also many of the ryotwari holdings [50]. Tenancy had long been increasing and so had rents [82]. As a result, among other things, of the increasing pressure of population on land associated with the accelerating rate of growth in the nation's total population. Roughly 50 to 60 percent of the gross produce on tenant farms was being paid to landlords as payment of rent in addition to the rendering of services for the landlords being permitted to cultivate their land.

Rural indebtedness had long been one of the country's most serious rural economic problems. The extent of indebtedness had been rapidly increasing for several decades, from Rs. 300 crores in 1911 to Rs. 1800 crores in 1938 [82].

Agricultural Infrastructures and Institutions

Agricultural service facilities and infrastructure feature were also at low level of development. Because of the low state of development of transport, communications and storage facilities, prices paid to farmers for their products differed much from one locality to another.

Some progress had earlier been made in the development of major canal irrigation system, especially in the Punjab [8]. Yet only

a small part of the Nation's vast irrigation potentials had yet been developed. Several major irrigation projects of promise had been reviewed and approved in principal but had not been implemented despite large governmental spending augmented by large sums spent by private agencies on famine reliefs at several different times in the first five decades of the twentieth century [50]. Little had been done to provide electric power for its rural population.

Rural education at both primary and secondary levels had been sadly neglected. Literacy rate for the country as a whole was only 17 percent in 1951. Fewer than 2 million pupils were in school at the secondary level in 1947. There were only 18 universities in the whole of India in the late 1930's.

Before partition, India had six agricultural colleges (at Koimbatore Poona, Cawnpore, Naini, Lyallpur—in West Pakistan and Nagpur) and only three central institutions for agricultural research (the Imperial Agricultural Research Institute at Delhi and the Imperial Institute of Animal Huscandry and Dairying at Bangalore and the Imperial Vetinary Research Institute at Muktesar in Uttar Pradesh [82].

Technologies and Production Trends

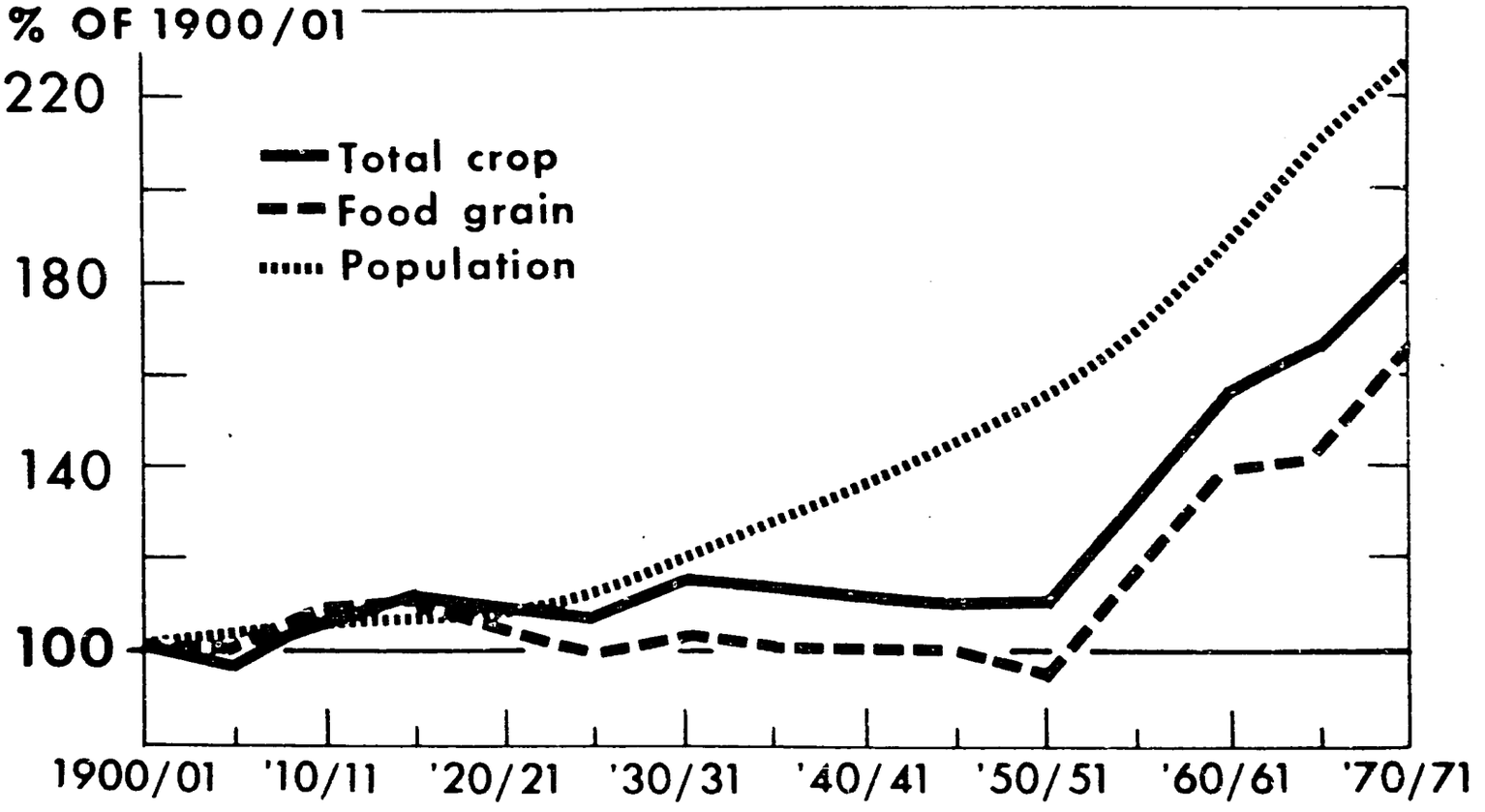
Crop yields in India were among the lowest observed in any part of the world. Methods of farming had changed very little for centuries. Total volume of foodgrain production varied little from one decade to another during the first hald of the twentieth century. India's population, however, had begun to rise as a results of improvements in medical and sanitation fields. Consequenly, by 1947, India's per capita volume of production of both foodgrains and all commodities had been declining for three decades (figure 1).

At the time of Independence, the reversal of this trend posed one of India's most urgent economic problems. Its solution was recognized as essential not only to alleviate widespread hunger and malnutrition but also to facilitate the nation's general economic progress.

The following chapter deals with the approaches taken in the 1950's and 1960's to inereasing the nation's agricultural output and productivity. Subsequent chapters indicates the progress that has been made in the problem's solution and contain analyses of the major factors contributing to these gains and to differences among states and among districts of selected states in the ratcs of increase in agricultural production.

Figure 1.

INDIA: TOTAL CROP PRODUCTION, FOOD GRAIN, AND POPULATION-INDEX NUMBERS, 5 YEAR AVERAGE



CHAPTER 2

Agricultural Development Strategies

Against the above background of conditions and problems, India's leaders turned to improving its agriculture after Independence. Despite critical social, economic and political problems, they were generally optimistic concerning its agricultural development prospects. The differences then existing in crop yields between India and economically advanced nations were viewed as *ipso facto* evidence of a large gap between applied and available technologies adaptable to Indian conditions. The closing of this gap appeared to offer a relatively cheap source of increases in agricultural production that could be quickly achieved through agricultural informational and motivational programs.

Pre-Independence Planning

Several years before Independence, India's leaders had already concluded that the State or public sector would need to play a major role in both agricultural and general economic development. The Indian Congress Party had begun work in 1937 preparatory to drawing up a national economic development plan. India's chief problem after Independence, in the views of its leaders, would be that of eradicating poverty. This would "require a radical reform" in the land system, including abolition of "landlordism". It would require the liquidation of agricultural indebtedness and "provision for cheap credit for the rural population". Strengthening of the cooperative movement was assigned high priority. Putting agriculture on a scientific basis was viewed as a necessity. Finally, it was held that agricultural development, instead of being adequate by itself, would have to be supplemented by a comprehensive scheme of industrial development, relying heavily upon state ownership and control [75].

Five Year Plans

In 1946, an advisory planning board was appointed to make further study and recommendations on the nation's economic development policies and programs [75]. However, the first major official document outlining India's agricultural and general economic development goals and the means proposed to achieve them was its First Five Year Plan presented in draft outline by the Planning Commission in July 1951 and in final form in December 1952 [52].

This Plan was mainly an anthology of the nation's individual projects already initiated or in blue print form. It nevertheless reflected some of the key ideas and hypotheses that have served as major guides to India's agricultural development since Independence.

In the First Five Year Plan, agriculture proper and community development were assigned high priority. They were allocated about 15 percent of a total plan outlay of Rs. 2,378 crore. In addition, irrigation projects accounted for 9.0 precent and multiple purpose irrigation-power projects for 10.8 percent of the plan expenditures. Some additional funds were allocated to the production of fertilizers and other industrially produced agricultural inputs and to the building of infrastructure features clearly essential to agricultural progress [58].

The First Five Year Plan, as did the next two Five Plans, put heavy emphasis upon institutions designed to close what was then presumed a large technological gap as opposed to research institutions for improving adaptable farm technologies [75]. Land reform, already undertaken, were viewed as means of increasing producer incentives and of achieving a more equitable distribution of economic opportunity. Land reform measures included elimination of zamindars, limiting size of owner holdings, consolidation of highly fragmented cultivator units, schemes of land distribution to landless workers, development of cooperative farming, and development of cooperative village management schemes [58].

Community development programs were intended to provide a means of quickly involving the masses of India's rural people in its democratic processes and its development plans and activities. These programs were to be designed primarily at local levels with district, state and Centre development officers, however, assisting in their broad general direction and coordinating functions. Each community development project was to encompass approximately 300 villages representing a population of about 2,000,000 people. It was broken down into 3 Development Blocks. Each Block, in turn, was divided into groups of 5 villages, with each group to be served by a village level worker. The main lines of activity to be undertaken in Community Development included, in addition to agriculture, irrigation and other farm related subjects, communications, education, health, housing, training and social welfare problems. People's participation was seen as the crux of the program, essential to insuring local participation in the planning process and implementation. This program was to be started with approximately 55 projects in selected areas, with availability of irrigation facilities or assured rainfall being one of the main selection criteria. They were later to be extended to encompass the whole nation [37, 38 and 58].

A closely related institutional innovation was the development of a national agricultural extension service to be carried on by departments of agriculture. The central government was to assist states in establishing extension organizations to provide coverage of the whole Nation within 10 years. Primary emphasis was put upon agricultural education functions. But since it was expected that the first impact of education would be to increase cultivators' demand for fertilizers, other inputs and credit, extension workers were assigned major responsibility for local distribution of these inputs and services.

The need for training facilities for extension workers as well as for village level workers was recognized. So was the need for strengthening the nation's program of agricultural research. It was recognized, however, that the development of agricultural

universities and research intsitutions as needed to sustain growth beyond that possible by closing the existing technological gap would require much time and careful planning.

Development of the cooperative movements, which had long been promulgated, was given a major role to play in India's agricultural and general economic development plans. Multipurpose and credit cooperatives, sale and purchase cooperative, cooperative forming, and a close linkage of cooperative to the Panchayats (or village governing bodies) and to community development projects were emphasized [152].

The announced goal of price policy was that of stabilizing prices of agricultural commodities. It was doubted that higher food prices would lead to substantial increases in agricultural production. Rather fears were expressed in the Plan Report that increases in food prices would lead to such large increases in prices of things that cultivators buy as to leave them no better off, or even worse off than they had previously been [58]. According to the Plan Report :

> .....In the last analysis what limits the real income of the primary producers is low productivity. To increase this latter, what is needed is a programme of public investment which will give him the water, the power, the seeds and the manures he needs. A policy which might raise prices all round and jeopardise the investment program itself is, therefore, of no ultimate benefit to the producer [58].

The free market was not regarded "as a dependable mechanism when the economy is or is likely to be under pressure due to short supplies", as has been the case throughout most of the period 1950-51 to 1967-68 [58].

Foreign Agricultural Assistance Programs

Since the early 1950's, India has drawn heavily upon economic and technical assistance provided by the government of other countries, international development agencies and private foundations [44]. The larger part of this assistance has been provided by the government of the United States under bilateral arrangements, by international development agencies to which the United States has been a large contributor, and by U.S. foundations (Appendix III).

A relatively large percentage of the U.S. technical personnel employed in India from 1952 to 1956 were extension specialists assigned to help the various states of India to establish an extension service and develop centers for the training of extension workers, including village level workers in Community Development programs. Such extension activities, however, have represented a relatively small part of U.S. monetary expenditures for improving India's agriculture. Rather, heavy emphasis has also been put on introduction into Indian agriculture of chemical fertilizers, pesticides, tubewells, hybrid maize, improved implements and other modern inputs ; upon research into uses of these inputs ; development of rural electric power sources, irrigation potentials, roads and other infrastructures ; organization and development of agricultural universities combining resident teaching, research and extension training programs ; strengthening of research centers ; and development of indigenous sources of supply of fertilizers and other modern inputs. Up to the end of 1968, the U.S. had also helped more than 5,000 Indian nationals to undertake advanced graduate study in the United States and other countries to improve their competence in education, research, and administration in a large number of fields,

with heavy emphasis on personnel in agricultural institutions [44].

In its assistance programs, USAID and predecessor agencies have collaborated closely with the Ford and Rockefeller foundations. In some cases it has joined with the Foundations in supporting specific projects. In other cases it has worked with them in so delineating areas of work as to make most effective use of the unique capabilities of each agency. Accordingly, the Ford Foundotion has assumed major responsibility for Community Development Programs and for the Intensive Agricultural District Program initiated in 1960. The Bockefeller Foundation began its opcration in India in 1955. Its activities have focused heavily on adaptive research to improve wheat, rice and other cereal varieties.

The New Strategy

During 1965-66 and 1966-67, India experienced about the most severe two years of consecutive drought in its history. As a result, its foodgrain production dropped from 89 million tons in 1964-65 to 72 million in 1965-66 and 74 million in 1966-67. This period of near disaster, however, marked the beginning of a new era in Indian agricultural development. This new era officially began with enunciation of what was called "The New Agricultural Strategy" late in 1965. The "New Strategy" called for the rapid introduction into Indian agriculture of greatly increased amounts of seeds of improved crop varieties, fertilizers, pesticides and other yield increasing inputs. It included also the decision to concentrate these new inputs into areas and on crops that could most productively use them in contrast to earlier attempts to raise output and productivity of all crops in all localities [47, 67 and 68].

Geographically, the new inputs were to be concentrated in areas having an assured supply of water from year around irrigation sources. This was envisaged as a means of making much more effective use of the irrigation facilities that India had already developed and of new irrigation potentials that could be quickly developed by the installation of tubewells in localities having both large underground water supplies and relatively good access to sources of electric energy.

Cropwise, these new inputs were to be allocated to crops for which high yielding varieties with demonstrated capacity for using greatly increased amounts of fertilizers and pesticides in conjunction with adequate supplies of water were available. This had been made possible by recent large varietal improvements for wheat, rice, maize, jowar and bajra. Such a new variety of wheat had been provided by introduction and successful adaptation of Mexican dwarf varieties developed in adaptive research by Rockefeller Foundation scientists building on research foundations earlier laid by scientists in the U.S. Department of Agriculture and affiliated agricultural experiments stations. New high yielding varieties of rice included mainly one imported from Taiwan (TN-1) and one developed from indigenous materials by India's own research institutions (ADT-27). New maize, jowar and bajra hybrids were a product of several years of earlier work initiated under TCM Project Agreement No. 45 [44] and subsequent research carried on by Indian research institutions with the help of Rockefeller Foundation scientists [34-36].

U.S. governmental contribution to the introduction and successful adaptation of most of these new crop varieties had been relatively small and for the most part indirect through its assistance to the building up of India's

research institutions. On the other hand, the Agency for International Development began in 1966 to supply greatly increased amounts of foreign exchange for procurement of the increased amounts of fertilizers, pesticides, tubewell casings and other inputs without which the New Strategy could not have succeeded. It also provided additional technical assistance through the provision of U.S. University and U.S. Department of Agriculture Agricultural Production Promotion teams attached to State Departments of Agriculture to help them to draw more fully upon the research findings and professional competence of U.S. supported agricultural univeasities as resources to implement the "New Strategy".

In brief, at a time when the achievement of substantial increases in agricultural production in India looked hopeless to many U.S. observers, the U.S. Agency for International Development provided greatly increased financial and technical assistance to help India to implement its new strategy and to realize the potentials of new varieties and other earlier improvements in agricultural production foundations laid in part with U.S. economic and technical assistance. This was done not by increases in U.S. assistance to India but by an increased emphasis on agriculture in the allocation of U.S. AID funds in line with increased emphasis on agricultural in India's own policy pronouncements and budgetary allocations.

CHAPER 3

India's Crop Output Growth Rates Since Independence

This chapter deals with India's progress in increasing its agricultural production since Independence. Its emphasis is on the period 1949-50 to 1964-65.

The year 1949-50 marked a return to normalacy following partition. The year 1964-65 has been chosen as the terminus of this longer period for two reasons. The first of these is that 1964-65 was followed by about the most severe two years of consecutive drought in the nation's history. The second reason is that these same drought years marked the beginning of what promises to be a new era of rapid increases in India's agricultural made possible by the combined influence of large new technological breakthroughs and of new policy directions with a greatly increased emphasis upon agriculture.

Crop production has been used as the measure of the Nation's agricultural performance for two main reasons. The first is that it normally accounts for from 80 to 85 percent of the value of India's total agricultural output [52]. The other is that time series on the output of livestock and livestock products are too limited for measurement and analytical purposes.

The All-India Record

From 1949-50 to 1964-65. India's total crop output increased at an annual compound rate of 3.2 percent per year (table 1). This was 1.0 percent per year above its population growth between the two census years of 1951 and 1961 and 0.7 percent above that now estimated for the period 1960 through 1965. In quantitative terms, output of foodgrains increased by nearly 30 million tons from the 1949-50 base of about 60 million tons ; oilseeds, excluding cottonseed, by 3.2 milllon tons from a base of 5.26 million tons ; cotton and jute combined by 5.8 million (180 kilogram) bales from a base of 5.9 million bales ; and sugarcane (gur) by about 6 million tons from a base of 6 million tons. Somewhat comparable percentage increases were achieved for most of India's crops. Foodgrain output in this 15 year period increased by an average of nearly 2 million tons per year in contrast to little or no increase in the preceding four decades (figure 1).

In this period, there were sizeable year to year variations in India's crop output resulting from vagaries of its monsoon climate (table 1). Otherwise, India's output of all crops

Table 1

India : Indices of output of foodgrains and all crops, 1949-50 to 1968-69[1]

(1949-50=100)

Year	Foodgrains	Non-foodgrains	All-crops
	percent	percent	percent
1949-50	100.0	100.0	100.0
1950-51	90.5	105.9	95.6
1951-52	91.1	110.5	97.5
1952-53	101.1	103.8	102.0
1953-54	119.1	104.7	114.3
1954-55	115.0	120.9	117.0
1955-56	115.3	119.9	116.8
1956-57	120.8	131.5	124.3
1957-58	109.2	129.5	115.9
1958-59	130.6	139.4	133.5
1959-60	127.9	135.0	130.3
1960-61	137.1	152.6	142.2
1961-62	140.3	153.9	144.8
1962-63	133.6	151.6	139.6
1963-64	136.5	156.5	143.1
1964-65	150.8	176.7	159.4
1965-66	120.9	154.8	132.1
1966-67	123.8	147.4	131.6
1967-68	159.0	165.1	161.0
1968-69	157.5	161.0	158.7

Source : [21]

[1] Foodgrains include all cereals and pulses. Nonfoodgrains refer to all other crops used in the development of Indian indices of agricultural production. Methods of constructing index numbers are described in References 16 and 17.

displayed a fairly consistent growth pattern. Total output during the 1949-50 to 1964-65 period followed roughly a straight line, indicating near equal annual increments to output but a steadily declining rate of growth in the Nation's total crop output. Increments to foodgrain output declined somewhat in the latter half of the 1949-50 to 1964-65 period. However, these decreases in foodgrain output were off set by increasing increments of output of nonfoodgrain crops.

State Difference in Crop Output Growth Rates

Indices of crop output appropriately adjusted for changes in reporting methods and coverages of crops and for changes in geographic boundaries have been developed on a

Table 2

All-India and 15 states : Annual compound crop output growth rates and population growth, 1952-53 to 1964-65

State	All-crops	Foodgrains	Nonfood grains	Population growth rate[1]	Foodgrain-population growth ratios
	percent	percent	percent	percent	ratio
Punjab	4.56	3.66	7.04	2.61	1.40
Gujarat	4.55	2.06	6.62	2.61	0.79
Madras	4.17	4.17	4.17	1.25	3.34
Mysore	3.54	3.31	4.08	2.08	1.59
Himachal Pradesh	3.39	3.63	1.50	2.22	1.64
Bihar	2.97	3.05	2.49	2.12	1.44
Maharashtra	2.93	2.20	4.38	2.32	0.95
Rajasthan	2.74	2.42	4.08	2.68	0.90
Andhra Pradesh	2.71	3.21	1.60	1.63	1.97
Madhya Pradesh	2.49	2.32	3.81	2.51	0.92
Orissa	2.48	2.39	2.95	2.16	1.11
Kerala	2.27	3.68	1.70	2.33	1.58
West Bengal	1.94	1.14	3.77	2.92	0.38
Uttar Pradesh	1.66	0.85	3.61	1.84	0.46
Assam	1.17	0.76	1.49	3.15	0.24
All-India	3.01	2.50	3.99	2.50	1.00

Source : [16].

[1]Population growth rates for states are for 1951 to 1961 ; that for All-India is the estimated rate for the period 1951 to 1965 [68].

state by state basis for the years 1952-53 through 1964-65. Crop output growth rates as shown in table 2 have been computed from these indices for India's several states.

India's states differ greatly in their physical, economic and cultural features. They also differed greatly in rates of growth in crop output during the period 1952-53 through 1964-65. Three states had growth rates of 4 percent or more per year. These were the consolidated Punjab (4.56 percent), Gujarat (4.55 percent), and Madras (4.17 percent). Two other states had growth rates above the All-India average of 3.01 percent per year. These were Mysore with a growth rate of 3.54 percent and Himachal Pradesh with a rate of 3.39 percent.

In contrast, 10 states were below the All-India average of 3.01 percent in rate of crop output growth. Three had growth rates

below 2 percent. These were Assam (1.17 percent), Uttar Pradesh (1.66 percent) and West Bengal (1.94 percent).

Hence, while India's crop output growth from 1952-53 to 1964-65 was short of its goals and needs, not all of its agriculture has been relatively static. About half has been static or retrogressing in output per capita of total population. The other half was fairly dynamic, comparing favourably in rate of growth with that made in the United States and other western countries during their periods of most rapid growth in agricultural production.

District Difference in Crop Output Growth Rates

Indices of the output, area and yields of major crops, crop groups and all crops combined have been developed for the years 1952-53 to 1964-65 on a district basis for the states of Punjab and Uttar Pradesh lying in the Indo-Gangetic Plains and for Madras and Orissa in the eastern Peninsular region. Each of these two pairs of states represents a study in contrasts with respect to rates of crop output growth during the period 1952-53.

Table 3

Punjab : Compound crop output growth rates per year by districts, 1952-53 to 1964-65

District	All-crops	Foodgrain	Non-foodgrains
	percent	percent	percent
Bhatinda	7.85	5.83	14.03
Patiala	7.75	7.99	7.25
Hissar	6.94	4.23	16.35
Karnal	5.53	4.63	7.83
Mahendra garh	5.11	3.97	15.25
Ludhina	4.85	4.62	6.70
Jullundar	4.62	3.77	6.49
Sangrur	3.58	4.03	2.72
Ferozepore	3.30	1.79	5.98
Hoshiarpur	3.38	2.34	7.32
Rohtak	2.94	1.09	6.86
Ambala	2.79	1.99	4.82
Gurgaon	2.42	1.01	8.30
Amritsar	2.07	2.31	1.50
Kapurthala	1.71	1.81	1.70
Kangra	1.16	0.83	4.36
Gurdaspur	1.24	1.32	2.25
All-State	4.56	3.66	7.04

Source : [27]

Table 4

Uttar Pradesh : Compound crop output growth rates per year by districts, 1952-53 to 1964-65

District	All-crops	Foodgrains	Non-foodgrains
	percent	percent	percent
Nainital	5.51	5.63	5.53
Saharanpur	3.57	1.69	5.77
Varanasi	3.40	2.99	5.31
Rampur	3.36	3.43	4.04
Bijnor	3.19	1.85	4.53
Ghazipur	3.15	2.68	5.44
Mirzapur	3.03	2.74	5.61
Banda	2.94	3.18	—8.17
Jalaun	2.60	2.56	3.90
Jhansi	2.50	2.75	—1.27
Etawah	2.47	1.82	7.15
Allahabad	2.30	2.22	3.28
Sultanpur	2.22	1.82	4.86
Kheri	2.15	0.64	4.33
Dehradun	2.10	0.73	7.47
Pillibhit	1.86	3.10	0-59
Bareilly	1.80	1.76	2.21
Barabanki	1.74	2.17	0.07
Jaunpur	1.67	1.45	3.07
Faizabad	1.54	1.13	3.41
Gorakhpur	1.51	1.52	1.32
Etah	1.51	0.99	5 36
Ballia	1.50	1.44	2.41
Azamgarh	1.50	1.74	0.89
Farrukhabad	1.43	1.41	1.51
Fatahpur	1.37	0.80	6.47
Aligarh	1.38	0.59	5.50
Rae Bareli	1.34	1.24	3 12
Mathura	1.33	—0.07	6.12
Kanpur	1.31	0.74	5.55
Badaun	1.30	—0.79	7.34
Lucknow	1.21	1.61	—1.48
Muzaffarnagar	1.20	0.82	1.61
Pratapgarh	1.11	1.14	0.70
Unnao	0.86	0.63	2.22

Table 4 (*Continued*)

Table 4 (*Continued*)

District	All-crops	Foodgrains	Non-foodgrains
Mainpuri	0.81	0.61	2.28
Meerut	0.71	—0.43	2.06
Bahraich	0.75	0.08	5.43
Moradabad	0.72	0.71	0.82
Basti	0.65	1.08	—1.09
Agra	0.65	0.32	4.22
Sitapur	0.60	—2.63	3.26
Deoria	0.57	1.61	—1.34
Shahjahanpur	0.49	0.22	1.28
Gonda	0.41	0.01	2.57
Hamirpur	0.33	0.27	1.31
Bulandshahr	—0.16	—0.60	1.22
Hardoi	—0.68	—1.93	2.78
All-state	1.66	0.85	3.61

Source : [30].

The differences among these states in rates of growth, however, are small compared with their respective inter-district differences.

Punjab Crop Output Growth Rates

Among the 17 districts of the Punjab as constituted before its division between Punjab, Haryana, and Himachal Pradesh in 1966, two districts had annual compound crop output growth rates of nearly 8 percent. These were Bhatinda with a growth rate of 7.85 percent and Patiala with a growth rate of 7.75 percent.

Five of the 17 districts had compound crop output growth rates of over 5 percent per year. Combined, these 5 highest growth districts have a total population of 5,683,000 people, nearly as large as that of either Sweden or Switzerland and appreciably larger than that of Norway. Denmark or Finland.

At the lower end of the scale, three districts had growth rates of less than two percent per year. These were Gurdaspur with a growth rate of 1.24 percent ; Kangra 1.16 percent ; and Kapurthala 1.71 percent (table 3).

Uttar Pradesh Crop Output Growth Rates

Seven of 48 districts in Uttar Pradesh increased crop output at rates above the All-India average (table 4). These were Nainital (5.51 percent), Saharanpur (3.57 percent), Varanasi (3.40 percent), Rampur (3.36 percent), Bijnor (3.19 percent), Ghazipur (3.15 percent), and Mirzapur (3.03 percent). In contrast, 33 districts had growth rates below two percent, 14 districts had growth rates below one percent; and two districts, Hardoi and Bulandshahr, had negative crop output growth rates.

Many of the districts with crop output growth rates under 2 percent have a larger population than do such states as Arkansas, Oregon or West Virginia in the United States and the population of most of these districts is increasing at annual compound rates of from 2 to 3 percent per year. Uttar Pradesh with a larger population than that of the United Kingdom, is heavily dependent upon agriculture.

Madras Crop Output Growth Rates

In contrast to Uttar Pradesh, Madras State, (now called Tamil Nadu) lying in the southern

part of Peninsular India, has been highly dynamic in both its agricultural and non-agricultural sectors. Within this state, however, crop output growth rates have been quite uneven. Leading the State's 11 agricultural districts is Ramanathapuram with a compound rate of growth in crop output of 6.25 percent per year. This is followed by North Arcot with a growth rate of 5.30 percent and by four other districts with growth rates of over 4 percent per year (table 5). At the lower end of the scale lie the districts of Nilgiris with a crop output growth rate of only 0.58 percent; South Arcot, 2.12 percent; and Tiruchirapalli with a crop output growth rate of 2.95 percent per year.

North Arcot with a crop output growth of 5.30 percent and South Arcot with a growth rate of only 2.12 percent are contiguous districts with many similarities in their physiographic and climatic features and market bases.

Orissa Crop Output Growth Rates

Crop output growth in Orissa, a low growth state, is also notable for large differences among its districts (table 6). One districts Kalahandi, had a crop output growth rate of 6.57 percent per year ; another, Ganja, had a growth rate of 4.91 percent; and two other districts, Cuttack and Bolangir, had growth rates above the all-India level. Nine of the state's 13 districts, however, fell below the all-India rate of 3.01; 8 districts had growth rates of less than 2 percent per year; and 5 districts had negative rates of growth.

Crop Output in the New Strategy Period

Announcement of the New Strategy near the end of 1965 was followed by a continuation of severe drought during the rabi season of 1965-66 and the 1966-67 kharif and rabi seasons throughout most of Bihar, eastern Uttar Pradesh and large parts of Madhya Pradesh

Table 5

Madras : Compound crop output growth rates per year by districts, 1952-53 to 1964-65

District	All-crops	Foodgrains	Non-food-grains
	percent	percent	percent
Ramanathpuram	6.25	5.80	7.11
North Arcot	5.30	5.88	6.12
Madurai	4.70	3.87	6.27
Tirunelveli	4.67	3.99	6.39
Tanjore	4.38	4.47	3.15
Coimbatore	4.01	6.30	2.85
Chingleput	3.23	2.84	6.66
Salem	3.16	3.00	3.53
Tiruchirapalli	2.95	3.17	2.52
South Arcot	2.12	2.77	0.89
Nilgiris	0.58	0.93	0.58
All state	4.17	4.17	4.17

Source : [28].

Table 6

Orissa : Compound crop output growth rates per year by districts, 1952-53 to 1964-65

Districts	All-crops	Foodgrains	Nonfood-grains
	percent	percent	percent
Kalahandi	6.57	5.70	9.69
Ganjam	4.91	3.66	11.07
Cuttack	3.49	1.70	8.09
Bolangir	3.18	1.89	8.87
Puri	2.02	0.34	13.30
Balasore	1.27	1.25	1.83
Bhenkanal	1.14	0.74	2.30
Koraput	1.14	0.34	6.59
Sundargarh	0.22	0.64	4.71
Mayurbhan	1.11	1.55	5.52
Boudh Phulbani	1.27	0.78	6.10
Keonjhar	1.48	1.36	2.60
Sambalpur	1.87	3.57	7.57
All-state	2.48	2.39	2.95

Source : [29].

and other states. Accordingly, India's crop output dropped from 159.4 in 1964-65 to 132.1 in 1965-66 and to 131.6 in 1966-67 (1956-57= 100).

This severe drought period, however, marked the beginning of India's largest and most successful efforts to increase its agricultural production through the use of new high yielding varieties of wheat, rice and other cereals in combination with greatly increased amounts of fertilisers, pesticides and other inputs concentrated in areas having an assured supply of water from irrigation sources. As a result, India crop output index rose to 161.0 in 1967-68 with its output of foodgrains reaching an all-time record of 95.6 million tons. During the khariff season of 1968-69, India experienced a recurrence of drought conditions in Andhra Pradesh, Mysore and Madras states but held its foodgrain output to roughly 94 million tons. Its output of wheat reached a new all-time record [10 and 13]. In 1969-70, under near normal weather conditions, foodgrain output reached a new record level of 99.5 million tons as against a normal weather estimated base of 95.0 million tons in 1968-69.

CHAPTER 4

India's Agricultural Growth and its General Economic Progress

Agriculture is by far India's most important industry. It is the main source of employment of nearly 70 percent of its total labor force, of nearly half of its net domestic product, and of 70 to 75 percent of its exports if textiles and other products fabricated from farm produced raw materials are included. In terms of product contributions, it is the main source of food for a population that has increased from 350 million people in 1948 to 530 million in 1968. It provides most of the raw materials for processing and manufacturing industries accounting in 1964-65 for 46 percent of total output in India's non-agricultural sector. Its long-run potentials as a source of markets for output of the rest of the economy, including both a wide range of consumer goods and nonfarm produced agricultural inputs and production services are among the largest for any nation on earth [41].

Agriculture's Product Contributions

From 1948-49 to 1967-68, India's agriculture accounted for 32.5 percent of the nation's growth in net domestic product of about 80 billion rupees at 1948-49 prices [41]. While this is a sizeable contribution, it falls far short of agriculture's share of the nation's labor and capital resources. It falls short also of fulfilling growth in the nation's economic demand for food and farm produced raw materials during the same period of time.

This is best illestrated by a reference to foodgrains which account for the larger part of India's total food production. India's output of foodgrains increased at a campound rate of 3.01 percent from 1949-50 to 1964-65 and 2.50 percent from 1952-53 to 1964-65. Its population increase in the latter period has been estimated at 2.5 percent per year and the increase in per capita income at 1.8 percent per year [67]. Assuming an income elasticity of demand for foodgrains of 0,50 the rate of increase in demand for foodgrains is estimated at 3.41 percent per year.

Expenditure elasticity of demand for certain nonfood products based on cross-section studies has been estmiated to be 2.08, 2.43 and 2.36 for woolen clothing, silk and footwears respectively and 1.62, 2.94, 1.46, 1.15 and 1.49 for cotton clothing, vegetable oils, sugar, tea and coffee respectively [64]. If we assume an

income elasticity of 1.8 for all non-foodgrain products, than the combination of population growth and per capita income increases yield a 5.7 percent per year increases in India's demand for such product. This is a rate of growth in demand of 1.8 percent more per year than was the Nation's growth in output of non-foodgrains of 3.99 percent per year from 1952-53 to 1964-65.

How much this disparity between output and demand growth has limited growth of farm-based industries has not been estimated. Its adverse effect have probably been substantial ; industries based on farm produced raw materials occupy an important position in India.

The dependence of Indian industries on agriculture for current inputs is shown in table 7 for industry groups, a summary of 62 organised industries, excluding railways and motor transport; 32 are either agriculture-based or require some inputs from agriculture. The total value of output in 1964-65 was Rs. 101,255 million. The value of output of the 32 agriculture-based industries was Rs. 46,839 million or about 46 percent of the value of total output in the industrial sector. If we leave out the construction industry, the value of output of agriculture-based industries is about 56 percent of the total value of industrial output. These figures indicate the large importance of the agriculture-based industries relative to all industries in the Indian non-agricultural sector.

Industry-wise breakdown of the number of workers engaged is not available, but it would seem that a large proportion of industrial workers are employed in agriculture-based industries, since these are more labor-intensive than the industries based on metal and minerals. More rapid growth in the agriculture-based industries would increase the demand for farm-produced raw materials at a rate higher than 5.7 percent per annum estimated above.

These considerations indicate that Indian agriculture's product contribution, though large when viewed against the overall growth of national product, has been inadequate to meet the demands generated by India's general economic growth. Consequences of agriculture's failure to fulfill the growth in demand are therefore reflected in non-price indicators, such as rationing in the urban areas, setting up of country-wide fair-price shops, reduction and restriction of the number of work shifts, increase of idle capacity in the agriculture-based industries, and ven in the closing down of some of these factories in recent years for want of raw materials. These consequences were brought into particularly sharp focus by the sharp breaks in agricultural production in 1965-66 and 1966-67 caused by drought.

Agricultural Inputs as Markets for Non-farm Industry

In the process of growth, the interdependence between agriculture and non-agricultural sectors increases. This is reflected by the increasing percentage of agricultural output moving into market channels and by the increasing dependence of agriculture upon non-farm produced inputs, which account in the main for its increasing productivity. Data bearing on the latter are shown in table 8 for 1964-65. These data are derived from the same input-output table on which table 7 is based. The agricultural sector is composed of four subsectors : crops (with 8 crops), animal husbandry, plantations and forest products. In 1964-65, inputs from the non-agricultural sector in value terms amounted to only 1.2 percent of the food crop output, 8.5 percent of plantations crops and 9.9 percent of animal husbandry sector output. For the whole agricultural sector, the proportion of inputs from non-agricultural sources amounted to only 2.5 percent of the value of the total agricultural output for the same year. Tubewells, pumpsets and tractors are not included in these estimates

Table 7

India : Dependence of industries on agriculture[1] for current inpute, 1964-65 (Value at 1960-61 prices)

Consuming Sector / Producing Sector	Crop sector	Agricultural sector	Sugar	Gur and khandsari	Vegetable oils & vanaspati	Milk products	Tobacco manufacturing industries	Leather industries	Cotton, silk and woolen textiles	Food and vegetable preservations	Cashew nut processing	Jute textile	Biscuit and confectionary starch	Rubber industries	Wood products matches	Paper and paper product	Chemicals	Drugs and pharmacy
	-	-	-	-	-			million	rupees		-	-	-	-	-			
1. Agriculture Proper	6696	11114	1372	3032	5042	23	785	-	2793	27	210	1389	3241	-	-	16	16	102
2. Plantations	-	-	-	-	-			-	-	-	-			146	-	-	8	6
3. Animal Husbandry	-	-	-	-	-	237	-	320	178	-	-	-	2	-	-	-	-	-
4. Forestry Products	-	-	-	-	-					-	-		-	-	338	-	39	-
5. Total inputs	6696	11114	1372	3032	5042	260	785	320	2971	27	210	1389	3243	146	338	16	63	108
6. Total of all inputs	7628	13388	1514	3063	6009	304	917	787	9378	61	213	1483	3541	214	391	399	775	433
7. Output of sectors	73773	87541	2465	3188	7329	478	2715	1541	15152	115	317	2485	4588	320	1527	1021	1988	1600
8. Proportion of Agricultural inputs to total putput	9.0	12.6	55.6	95.1	68.7	54.3	28.9	20.7	19.6	23.4	66.2	55.9	70.6	45.6	22.1	1.5	3.1	6.1
9. Proportion of Agricultural inputs to total inputs (%)	87.7	83.0	90.6	98.9	83.9	85.5	85.6	40.6	31.6	44.2	98.5	93.7	91.5	68.2	86.4	4.0	8.1	24.9
10. Value added in sector	62802	70375	440	115	907	57	629	477	3822	24	70	638	393	54	899	262	525	656

Sources : [64]

[1] Agricultural sector includes crops, animal husbandry and foreste products.

Up to 1964-65, however, these constitute such a small proportion of total inputs that their enclusion does not alter the significant character of the proportion of non-agricultural inputs to output. These small uses of purchased inputs suggest the relatively low stage of development of India's agriculture.

India's production of selected modern inputs is shown in table 9. Production of certain modern agricultural inputs, notably tractors and insecticides was not begun in India until about 1960-61. The production of improved agricultural implements had been on a very limited scale. Production of pumpsets, diesel engines and tubewells until 1961 was perhaps limited by the policy emphasis on major irrigation projects rather than on small-scale irrigation. Until 1965, growth in the production of fertilizers was slow.

Table 8

India : Dependence of agriculture on industries for current inputs, 1964-65:

Inputs	Crop sector	Plantation	Animal Husbandry	Total agricultural sector
		million rupees[2]		
Industrially produced inputs				
Fertilizers	635	74	—	709
Petroleum products	73	11	—	84
Inseticides	79	—	—	79
Electricity	143	1	—	144
Misc. Chemicals	—	18	—	18
Coal and coke	—	—	—	3
Vegetable oils	—	—	1000	1000
Drugs and pharmaceuticals	—	—	158	158
Jute textiles	—	8	—	8
Food products	—	59	—	59
Paper and paper products	—	10	—	10
Total	930	184	1158	2272
Farm produced inputs	6696	—	4418	11114
Total of all inputs	7626	184	5576	13386
Value of agricultural output	73773	2141	11627	87541
Industrial inputs as a percentage of agricultural output	percent 1.2	percent 8.5	percent 9.9	percent 2.5

Source : Computations based on table 7.

[1] Inputs from universal service sectors, railways and motor transport are excluded.

[2] At 1960-61 producer prices.

The production of inputs for agriculture as a proportion of all goods produced in the non-agricultural sector ranged from 1.1 to 18 percent for the three selected years shown in table 10. Such low rations indicate that patterns of development in India's emerging industrial sector may not have been of optimal kinds from the point of view of improving the inputs needed for a rapidly developing agriculture.

Agriculture's Labor Contributions

Recent growth theories have made the take-off in agricultural development heavily dependent on the achievement of enough growth in agricultural sectors to convert agriculture from a labor-surplus to a labor-scarce sector [24].

This emphasis as applied to India appears to hava its application if at all, in a period several decades ahead rather than in the recent past or near future.

The size of labor force in the agricultural and the non-agricultural sectors is shown in table 11 for 1941, 1951 and 1961 together with projections for 1971 based on specified assumptions as to growth rates and inter sectoral distribution of the Nation's labor force.

From 1941 to 1951, India's labor force increased from 123.0 million to 143.2 million workers but the farm to nonfarm ratio held constant at 70 : 30 percentages. India's total labor force increased from 143.2 in 1951 to 183.6 million in 1961; the ratio of farm to nonfarm workers dropped only to 69.5 : 30.5. Meantime, the number of agricultural workers increased from 100.3 million in 1951 to 131.1 million in 1961. Projections of the previous all-India growth rate, taking account of farm and non-farm differences in rates of growth, indicate that by 1971, India will have a total labor force of 231.9 million workers with 160.0 million in agriculture compared with 131.1 million in

Table 9

India : Domestic production of selected inputs from non-agricultural sources used by agriculture, 1950-51 to 1965-66

Items	1950-51	1955-56	1960-61	1965-66
	No.	No.	No.	No.
Fertilizers				
Nitrogenous (000 tons)	9	79	153	344
Phosphatic (000 tons)	9	12	N.A.	N.A.
Agricultural implements				
Power driven pumps (000)	34	37	105	200
Diesel engines (000)	5.5	10	43.2	85
Tractors (000)	—	—	—	5.6
Insecticides (000 tons)	—	—	6.7	15.0
Eleetricity (million kwh)	203	—	832	1730
Fuel oil (value in crores)	4.5	—	14.6	27.7

Sonrce : [61 and 68].

Table 10

India : Gross value of production of agricultural inputs and of industrial output 1960, 1961 and 1963

	1960	1961	1963
	—	— lakhs of rupees —	—
All industries[1]	315038	369323	479931
Agricultural input industries			
Inorganic fertilizers	2084	2675	4280
Mixed fertilizers	331	498	411
Power driven pumps	445	529	598
Tractors, harvestors, etc,	7	7	30
Agricultural implements	384	483	562
Insectcides	385	299	531
Agricultural inputs as percent	percent	percent	percent
of all induslrial output	1.1	1.2	1.3

Source : [6].

[1] Excludes the value of output of certain mining industries, quarrying and crude petroleum and natural gas industries.

Table 11

India : Distribution of the work force between the agricultural and the non-agricultural sector, 1941, 1951. 1961 and 1971

Sector	1941	1951	1961	1971[1]		
				Trend projection	With 60 : 30 ratio[2]	With number of agricultural workers at 1961 level
	—	—	million		—	—
Agriculture	86.1	100.3	131.1	160.3	139.1	131.1
Non-agriculture	36.9	42.9	57.5	71.9	92.8	100.8
Total economy	123.0	143.2	183.6	231.9	231.9	231.9
Percentage in	—	—	percent		—	—
agriculture	70.0	70.0	69.5	69.0	60.0	56.5

Source : [6].

[1] Estimates based on projection of current rates of population growth.

[2] Ratio of agricultural to non-agricultural workers.

1961 and with 71.9 million non-agricultural workers compared with 57.5 million in 1961. With growth in the non-agricultural sector large enough to reduce the farm to nonfarm workers to a ratio of 60 : 40 (compared with a decline from 70 : 30 to 69. 5. : 30.5 in the twenty years 1941 to 1961) India would still have in 1971, 8 million more agricultural workers than it had in 1961.

These data suggest that at any now foreseeable rate of growth in India's nonfarm economy, India's agricultural labor force will not reach its maximum size within the next three or four decades simply because of its high population growth rate coupled with the large size of its agricultural labor force as a percentage of its total labor force.

Agricultuer's Capital Contributions

Rural Savings

Little information is available on the importance of agriculture as a source of savings for use in non-agricultural sectors. Studies by the Reserve Bank of India, however, reveal that annual savings by rural households amounted to Rs. 178.5 crores in

Table 12

India : Exports of agricultural and all commodities, 1952-53 to 1964-65

Year	Agricultural commodities			All exports	Agricultural exports as percentages of all exports		
	Unprocessed	Processed	Total		Unprocessed	Processed	Total
	—	—	— Rs. crores[1]	— — —	percent	percent	percent
1952-53	210.9	238.0	448.9	577.3	36.53	41.23	77.76
1953-54	179.6	214.7	394.3	507.3	35.40	42.32	77.72
1954-55	275.5	243.1	518.6	607.7	45.33	40.00	85.33
1955-56	275.9	253.8	529.7	644.8	42.79	39.36	82.15
1956-57	236.9	215.0	451.9	574.1	41.26	37.45	78.71
1957-58	198.7	200.7	399.4	585.9	33.91	34.26	68.17
1958-59	211.4	171.8	383.2	514.4	41.10	33.40	74.50
1959-60	223.2	204.8	428.0	546.3	40.86	37.49	78.35
1960-61	201.0	203.0	404.0	528.6	38.02	38.40	76.42
1961-62	209.1	214.3	423.4	543.3	38.49	39.44	77.93
1962-63	227.2	223.9	451.1	557.9	40.72	40.13	80.85
1963-64	224.3	229.1	453.4	586.3	38.26	39.07	77.33
1964-65	193.1	202.2	395.3	534.6	36.12	37.82	73.94
1965-66	156.3	190.8	347.1	490.4	31.87	38.91	70.78

Source : [3 and 6].

[1]At 1952-53 prices.

1956-57 and to Rs. 200.6 crores in 1960-61 (at 1948-49 prices). Rural households accounted for 20.5 percent of total domestic savings in the period 1950-51 to 1962-63. The ratio of savings to income was only 2.3 percent for rural households compared with 15.1 percent for urban households and 6.0 percent for all households [73].

In addition to savings, the agricultural sector in 1958-59 contributed through tax payments Rs. 42.4 crores to governmental sectors [42]. While these data indicate a relatively low level of performance in respect to savings by the agricultural sector, the fact remains that per capita incomes in the agricultural sector have been less than half as large as in non-agricultural sectors. Agriculture's share in growth in net national income from 1951 to 1961 was only 41 percent despite the fact that it accounts for about 70 percent of the Nation's total population. It's low level of performance in regard to savings, therefore, reflects its lower level and slower rate of growth in per capita incomes.

Foreign Exchange Earning

An important part of agriculture's capital contributions to the general economic

Table 13

India : Imports of food and other commodities, 1952-53 to 1966-67

Year	Food	Non-food	Raw materials and intermediate goods for producing		Capital goods	Total imports
			Consumer goods	Capital goods		
			Rs. crores[1]			
1952-53	181.6	41.9	164.0	141.7	138.5	667.7
1953-54	91.9	40.7	153.8	136.7	117.9	542.1
1954-55	113.9	56.6	190.0	178.5	138.0	673.3
1955-56	60·5	88.9	195.5	181.6	210.6	734.1
1956-57	39.5	71.9	173.3	281.0	240.7	806.2
1957-58	87.3	62.2	164.4	355.7	286.4	955.3
1958-59	165.3	43.8	120.4	209.6	220.5	761.1
1959-60	155.3	37.1	159.1	235.4	238.6	820.6
1960-61	172.9	41.1	171.2	247.7	266.6	898.0
1961-62	119.8	41.2	164.4	254.4	293.8	871.4
1962-63	145.5	51.4	165.5	224.6	302.9	884.7
1963-64	124 0	49.0	147.1	217.1	311.6	845.2
1964-65	207.1	40.0	144.3	168.5	312·8	883.4
1965-66	182.3	26.3	117.0	134.9	255.4	733.1
1966-67	354.5	38.1	189.9	145.6	301.1	1086.5

Source : [3 and 6].

[1]At 1952-53 prices.

development of developing countries is that represented by its contributions to foreign exchangs through exports of agricultural commodities. Available data indicate little if any growth since the early 1950's in this important component of agriculture's contributions. Rather, India's total agricultural exports measured in constant value terms were lower in 1964-65 and 1965-66 than they were in any of the years 1954-55 to 1956-57 (table 12). Meantime, India's imports of food have been rising since the middle 1950's (table 13) constituting an increassing share of its total imports including those for capital and nonfood consumer goods. The otherwise adverse consequences of these declining food trade balances for the growth of its national economy have been alleviated only by the availability of food imports on a concessional basis, mainly from PL, 480 sources.

* * *

In resume, the hall mark of a developing agriculture is that of its increasing dependence on nonfarm sectors of the economy as sources of inputs and as sources of markets for its output. In the course of this growing dependence, agriculture also provides growing markets as well as food and raw materials to sustain growth in nonfarm sectors. Hence, farm and nonfarm sectors in the development process bear a highly complementary relationship to each other, each contributing to and benefitting from growth of the other. Such growing dependence of agriculture underlies a large part of even the modest gains that India has already made in raising the productivity of its agriculture, as will be shown more fully in succeeding chapters.

CHAPTER 5

Elements of All-India Crop Output Growth

This chapter is directed to an analysis of India's crop output changes from 1949-50 to 1967-68 with emphasis on (a) composition by major crop groups of the crop output growth; (b) area, yield and other main components of the growth ; (c) input and technological basis of the crop output growth and of its yield and other major components : and (d) price relationships and other factors underlying the observed changes.

Growth Rates of Major Crop Groups

Foodgrains, an Indian crop category including cereals and pulses, account for about two third of the value of production of the 28 forecast crops used in the construction of India's annual crop production indices. Non-foodgrain crops are most heavily weighted by oilseeds, sugarcane, tea, cotton and chillies in this order of importance, but they also include tobacco, jute, black peppers, potatoes, ginger, coffee and rubber.

From 1949-50 through 1964-65, non-foodgrain crops gained on foodgrains in their relative importance (table 1). Their output growth rate from 1949-50 to 1964-65 was 3.61 percent per year on a compound basis compared with 2.98 percent per year for foodgrains (table 14).

Among foodgrains, however, the output growth rate of wheat, maize and rice has been above the all-crop level of 3.19 percent per year, with the output gains for these three crops per year, on a compound basis being 3.97 percent, 3.79 percent and 3.37 percent respectively. The output of pulses—now relatively low yielding crops per unit of land—has been increasing at only 1.62 percent per year. Output growth rates of jowar, bajra, ragi, and barely—crops generally lower than rice, wheat and maize in value of output per unit of land—have fallen below that for all foodgrains.

Among non-foodgrain crops, coffee, sugarcane, cotton and groundnuts have each registered output growth rates (compound) of more than 4 percent per year, ranking in rates of growth in the order named. The output of jute has also been increasing at a compound rate of 3.54 percent per year.

Major Sources of Crop Output Growth

Growth rates and percentage distribution of the all-India crop output growth for the years 1952-53 through 1964-65 have been

Table 14

India : Compound rate of growth in crop output, area and yield by crops, 1949-50 to 1964-65

Crop	Output	Area	Yield/ha
	Percent	Percent	Percent
Foodgrains			
Cereals			
Rice	3.37	1.26	2.09
Jowar	2.50	0.91	1.58
Bajra	2.23	1.01	1.20
Maize	3.79	2.63	1.13
Ragi	2.80	0.53	2.26
Wheat	3.97	2.70	1.24
Barley	—0.29	—0.65	0.37
All cereals	3.16	1.22	1.92[1]
Pulses	1.62	1.87	—0.24
All foodgrains	2.98	1.34	1.61[1]
Non-foodgrains			
Oilseeds			
Groundnuts	4.18	3.81	0 36
Sesamum	—0.52	0.15	—0.68
Rapeseed and mustard	3.16	2.86	0.29
All oilseeds	3.20	2.55	0.64
Fibres			
Cotton	4 44	2.42	1.97
Jute	3.54	3.01	0.52
All fibres	4.37	2.52	1.81[1]
Sugarcane	4.59	3.26	1.29
Tea	2.01	0.52	1.48
Coffee	8.48	2.18	6.17
Tobacco	2.69	1.78	0.90
All non-foodgrains	3.61	2.52	1.06
All-crops	3.19	1.55	1.60[1]

Source : [16].

[1] The yield estimates for crop groups reflect the influence of changes in crop patterns, crop location shifts and interaction between these factors as well as pure yield increases.

computed for each of several major sources of growth, as shown in table 15. These sources include crop area increases, changes in crop output per unit of land, changes in crop pattern, and changes resulting from interaction among the foregoing sources (using the methods outlined in Appendix II).

During the 1952-53 to 1964-65 period, total crop output increased at an average compound rate of 3.01 percent per year. The associated growth rate for area of crops was 1.21 percent per year, and that for output per unit of land was 1.77 percent per year. Of this latter growth, 63.4 percent resulted from changes in crop yield per unit of land; 26.6 percent resulted from changes in crop patterns; and 9.9 percent resulted from the interaction between the other two sources of increase. In growth rate terms, the rates were 1.21 percent per year for crop area; 1.14 percent for crop yields alone; 0.47 percent for growth from crop pattern changes; and 0.18 percent for growth from interaction effects.

Growth in Crop Area

Growth in gross area of crops has come from (1) increases in the successive production of two or more crops per year on the same land, commonly referred to in Indian agricultural statistics as "increasing crop intensity"; (2) reduction in fallow lands; (3) reduction in the area classified as cultivatable waste; and (4) reclamation of land that had become unsuited for cultivation as a result of such things as soil erosion, water logging and salinity. Of these sources, reductions in area under fallow and under cultivatable wastes have been most important.

Foodgrains were allocated 65.3 percent and non-foodgrains 34.7 percent of the new gross area brought into cultivation from 1952-53 to 1964-65. This compares closely with the earlier relative importance of these two major crop groups measured by value of their output. Rice, however, led all other individual crops in its actual area gains and

Table 15

India : Source of growth in all-crop output, 1952-53 to 1964-65

Source of Growth	Growth rate
	Percent
Change in crop area	1.21
Change in yield alone	1.14
Change in crop pattern	0.47
Interaction	0.18
Total :	3.01

Source : Computations based on data from references 10, 14, 15 and 16.

[1] The combination of yield, crop pattern and interaction changes are called "productivity changes" in *Growth Rates in Agriculture 1949-50 to 1964-65*, Directorate of Economics and Statistics, Ministry of Food and Agriculture, Government of India, 1966.

Table 16

India : Percentage distribution of specified sources of total crop output growth by kind of crop, 1952-53 to 1964-65

Crop and crop group	Source of output increase		
	Area change[1]	Yield change	Crop pattern change
	percent	percent	percent
Rice	33.08	45.30	17.86
Jowar	5.34	7.37	—9.15
Bajra	2.45	3.42	—7.53
Maize	2.53	1.02	5.72
Ragi	0.96	1.52	—1.25
Wheat	8.40	7.02	19.23
Barley	2.00	—0.28	—11.64
All cereals[2]	55.84	68.73	6.91
All pulses	9.48	—5.23	2.80
All foodgrains[2]	65.32	63.50	9.71
Groundnut	5.22	3.85	—4.73
Sesamum	1.06	0.86	—3 24
Rapseed and mustard	1.97	0.63	7.59
All oilseeds [2]	9.09	4.40	1.99
Cotton	2.81	5.13	0
Jute	1.71	1.20	7.65
All fibers[2]	4.81	6.51	10 89
Tea	2.91	4.11	—2.55
Coffee	0.24	0.99	0.99
Sugarcane	11.53	17.81	66.52
Tobacco	1.71	2.40	1.43
All non-foodgrains[2]	34.68	36.50	90.29
All crops	100.00	100.00	100 00

Source : Computed from data in references 10,14, 15 and 16.

[1] Based on the assumption of a uniform area increase applicable to all crops such that there would have been no change in percentage distribution of gross sown area by kind of crop.

[2] Because of commission of some minor crops, totals of crop groups and sum of constituent members of the group as shown here are not equal.

in the percentage contribution of area gains to all-crop output growth (table 16).

Crop Pattern Changes

The percentage distribution of the all-India crop output growth resulting from crop pattern changes is shown in table 16. Foodgrains accounted for slightly less than 10 percent of the all crop output growth attributed to crop pattern changes; non-foodgrains accounted for the remaining nine tenths. Among foodgrains, however, growth in the percentage of gross crop-area allocated to wheat, rice and maize accounted for 19.2 percent, 17.9 percent and 5.7 percent, respectively of the output growth from crop pattern changes. Growth in the relative importance of these three crops combined accounted for 43 percent of the output growth from crop pattern changes. But within the foodgrain group, this was offset by the declining relative importance of barely, jowar, bajra and ragi.

Among non-foodgrains, growth in percentage of the crop area allocated to sugarcane was responsible for two thirds of the all-crop output growth attributable to crop pattern changes. Cotton merely retained its earlier relative importance in the allocation of crop land, hence made a zero contribution to the crop-pattern-change source of crop output growth.

Available data do not permit an evaluation of the economic potentials in India of increasing crop output through crop pattern changes. Such potential, however, is probably large. Moreover, potentials for increasing total crop output by shift from crops of low value to those of high value per hectare are likely to be greatly increased with growth in available supplies of water from irrigation sources, fertilizers and other modern production inputs. New high yield varieties for some crops and not for others increase this source of possible growth in crop output.

Output Growth from Yield Changes Alone

Rice accounted for 45 percent of the all-India crop output growth resulting from yield increases alone (table 16). Sugarcane was the next largest contributor to yield gains accounting for 17.8 percent of the total. Cotton accounted for only 5.1 percent of the all-crop output growth from yield increases.

Input and Technological Basis of Crop Output Growth

Land Inputs

As indicated above, increases in gross sown area of land have been a major input source of India's crop output growth since its Independence. From 1952-53 to 1964-65, the gross area sown to crops increased from 137.7 million to 158.1 million hectares, or by 14.8 percent. Combined with proportionate increases in all other crop production inputs, this increase in gross sown area alone would have increased India's agricultural output from 1952-53 to 1964-65 by 14.8 percent, or from an index of 82[1] in 1952-53 to about 95 in 1964-65 [19].

Fertilizers

The increased use of chemical fertilizers has been a second major input source of the all-India increase in crop output [46]. In 1947, India's consumption of chemical fertilizers was only 7 thousand tons, less than 0.1 kilogram per hectare of gross sown area [22]. From 1952-53 to 1964-65, consumption of plant food nutrients from chemical fertilizers increased from 65.7 to 712.3 thousand tons (table 17). At 1952-53 rates of application, India's consumption of fertilizers, as a result of increases made in gross sown area would have been in 1964-65 only 75.4

[1] Using 1956-57 as 100.

Table 17

India : Consumption of fertilizers, 1947 to 1967-68

Year	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)	Total
	—	thousand metric tons	—	—
1947	4.3	0.9	1.8	7.0
1951	58.7	6.9	7 7	73.3
1952-53	57.8	4.6	3.3	65.7
1953-54	89.3	80.3	7.5	177.1
1954-55	94.8	15.0	11.1	120.9
1955-56	107.5	13.0	10.3	130.8
1956-57	123.1	15.9	14.8	153.8
1957-58	149.0	21.9	12.8	183.7
1958-59	172.0	29.5	22.4	223.9
1959-60	229.3	53.9	21.3	304.5
1960-61	211.7	53.1	29.1	293 9
1961-62	291.5	63.9	28.0	383.4
1962-63	360.0	81.4	36.5	477.9
1963-64	425.9	120.8	51.9	598.6
1964-65	492.2	148.5	71.6	712.3
1965-66	582.6	134.1	89.6	806 3
1966.67	830.2	274.6	133.7	1,238.5
1967-68	1,070.0	340.0	170.0	1,580 0

Source : [22 and 25].

thousand tons of plant food nutrients, 636.9 thousand tons below that actually used. If all of this increment had been used for foodgrains at a response ratio of 10 : 1 (table 18), it would have accounted for additional output of 6.369 million tons and would have increased the foodgrain output index from 83.7 in 1952-53 to about 93 in 1964-65 [25].

If it is further assumed (1) that fertilizer response ratios for other crops are the same as for foodgrains and (2) that foodgrains account for two thirds of the total value of crop output in India, then this fertilizer increment would have increased the All-India crop output index from 82 in 1952-53 to about 90 in 1964-65 (using 1952-53 as base).

Since 1964-65, India's consumption of chemical fertilizers has more than doubled.

Irrigation

A third major contributor to crop output growth in India has been growth in area under irrigation. From 1952-53 to 1964-65, the gross sown area of all crops, irrigated and unirrigated combined, increased from 137.7 million to 158.1 million hectares, or 14.8 percent [19]. With a proportional increase in gross sown area irrigated, the 1964-65 gross irrigated area would have been 26,754,000

Table 18

India : Fertilizer response ratios for traditional varieties of selected crops in fertilizer fields

Crop	N			P_2O_5		
	Experiments	Amount per hectare	Response in tons of yield per ton N	Experiments	Amount per hectare	Response in tons of yield per ton N
	number	kg.	ratio	number	kg.	ratio
Rice	11,577	22.4	10.8	6,837	22.4	7.1
	11,577	44.8	8.2	6,837	44.3	5.5
Unirrigated wheat	3,488	22.4	7.6	2,050	22.4	4.1
Irrigated wheat	8,542	22.4	14.1	5,331	22.4	8.7
	8,542	44.8	11.5	5,331	44.8	7.5
Maize	2,902	22.4	12.0	2,360	22.4	6.8
	2,902	44.8	9 6	2,360	44.8	5.8
Gram	526	33.6	5.5	2,699	33.6	6.4
Sugarcane	6,529	84.1	171.2	3,685	44.8	136.2
Unirrigated cotton	1,524	22.4	5.0	774	22.4	2.8
Irrigated cotton	533	56.0	5.7	225	22.4	5.8

Source : [57].

hectares, 3.66 million hectares short of the total gross irrigated area of 30.41 million hectares actually reported. This addition to irrigated area over that required to maintain the initial ratio of irrigated to total sown area represents an increment capable of conributing in each of three main ways to increasing output per unit of net sown area : (1) by increasing scope for the successive production of two or more crops per year on the same land ; (2) by making it possible to shift to crops that yield a larger value of output per hectare but that are heavily dependent upon assured supplies of water ; (3) by contributing directly to increased yields per unit of land ; and (4) most important of all, by increasing the capacity of the area so irrigated to absorb productively fertilizers, pesticides, labour, animal power and other inputs.

Since land already under irrigation in 1952-53 could have fully absorbed all of the increases made in fertilizers between 1952-53 and 1964-65, the increment of 3.66 million hectares in gross sown area irrigated made in

Table 19

India : Average irrigation resopnnse coefficients for selected crops

Crop	Increase in yield as percentage of unirrigated yield
Rice	30
Wheat	20
Other Cereals	20
Cotton	125
Oilseeds	20

Source : *[55].*

this interim represented a wholly additional source of growth. The all-India average yield of foodgrains in 1964-65 was 1,229 kilograms per hectare on irrigaed land and 836 kilograms per hectare on unirrigated land. The average for the irrigated land reflects the influence of fertilizers and other yield increasing inputs in addition to water. If, however, it is assumed that irrigation without fertilizers normally increases the yield of foodgrains by 250 kilograms per hectare (see table 19) then this increment of 3.66 million hectares in gross irrigated crop area would have given India in 1964-65, 0.915 million tons of foodgrain above what it would otherwise have produced. Together with the increases made in gross sown area of crops, proportionate increases in other inputs and increases in fertilizers used per hectare, this addition to gross irrigated area would have increased the index of India's total crop output from about 82 in 1952-53 to 105 in 1964-65 (using 1956-57 as 100).

Other Inputs

Other inputs than land, fertilizers and water accounted for about 48.0 percent of the all-India increase in output of all crops. These included labor, bullock power and modern inputs such as pesticides and seeds of improved crop varieties. Changes in crop patterns,

Table 20

India : Number of agricultural labourers, work animals, tractors and iron plows, 1951 and 1961

Item	1951	1961	Increases
	Thousands	Thousands	Percent
Labourers	103,217	106,505	3.19
Work cattle	67,383	80,443	19.38
Tractors	8,635	34,707	301.93
Iron plows	931	2,298	246.88

Source : Census of India, 1951 and 1961

noted above, have probably made increasing intensity in the use of labor, bullock power, and farm machinery economically feasible (table 20).

Estimates of changes in the use of pesticides are difficult to make because of changes in kinds used [53]. The use of pesticides on a significant scale in Indian agriculture, however is of recent origin [45]. In 1960-61, only 6.5 million acres of crops were under plant protection measures. The quantities of all pesticide materials used or sold to agriculture in 1961 as reported in the *1964 Production Yearbook* of the Food and Agriculture Organization of the United Nations [26] was only 787 metric tons. This increased to 6,363 tons in 1962 and to 5,467 metric tons in 1963. The all-India area of crops under plant protection reached 17.4 million hectares in 1965-66 with 25,800 metric tons of technical grade materials used compared with 14,600 tons used in 1961 [22].

Within the last three to four years, highly dramatic improvements have been made in the varietal basis of Indian foodgrain production. These include varietal gains for rice, wheat, maize, jowar and bajra, somewhat comparable in their yield increase potentials to the introduction of hybrid maize in the United States. Earlier large improvements had been made in sugarcane varieties. These varietal improvements made an important contribution in 1967-68 to the Nation's new record high level of agricultural production [34 to 36]. However, they came too late to have influenced India's agricultural trends in the years 1952-53 to 1964-65.

Important work directed to improving crop varieties had been underway in India for several years before introduction and development of the new high yield varieties and hybrids. However, earlier variety improvements increased yields by only 7 to 12 percent [79] compared with increases of 100 percent or more from recently introduced new high yielding varieties.

Price Incentives

That the level and stability of prices paid to cultivators has an important influence upon agricultural production in India has been officially recognized by the creation in 1965 of the Agricultural Prices Commission. Changes in relative prices tell cultivators what changes, if any, they need to make in the organization and operation of their farms to meet growing needs of the society in which they live.

Farm harvest prices probably provide the best available indication of prices received by cultivators during the period under study. Indices of farm harvest prices of all agricultural commodities (table 21) indicate relatively little change before 1963-64 except for a sharp break in the years 1953-54 to 1955-56. Harvest prices of rice, however, moved upward from 1955-56 to 1964-65. The output growth rate for rice was appreciably above that for both all foodgrains and all crops. On the other hand, wheat prices did not rise in this period. Yet output of wheat increased at an even more rapid rate than did rice. This suggests that increases in wheat output must be explained by such factors as improvements in wheat technology, or by the other measures inducing increased use of inputs in predominantly wheat growing states, of which Punjab was one of the most important.

The index of harvest prices of all foodgrains reached a high of 110.1 in 1962-63, after having broken sharply in the years 1953-54 to 1955-56. By comparison, indices of the prices of manufactured commodities have shown a much sharper upward trend, rising to 122.7 in 1962 and to 124.8 in 1963 (table 22 to 24). The prices of all commodities and of manufactured items may be regarded as fairly good indicators of the prices farmer pay for the nonfarm produced goods they buy.

Table 21

India : Indices of harvest prices of specified farm products, 1950-51 to 1962-63[1]

Year	Rice	Jowar	Maize	Wheat	All foodgrains	All oil seeds	Sugar	Cotton	All commodities
	—	—	—	(1950—51 = 100)			—	—	—
1950-51	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1951-52	105.5	90.0	93.3	94 5	100.7	78.8	65 3	87.8	93.2
1952-53	100.7	99.3	84.8	80.5	100.2	72.9	67.5	79.9	90.2
1953-54	93.8	97.2	83.5	85.5	91.0	77.2	75.4	88.3	86.1
1954-55	79.4	58.3	59.3	63.6	70.4	47.2	50.5	75.3	65.2
1955-56	86.0	72.3	59.6	83.0	81.8	60.1	57.1	82.3	76.1
1956-57	105.8	113.3	82.7	94.4	102.2	76.1	58 0	95.6	92.2
1957-58	113.5	97.0	88.2	90.5	103.7	72.2	64.4	91.4	93.0
1958-59	111.7	95.6	95.5	97.2	105.6	77.0	81.7	101.0	96.9
1959-60	114.0	106.8	80.5	87.7	104.9	80.6	88.3	104.2	98.4
1960-61	113.5	108.4	78.7	85.2	104.1	91.3	75.1	104.9	99.6
1961-62	115.7	95.8	80.9	91.1	105.1	96.5	67.8	104.2	98.0
1962-63	116.8	113.5	80.5	89.1	110.1	94.4	92.4	110.7	99.6

Source : [19]

1 Data are not available for years since 1962-63.

Table 22

India : Indices of wholesale prices of all commodities and of specified groups of commodities, 1951 to 1966

Year	All commodities	Agricultural commodities	Foodgrains	Sugar and gur	Food articles	Industrial raw materials	Manufactures
	—	—	—	— (1951=100)	—	—	—
1951	100.0	100.0	100.0	100.0	100.0	100.0	100 0
1953	105.5	108.0	108.0	78.2	98.7	108.3	115.6
1954	93.6	96.2	102.5	78.7	94.8	83.9	95.8
1955	87.2	85.7	80.5	72.4	84.1	78.0	97.5
1956	82.7	80.0	77.6	55.9	77.0	75.7	96.6
1957	94.2	95.0	99.3	61.5	90.9	88.8	103.0
1958	97.0	97.6	103.6	67.9	94,7	89.1	104.7
1959	101.0	103.6	112.8	79.8	102.4	88.4	105.0
1960	104.7	105.9	108.5	92.3	105.8	94.6	108.2
1961	111.7	112.5	108.6	83.4	106.7	111.2	120.1
1962	111.9	111.7	106.6	75.1	106.8	109.1	122.7
1963	114.4	112.1	112.0	91.0	112.1	104.4	124.8
1964	123.0	119.5	123.2	118.5	121.6	106.7	127.0
1965	136.6	141.6	152.9	118.1	142.1	124.5	133.0
1966	147.7	154.0	159.8	99.4	150.0	144.7	144.7

Source : [18]

Table 23

India : Indices of prices of manufactured commodities as percentages of indices of prices of foodgrains and all agricultural commodities, 1951 to 1966

Year	Foodgrains	All agricultural commodities
1951	100.0	100.0
1953	107.0	107.0
1954	93.5	99.0
1955	121.1	113.8
1956	124.5	120.8
1957	103.7	108.4
1958	101.1	107.3
1959	93.1	101 4
1960	99.7	102.2
1961	106.8	106 8
1962	115.1	109.8
1963	111.4	111.3
1964	103.1	106.3
1965	87.0	93.9
1966	90.5	93.6

Source : Calculations based on table 22.

Foodgrain prices have increased sharply since 1963-64, but these increases probably had little effect upon India's agricultural production from 1952-53 to 1964-65.

The fact that during the period 1952-53 to 1963-64, prices of all agricultural commodities combined did not move upward relative to the all commodity price level is worthy of note. For this entire period was marked by near continuous growth of at least 3.5 percent per year in the Nation's demands for foodgrains compared with a foodgrain output growth rate of less than 3 percent. According to the postulates of general economic theory, such a widening of the gap between foodgrain demand and output would have caused foodgrain prices to rise relative to price of things farmers buy had it not been for alternative sources of supply. Such increases in farm product prices would have served as incentives to farmer to produce more foodgrains and as breaks on consumption of the foodgrains produced. In such ways, prices would ultimately have brought supplies and demand into equilibrium, with the equilibrium level depending on supply and demand elasticities.

Why did not prices of foodgrains so behave? Indians internal farm product price and procurement policies have been one factor (table 25). Devaluation of the rupee in September 1949 consequent on the devaluation of the Sterling was an early factor of some additional importance [1].

Product price movements in India's agricultural sector have also been influenced by world trade movements, those related to the

Table 24

India : Ratio of wholesale price indices of crops and crop groups to the general index of wholesale prices, 1951-52 to 1964-65 (1952-53 = 100)

Year	All commodities	Agricultural commodities	Total food article	Cereals	Pulses	Sugar and gur	Fibers	Oilseeds	Rice	Wheat	Jowar	Gram	Gur	Cotton, raw	Groundnut
	percent														
1951-52	100.0	100.0	94.1	86.4	85.6	105.9	137.3	111.9	88.1	79.7	82.2	72.9	115.3	108.5	105.9
1952-53	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1953-54	100.0	101.1	102.0	93.7	87.0	119.5	97.5	118.5	95.6	88.9	95.6	85.1	134.8	99.4	121.4
1954-55	100.0	96.0	197.1	82.1	60.6	118.1	110.9	94.5	84.2	77.0	79.1	55.4	125.3	104.7	84.2
1955-56	100.0	95.1	93.6	82.2	66.0	96.2	114.6	91.9	84.3	77.8	72.4	53.0	95.1	104.9	85.4
1956-57	100.0	99.2	97.2	91.2	76.9	93.1	110.2	114.0	92.1	83.6	116.8	67.4	95.0	105.4	105.4
1957-58	100.0	99.1	98.2	83.2	75.6	99.6	108.9	110.7	96.9	81.2	105.2	62.7	98.7	97.9	99.6
1958-59	100.0	101.0	102.1	94.8	93.1	112.5	95.7	112.5	93.0	93.0	93.0	85.0	116.0	87.7	103.6
1959-60	100.0	99.5	101.6	88.8	80.3	125.5	89.2	115.3	89.7	82.0	101.6	64.0	137.5	90.5	111.9
1960-61	100.0	99.1	96.1	83.3	74.5	106.5	121.7	120.1	86.5	72.1	97.7	69.7	108.9	89.7	116.9
1961-62	100.0	98.2	96.0	81.5	73.5	95.9	110.3	124.7	83.9	72.7	89.5	66.3	92.7	87.1	123.9
1962-63	100.0	96.4	98.6	82.9	82.1	113.4	100.9	118.1	86.8	70.4	101.6	69.6	119.6	88.4	109.5
1963-64	100.0	96.6	101.1	85.7	85.0	139.7	98.3	113.8	92.3	73.2	85.7	73.9	161.1	88.0	106.4
1964-65	100.0	101.8	104.7	91.0	108.5	123.1	93.6	131.0	87.8	85.1	123.8	103.5	137.5	82.5	121.8

Source : Computed from data in Reference 18.

Table 25

India : Internal procurement of foodgrains by state and central governments, 1947—1966

Year	Procurement by		
	States	Central government	Total
	—	thousand tons	—
1947	4,279	—	4,279
1948	2,736	—	2,736
1949	4,684	—	4,684
1950	4,691	—	4,691
1951	3,826	—	3,826
1952	3,477	—	3,477
1953	2,094	—	2,094
1954	1,430	—	1,430
1955	15	117	132
1956	37	—	37
1957	127	168	295
1958	238	288	526
1959	901	905	1,806
1960	734	541	1,275
1961	236	305	541
1962	183	296	479
1963	205	545	750
1964	689	741	1,430
1965	2,353	1,678	4,031
1966	3,279	730	4,009
1967	3,400	1,000	4,400

Source : [18].

outbreak of the Korean War being of notable importance. The Nation's general price index rose from 405 in July 1950 to 458 in April 1951 [1]. Price gains in this period, however, were limited mainly to industrial raw materials and manufactured articles. In contrast, food prices declined somewhat, a decline not associated with or following any increase in production. Thus India's farmers were confronted at times both with declining absolute prices and with an even worsening situation with respect to terms of trade.

Despite the combined influence on agricultural product prices of India's own internal price and monetary policies and of trade disturbances caused by the Korean War, however, farm product prices in India throughout most of the study period have probably been close to the level needed to maintain equilibrium between the aggregate national demand and aggregate national supplies of agricultural products. In achieving and maintaining such an equilibrium, food imports (table 26) mainly of concessional nature, and not freely fluctuating free market prices, as determined in normal trade channels, have been the main equilibrating mechanism.

Table 26

India : Availability of cereals and pulses, 1951 to 1960

Year	Population	Cereals				Pulses net availability	Per capita availability		
		Net production	Net Imports	Change in government stocks	Net availability		Cereals	Pulses	Total foodgrains
—	—	—	—	—	million tons	—	—	kgs. per year	—
1951	363.4	40.02	4.80	0.59	44.23	8.03	122	22	144
1952	369.6	40.60	3.93	0.62	43.91	7.97	119	22	141
1953	376.1	45.37	2.04	—0.48	47.89	8.59	127	23	150
1954	382.9	53.44	0.83	0.20	54.07	9.72	141	25	166
1955	390.2	51.60	0.60	—0.75	52.95	10.10	136	26	162
1956	397.8	50.34	1.40	—0.60	52.34	10.21	132	26	153
1957	405.8	52.68	3 63	0.86	55.45	10.61	137	26	163
1958	414.3	49.36	3.22	—0.27	52.85	8.82	128	21	149
1959	423.3	57.30	3.86	0.49	60.67	11.54	143	27	170
1960	432.7	56.77	5.13	60.50	60.50	10.32	140	24	164
1961	442.7	60.65	3.49	—0.17	64.31	11.11	145	25	170
1962	453.4	62.08	3.64	—0.36	66.08	10.28	146	23	169
1963	464.3	58.63	4.55	—0.02	63.20	9.99	136	22	158
1964	475.5	61.41	6.26	—1.24	68.91	8.79	145	18	163
1965	487.0	66.99	7.45	1.06	73.38	10.88	151	22	173
1966	498.9	54.47	10.34	0.14	64.67	8.76	130	18	148

Source : [16].

Estimates based upon population and per capita income growth and relevant income and price demand elasticities, indicate that foodgrain prices in 1962-63 would need to have been at least 25 percent higher than they were to have achieved a supply-demand equilibrium through the pricing mechanism had there been no foodgrain imports.

If we assume that India's farmers were in economic equilibrium in 1952-53 and that little improvement was made before 1962-63 in their available farm technology, then under the subsequently prevailing factor-product price relations it would have been to the economic disadvantage of India's farmers to have increased their agricultural production at a much faster rate than they have done. Assuming such equilibrium in the early 1950's, the increased availability of fertilizers, water from irrigation sources, or other inputs would have increased their uses only if there had also been a reduction in their prices. Otherwise increased supplies of water for irrigation and other inputs would have led not to increases in their use, but to increases in undistributed supplied as indicated for irrigation facilities by Kusum Nair in her *Blossoms in the Dust* [49].

Whether India's farmers were in disequilibrium in the early 1950's and by how much may be debatable. But that there were no marked improvements in price incentives to farmers to increase their output from the early 1950's through 1963-64 is beyond question. Rising farm product prices might not have been sufficient to have set off by themselves alone a high sustained rate of growth in India's agricultural production. But without marked reduction in the prices of purchased inputs and/or improvements in available agricultural technology, they would have been necessary to have induced a faster rate of increase in output per worker or hectare of land.

Supporting Infrastructure and Services

In its approach to increasing agricultural production, India's emphasis has been on improving availability of water for irrigation, fertilizers, improved seeds and other inputs and on institutional reforms instead of upon price signals capable of indicating to farmers the Nation's growth in output needs. The post independence period has therefore been marked by an array of achievements in building up the Nation's agriculturally supporting facilities and service agencies that are impressive compared with progress in the first half of this century.

Irrigation and Power

India's water resources usable for irrigation is estimated at 55,500 crore (55.5 billion) cubic metres. In 1951, about 9.37 billion metres, or 16.9 percent of this flow was being used. At the end of the Third Five Year Plan period, about 33 percent of the usable flow was in use.

The net area irrigated by means of major and medium irrigation projects, principally canal systems fed by river sources, increased from 9.7 million hectares in 1950-51 to 13.0 million hectares in 1960-61 and to 21.4 million hectares at the end of the Third Plan period. The net area irrigated by minor schemes increased from 11.9 million hectares in 1950-51 to 15.8 million hectares in 1960-61 and to about 19 million hectares in 1965,66 [58, 59, 61 and 68].

In recent years, heavy emphasis has been placed upon the impounding by dams of water from monsoon rains for use in dry weather and upon the use of wells, especially tubewells, to tap underground water resources [67]. Progress with respect to use of tubewells has been facilitated by the development of rural electric power.

In 1947, total installed capacity of electric power generating plants in India was rated at 1,363, 000 kw's. It increased more than five-fold from 1947 to 1965, to 7,310,200 kw. Energy actually generated increased from 883, 000 kw. in 1947 to 5,256, 000 kw. in 1963-64. As a result of this increase, the number of towns and villages with a population under 10,000 electrified increased from 3,603 in 1951 to 26,891 in 1961 and to 46, 016 in 1965 [2 and 62].

The percentage of rural places electrified was 1.3. percent at the end of the first Plan in 1956 and 6 3 percent by March 1963 [59 and 62]. Rural electrification schemes, particularly ones relating to irrigation pumping, have received priority over urban sectors in several states in recent years.

Most of the expansion in electric power generating capacity has come in state-owned facilities, which in 1963-64 accounted for nearly 64 percent of the Nation's capacity compared with only 27 percent in 1950 [59]. Much of the increase in electric power generating capacity has come through the development of large multi-purpose dams, including among others the Bhakra Nangal Project developed jointly by Punjab and Rajasthan; the Tungabhadra Project completed by Andhra Pradesh and Mysore in 1958 ; and the Hirakund Dam Project developed in Orissa.

Transportation

Since Independence, improvements made in India's railway and road systems have linked many of its farmers more closely to markets for their agricultural surpluses and to sources of purchased farm inputs and consumer goods. In the case of railways, the progress has consisted more of improvements in services and transport capacities than in length of lines. However, in terms of length of lines, Indian railways have been increased from 54,845 kilometres in 1950-51 to 58,273 in 1964-65. Goods carried have been increased from 11.71 million to 19.51 million tons.

Surfaced roads have been increased from 145,855 kilometres in 1947 to 283, 680 kilometres in 1966 [6]. Improved but unsurfaced roads were increased from 242,371 kilometres in 1947 to 674.240 in 1966. An important component of the Nation's road building program has been that of expanding its national highways or grand trunk roads which now connect the Nation's several States. Improvements have also been made in the Nation's water ways, harbours and air transport facilities.

Land Development Programs

Flood control, land reclamation, soil conservation, and reforestation have also engaged the interests of India's agricultural leaders in recent years. An outlay of about Rs. 72 crores was provided for soil conservation schemes in the Third Plan compared with Rs. 1.6 crores in the First Plan and Rs. 18 crores in the Second Plan period. Considerable emphasis has necessarily been placed on soil and land-use surveys to provide a better informational basis for action programs in these areas [66].

Input Production Industries

Fertilizers

In 1966-67, India produced 309,000 metric tons of nitrogen fertilizers in terms of plant food nutrients and imported 575,000 tons (table 27). This compares with production of only 52,000 tons and imports of only 58,000 tons in 1952-53. India's domestic production of phosphate fertilizers increased from 7.445 tons in 1952-53 to 145,678 tons in 1966-67. These statistics, shown in table 27 on a yearly basis for the years 1952-53 through 1966-67, record the virtual beginnings and much of the recent development of the

Table 27

India : Production, imports and distribution of fertilizers, 1952-53 to 1966-67

Year	Nitrogen (N)			Phasphoric Acid P_2O_5			Potash K_2O	
	Produced	Imported	Distributed	Produced	Imported	Distributed	Imported	Distributed
—	—	—	—	Metric tons —		—	—	—
1952-53	53,067	44,294	57,822	7,445	—	4,552	3,311	—
1953-54	52,905	19,346	89,287	13,831	—	80,261	7,490	—
1954-55	68,478	19,984	94,810	14,345	—	15,027	11,097	—
1955-56	76,859	53,370	107,494	12,365	—	13,018	10,265	—
1956-57	78,788	56,768	123,054	17,585	—	15,874	14,791	—
1957-58	81,144	110,100	149,019	25,785	—	21,922	12,786	—
1958-59	80,766	97,540	171,988	30,987	—	29,490	22,366	—
1959-60	83,694	142,335	229,326	51,407	3,819	53,930	33,103	21,342
1960-61	111,987	171,926	211,685	53,722	128	53,134	24,845	29,052
1961-62	154,326	142,920	291,536	65,360	645	63;932	30,381	27,982
1962-63	194,194	229,462	360,033	88,300	7,959	81,385	44,276	36,503
1963-64	219,072	197,691	425,872	107,836	12,267	120,847	64,060	51,860
1964-65	243,230	256,517	492,249	131,021	12,293	148,530	57,176	71,640
1965-66	237,889	376,270	582,588	118,779	21,766	134,085	93,641	89,613
1966-67	308,993	574,628	830,171	145,678	129,158	274,601	143,337	133,666

Source : [25].

[1]Data from 1952-53 to 1956-57 relate to calendar years ; those for 1957-58 to 1966-67 are on April-March basis.

fertilizer production industry in India. In September 1967, installed capacity for nitrogen fertilizer production in the Nation was rated at 504, 540 metric tons. An additional capacity of 1, 057, 810 metric tons was in process of being developed and plans for the building of plants capable of producing 626,220 metric tons of nitrogen fertilizers (in terms of N) had been approved in principle. When completed, the combined capacity of plants already in production, under construction, and already approved in principle would be 2,188,570 metric tons [25].

In recent years, an increasing percentage of India's domestic output of chemical fertilizers is being produced and distributed by private sector.

Pesticides

Pesticide use on a significant scale in India began in the early 1950's. Their production in India was begun in 1952 by a private entrepreneur located near Calcutta [22]. A government manufacturing plant was established in Delhi in 1955. Through the Second and Third Plan periods several additional schemes for the manufacture of pesticides were implemented. In 1967, total capacity had reached 38,000 metric tons.

Promotion of the use of pesticides has necessitated provision of not only basic materials but also of equipment for their application, including both manually and power operated appliances. It has also required the use of many plant protection specialist to counsel farmers on use of pesticides and care and maintenance of spray equipment.

Improved Seeds

The multiplication and distribution of improved seeds was one of the principal programs envisioned in the First Five Year Plan for increasing the Nation's agricultural production. The first Plan, however, failed to provide clearly defined implementing procedures beyond recommending establishment of "a large number of seed farms operated by or under close supervision of the Agricultural Department" [58]. In the Second Plan production of improved seeds was given greater emphasis. Development of 25 acre Government Seed Multiplication Farms in each block was programmed. During the Plan period, many such farms were established and by 1965, 4000 were in existence. The Third Plan proposed setting up new larger units [61].

The establishment and maintenance of purity and quality, even for seed produced on Government farms, has posed a continuing problem During the Third Plan Period, an "Action Program of Improved Seeds" was drawn up by the Ministry of Food and Agriculture and circulated to States for implementation. A National Seeds Corporation was alsa established as an autonomous body with the objectives of popularizing improved crop varieties (other than paddy and wheat) and of fostering a sound seed industry.

In addition to governmental agencies, private seed farms have also played a role in seed production and can play an even more important role in the future.

Agricultural Implements

Measures to increase the supply or to improve the quality of the Nation's agricultural implements were relatively limited during the first two Five Year Plans. Since start of the Third Plan Period, however, improving farm implements and tools has been given larger attention in governmental efforts. By 1965, the manufacture of improved ploughs, harrows, seed drills, levellers, plant protection equipment and hand tools was being done by a large number of small manufacturing firms in addition to 6 State-owned

factories and 120 organized major industrial units. The Central Government at that time was also giving a subsidy of 25 percent on improved implements matched by State Government subsidies of equal amounts in many States [47].

Shortages of high grade iron and steel and of distribution and service facilities have been major limiting factors to a more rapid development of the Nation's farm implement industry [47].

Credit Facilities

For centuries India's farmers have depended prsmarily upon individual money lenders and landlords for credit with which to finance their farming operations and consumption credit needs, includlng 'those for weddings and other ceremonial uses. According to the All-India Rural Credit Survey, 70 'percent of the credit needs of cultivators in 1951-52 was provided by money lenders (table 28). An additional 14.2 percent was provided by relatives and 5.5 percent by traders and commission agents, leaving only 10.6 percent provided by cooperatives, governmental credit agencies and other sources [73].

Money lenders have been able to meet the credit needs of cultivators well enough to insure the year to year and inter-generation survival of traditional agricultural systems in a reasonably effective manner because of their ready accessibility, their simple and flexible way of doing business, and their intimate knowledge of the borrowers with whom they deal. Because of the small scale of their operation and the absence of alternative credit sources, however, the costs of such credit have usually been high. Moreover, such lenders are limited in their ability to fulfill the ever increasing credit needs of a rapidly developing agriculture.

Table 28

India : Percentage distribution of rural credit by source of borrowings, 1951-52 and 1961-62

Credit source	Distribution of borrowings	
	1951-52	1961-62
	percent	percent
Money lenders	69.7	46.6
Traders and commission agents	5.5	10.1
Relatives	14.2	8.8
Cooperatives	3.1	13.8
Government	3.3	2.3
Other sources	4.2	18.4
Total	100.0	100.0

Source : [73]

Table 29.

India : Progress in cooperative credit societies, 1950-51 to 1963-64

Item	1950-51	1954-55	1955-56	1960-61	1961-62	1963-64
Number of credit societies						
State societies	20	33	33	39	38	39
Central societies	505	485	478	390	387	387
Primary agricultural societies	115,748	151,714	168,410	222,004	224,004	219,212
Primary non-agricultural societies	7,810	9,348	10,003	11,995	12,477	13,323
Total	124,083	161,580	178,924	234,428	237,709	232,961
Number of members (000)						
State societies	31	102	127	216	224	290
Central societies	207	272	300	388	396	375
Primary agricultural societies	5,369	7,528	8,835	18,959	21,656	26,354
Primary non-agricultural societies	2,178	2.448	3,073	4,573	4,969	5,677
Working capital of all societies (lakhs of rupees)						
Share capital	2,697	4,291	5,114	15,561	18,462	24,660
Reserve and other funds	2,177	2,968	3,353	5,203	6,026	7,955
Deposits	9,938	12,972	15,318	29,585	32,932	45,421
Other borrowings	5,576	8,850	11,529	52,617	63,088	86,798
Loan transactions of primary societies (lakhs of rupees)						
Loans advanced to individuals	7,148	9,948	12,998	34,232	40,507	52,306
Loans repaid	5,885	8,879	10,480	28,570	34,315	43,379
Loans outstanding	7,590	11,393	13,231	36,180	42,614	58,427
Loans overdue	978	2,116	2,160	6,460	7,400	9,154

Source : [74].

For these reasons, the strengthening of institutional sources of credit has been a major objective in India's post-Independence agricultural development policies and programs. Legislation has been enacted in many states to restrict and regulate the activities of money lenders. The main thrust of governmental efforts in the farm credit field has been directed to increasing the number and the financial resources of cooperative credit societies.

In 1950-51, India had 124,083 cooperative credit societies (table 29). These included 20 state societies, 505 central societies, 115, 748 primary agricultural societies and 7,810 primary non-agricultural societies.

These had a total of 7,785,000 members and working capital amounting to Rs. 20,288 lakhs (1 lakhs—100,000). The primary credit societies advanced loans to individual during the year totalling Rs. 7,148 lakhs. Loans repaid amounted to Rs. 5,885 lakhs. Loans overdue from individuals amounted to Rs. 879 lakhs [74].

In 1963-64, there were 232,961 credit societies in existence in the country with a membership of 32.6 million and working capital of Rs. 1,64,834 lakhs. Loans advanced during 1963-64 amounted to Rs. 52,306 lakhs compared with only Rs. 7,148 lakhs in 1950-51 [74].

These credit societies have been serving mainly short-term credit needs. Land mortgage banks have been a principal agency for serving long-term credit needs. In the Land Mortgage Bank system, farmers are served directly by primary land mortgage banks which received their credit applications and pass them on to the Central Land Mortgage Bank. In this system, loans are granted for 15 to 20 years at interest rates of about 6 percent. In 1961-62, these banks advanced about 13 crores of rupees in credit to the Nation's farmers, a small amount relative to the needs of a now rapidly developing agriculture.

The Reserve Bank of India serves farmers' needs indirectly through its financing of Central Cooperative Banks and primary cooperative societies. In 1950-51, it provided only about Rs. 3 crores of credit funds to agriculture. In 1966-67, it provided Rs. 330 crores or 110 times as much as in 1950-51.

In the 1950's the Government established the State Bank of India which serves rural areas previously having no banking facilities. It has opened branches in small towns and mandis (market places), thereby promoting use of banking facilities among farmers. It had 497 such branches at the end of 1955, 907 at the end of 1960 and 1,423 in 1967. The State Bank also makes short-term loans at concessional interest rates to cooperative credit societies, provides remittance facilities to cooperatives, lends to cooperative marketing and processing societies, and provides credit for the construction of warehouses and other agricultural uses [9].

Marketing facilities and service

The rising productivity of India's agriculture since the early 1950's has increased the demand, among other things, for expansion and improvements in its agricultural marketing facilities and services. The establishment of "regulated" markets has been one important approach to improving market services. In regulated markets, farmers pay standard market charges and are insured reasonably fair prices. In 1951 there were 200 regulated markets in India. This number had increased to 1,855 by the end of March 1968 [9 and 67].

A second major approach to the provision of improved marketing facilities and services has been that of developing and strengthening cooperative marketing societies. During the Second Five Year Plan, there were nearly

2,000 primary cooperative marketing societies in the Nation being assisted through the National Cooperative Development and Warehousing Board.

The development of Central and State Government warehouses has been a third major approach to improving the Nation's market facilities. The total capacity of Central warehouses was increased from 79,000 to 257,000 tons from March 1961 to March 1964 and the capacity of State warehouse was likewise doubled. In 1967-68, the storage capacity of Centre and State governmental agencies was up to nearly 11 million tons [67].

Quantitative estimates of the contribution of these and other marketing facilities and service to recent growth in India's agricultural production is not possible with available data, but development of such facilities and services is an integral and necessary part of the Nation's agricultural development.

Agricultural Education, Extension and Research

At the time of publication of the First Five Year Plan, there were 22 agricultural colleges in India turning out about 1,000 graduates per year. Most of these were employed by State Departments of Agriculture for extension, research and educational work [58]. Since the early 1950's the Nation's programme of agricultural education at the college and graduate school level has been greatly improved by the development of several agricultural universities patterned along line of the landgrant universities in the United States and by the strengthening of graduate training program in the Indian Agricultural Research Institute at Pusa.

Agricultural universities combining research, resident teaching and extension are now operating in Andhra Pradesh, Madhya Pradesh, Maharashtra, Mysore, Orissa, Punjab, Haryana, Rajasthan and Uttar Pradesh. Most of these, however, were not developed until the late 1950's or early 1960's ; hence, they had little impact upon India's agricultural production before 1964-65. They can be expected to play an increasingly important role in the years ahead [48 and 69].

Much progress has been made in developing staff and institutional structures for a National Agricultural Extension Service. The effectiveness of such program during much of the past 15 years, however, was somewhat limited by limitations in knowledge of how to increase production and by the lack of incentives at levels needed to induce increasing intensity in the use of available inputs. Important advances made within the last four or five years in the Nation's agricultural technologies together with improvements in farm product prices have now greatly increased the need for agricultural extension services.

Other Factors

Land Reform

As indicated in Chapter 2, large emphasis was placed upon land tenure reform in pre-Independence and early post-Independence years. Accordingly, before initiation of the First Five Year Plan, legislation had been enacted in most States to abolish the intermediaries acting as revenue collectors between cultivators and government. Other measures were directed to regulating rents, limiting size of holdings, consolidation of highly fragmented operating units, and the development of cooperative farming [58].

These land reform measures have not led to dramatic increases in agricultural productivity. One reason has been that some of the reform measures have not yet been effectively implemented. Another reason has been the unforeseen lessening of security of tenants caused by measures intended to help them. For

example, according to one authority, a large number of tenants pay higher rents than those prescribed by law and "as for security of tenure, there have been more evictions and changes of tenants during the years following the tenancy legislation than in any previous period in recent history..... Landlords attempt to forestall the accrual of occupancy rights which was conditioned on continuous possession of lease for a certain minimum period" [79].

Community Development

Community Devlopment has also been given large emphasis as a rural and agricultural developments agency. Started with 55 pilot projects in 1952 this program now covers the entire rural area of India.

This program has probably put larger emphasis on welfare activities than on economic development. Some authorities believe that it also suffered from too rapid expansion, failures to clearly define priorities, limited training of personnel, and tendencies toward serving the special interests of the privileged few [9].

Much more crucial to the effectiveness of Community Development programs, if not also of cooperatives,has probably been the inadequacy of incentives to producers to increase their inputs and to make organizational and operational changes of the kinds required to increase production. Had there been more adequate incentives provided through rising product prices, decreasing input prices, or improved technologies, Community Development programs would likely have been more effective instruments of agricultural progress. Lacking adequate farm production incentives, there has been little demand by farmers for even the limited services that have in fact been available under these programs. It is not surprising, therefore, that emphasis in Community Development has been heavily focused upon general welfare improvement schemes based on the allocation of resources through other than open market channels.

* * *

Increases in area of crops, irrigation and fertiliszers account for over half of the observed growth in crop output. Because of the widening gap between India's demand for food and its supplies from domestic sources, one might have expected increases in the prices of food relative to non-food goods and services with these increases serving as production incentives to cultivators and as disincentives to consumers thereby balancing supply and demand. Until 1964-65, no such shifts in prices of agricultural commodities relative to those of non-agricultural products occured. Rather, price relationships between the two groups of commodities were highly stable with food imports, rather than prices, functioning as the main demand-supply equilibrating mechanism. Prices of foodgrains in 1963-64 would need to have been at least 25 percent higher than they were to have performed such equilibrating function without any foodgrains imports.

In its development policies, India put its emphasis upon improving input supplies and the institutional foundations of its agriculture. Such improvements have been necessary. Failure of prices to rise in response to growth in the Nation's food demand, however, has reduced the effectiveness of these and other improvements in the supply foundation of India's agriculture made in the last two decades.

Finally, notwithstanding constraints operating at the all-India level of aggregation on input supplies, infrastructures, incentives and administrative facilities, rates of crop output growth, as shown in Chapter 3, have been highly uneven as among states and as among districts within both rapid growth and slow growth states. An attempt is made in the next few chapters to identify and to assess the importance of factors accounting for these geographic differences in rates of crop output growth.

CHAPTER 6

Analysis of State Difference in Crop Output Growth

Major Sources of Growth

Growth in productivity[1] contributed more than growth in area in India's seven leading states in crop output growth (table 30). Punjab high rate of crop output growth, however, was achieved by rates of growth in both area and productivity that were above the all-India average. Only Rajasthan had a higher area growth rate than Punjab, but this was offset by a decrease in productivity.

Available data indicate that in the period 1952-53 to 1964-65, crop pattern changes accounted for 68 percent of the crop output growth in Gujarat ; 46 percent in Maharashtra 37 percent in Andhra Pradesh ; and 75 percent in West Bengal [43]. Yield changes were less important than crop pattern changes as a source of increased productivity in Gujarat, Rajasthan, Maharashtra and West Bengal [16].

Foodgrains led non-foodgrains in output growth in Himachal Pradesh, Bihar, Andhra Pradesh and Kerala (table 31). Foodgrains matched the rate of growth of non-foodgrains in Madras. Generally states with high rates of growth in nonfoodgrain output also had high rates of growth in foodgrain output. This suggests that measures which contribute importantly to growth of the one contribute to growth of the other.

Among non-foodgrains, sugarcane led other crops in output growth rate in Gujarat, Madras, Mysore, Maharashtra and Andhra Pradesh. Cotton was the leader in only Punjab and Rajasthan (table 32). Oilseeds made output gains of more than 4 percent per year (compound) in Punjab, Gujarat, Madras, Maharashtra and Uttar Pradesh.

Input Basis of State Differences in Output Growth

Land Inputs

Growth of gross sown area was an important source of increase in total crop output in all states during the period 1952-53 to 1964-65 (table 30). Among states, however, there was little, if any, correlation between crop output growth rate and that for area alone. Rather, in accounting for crop output growth, yield increasing inputs were also generally important: they compensated heavily for small area increase in Gujarat, Mysore, Himachal Pradesh, Bihar Andhra Pradesh and Madras.

Increase in crop area sown more than once have accounted for a part of the crop area

[1] The term *productivity* is used here to include all increases in output not accounted for by increase in area of crops.

Table 30

India : Annual compound rates of growth in crop output, area and productivity by states, 1952-53 to 1664-65

State	Output	Area	Productivity
	percent	percent	percent
Punjab	4.56	1.90	2.61
Gujarat	4.55	0.45	4.09
Madras	4.17	1.10	3.04
Mysore	3.54	0.81	2.71
Himachal Pradesh	3.39	0.71	2.67
Bihar	2.97	0.71	2.25
Maharashtra	2.93	0.44	2.45
Rajasthan	2.74	2.85	—0.11
Andhra Pradesh	2.71	0.26	2.45
Madhya Pradesh	2.49	1.28	1.21
Orissa	2.48	0.81	1.66
Kerala	2.27	1.30	0.96
West Bengal	1.94	0.59	1.34
Uttar Pradesh	1.66	0.72	0.94
Assam	1.17	1.25	—0.08
India	3.01	1.21	1.77

Source : [16].

growth with states ranking high in the latter also ranking high in growth of multiple cropping (table 33). Most of the crop area growth, however, resulted from a diversion of land from other uses, principally fallow and culturable waste.

Fertilizers

State data on fertilizer consumption in 1952-53 for the present breakdown of states in India are not readily available. However, consumption in 1952-53 for all of India was only 65.7 thousand tons in terms of plant food nutrients for nitrogen (N), phosphoric acid (P_2O_5) and potash (K_2O) combined. By 1964-65, the all-India consumption had reached 711.2 thousand tons. Data on fertilizer consumption by states for 1964-65 are shown in table 34.

The contribution of increases in fertilizer use to growth in crop output from 1952-53 to 1964-65 have been estimated for states (tables 35, 36 and 37) under the assumptions of a 10 to 1 yield response ratio and zero consumption rates in 1952-53. Table 35 reveals a fairly close positive relationship between increases in the use of fertilizers and increases in total crop output. Fertilizer uses increased enough in the three leading growth states, Punjab, Gujarat and Madras to increase output from 1952-23

Table 31

India : Annual compound rates of growth in output, area and productivity of foodgrains and non-foodgrains crop by states, 1952-53 to 1964-65

State	Foodgrains			Non-foodgrains		
	Output	Area	Productivity	Output	Area	Productivity
	percent	percent	percent	percent	percent	percent
Punjab	3.66	1·53	2.10	7.04	4.11	2.81
Gujarat	2.06	—2.45	4.64	6.72	4.82	1.71
Madras	4.17	0.75	3.39	4.17	2.24	1.90
Mysore	3.31	0.87	2.42	4.08	0.59	3.46
Himachal Pradesh	3.63	0.62	3.00	1.50	2.87	—1.34
Bihar	3.05	0.54	2.39	2.49	1.75	0.74
Maharashtra	2.20	0.32	1.87	4.38	0.81	3.24
Rajasthan	2.42	2.68	—0.25	4.08	4.36	0.27
Andhra Pradesh	3.21	0.81	2.40	1.60	—1.71	3.37
Madhya Pradesh	2.32	1.22	1.09	3.81	1.54	2.24
Orissa	2.39	0.75	1.64	2.95	1.49	1.45
Kerala	3.68	0.50	3.22	1.70	1.90	-0.20
West Bengal	1.14	0.26	0.88	3.77	3.61	0.15
Uttar Pradesh	0.85	0.40	0.45	3.61	1.98	1.59
Assam	0.76	1.28	—0.52	1.49	1.15	0.33
India	2.50	0.98	1.51	3.99	2.30	1.66

Source : [16].

to 1964-65 by 10.5 percent, 18.3 percent and 17.8 percent, respectively. Only one other state, Andhra Pradesh, increased its consumption of fertilizers enough to increase crop output by more than 10 percent. Andhra Pradesh. however, had the smallest increase in crop area of any State in India, hence ranked ninth among the states in total crop output growth rate.

Fertilizer consumption per hectare of cropped area was highest in Kerala, Madras, and Andhra Pradesh, all southern states in which non-foodgrain crops like tea, cotton and sugarcane are relatively important (table 38). Among northern states, Punjab had the highest rate of fertilizers consumption, 10.2 kilograms of total nutrients per hectare. Uttar Pradesh, although having a much greaetr population, had a rate of only 6.4 kilograms per hectare. The level of fertilizer use even in Indian states having the highest rates of application is still less than one tenth as high as that in Japan, Taiwan, Belgium West Germany and the Netherlands. It is less than one fifth as large at that in the UAR, to mention other countries which like India are so densely populated that they have no alternative to using chemical fertilizers as a

Table 32

India : Annual compound rates of growth in output, area and yield of major crops by states, 1952-53 to 1964-65[1]

State	Rice			Jowar			Bajra			Maize			Wheat			Barley		
	Output	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output	Area	Yield
	- - - -	- - - -	-	- p e r c e n t - - - -														
Punjab	8.68	6.82	1.74	0.98	0.46	0.51	-2.16	-2.95	0.82	3.83	3.91	-0.08	5.38	3.34	1.98	-3.11	-3.09	-0.02
Gujrat	-	-	-	1.06	-1.68	2.78	-0.52	-5.14	4.88	-	-	-	3.12	0.19	2.93	-	-	-
Madras	4.89	2.84	1.99	4.20	0.10	4.08	3.32	-2.53	6.00	-	-	-	-	-	-			
Mysore	4.77	1.84	2.88	2.67	1.65	1.01	-	-	-	-			4.07	0.93	3.11	-	-	-
Himachal Pradesh	3.71	0.29	3.41	-	-	-	-	-		5.62	0.72	4.87	3.29	1.34	1.93	-	-	-
Bihar	3.32	0.23	3.08	-	-	-	-	-		3.17	1.48	1.67	2.52	0.98	1.52	0.91	-0.41	1.32
Maharashtra	2.97	1.63	1.32	2.76	0.84	1.90	1.87	-1.18	3.09	-	-	-	3.80	1.94	1.83	-	-	-
Rajasthan	-	-	-	-0.41	0.59	-1.07	4.08	3.26	0.79	5.21	3.36	1.79	2.01	2.91	-0.87	-2.24	-1.72	-2.52
Andhra Pradesh	4.32	2.80	1.48	1.54	0.18	1.24	0.80	-0.92	1.74	-	-	-	-					-
Madhya Pradesh	2.01	1.20	0.80	2.59	-0.22	2.82	-	-	-	3.40	1.63	1.74	3.16	3.74	-0.56	-	-	-
Orissa	2.63	1.08	1.52	-	-	-	-	-	-	-	-	-	-	-		-	-	-
Kerala	3.72	0.52	3.18	-	-	-	-		-									
West Bengal	1.38	0.13	1.24	-	-	-	-	-					-	-	-	-	-	-
Uttar Pradesh	4.21	1.81	2.36	-1.46	-0.81	-0.66	-1.38	-0.99	-0.40	0.91	1.37	-0.46	1.44	0.76	0.67	-2.15	-2.11	-0.04
Assam	0.74	1.25	-0.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
India	3.18	1.47	1.68	1.96	0.40	1.56	1.38	-0.20	1.58	2.80	2.28	0.51	3.30	2.31	0.97	-1.62	-1.47	-0.16

(Contd.....)

Table 32 (*Contd*)

St.	Gram			Oilseeds			Cotton			Sugarcane			Potatoes		
	Output	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output	Area	Yield	Output	Area	Yield
	percent														
Punjab	1.26	2.11	-0.83	6.13	3.27	2.77	7.06	4.68	2.28	6.72	4.61	2.01	11.61	8.31	3.03
Gujrat	-	-	-	7.64	7.17	0.44	5.42	2.45	2.90	10.57	9.97	0.53	-	-	-
Madras	-	-	-	4.07	2.47	1.56	4.56	1.14	3.38	7.68	7.63	0.04	-	-	-
Mysore	-	-	-	0.68	0.28	0.41	1.94	0.72	1.21	9.50	5.81	3.49	-	-	-
Himachal Pradesh	-	-	-										4.81	3.94	0.84
Bihar	-0.13	-0.84	0.71	2.38	-0.67	3.05	-	-	-	0.69	1.92	-1.21	5.96	7.81	-1.72
Maharashtra	-	-	-	4.55	0.69	3.82	2.24	0.63	1.59	7.06	6.02	0.98	-	-	-
Rajasthan	4.52	5.08	-0.54	2.34	4.79	-2.35	5.15	2.43	2.66	4.88	5.63	-0.71	-	-	-
Andhra Pradesh	-	-	-	-2.16	-3.06	0.93	0.72	-0.50	1.23	8.69	6.28	2.26	-	-	-
Madhya Pradesh	1.83	0.85	0.97	6.56	2.78	3.67	-1.39	-0.93	-0.46	5.66	6.75	-1.01	-	-	-
Orissa	-	-	-	2.24	0.67	1.56	-	-	-	-	-	-			
Kerala	-	-	-	0.83	1.46	-0.62	-	-	-	-	-	-	-		
West Bengal	-	-	-	-1.36	2.23	-3.50	-	-	-	5.45	5.63	-0.17	6.27	4.58	1.61
Uttar Pradesh	-0.09	-0.08	-0.01	4.36	1.44	2.90	-	-	-	3.46	3.17	0.28	1.97	3.03	-1.02
Assam	-	-	-	-0.16	0.71	-0.86	-	-	-	2.80	1.18	1.60	0.61	2.94	-2.26
India	0.83	1.15	-0.31	3.46	2.60	0.83	3.32	1.22	2.08	5.91	4.73	1.82	NA	NA	NA

Source : [16].

[1] Growth rates for crops in states where they are not important are not shown.

Table 33

India : Growth in crop area and in multiple cropped area by states, 1953-53 to 1960-63[1]

State	Annual crop area growth rate 1952-53 to 1964-65	Decennial increases in area sown more than onec
	percent	percent
Rajasthan	2.85	114.2
Punjab	1.90	101.1
Kerala	1.30	47.4
Madhya Pradesh	1.28	39.1
Assam	1.25	19.1
Madras	1.10	54.9
Mysore	0.81	32.3
Orissa	0.81	88.7
Uttar Pradesh	0.72	32.1
Bihar	0.71	28.7
West Bengal	0.59	29.6
Maharashtra	0.44	75.7
Andhra Pradesh	0.26	36.3
All-India	1.21	47.4

Source : [19]

[1]Crop area growth is for 1952-53 to 1964-65. Growth in multiple cropping is that from 1950-51—1952-53 to 1960-61—1962-63. State indices for later years have not been published. Data for Himachal Pradesh and Gujarat for multiple cropping were not available for both sets of years.

substitute for land area in fulfilling their agricultural production needs.

The use of fertilizers in India on only its irrigated crop land at a rate equal to that in Japan would require about 8 million tons of fertilizers in plant nutrients compared with less than 2 million tons used in 1967-68. Expressed in another way, self-sufficiency in fertilizers production for use on irrigated land alone at these rates would require a fertilizer industry capable of producing 12 times as much fertilizers as India produced in 1967-68 and 4 times as much as that represented by its imports and domestic production combined. What the development of a fertilizer industry of this size would require, and employ, in the way of capital, foreign exchange, labour and technical skills has not been estimated. But clearly this kind of industrial development bears a highly complementary relationship to agricultural development and thereby to development of the nonfarm economy. The development of

Table 34

India : Consumption of Fertilizers by States, 1964-65

State	Nitrogen N	Phosphoric acid P_2O_5	Potash K_2O	Total
	tons	tons	tons	tons
Punjab	58,597	4,186	907	63,690
Gujarat	23,829	21,044	2,411	47,284
Madras	78,616	15,882	15,927	110,425
Mysore	32,413	9,635	9,019	51,067
Himachal Pradesh	1,104	595	41	1,740
Bihar	14,876	4,828	3,221	22,925
Maharashtra	55,007	19,840	8,878	83,725
Rajasthan	9,431	1,537	85	11,053
Andhra Pradesh	72,552	29,909	2,620	105,081
Madhya Pradesh	23,295	8,369	181	31,845
Orissa	7,902	1,858	796	10,556
Kerala	8,554	3,722	12,955	25,231
West Bengal	19,517	10,586	8,922	39,025
Uttar Pradesh	50,738	5,187	297	56,222
Assam	1,605	1,689	961	4,255
All-India	492,249	147,269	71,640	711,158

Source : [25].

this industry, assuming the parallel development in agriculture of markets for its output, would generate growth in the demand for roads, motor and railway transport facilities not only for fertilizers and farm products but for increased flows of many other commodities, both consumer and capital, that would emerge in this process as an essential condition of sustaining the predicated growth in the fertilizer industry. In these ways, such a pattern of development could generate growth in industry, employment, trade and commerce not only in major fertilizer producing centers but in villages and towns throughout the whole length and breadth of India.

Irrigation

The gross sown area under irrigation in India increased from 23.3 million hectares in 1952-53 to 31.2 million hectares in 1964-65, an increase of 7.9 million hectares. About 3.6 million hectares of this increase was required (in view of an increase of 15.36 percent in total gross sown area) to maintain the same ratio of irrigated to unirrigated land as India had in 1952-53. Its contribution to output increase is therefore one of the components of that shown under column 2 in table 35. The remaining increase of 4.3 million hectares of gross sown area represented a gain in the nation's ratio of irrigated to unirrigated land contributing to output growth through its effects on crop yields.

In a few states, notably Andhra Pradesh, Punjab, Madras and Mysore the percentage increase from 1952-53 to 1964-65 in the gross

Table 35

India : Percentage contribution to crop output growth by specified kinds of inputs by states, 1952-53 to 1964-65

State	Crop output growth rate	Percentage of crop output growth contributed by			
		Increase in crop area and proportionate increases in other inputs	Increases in fertilizers per hectare of crops	Increases in other inputs per hectare of crops	Total
	—	—	percent	—	—
Punjab	4.56	37.30	15.81	46.89	100.00
Gujarat	4.55	8.98	37.08	53.94	100.00
Madras	4.17	23.01	30.14	46.85	100.00
Mysore	3.54	20.44	19.56	60.00	100.00
Bihar	2.97	22.11	9.50	68.39	100.00
Maharashtra	2.93	13.79	26.10	60.11	100.00
Rajasthan	2.74	104.87	6.09	*	100.00
Andhra Pradesh	2.71	8.82	33.06	58.12	100.00
Madhya Pradesh	2.49	48.38	11.29	40.33	100.00
Orissa	2.48	30.88	7.54	61.58	100 00
Kerala	2.27	54.76	31.72	13.52	100.00
West Bengal	1.94	28.99	22.50	48.51	100.00
Uttar Pradesh	1.66	40.66	13.55	45.79	100.00
Assam	1.17	105.61	7.33	*	100 00
All-India	3.01	37.43	18.32	44.25	100.00

Source : Computed from data in references 16, 19 and 25.

* New land brought into cultivation appears to have been less productive than land already in use in 1952-53.

sown area under irrigation exceeded the percentage increases in gross sown area by amounts large enough to provide for a sizeable increase in the ratio of irrigated to unirrigated area. In several other states, notably Bihar, Kerala, Orissa and West Bengal the ratio of irrigated to unirrigated land increased little or actually decreased, notwithstanding in some cases ~~to~~ an absolute increases in the gross sown area irrigated. No state had a large enough increase in its ratio of irrigated to unirrigated land large enough to account for more than 10 percent of its increase in total agricultural production from 1952.53 to 1964-65. Data on gross sown irrigated area by sources of water are shown in table 39.

Other Inputs

Other inputs than increases in area and increases in fertilizers and water per hectare of land have played a demonstrable part in accounting for differences among states in their rate of growth in crop output (table 35). India's first five states in order of crop output growth were Punjab, Gujarat, Madras

Table 36

India : Percentage increase in crop output from 1952-53 to 1964-65 and the part of this percentage increase contributed by increases in specified inputs by states

State	Increase in crop output 1952-53 to 1964-65	Increase in crop output contributed by		
		Increases in crop area and proportionate increases in other inputs	Increases in fertilizer per hectare of crops	Increases in other inputs per hectare of crop
	— — — percent — — —			
Punjab	66.72	24.72	10.48	31.52
Gujarat	61.44	5.52	18.26	37.66
Madras	58.92	13.56	17.76	27.60
Mysore	48.73	9.96	9.53	29.23
Bihar	38.52	8.52	3.66	26.34
Maharashtra	38.28	5.28	9.99	23.01
Rajasthan	36.96	38.76	2 25	*
Andhra Pradesh	36.72	3.24	12.14	21.34
Madhya Pradesh	33.48	16.20	3.78	13.50
Orissa	32.64	10.08	2.46	20.10
Kerala	30.24	16.56	9.59	4.09
West Bengal	24.84	7.20	5.59	12.05
Uttar Pradesh	21.84	8.88	2.96	10.00
Assam	15.00	15.84	1.10	*
All-India	41.04	15.36	7.52	18.16

Source : Computations based on data from table 35.

* New land brought into cultivation appears to have been less productive than land in use in 1952-53.

Mysore and Bihar. These were also the five highest states in percentage of increase in such other inputs, although differing in rank in this regard from their rank in rate of crop output growth.

Data limitations have not permitted a breakdown of these "other inputs" by kinds on a state basis. One may be reasonably sure, however, that states leading in growth in uses of fertilizers and water were also among the leaders in the use of pesticides, improved seeds, mechanical power, improved implements and other modern inputs.

Growth in the use of modern inputs appears at this stage in India's agricultural development to be positively related to growth in the use of traditional inputs like bullock power and human labour. Some data relevant to this particular thesis have been compiled and analyzed for the erstwhile Punjab state, a fortunate by-product of detailed and fairly dependable quantitative data on stocks of

Table 37

India : Productivity growth rate and percentage increases in crop output resulting from increases in uses of fertilizers by states, 1952-53 to 1964-65

State	Annual productivity growth rate	1952-53 to 1964-65 increases in crop output contributed by increases in fertilizers/hectare
	percent	percent
Gujarat	4.09	18.26
Madras	3.04	17.76
Mysore	2.71	9.53
Punjab	2.61	10.48
Andhra Pradesh	2.45	12.14
Maharashtra	2.45	9.99
Bihar	2.25	3.66
Orissa	1.66	2.46
West Bengal	1.34	5.59
Madhya Pradesh	1.21	3.78
Kerala	0.96	9.59
Uttar Pradesh	0.94	2.96
Assam	—0.08	1.10
Rajasthan	—0.11	2.25
All-India	1.77	7.52

Source : Tables 30 and 36.

capital over a fairly long time collected by Punjab governmental agencies. Data in table 40 shows trends in the Punjab of major forms of agricultural inputs from 1950-51 to 1964-65. Table 41 shows quantitative indices of specified forms of capital used in agriculture for each of four years. Table 42 shows the percentage distribution between traditional and non-traditional forms of fixed capital and table 43 shows the value of specified inputs and their percentage distribution between traditional and nontraditional classes.

Salient points emerging from data in these tables can be summarized as follows :[1]

1. There has been considerable addition to the stock of fixed capital in Punjab agriculture since 1950-51.
2. The composition of the fixed capital, however, has been changing. The proportion of nontraditional assets has increased from a lowly 3 percent in 1950-51 to 14 percent in 1964-65.

[1]These and other data together with a fuller analysis are contained in a paper by Dr. B. Sen published under the title "capital Inputs in Punjab agriculture", *Economic and Political Weekly*, December 26, 1970.

Table 38

India : Consumption of fertilizer nutrients per hectare of gross sown area by states, 1952-53, 1964-65 and 1967-68[1]

States	1952-53			1964-65				1967-68			
	Nitrogen N	Phosphoric acid P_2O_5	Total	Nitrogen N	Phosphoric acid P_2O_5	Potash K_2O	Total	Nitrogen N	Phosphoric acid P_2O_5	Potash K_2O	Total
	kgs.	kgs.	kgs.	kgs.	kgs.	kgs.	kgs.	kgs.	kgs.	kgs.	kgs.
Punjab	0.52	0.05	0.57	5.84	0.42	0.09	6.34	14.00	3.68	1.05	18.73
Pepsu	0.27	0.01	0.05								
Gujarat				2.35	2.08	0.24	4.67	5.97	3.20	0.30	9.47
Saurashtra	0.08	—	0.08								
Madras	2.78	0.22	3.00	10.79	2.18	2.18	15.15	20.71	9.19	6.24	36.14
Mysore	0.52	0.08	0.60	3.01	0.90	0.84	4.75	8.06	4.35	1.98	14.39
Ghorg	0.74	0.07	0.81								
Himachal Pradesh	0.02	—	0.02	2.49	1.34	0.09	3.93	10 65	5.29	0.49	16.43
Bihar	0.38	0.01	0.39	1.34	0.44	0.29	2.07	6.01	2.44	0 28	9.73
Maharashtra	0.30	0.06	0.36	2.90	1.05	0.47	4.42	5.38	2.90	1.12	9.40
Rajasthan	0.04	0 01	0.48	0.64	0.10	0.01	0.75	1.59	0.49	0.08	2.16
Ajmer	0.06	—	0 06								
Andhra Pradesh	1.72	0.28	2.00	5.65	2.33	0.20	8.18	12.50	3.97	0.33	16.80
Hyderabad	0.36	0 11	0.47								
Madhya Pradesh	0.27	0.01	0.28	1.27	0.45	0.01	1.73	1.32	0.44	0.19	1.95
Madhya Bharat	0.03	—	0.03								
Bhopal	0.03	—	0.03								
Orissa	0:33	—	0.33	1.14	0.27	0.11	1 52	1.50	0.23	0.29	2.02
Kerala				3.50	1.52	5.29	10.31	10.48	4.72	8.04	23.24
Travancore-Cochin	0.45	0.05	0.50								
Uttar Pradesh	0.47	0.01	0.48	2.31	0.24	0.01	2 56	8.24	2.65	2.04	12.93
Assam	0.10	—	0.10	0.58	0 61	0.35	1.55	0.15	0.57	0.26	0.98
All-India	0.65	0.06	0.71	3.14	0.94	0.46	4.54	7.18	2.77	1.30	11.25

Source : [25].

Note : The coverage for 1952-53 is not comparable to those of later years but may be indicative of changes in use of fertilizers.

Table 39

India : Gross sown area irrigated by sources of water, by states, 1952-53 and 1964-65

State	1952 - 53							1964 - 65						
	Canals			Tanks	Wells	Other sources	Total	Canals			Tanks	Wells	Other sources	Total
	Government	Private	Total					Government	Private	Total				
	thousand hectares													
Punjab	1,807	57	1,864	7	997	15	2,883	2,227	49	2,276	6	1,057	46	3,385
Gujrat[1]								110	1	111	22	668	36	837
Madras	722	2	724	637	427	52	1,840	891	1	892	892	599	41	2,425
Mysore	136	6	142	285	138	52	618	348	6	353	371	173	133	1,031
Himachal Pradesh	-	-	-	-	-	39	39						38	38
Bihar	384	307	691	410	225	575	1,902	584	13	596	200	313	872	1,980
Maharashtra[2]	207	18	225	205	816	38	1,284	326	34	359	235	1,351	83	2,028
Rajasthan	240	-	240	146	858	45	1,289	614	-	614	295	1,127	43	2,080
Andhra Pradesh	1,196	21	1,214	751	286	64	2,318	1,249	26	1,275	1,341	405	138	3,158
Madhya Pradesh	379	-	379	125	265	36	804	542	1	543	127	364	42	1,077
Orissa	191	31	221	278	28	255	783	197	28	225	495	38	219	977
Kerala	121	28	149	33	11	131	323	162	8	170	56	4	122	352
West Bengal[3]	125	347	472	418	17	233	1,140	514	388	902	328	16	184	1,430
Uttar Pradesh	1,872	11	1,883	5	2,432	640	4,961	2,225	9	2,233	409	2,574	274	5,490
Assam	71	307	378	-	-	250	628	72	292	364	-	-	247	611
India	7,511	1,350	8,861	3,303	6,521	2,437	21,122	9,951	855	10,806	4,755	8,021	2,482	26,062

Source : [19 and 25].

[1] Included in Maharashtra in 1952-53.

[2] Includes Gujarat

[3] Data in 1964-65 column are for 1962-63 since 1964-65 data are not available.

Table 40

Punjab : Indices of land, labour and fixed capital used in agriculture, 1950-51 to 1964-65

Year	Land	Labour	Fixed capital	Ratio of fixed capital to	
				Land	Labour
	—	—	—	percent —	— —
1950-51	100.0	100.0	100.0	1.00	1.00
1955-56	105.5	105.5	127.4	1.05	1.06
1960-61	109.1	111.3	142.4	1.14	1.15
1964-65	112.4	116.8	151.9	1.11	1.13

Source : [23]

Table 41

Punjab : Quantity indices of specified forms of capital used in agriculture, 1950-51 to 1964-65

Item	1950-51	1955-56	1960-61	1964-65
	— —	— percent	— —	— —
Wooden ploughs	100.0	125.1	117.0	119.3
Iron ploughs	100.0	171.8	293.1	448.1
Sugarcane crushers				
Power driven	100.0	114.6	399.1	690.5
Bullock drawn	100.0	117.2	137 4	155.8
Carts	100.0	120.4	138.7	154.9
Wells	100.0	105.5	112.3	117.0
Persian wheels	100.0	105.5	113.3	117.0
Oil engines	100.0	306.9	495.0	1,540.5
Electric pumps	100.0	2,104.3	2,699.7	7,126.7
Tractors	100 0	252.7	520.6	894.7
Bullocks	100.0	107.1	115.5	114.8

Source : [23]

However, weight of the traditional is still heavy in total stocks.

3. The inputs of fixed capital (as distinct from stocks) has increased in the same manner as stocks.

4. The increases in working capital has been large and is suggestive of important technological changes. The share represented by fertilizers, water, electricity and fuel oil has increased significantly.

5. The absolute amount of capital from farm sources has increased perceptiably during this same period of

Table 42

Punjab : Share of traditional and nontraditional items of fixed capital used in agriculture 1950-51 to 1964-65

Year	Traditional[1]	Nontraditional[2]	Total
	percent	percent	percent
1950-51	96.7	3.3	100.0
1955-56	94.2	5.8	100.0
1960-61	91.6	8.4	100.0
1964-65	85.7	14.3	100.0

Source : [23].

[1]Includes bullocks, wooden ploughs, carts, wells and Persian wheels for irrigation.

[2]Includes iron ploughs, tractors, electric pumps, oil engines and sugarcane crushers.

Table 43

Punjab : Estimates of value of specified agricultural inputs and ratio of traditional to nontraditional inputs in agriculture 1950-51 to 1964-65 (at 1950-51 prices)

Item	1950-51	1955-56	1960-61	1964-65
	— — — thousand rupees — — —			
Seeds	192,529	227,193	232,497	241,790
Manures	41,020	48,405	49,535	51,515
Fuel oil	2,148	6,593	10,636	33,097
Electricity	382	8,049	10,326	27,261
Fertilizer	1,651	11,120	15,282	120,950
Land services	24,018	25,419	26,149	27,000
Water	52,003	63,300	67,210	77,763
Miscellaneous	4,996	5,896	6,033	6,275
Total	318,750	395,978	417,722	585,654
	— — — ratio — — —			
Ratio of nontraditional to traditional inputs[1]	0.21	0.29	0.33	0.79

Source : [4 and 23].

[1]Seeds, manures, land services, and miscellaneous items are classified as traditional inputs and the other inputs are classified as non-traditional inputs in the calculation of these ratios.

time. So has the employment of both labor and land in Punjab agriculture.

6. The productivity of capital, both traditional and nontraditional kinds, inferable from the Punjab's rapid rate of growth in crop output, appears to have been large.

Such data as are available for Gujarat and Madras, ranking second and third respectively, following Punjab in rate of crop output growth, suggests a somewhat similar pattern of development—one involving substantial increases in a mix of highly complementary modern inputs like fertilizers, water and improved implements that in turn have been associated with increasing employment of such traditional inputs as land, labor and cattle for power. It is worthy of note also that associated with these patterns of agricultural development there has occurred in these three states appreciable growth in manufacturing and trade, with considerable emphasis on enterprises highly complementary to agriculture.

Price Incentives

Research in India on efficacy of the pricing machanism in foodgrain markets reveals that it does function somewhat as postulated in the theory of competitive markets [7 and 32]. It might, therefore, appear that inter-state differences in farm product prices would have been relatively unimportant in accounting for inter-state differences in rates of growth in agricultural output and productivity. India, however, is geographically a large nation without a highly developed net-work of modern roads and transport facilities. India's states also differ widely in their ratio of rural to industrial and urban population ; the latter provide the main source of markets for agricutural surpluses. The states of West Bengal, Maharashtra and Madras have large urban centers. Much of Punjab and western Uttar Pradesh lie in close proximity to the large metropolitan area represented by the Union terrirority of Delhi. The states of India also differ somewhat in respect to their comparative advantage as between the production of foodgrains and the production of industrial raw materials and export crops like jute, tea and spices ; hence they differ widely in their ratio of foodgrain to nonfoodgrain production.

These differences in (a) ratios of rural to urban population and (b) in ratios of foodgrain to nonfoodrain crops mean that India's states differ markedly in their degree of self-sufficiency in foodgrain production. Given large differences in foodgrain self-sufficiency among states spatially separated in a large nation highly under-developed in marketing and transport facilities, inter-state differences in price of foodgrain would be much larger than in a smaller nation or in one where the urban population is more equally distributed geographically.

It is against this background of conditions that inter-State differences in farm product prices as factors affecting differences in rates of growth in agricultural output and productivity need to be examined.

Wholesale prices of rice and wheat per 100 kilograms are shown in tables 44 and 45 for years from 1952 to 1968. The position of states with respect to their net imports and exports and degree of self sufficiency in foodgrain production is shown in table 46.

States with normally large foodgrain deficits include West Bengal, Maharashtra, and Madras, having the major metropolitan centers of Calcutta, Madras and Bombay, respectively. The Union territory of Delhi is another major metropolitan area which also provides markets for large imports of

Table 44

India : Wholesale price of rice per 100 kilograms by states, 1952 and 1961 to 1968[1]

States	1952	1961	1962	1963	1964	1965	1966	1968
	—	—	—	— rupees	—	—	—	—
Punjab	N.A.	44.21	44.21	44.21	50.17	60.00	60.00	N.A.
Gujarat	N.A.	N.A	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Madras	58.46	60.24	59.05	57.21	65.33	66.03[2]	65.10[2]	66.81
Mysore	N.A.	59.44	59.59	53.53	66 80	89.36	116.60	N.A.
Himachal Pradesh	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Bihar	61.61	55.73	57.74	63.54	70.51	85.08	126.43	110.52
Maharashtra	52.73	55.78	52.20	59.74	68 92	70.05[2]	69.72[2]	84.71
Rajasthan	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Andhra Pradesh	50.56	55.62	54.99	54.39	61.24	63.07[2]	65.02[2]	109.00
Madhya Pradesh	32.92	41.52	43.92	52.26	58.13	58.23[2]	64.80[2]	112.33
Orissa	46.98	39.71	48.86	61.59	61.20	59.90[2]	76.56	104.00
Kerala	54.15	60.91	58.57	60.90	71.20	63.50	68.67	96,00
West Bengal	53.93	52.57	61.26	77.73	64.05	66.11[2]	72.00[2]	129.13
Uttar Pradesh	68.18	51.51	52.20	54.34	69.16	65.67[2]	129.09	107.45
Assam	57.62	51.12	55.65	59.92	66.06	65.58[2]	65.14[2]	65.14

Source : [11].

[1] Price as reported on February 11,1968.

[2] Statutory controlled prices fixed by State Governments (Average).

foodgrains from other parts of India. Other states with normally large foodgrain deficits are Kerala, Assam, Bihar and Uttar Pradesh. Kerala and Assam are important producers of export crops. The deficits in Bihar and Uttar Pradesh are related to their low per capita production, although western Uttar Pradesh has been a major sugarcane producing area.

In the several years for which data are shown in table 44, the price of rice per 100 kilogram was lower in Punjab, Orissa, Madhya Pradesh and Andhra Pradesh, major surplus foodgrain states, than in the deficit states. Among wheat growing states, prices were lower in surplus than in deficit states. The price differences that would normally have prevailed between surplus states and deficit states having large metropolitan centres, however, have been distorted by the flows of concessional food imports, which except in the severe drought years of 1966 and 1967 (characterized by near famine conditions in Bihar, eastern Uttar Pradesh and northern Madhya Pradesh) have moved predominantly into the Nation's urban areas for distribution at below open market prices.

These factors, coupled with a tendency for official wholesale price statistics to reflect statutory prices as fixed by state governments

Table 45

India : Wholesale price of wheat per 100 kilograms, major wheat producing states, 1952 and 1961 to 1968

States	1952	1961	1962	1963	1964	1965	1966	1968[1]
	—	—	—	rupees	—	—	—	
Punjab	24.78	39.41	42.49	40.34	51.47	58.40	70.88	94.00
Gujarat	57.37	51.20	51.02	51.17	62.98	68.99	72.98	93 78
Bihar	68.77	49.59	48.92	49.96	69.30	97.00	107.50	92.50
Rajasthan	41.98	43.72	41.69	39.38	52.32	51.23	74.14	95.00
Madhya Pradesh	45.90	36.62	40.28	40.48	56.55	60.57	60.16	94.33
Uttar Pradesh[2]	50.82	40.24	38.64	41.23	69.41	72.19	75.96	76.57

Source : [11].

[1] Price as reported on February 11, 1968,

[2] Average price of red, white and dara varieties.

(as shown in footnotes to tables 44 and 45) make it exceedingly difficult to measure statistically the influence of interstate price differences on differences among states in their agricultural output and productivity growth rates.

Surplus states like Punjab, Madras and Gujrat that have had a rapidly growing industrial sector have been able to achieve and maintain fairly high rates of growth in both their agricultural output and their agricultural productivity. Punjab's close linkage with the Union territory of Delhi has given it an added advantage. On the other hand, Bihar and eastern Uttar Pradesh, both with a comparative advantage in foodgrain but with limited industrial development, have remained major deficit foodgrain producing areas.

Other Factors

Data limitations and institutional factors influencing prices make measurement of the influence of other economic and institutional factors on interstate differences in agricultural output and productivity growth rates exceedingly difficult. This section, however, presents state data on a few selected factors which would normally be expected to influence rates of growth in agricultural output and productivity.

Income and Capital Asset Position

Other factors being equal, farmers having the higher income or having a higher value of capital assets would have a larger capacity for savings and thereby for growth in their output and productivity than would farmers having lower incomes and wealth. Estimates of the value of agricultural output per worker and per acre of land in 1960-61 are shown in table 47 for states arrayed from high to low in their rates of crop output growth from 1952-53 to 1964-65.

Table 46

India : Net imports and exports of total foodgrains by states, 1962-63 to 1964-65

State	1962-63		1963-64		1964-65		Average 1962-63/1964-65	
	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports
	—	—	—	metric tons	—	—	—	—
Total[1]								
Punjab	—	520,420	—	610,960	—	253,884	—	461,755
Gujarat[2]	441,988	—	220,834	—	—	270;420	130,801	—
Madras	63,750	—	70,980	—	84,618	—	73,116	—
Mysore[2]	310,548	—	233,539	--	369,070	—	304,386	—
Himachal Pradesh	4,369	—	4,313	—	7,565	—	5,416	—
Bihar	431,735	—	469,181	—	303,964	—	401,627	—
Maharashtra[2]	—	201,993	—	263,498	—	478,254	—	314,582
Rajasthan	—	207,311	—	223,343	101,026	—	—	109,876
Andhra Pradesh	—	650,450	—	820,299	—	663,999	—	711,583
Madhya Pradesh	—	604,542	—	769,400	—	536,667	—	636,870
Orissa	—	216,062	--	47,704	—	137,565	—	133,784
Kerala[2]	613,758	—	717,953	—	484,622	—	605,444	—
West Bengal[2]	301,703	—	—	13,491	—	296,092	—	2,627
Uttar Pradesh	—	59,292	448,217	—	727,443	—	372,123	—
Assam	166,806	—	294,715	—	241,839	—	334,453	—
Delhi	121,096	—	260,716	—	289,890	—	223,901	—
Total excluding ports[1]								
Gujarat	616,347	—	553,881	—	343,701	—	504,643	—
Madras	155,586	—	207,193	—	222,528	—	195,102	—
Mysore	290,051	—	230,263	—	306,786	—	275,700	—
Maharashtra	284,778	—	253,406	—	526,076	—	354,753	—
Andhra Pradesh	—	359,008	—	580,165	—	362,241	—	433,805
Kerala	176,016	—	205,069	—	179,747	—	186,944	—
West Bengal	301,438	—	304,697	—	65,037	—	223,724	—

Source [19].

[1] Includes imports and exports at parts in these states.

[2] States having port cities.

Table 47

India : Value of agricultural output by states, 1960-61

State[1]	Value of agricultural output		
	Gross value per acre	Net value	
		Per acre	Per worker
	— — — Rupees	— — —	
Punjab	175.83	155.55	861
Gujarat	153.10	136.77	578
Madras	338.92	282.87	530
Mysore	167.41	137.94	476
Himachal Pradesh	164.13	136.04	214
Bihar	186.83	161.53	302
Maharashtra	152.24	132.08	467
Rajasthan	84.41	71.34	343
Andhra Pradesh	188.23	156.65	365
Madhya Pradesh	125.29	106.10	360
Orissa	208.21	180.80	488
Kerala	521.56	445.44	1159
West Bengal	348.84	313.21	824
Uttar Pradesh	199 88	167.09	479
Assam	370.87	347.78	620
India	187.21	160.61	477

Source : [51].

[1] States arrayed by rate of growth in crop output, 1952-53 to 1964-65.

There was little correlation between these values and crop output growth. However, the three leading states in crop output growth had a net values of agricultural output per worker appreciably above all-India average of Rs. 477.

Data on average value per rural household of assets (table 48) reveals a somewhat closer relationship to crop output growth rates. The top growth states of Punjab, Gujrat, Madras and Mysore were the four highest states in value of assets per rural household.

Capital Expenditures and Uses of Credit

Data on capital expenditures and on the percentage of these expenditures financed by credit are shown by states for the year 1961-62 in table 49. Capital expenditures per cultivator tended to be highest in states highest in rate of crop output growth. Borrowing of funds for the financing of expenditures displayed a similar pattern of relationships.

The distribution of these capital expenditures and borrowings by kind of expenditure is shown in table 50. Purchase of land and land rights was the largest single items of expenditure with purchase of livestock, purchase of implements, building and other land improvements being other major items of expense. Purchases of livestock and implements were in general higher in states having high crop output growth rates.

Table 48

India : Average value of assets per rural households by states, 1962

State[1]	Total assets	Land and land rights	Livestock	Equipment[2]	Other assets
	— — — Rupees — — —				
Punjab	10,507	5,999	788	315	3,405
Gujarat	6,692	3,527	649	348	2,168
Madras	5,230	3,525	230	157	1,318
Mysore	7,073	4,689	439	170	1,775
Bihar	5,621	4,053	253	62	1,253
Maharashtra	5,147	3,495	422	185	1,045
Rajasthan	5,468	2,329	864	241	2,034
Andhra Pradesh	5,779	3,924	347	121	1,387
Orissa	3,486	2,106	248	80	1,052
Kerala	5,268	3,577	79	79	1,533
West Bengal	3,986	2,527	215	72	1,172
Uttar Pradesh	5,261	2,830	405	147	1,879
Assam	3,153	1,646	344	82	1,081

Source : [73].

[1] States are arrayed from high to low according to their crop output growth rates 1952-53 to 1964-65.

[2] Includes equipment used in farm and nonfarm businesses and for transport.

Differences among states in uses of credit for both capital investments and operating expenses are shown in table 51 for the year 1961-62. In general, in states having a high crop output growth rate, cultivators used much more credit than in slower growth states, reflecting on this score a higher degree of monetization of operations associated with growth in output.

Data on sources of credit indicates a slightly large dependence by cultivators on institutional sources (government, cooperatives and commercial) in rapid growth than in slow growth states, However, Punjab, a heavy user of credit and India's most rapid growth state, depended more heavily on non-institutional sources than did either Orissa or Uttar Pradesh.

Rural Electrification

The extension of electric power facilities into rural areas is important as a contributor to increasing both the productivity and level of welfare of rural people. Data in table 52 reveals that in general states ranking high in crop output growth rates excell those ranking low in crop output growth in percapita generation of electricity and in percentage of villages and towns electrified. Exceptions in respect to percapita generation of electricity include many states having a large urban population, notably Maharashtra, West Bengal and Kerala (see table 54 for percentage of rural population).

Table 49

India : Rural capital expenditures and borrowings per rural household by states, 1961-62

State	Cultivators		Non-cultivaters		All rural household	
	Average expen-diture	Financed from borrowing	Average expen-diture	Financed from borrowing	Average expen-diture	Financed from borrowing
	Rupees	Percent	Rupees	Percent	Rupees	Percent
Punjab	264.4	26.9	41.6	38.3	172.9	28.0
Gujarat	188.2	32.2	5.2	42.8	129 2	44.8
Madras	186.0	46.7	13.3	42.4	122.2	46.6
Mysore	243.6	31.2	16.9	40.4	183.1	31.4
Bihar	58.4	22.9	5.6	18.1	46.9	22.8
Maharashtra	127.9	26.8	10 7	22.6	90.6	26.6
Rajasthan	176.6	54.3	21.0	26.2	155.9	53.8
Andhra Pradesh	176.2	38 8	22.8	46.3	123.1	39.3
Orissa	51 9	16.2	3.1	25.0	37.8	16 4
Kerala	82.4	24.7	17.4	3.6	69.7	23.6
West Bengal	51.3	19.6	7.3	27.6	36.7	20.1
Uttar Pradesh	121.2	29.3	21.7	48.0	101.3	80.1
Assam	49.6	14.8	9.5	—	39.7	14.0
India	124.3	33.1	15.0	37.6	95.2	33.3

Source : [73].

Land Tenure

Land is still the major source of economic opportunity in rural India. India's land tenure system is, therefore, its most important institution affecting the interpersonal distribution of both employment opportunity and income among its rural people. Through these distributive relationships, it affects the prices of both land and labor. It affects also the extent to which the distribution of expenses of modern inputs and yields between land owners and tillers of the soil is in accord with marginal productivity and distribution principles. It is, therefore, an important institution affecting the rate of adoption of modern yield increasing inputs like fertilizers, pesticides and improved crop varieties.

Comparative data now available on tenure patterns by states, however, are limited mainly to those on households in such broad general categories as "owners", "pure tenancy" and "agricultural laborers" supplemented by highly general information on the nature of land rights associated with more traditional tenure forms in various parts of India.

Data on the area under major tenure categories applicable under British colonial rule

Table 50

India : Borrowings as source of finance for capital expenditures in farm business by states, 1961-62

State 1/	Purchase of land		Purchase of land rights		Reclamation of land		Building and other land improvements		Orchards and Plantations		Wells	
	Average expenditure per household	Financed from borrowings	Average expenditure per household	Financed from borrowings	Average expenditure per household	Financed from borrowings	Average expenditure per household	Financed from borrowings	Average expenditure per household	Financed from borrowings	Average expenditure per household	Financed from borrowings
	Rs.	percent	Rs.	percent	Rs.	percent	Rs.	percent	Rs.	percent	Rs.	percent
Punjab	37.7	46.9	1.1	44.6	4.3	-	5.2	2.5	0.8	-	9.7	17.3
Gujrat	17.6	33.3	1.6	16.5	1.2	18.3	25.5	8.9	0.5	-	16.5	33.4
Madras	55.6	62.5	-	-	9.2	56.4	10.4	24.3	0.9	28.1	24.4	47.7
Mysore	37.1	43.2	0.4	100.0	14.7	32.3	47.4	28.8	13.6	26.3	23.3	54.2
Bihar	12.6	41.5	0.2	49.6	0.5	5.8	3.3	6.9	0.2	-	2.2	21.2
Maharashtra	26.3	37.2	1.3	46.4	4.6	5.4	23.5	31.4	1.0	20.9	20.6	23.4
Rajasthan	13.4	61.9	5.4	73.8	0.8	47.2	3.3	23.5	0.1	-	11.0	61.0
Andhra Pradesh	63.2	44.2	1.1	53.6	3.8	26.7	15.8	27.0	0.2	55.6	12.2	42.3
Madhya Pradesh	12.7	38.7	0.5	5.0	0.7	-	11.2	11.3	0.4	-	7.0	25.9
Orissa	10.4	20.8	-	-	8.8	29.2	8.7	6.3	0.1	-	0.9	-
Kerala	24.3	31.1	6.6	26.2	3.9	33.6	8.2	20.0	5.1	22.7	0.8	-
West Bengal	17.1	29.3	-	-	1.0	12.7	4.5	4.1	0.7	-	0.2	24.2
Uttar Pradesh	10.8	29.5	1.2	12.5	2.2	21.2	5.2	10.5	0.7	10.5	5.3	28.9
Assam	10.5	38.4	0.4	-	6.1	11.1	2.9	2.2	0.9	37.8	1.0	-
India	23.4	42.9	1.2	39.6	3.6	28.0	11.1	20.5	1.4	21.3	8.9	37.4

(*Continued*)

(**Table 50** *Continued*)

State	Other irrigation resources		Agr. implements, machinery, transport, equip.		Farm houses grains golms & cattlesheds		Purchase of Livestock		Other capital exp. in farm business		Total capital expenditure	
	Average expenditure per household	Financed from borrowings	Average expenditure per household	Financed from borrowings	Average expenditure per household	Financed from borrowings	Average expenditure per hougehold	Financed from borrowings	Average expenditure per household	Financed from borrowings	Average expenditure per household	Financed from borrowings
	Rs.	percent	Rs.	percent	Rs.	percent	Rs.	percent	Rs.	percent	Rs.	percent
Punjab	2.9	-	36.8	11.3	8.9	15.5	156.9	29.1	0.1	-	264.4	26.9
Gujrat	3.9	18.4	61.5	39.9	7.9	37.0	51.5	35.2	0.5	33.4	188.2	32.2
Madras	0.4	-	28.6	43.1	2.2	9.6	52.7	37.3	1.8	15.9	186.0	46.7
Mysore	2.3	37.2	27.7	18.2	5.3	26.6	64.6	25.9	7.3	12.3	243.6	31.2
Bihar	0.8	28.8	5.3	7.9	1.4	1.8	31.8	20.9	0.1	14.8	58.4	22.9
Maharashtra	1.6	15.5	14.8	27.4	4.5	17.6	29.3	20.6	0.3	8.0	127.9	26.8
Rajasthan	1.2	38.6	21.0	28.0	1.9	31.5	118.4	58.0	0.1	-	176.6.	54.3
Andhra Pradesh	0.8	-	17.1	26.9	3.6	21.3	58.2	41.2	0.3	4.8	176.2	38.8
Madhya Pradesh	0.1	-	6.8	5.3	2.5	6.6	48.8	44.2	0.4	87.2	90.9	33.4
Orissa	0.1	-	5.2	1.9	2.2	1.0	15.4	19.5	0.1	-	51.9	16.2
Kerala	2.0	89.4	5.2	9.9	2.7	1.9	22.1	18.5	1.5	35.2	82.4	24.7
West Bengal	0.2	-	3.8	3.7	4.6	12.4	19.1	20.7	0.2	15.5	51.3	19.6
Uttar Pradesh	1.4	-	7.9	14.5	3.8	8.9	82.5	33.9	0.3	9.9	121.2	29.3
Assam	-	-	2.7	1.0	3.5	6.3	20.6	9.3	1.0	10.9	49.6	14.8
India	1.1	20.0	14.1	24.9	3.6	14.4	55.2	35.0	0.7	17.8	124.3	33.1

Source : [73].

States are arrayed according to their crop output growth rates, 1952-53 to 1964-65.

Table 51

India : Cash loans per cultivator household and their distribution by sourcee of loan by states, 1961-62[1]

State	Total Borrowings per household	Distribution of borrowings by source of loan									
		Government	Cooperatives	Commerical bank	Landlords	Agricultural money lenders	Professional money lenders	Traders and commission agents	Relatives	Others	Total
	Rs.	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent
Punjab	365.1	2.1	10.5	-	3.8	30.9	16.5	3.6	13.9	18.7	100.0
Gujrat	370.3	1.1	25.7	-	-	5.8	6.3	11.6	21.2	28.2	100.0
Madras	297.8	2.7	16.5	1.2	0.2	59.8	6.8	2.3	3.6	6.9	100.0
Mysore	323.3	6.1	20.6	0.6	1.8	43.1	0.9	9.2	6.5	11.2	100.0
Himachal Pradesh											
Bihar	102.5	1.0	2.6	-	0.1	62.7	14.8	6.3	7.5	4.9	100.0
Maharashtra	220.9	8.3	38.3	0.1	2.3	16.2	8.5	3.6	15.5	9.4	100.0
Rajasthan	389.4	0.8	3.8	0.1	-	26.3	23.8	18.3	6.2	20.6	100.0
Andhra Pradesh	275.9	0.5	12.7	-	0.4	59.3	9.6	10.2	1.6	4.2	100.0
Madhya Pradesh	169.4	1.2	17.4	0.3	0.1	34.0	28.1	11.4	3.4	4.2	100.0
Orissa	54.9	4.2	16.6	-	0.2	15.1	28.8	19.8	3.8	11.5	100.0
Kerala	203.7	1.1	11.9	4.0	1.2	7.2	3.3	8.3	11.3	51.6	100.0
West Bengal	143.9	2.1	5.9	0.1	1.7	28.1	4.0	9.7	16.4	32.1	100.0
Uttar Pradesh	167.5	2.6	16.6	0.4	0.2	35.9	20.0	6.9	9.2	8.2	100.0
Assam	35.8	4.5	1.7	-	-	38.1	10.8	11.0	21.2	12.7	100.0
India	205.4	2.6	15.5	0.6	0.6	36.0	13.2	8.8	8.8	13.9	100.0

Source : [73],

[1] July 1961 to June 1962

Table 52

India : Percapita generation of electricity and percentage of villages and towns electrified by states, 1962-63

State	Per capita generation of electricity[1]	Percentage of village and towns electrified[2]
	Kw. hours	percent
Punjab	116.2	21.9
Gujarat	76·5	6.1
Madras	84.6	41.6
Mysore	52.0	12.2
Himachal Pradesh	N.A.	N.A.
Bihar	26.1	4.7
Maharashtra	102.7	4.8
Rajasthan	11.9	1.1
Andhra Pradesh	32.3	13,1
Madhya Pradesh	32.7	1.0
Orissa	68.3	0.7
Kerala	40.8	36.6
West Bengal	81.4	1.7
Uttar Pradesh	25 8	5.0
Assam	5.1	0.3
India	57.8	6.3

Source : [62].

[1] Year 1962-63.

[2] As of March 31, 1963.

before Independence, as shown in table 53, are about as indicative of existing tenural relations as are recent census classes. The major categories under British colonial rule were the *zamindari* and *ryotwari* systems, terms relating to the relationship between cultivators and the state in the payment of land revenues but they indicate nature of the land rights vested in the intermediaries serving as collectors of land revenues. The more important of these was the *zamindari* wherein a person or a few co-sharers possessed proprietary rights in land of a village against the actual cultivator and was responsible for payment of land revenue to the state. This system was most important in Uttar Pradesh, Madhya Pradesh, Bihar, Orissa and Punjab. In contrast, under the ryotwari system, peasant proprietors were directly responsible for revenue payment. This system was dominant in Madras, Mysore, Rajasthan and in Hyderabad which comparises a part of the current state of Andhra Pradesh.

The zamindari system has been abolished in most states, but too little is known about rights under tenure forms that have supplanted the zamindari system to relate these changes to growth in agricultural output and productivity [58, 61 and 67]. Rather, there is need for careful research into Indian land tenure systems using, instead of the kinds of tenure categories common to western land tenure research, categories which reflect peculiarities of Indian land tenure systems, including attention

Table 53

India : Area under major tenure systems by states before Independence[1]

State	Area under specified tenure systems			
	Ryotwari	Zamindari	Miscellaneous tenure	Total
	— — thousand acres — —			
Punjab	23,208	—	—	23,208
Bombay	46,878	3,965	—	50,843
Madras	59,555	—	21,241	80,796
Mysore	18,852	—	—	18,852
Himachal Pradesh	1,956	—	—	1,956
Bihar	—	4,575	39,752	44,327
Rajasthan	76,608	5,703	—	82,311
Hyderabad	52,927	—	—	52,927
Madhya Pradesh	27,625	—	—	27,625
Orissa	3,930	16,190	22	20,142
West Bengal	5,840	—	14,329	20,169
Uttar Pradesh	—	59,520	9,101	68,621
Assam	30,212	1,486	1,702	33,400

Source [71].

[1] Data for most of the states relate to the years 1946 to 1948.

to inheritance and alienation rights, rights to the use of grazing lands, and permancy of tenure rights. In such research, considertion needs to be given also to the tenurial rights of agricultural laborers.

Selected Population Characteristics

Data on selected population attributes by states are shown in table 54. There appears to be little relationship between population density or population growth and rate of growth in crop output. On the other hand, states ranking low in percentage of male labor force employed in agriculture generally ranked high in their rate of crop output growth, notable exceptions being Kerala and West Bengal. Literacy rates were not appreciably higher in states that were above the all-India rate of growth in crop output than in those below the all-India average. Data on religion and percentage of population in scheduled castes and scheduled tribes reveal no well defined relationships between these factors and rates of growth in crop output. Scheduled castes and tribes, however, comparise a large percentage of the total population in Madhya Pradesh, Orissa West Bengal, Uttar Pradesh and Assam, all of which had rather slow rates of crop in crop output from 1952-53 to 1964-65.

Other Institutional Features

Other institutional features assigned a prominant role in the economic modernization of India's agricultural agriculture have included coperatives, comunity development programs, extension services and agricultural universities.

Agricultural universities patterned somewhat along the lines of American land-grant college systems have been developed in Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra Punjab, Haryana, Mysore, Rajasthan and

Table 54

India : Selected population attributes by states

State	Total population, 1961	Population per square mile 1961	Population in urban areas 1961	Male workers engaged in agriculture 1961	Population growth, 1951 to 1961	Population growth 1901 to 1911	Literate population 1961 1/	Literate males 1961 1/	Population by kind of religion 1961: Hindus	Muslims	Others	Population in scheduled casts 1961	Population in scheduled tribes 1961
	millions	numbers	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent	percent
Punjab	20.3	429	20.13	60.24	25.86	-9.96	28.77	38.92	63.67	1.94	34.39	20.38	0.07
Gujrat	20.6	290	25.77	61.49	26.88	7.79	36.19	48.71	88.96	8.46	2.58	6.63	13.35
Madras	33.7	672	26.69	56.17	11.85	8.57	36.39	51.59	89.94	4.63	5.43	18.01	0.75
Mysore	2/ 23.6	319	22.33	65.96	21.57	3.60	29.80	42.29	87.27	9.87	2.86	13.22	0.81
Himachal Pradesh													
Bihar	46.5	694	8.43	73.33	19.77	3.67	21.75	35.19	84.70	12.45	2.85	14.07	9.05
Maharashtra	39.6	334	28.22	58.80	23.60	10.74	35.08	49.26	82.24	7.67	10.09	5.63	6.06
Rajasthan	20.2	153	16.28	72.22	26.20	6.70	18.12	28.08	89.96	6.52	3.52	16.67	11.46
Andhra Pradesh	36.0	339	17.44	62.19	15.65	12.49	24.62	34.98	88.41	7.55	4.04	13.82	3.68
Madhya Pradesh	32.4	192	14.29	73.44	24.17	15.30	20.48	32.18	93.99	4.07	1.94	13.14	20.63
Orissa	17.5	292	6.32	74.88	19.82	10.44	25.24	40.26	97.57	1.23	1.20	15.75	24.07
Kerala	16.9	1127	15.11	36.[illegible]	24.76	11.75	55.08	64.89	60.83	17.91	21.26	8.49	1.26
West Bengal	34.9	1021	24.45	53.17	32.80	6.25	34.46	46.57	78.80	20.00	1.20	19.73	5.88
Uttar Pradesh	73.7	648	12.85	72.68	16.66	-0.97	20.73	31.89	84.66	14.63	0.71	20.88	
Assam	11.9	251	7.69	97.08	34.45	16.73	32.98	44.28	66.41	23.29	10.30	6.17	17.39
India	439.2	358	17.97	64.87	21.51	5.75	28.30	40.39	83.51	10.69	5.80	14.67	6.86

Source : Census of India, 1961

[1] Excludes 0-4 age group.

[2] Data not available.

Uttar Pradesh. All of these have been developed since 1957, and most of them, since 1960. They are still in early stages of development, hence had no large impact on agricultural output and productivity growth before 1964-65 [48 and 69].

There is a vast array of statisics on a number of operations of cooperatives which have been rather widely distributed among states, with heavy emphasis on cooperatives as alternatives to private agencies in the distribution of inputs and credit and in the marketing of agricultural products. The same is true also of community development and agricultural extension programs. It is difficult with available data, however, to assess the contributions of these agencies to increasing agricultural output and productivity either in India as a whole or in any of its constitutent states. During the period 1952-53 to 1964-65, their effectiveness as agents of change was limited by inadequacies in technological foundations for increasing agricultural productivity if not also by lack of improvement in price incentives large enough to induce substantial increases in uses of fertilisers and other inputs.

Finally, much attention has been given by western observers to inadequacies in administrative machinery at state, district, block and village levels as a factor impeding change. The basic administrative organization applicable to India, however, is much the same from state to state and among districts, blocks and villages within states. Hence, it is difficult to acribe differences in rates of growth in agricultural productivity to differences in administrative structures.

* * *

In the above analysis of inter-state differences in growth of agricultural output and productivity, major attention has been given to changes in land inputs, cropping patterns and yields and to fertilisers, water and other inputs. Differential rates of change in these inputs have accounted in large measure for differences in output and productivity growth rates. The crucial question from the viewpoint of development policy, however, is what accounts for inter-state differences in rates of increase in key inputs ?

One could attempt to answer this question by a reference to differences in resource endowments and/or by a references to differences in policies pertaining to the allocation of such inputs as fertilizers. The former of these has some validity as applied to diffifferences among states and even more so as applied to differences among districts within states. However, we are on less sure grounds with respect to differences among states in their allocation of strategic inputs. This is so in part because use of some modern inputs on an appreciable scale has come too late to have accounted for much of the increase in output from 1952-53 to 1964-65. It is so in part also because some of these inputs, especially fertilizers, have been distributed to states from a central pool with allocation based on estimates of demand prevailing in the states.

Hence, one must turn to other explanations such as differences in investment policies, in effort and initiative, and pricing and procurement policies. Admittedly, initiative and effort at state level have been far from uniform, but the differences applicable directly to agriculture need to be viewed by close reference to the influence of agricultural product price, procurement and distribution policies upon differences among states in markets for output of their cultivators. Given free trade among states, price and market differences would be relatively unimportant in accounting for inter-state differences in rates of growth. Within such market system, growth in demand result-

ing from growth in population and per capita incomes would generate growth in agricultural output throughout the whole national economy. Because of spatial considerations, however, there would be associated with such growth increasing geographical specialization according to the comparative advantage enjoyed by each locality.

Price relationships among states, however, have been influenced by each of several institutional factors which make it difficult to identify such development patterns.

CHAPTER 7

District Crop Output Growth Rates in Punjab[1]

Some General Features of the Area

Punjab[2] lies in northwest India. Much of its northern part lies in the Himalayan mountain ranges; the rest lies in the broad Indo-Gangetic Plain. Major rivers have given this part of India its name, Punj meaning five and *ab* meaning rivers, or the land of five rivers.

Economically, Punjab since Independence has been one of India's most progressive states in both its agricultural and its industrial sectors. The state has no large urban centers like Madras, Bombay or Calcutta, but it has been developing a substantial amount of small industry. Its agriculture in particular has florished, backed by a reasonably good irrigation system. Increases in waterlogging soil salinity, and erosion, however, have been major agricultural problems.

Some Features of Crop Output Growth by District

All Crops Combined

The compound rates of growth in total crop output in Bhatinda, Patiala, Hissar, Karnal, Mahendragarh, Ludhiana and Jullundur, ranging from 7.85 percent down to 4.62 percent per year, exceeded the all-Punjab growth rate of 4.56 percent (table 55). The districts of Rohtak, Ambala, Gurgaon, Amritsar, Kapurthala, and Kangra were below the all-India average in crop output growth rates.

Area growth rates were above 3.0 percent in Patiala, Karnal, Hissar and Kapurthala. They were below 1.0 percent in Amritsar, Hoshiarpur, Ferozepore, Gurdaspur, Bhatinda, Rohtak, Sangrur and Kangra districts.

[1] This chapter in a condensation of much longer report prepared by R. Giri and William E. Hendrix entitled *Regional Differences in Crop Output Growth in Punjab, 1952-53/1964-65*, published by the Directorate of economics and Statistics, Ministry of Food, Agriculture, Community Development and Cooperation, Government of India in December, 1967 [27].

[2] All references in this chapter are to the state as constituted before its division into the two states of Punjab and Haryana.

Productivity growth rates in Mahendragarh, Hissar, Sangrur, Patiala, Ludhiana, Rohtak, Ferozepore, Jullunder, Hoshiarpur, and Karnal exceeded the all-India average. Growth in productivity was responsible for the larger part of the growth in crop output in all of the districts except Patiala, Karnal, Ambala, Gurgaon, Kapurthala, and Gurdaspur.

Foodgrains and Non-foodgrains Output Growth Rates

Foodgrains excelled non-foodgrains in rates of growth in both area and productivity in Patiala ; in area in Karnal, Hoshiarpur, Amritsar and Gurdaspur ; and in productivity in Ludhiana, Mahendragarh, Sangrur and Ferozepore. In all other cases, non-foodgrains excelled foodgrains (table 56). In the case of both foodgrains and non-foodgrains, area was the major contributor in more than half of the districts ; productivity, in the rest.

Inter-crop Allocation of Land and other Inputs

Rates of growth in area and productivity of different crops (table 57) indicate intercrop allocation of land and yield increasing inputs. In more than half of the districts, and in Punjab as a whole, cropped area was diverted from bajra and barley. Jowar and gram received additional area, but a small share of the total increase in the crop area in the state. On the other hand, an increasing percentage of the crop area was allocated to rice, maize, wheat, cotton, oilseeds, potatoes, and sugarcane.

Table 55

Punjab : Compound growth rates of crop output, area and productivity by districts, 1952-53 to 1964-65

Districts	All — Crops		
	Output	Area	Productivity[1]
	percent	percent	percent
Bhatinda	7.85	0.56	7.26
Patiala	7.75	4.79	2.83
Hissar	6.94	3.23	3.59
Karnal	5.53	3.54	1.92
Mahendragarh	5.11	1.35	3.71
Ludhiana	4.85	2.18	2.62
Jullunder	4.62	2.09	2.48
Sangrur	3.59	0.34	3.24
Ferozepur	3.30	0.91	2.37
Hoshiarpur	3.38	0.96	2.40
Rohtak	2.94	0.55	2.39
Ambala	2.77	1.56	1.19
Gurgaon	2.42	1.59	0.82
Amritsar	2.07	0.99	1.06
Kanpurthala	1.71	3.05	—1.30
Kangra	1.16	—0.10	1.26
Gurdaspur	1.24	0.72	0.52
Punjab	4.56	1.90	2.61

[1] This represents the combined influence of changes in yields, crop patterns and the interaction factor.

The productivity growth rates indicate that in more than half of the districts, and in the state as a whole, yield raising inputs were applied to rise, maize, jowar, bajra, barley, gram, and sugarcane to lesser extent than to wheat, oilseeds, cotton and potatoes. Differences in changes in components of technology of production might have also contributed to differences among crops in productivity growth.

Factors Associated with District Differences in Crop Output Growth Rates

Both natural factors and a large number of social, economic and institutional factors have been working singly and in various combinations to influence these districts differences in rates of growth.

Table 56

Punjab : Compound growth rates of output, area and productivity [1] of foodgrains and non-foodgrains crops by districts, 1952-53 to 1964-65

Districts	Foodgrains[2]			Non-Foodgrains		
	Output	Area	Productivity	Output	Area	Productivity
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	—	—	— percent	—	—	—
Bhatinda	5.83	—0.28	6.13	14.03	4.30	9.33
Patiala	7.99	4.87	2.98	7.21	4.62	2.48
Hissar	4.23	2.41	1.78	16-31	11.71	4.09
Karnal	4 63	3.82	0.78	7.83	1 55	6.19
Mahendragarh	3.97	0.82	3.12	15.25	16.54	—1.11
Ludhiana	4.62	1.41	3.17	6.70	4.39	—0.99
Jullunder	3.77	1.82	1.91	6.49	3.38	3.01
Sangrur	4.03	0.02	4.00	2.72	1.72	0.98
Ferozepur	1.79	—0.07	1.86	5.98	4.70	1.22
Hoshiarpur	2.34	1.04	1.29	7.32	—0.02	7.33
Rohtak	1.09	0.07	1.01	6.86	4.75	2.01
Gurgaon	1.01	1.36	—0.34	8.30	2.91	5.23
Ambala	1.99	1.17	0.80	4.82	3.40	1.36
Amritsar	2.31	1.39	0.91	1.50	—0.48	1.98
Kapurthala	1.81	2.68	—0.85	1.70	6.01	—4.06
Kangra	0.83	—0.11	0.94	4-36	0.70	3.65
Gurdaspur	1.32	1.09	0.23	2.25	—1.24	3.53
All-State	3.69	1.53	2.10	7.04	4.11	2.81

Source : (27)

[1] This includes the combined influences of yield, crop patterns and the interaction factor.

[2] This includes cereals and pulses.

Land and Other Natural Features

Differences in growth rates among districts appear to have been infiuenced by the extent to which the districts have been free from such growth-inhibiting factors as poor soils, water-logging, soil salinity and alkalinity, soil erosion and inadequate and uneven rainfall. These conditions have limited growth in crop output growth by their effects upon the capacity of land to absorb additional inputs economically.

Quality of Soils. The montane and submontane regions, comprising Kangra and eastern parts of Gurdaspur, Hoshiarpur and Ambala have forest and hill soils which are acidic to neutral in reaction. Though rich in humus, these soils contain very little soluble salts and are somewhat deficient in line and phosphoric acid. The western parts of Ferozepore, Mahendragarh, and Gurgaon, which adjoin Rajasthan, have desert soils which lack water and are deficient in organic matter, nitrogen, and phosphorus.

Water-logging and Salinity. The predominant soils in rest of the state are fertile, alluvial soils which, however, have an alkaline reaction from sodium in the soil crust. These soils are also deficient in nitrogen, phosphorus, and potassium. Large canal irrigation, without proper drainage system, has led to water-logging ; hence, salinity and alkalinity of soils are acute in Amritsar, Ferozepore, Gurdaspur, Jullunder, Kapurthala, and Ludhiana. The total area in the state affected by water-logging and salinity and alkalinity in 1960-61 was estimated at about 2.0 million hectares and 1.2 million hectares, respectively.

Soil Erosion. Soil erosion by water or wind is a serious problem in the greater part of Gurgaon, Ambala, Hoshiarpur, Kangra and Gurdaspur. Large areas in Hoshiarpur and Ambala are devastated by torrents (chos) during the rainy season. The total area in the state affected by water and wind erosion in 1960-61 was estimated at 2.0 million hectares, and0.8 millions hectares respectively.

Rainfall. The average annual rainfall in the state is 30 inches. Except for montane and sub-montane regions which receive 50 inches or more of rainfall, most parts have precipitation of less than 20 inches. Rainfall in the south-western parts amounts to 4 inches only. The crop enterprises are, therefore, highly dependent on irrigation, the inadequacy of which is a serious limiting factor in Kangra, Ambala, Hoshiarpur, Gurgaon and Mahendragarh. The poor rainfall coupled with inadequacy of irrigation limits the capacity for economical use of fertilizers and other improved inputs and thus impedes the rate of increase in the growth of crop output.

Initial Differences in Extent of Use of Arable Land

The districts of Patiala, Karnal, Hissar, and Kanpurthala, which had very high rates of growth in area, had a low ratio of net sown area to total arable area as well as a fairly low percentage of land used for more than one crop per year during 1952-53, thus providing large scope for both extention of cultivation and increase in multiple cropping (table 58). Fuller utilization of these potentialities appears to have led to large expansion in crop area.

District with high rates of growth in crop area had a low potential for extension of cultivation but a large potential for increasing multiple cropping. Their crop area growth was achieved mostly by increases in multiple cropping ; however, extension of cultivation was substantial in Ludhiana and Jullunder.

Table 57

Punjab : Compound growth rates of output, area and productivity of important crops by districts 1952-53 to 1964-65

Districts	Rice			Jowar			Bajra			Maize			Wheat			Barley		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
									percent									
Bhatinda	-	-	-	1.44	-6.31	8.26	-5.67	0.44	-6.10	3.94	6.17	-2.10	8.95	3.74	5.02	-4.54	-8.65	4.50
Patiala	17.27	11.12	5.54	-	-	-	6.23	7.06	-0.77	-1.63	0.07	-1.70	9.30	5.47	3.63	20.21	0.36	19.77
Hissar	11.39	9.14	2.06	4.41	2.77	1.60	-1.97	-4.54	2.69	15.15	12.60	2.19	9.86	8.65	1.26	-4.56	-6.81	2.41
Karnal	8.46	11.06	-2.34	-6.19	-1.67	-4.62	-3.96	-3.67	-0.30	8.42	11.93	-3.14	5.95	6.00	-0.06	-0.19	8.70	-8.18
Mahendragarh	-	-	-	-6.01	-2.33	-3.77	2.87	-0.06	3.24	-	-	-	8.53	7.70	0.78	1.09	0.66	0.43
Ludhiana	7.00	11.25	-3.00	-	-	-	-8.55	-11.00	-10.61	5.62	5.61	0.01	6.26	3.13	3.04	3.01	0.93	2.06
Jullundar	13.19	17.06	-3.31	-	-	-	-8.23	-14.28	7.05	3.44	4.22	-0.75	2.95	2.02	2.35	-7.12	-6.93	-0.21
Sangrur	15.05	12.38	2.38	-1.35	1.44	-2.76	2.40	-1.25	3.70	1.62	3.60	-1.91	6.97	3.53	3.32	-2.86	-5.26	2.54
Ferozepur	-0.03	1.95	-2.00	-3.43	-0.59	-2.80	-1.61	-3.50	1.85	5.19	7.71	-2.33	4.41	2.81	1.55	-3.78	-4.23	0.48
Hoshiarpur	1.34	7.09	-5.36	-3.54	-3.38	-0.16	-10.59	-11.48	1.04	5.19	1.69	3.52	1.84	0.04	1.80	1.94	-4.69	6.95
Rohtak	4.79	5.44	-0.62	-2.07	0.71	-2.77	-5.30	-4.20	-1.15	4.14	4.19	0.00	4.54	4.13	0.39	-2.56	-1.09	-1.50
Ambala	1.48	3.45	-1.90	-8.62	-10.02	0.28	-17.81	-4.58	-13.86	5.97	5.22	0.71	2.03	1.30	0.78	-2.88	-2.45	0.60
Gurgaon	-	-	-	-3.30	1.39	-4.62	-2.88	-1.20	-1.71	4.94	2.40	2.49	4.39	4.89	-0.47	-3.02	-3.34	-2.35
Amritsar	1.25	8.03	-6.28	-	-	-	-2.93	-6.44	3.76	3.25	3.21	0.04	3.64	1.62	1.99	3.76	0.07	3.70
Kapurthala	14.37	11.13	2.92	-	-	-	-11.15	-9.48	-1.85	2.24	3.89	-1.58	0.64	2.74	-2.05	5.66	-1.68	7.51
Kangra	-5.62	0.30	-5.89	-	-	-	-	-	-	0.77	0.02	0.75	4.90	0.67	4.20	0.70	-0.53	1.26
Gurdaspur	0.38	4.90	-4.30	-	-	-	-2.51	-5.93	3.64	1.25	1.15	0.09	2.23	0.66	1.56	-0.90	0.70	1.60
Punjab	8.68	6.82	1.74	0.98	0.46	0.51	-2.16	-2.95	0.82	3.83	3.91	-0.08	5.38	3.34	1.98	-3.11	-3.09	-0.02

Table 57 *Contd.....*

Table 57 *Contd... .....*

Districts	Gram			Oilseeds			Cotton			Sugarcane			Potatoes		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
	-	-	-	-	-	-	-	percent	-	-	-	-	-	-	-
Bhatinda	5.00	-1.67	6.78	19.90	8.77	10.30	13.85	2.99	10.54	5.66	8.18	-2.33	37.78	17.78	16.99
Patiala	9.96	8.00	1.80	10.98	5.16	5.60	8.85	5.61	3.08	4.04	4.43	-0.37	14.18	-2.49	17.10
Hissar	4.52	7.10	-2.41	21.97	13.19	7.76	13.19	9.42	3.45	20.62	13.92	5.89	6.73	4.75	1.89
Karnal	0.32	1.00	-0.67	-2.39	-5.33	3.10	0.80	1.20	-0.39	14.30	9.33	4.55	3.94	4.36	-0.41
Mahendragarh	13.73	7.13	6.17	22.78	16.99	4.95	-	-	-	-	-	-	-	-	
Ludhiana	-3.13	-3.56	0.43	2.26	4.39	-2.04	7.04	5.14	1.81	5.33	3.63	1.66	18.28	15.76	2.17
Jullunder	0.55	-0.23	0.78	7.37	10.12	-2.49	1.71	0.90	0.80	3.71	1.81	1.87	16.32	13.79	2.00
Sangrur	0.74	-2.11	2.92	-2.67	-0.30	-2.38	4.31	1.91	2.36	3.24	4.21	-0.93	7.53	-1.69	9.39
Ferozepur	-3.33	-3.00	0.34	6.16	13.05	-8.88	6.16	4.55	1.54	4.66	3.77	0.86	11.04	9.16	1.72
Hoshiarpur	-0.47	1.89	-2.23	2.09	2.49	-0.40	-6.20	-5.12	-1.14	0.70	-0.37	1.04	32.11	29.02	2.39
Rohtak	-0.90	0.39	-1.30	5.41	2.59	2.90	6.46	4.57	1.81	7.43	6.49	0.89	3.78	2.52	1.22
Ambala	0.34	-0.01	0.34	1.38	0.40	0.97	5.26	4.99	0.26	4.72	3.55	1.13	7.12	4.49	2.51
Gurgaon	4.70	6.25	-1.47	5.81	1.41	4.32	4.49	-0.14	14.64	13.34	12.78	0.49	5.59	2.71	2.80
Amritsar	-2.52	-4.04	1.58	-0.30	-3.56	3.43	0.38	0.94	-0.55	0.39	-1.47	1.90	7.89	7.70	0.18
Kapurthala	-	-	-	-3.21	18.62	-21.00	10.71	1.44	9.14	-0.22	-0.10	-0.12	11.94	6.10	5.27
Kangra	0.82	-0.91	1.75	4.36	0.29	4.05	-9.00	-10.11	1.23	-2.71	-0.02	-2.69	5.36	4.92	0.36
Gurdaspur	0.55	1.49	-0.93	-2.07	-4.07	2.09	0.10	-0.89	1.00	3.10	0.58	2.51	0.74	-2.16	2.96
Punjab	1.26	2.11	-0.83	6.[illegible]	3.27	2.77	7.06	4.68	2.28	6.72	4.61	2.01	11.61	8.33	3.03

Source : [27].

Initial Differences in Crop Yields

In a long-run context, limits to yield increasing potentials are as difficult to define as are limits to the applications of modern scientific methods. Comparison of the yield levels during the initial and end triennia is nonetheless informative. Such indicators of yield levels are provided in measures of value of gross output at 1956-57 prices per hectare of gross sown area (table 59).

The increase in value of output per hectare of gross sown area from 1952-55 to 1962-65 exceeded Rs. 100 in four districts, *viz.*, Bhatinda, Patiala, Ludhiana and Jullundur. The last two districts were already at a high yield level during 1952-55. This suggests that

Table 58

Punjab : Availability of arable land[1] and extent of multiple cropping by districts, 1952-55 and 1962-65

District	All-crop area growth rate	Net area sown as percentage of total arable land		Intensity of Cropping[2]	
		1952-55	1962-65	1952-55	1962-65
	—	—	percent	—	—
Very high area growth districts					
Patiala	5.83	52.4	90.5	1.21	1.27
Karnal	4.20	63.3	88.0	1.28	1.35
Hissar	3.64	73.2	92.9	1.11	1.23
Kapurthala	3.52	60.1	92.8	1.17	1.30
High area growth districts					
Ludhiana	2.47	81.6	90.7	1.25	1.33
Jullunder	2.33	81.9	92.7	1.19	1.28
Ambala	1.68	80.6	80.7	1.14	1.32
Gurgaon	1.67	90.0	94.6	1.12	1.20
Mahendragarh	1.30	87.8	90.7	1.23	1.39
Fair area growth districts					
Amritsar	1.05	77.4	79.8	1.42	1.50
Hoshiarpur	1.00	85.5	88.7	1.23	1.37
Ferozepore	0.90	78.4	88.2	1.13	1.20
Gurdaspur	0.76	80.9	86.9	1.24	1.40
Bhatinda	0.53	88.5	97.4	1.13	1.19
Rohtak	0.52	83.7	85.3	1.34	1.47
Sangrur	0.34	85.8	98.3	1.25	1.35
Low area growth district					
Kangra	0.51	63.2	61.1	1.68	1.65
Punjab	2.06	77.2	88.5	1.22	1.31

Source : [27]

[1] Arable land is defined as the total of net sown area, fallows, culturable waste, pasture and other grasing land, and miscellaneous tree crop land. Cropping intensity is defined as the ratio of gross sown area to net sown area.

[2] Ratio of gross to net sown area.

an initially high level of yield, can be raised to still higher levels with the development of technology and other factors promoting growth.

Irrigation

About 45 percent of the net sown area in the state was irrigated during 1952-55 (table 60). This percentage was exceeded in Amritsar, Ferozepore, Ludhiana, Sangrur, Bhatinda, Gurdaspur, Patiala, Karnal, Jullunder, and Kapurthala. The proportion declined from 1952-55 to 1962-65 in all of these districts except the last two. The proportion of multiple sown area irrigated, however, increased appreciably in most of these districts, thereby increasing the proportion of gross sown area irrigated. Among districts with moderate irrigation Hissar had a large increase from 1952-55 to 1962-65 in the proportion of net sown area irrigated; Rohtak and Kangra changed little.

Table 59

Punjab : Value of gross output per hectare of gross sown area by districts, 1952-55 and 1962-65

Districts	All crop productivity growth rates	Value of gross output per hectare of gross sown area	
		1952-55	1962-65
	percent	Rs.	Rs.
Very high productivity growth district			
Bhatinda	10.18	298.4	424.0
High productivity growth districts			
Mahendargarh	4.33	100.1	149 1
Hissar	4.27	200.5	200.7
Sangrur	3.51	314.9	411.7
Patiala	3.20	367.7	488.5
Ludhiana	2.79	475.2	585.3
Rohtak	2.58	306.3	365.7
Ferozepore	2.52	403.2	482.6
Jullunder	2.50	529.3	634.3
Hoshiarpur	2 48	347.8	427.2
Karnal	2.13	353.6	409.6
Fair productivity growth districts			
Kangra	1.49	369.7	393.6
Ambala	1.20	391.5	379.5
Amritsar	1.17	433.3	457.6
Low productivity growth districts			
Gurgaon	0.92	222.2	251.7
Gurdaspur	0.42	381.9	393 2
Kapurthala	—1.28	612.5	498.8
Punjab	2.86	325.8	393.7

Source : [27]

Table 60.

Punjab : Percentages of net sown area, multiple sown area and gross sown area irrigated by districts, 1955-55 and 1962-65.

Districts	Net area irrigated		Multiple sown area irrigated		Gross sown area irrigated	
	1952-55	1962-65	1952-55	1962-65	1952-1955	1962-65
—	—	—	percent	—	—	—
Bhatinda	57.0	49.9	1.1	83.7	50.6	55.4
Patiala	46.8	37.6	26.9	80.8	43.3	46.6
Hissar	25.7	47.5	—	—	23.1	38.6
Karnal	45.4	37.5	25.1	40.8	40.9	38.3
Mahendragarh	4.3	8.8	—	—	—3.9	6 3
Ludhiana	66.9	52.7	43.6	95.8	62.3	63.3
Jullunder	66.3	67.3	54.0	57.3	64.1	65.2
Sangrur	61.0	48.5	4.1	77.4	49.5	55.9
Ferozepur	74.0	65.2	—	76.1	66.2	67.0
Hoshiarpur	12.8	14.1	14.2	8.5	13.1	12.6
Rohtak	39.5	38.7	41.1	17.9	39.9	32.1
Ambala	9.7	13.3	4.0	1.8	9.0	10.6
Gurgaon	18.5	15.3	3.6	1.1	16.3	13.0
Amritsar	92.3	86.2	82.8	89.6	89.6	87.8
Kapurthala	57.4	67.2	95.6	91.4	65.1	73.1
Kangra	23.2	22.5	21.7	22.1	22.7	24.0
Gurdaspur	51.9	50.2	—	24.1	42.0	42.8
Punjab	45.1	44.0	23.6	42.8	41.4	43.7

Source : [27].

Cropping intensity, or multiple cropping was appreciably higher in irrigated areas than in unirrigated areas. In most districts, higher value crops like wheat, rice, sugarcane, cotton, etc., were given preference over lower value crops like bajra, barley, gram, etc., in allocation of one or both of area and productivity-raising inputs (table 61).

Generally, wheat, cotton, maize, rice, sugarcane and fodder are dominant in irrigated areas, and gram, wheat-gram mixtures, jowar, bajra, barley, barley mixtures and pulses are dominant in unirrigated areas.

Irrigation has been a major contributor to growth in productivity. The districts of Ferozepore, Ludhiana, Sangrur, Bhatinda, Jullunder, Patiala, Karnal, and Hissar, with large irrigation recorded high rates of growth in productivity. However, water-logging, salinity and alkalinity of soils associated with canal irrigation without adequate drainage, as mentioned earlier, seem to have impeded growth in productivity in Gurdaspur, Kapurthala, and Amritsar.

Utilization of ground water for irrigation through percolation wells and tubewells, besides

Table 61

Punjab : Changes in distribution of crops on irrigated and unirrigated land for specified regions and time periods

Crop	Amritsar-Ferozepore region, 1954-55 to 1956-57		Rohtak-Karnal-Jind (Sangrur) region, 1961-62 to 1962-63		All-state				All-state			
					1952-53 to 1954-55		1961-62 to 1963-64		1952-53 to 1954-55		1962-63 to 1964-65	
	Irrigated	Unirrigated	Irrigated	Unirrigated	Irrigated	Unirrigated	Irrigated	Unirrigated	Irrigated	Unirrigated	Irrigated	Unirrigated
	percent											
Wheat	15.1	13.3	32.5	11.8	24.3	10.7	28.0	13.3	29.4	14.1	30.3	19.1
Wheat-gram	15.1	42.6	3.6	6.1	6.3	9.0	6.0	5.7	not available			
Rice	6.0	—	10.0	1.1	4.7	1.7	7.0	4.3	5.4	1.5	8.2	2.3
Maize	4.2	0.9	1.9	2.2	8.0	3.0	9.7	7.0	5.3	4.4	5.9	5.9
Gram	5.7	22.0	7.9	31 6	9.0	18.7	5.3	23.3	13 5	27.6	11.3	30.2
Sugarcane	1.2	—	17.4	1.0	5.0	0.7	5.7	2.7	3.8	0.7	4.4	1.0
Cotton	20.4	—	6.0	0.5	9.0	0 7	12.0	0.7	10.9	0.6	14.0	0.9
Fodders	24.0	7.7	11.7	19.8	19.3	16.7	17.7	14.0	11.3	9 0	14.7	10.0
Others	8.3	13.5	9.0	25.9	14.4	38.8	8.6	29.0	20.4	42.1	11.2	30.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : [27]

Table 62

Punjab : Electric pumps, oil engines and electrification of villages by districts 1951 and 1961

Districts	Total electric pumps		Total oil-engines		Electric pumps and oil-engines per 10,000 hectares of gross irrigated area		Percentage of villages, places electrified	
	1951	1961	1951	1961	1951	1961	1951	[illegible]
	number	number	number	number	number	number	percent	
Bhatinda	—	21	16	307	1	8	0.0	14.2
Patiala	37	543	185	638	16	54	0.0	19.4
Hissar	10	58	41	159		5	0.0	17.5
Karnal	21	811	154	508	9	49	2.0	19.0
Mahendragarh	1	45	21	17	17	34	0.0	12 1
Ludhiana	14	946	262	1806	17	139	1.1	42.6
Jullunder	59	1963	277	704	22	128	5.5	34.1
Sangrur	13	209	126	993	3	25	0 0	16.7
Ferozepore	17	221	111	1354	2	26	0.4	19.9
Hoshiarpur	2	1056	65	454	18	270	0.0	14.7
Rohtak	1	67	44	96	2	8	0.0	32.8
Ambala	10	353	104	266	48	138	0.1	12.2
Gurgaon	5	437	61	157	11	87	0.2	16.0
Amritsar	104	1122	56	361	4	38	4.0	70.2
Kapurthala	10	177	50	205	12	48	0.0	14.1
Kangra	—	3	29	16	4	3	3.2	41.9
Gurdaspur	21	742	46	117	6	69	2.4	43.5
Punjab	264	8,774	1,250	8,158	6	44	1.0	23.5

Source [27]

Table 63

Punjab : Consumption of fertilisers by districts, 1962-63 to 1964-65

Districts	Fertiliser nutrient per hectare of gross cropped area				Fertiliser nutrients per hectare of gross irrigated area			
	Nitrogen		P_2O_5		Nitrogen		P_2O_5	
	1962-63	1964-65	1962-63	1964-65	1962-63	1964-65	1962-63	1964-65
	—	—	—	kilograms		—	—	—
Bhatinda	2.23	4.96	0.09	0.13	3.98	8.67	0.16	0.22
Patiala	1.60	4.43	0.15	0.67	3.54	9.23	0.33	1.40
Hissar	0.60	2.32	0.02	0.07	1.63	5.92	0.07	0.18
Karnal	1.08	4.04	0.08	0.31	2.99	10.35	0.22	0.80
Mahendragarh	0.31	1.19	0.01	0.04	5.64	15.45	0.18	0.48
Ludhiana	6.81	13.04	1.06	2.73	10.91	20.14	1.70	4.21
Jullunder	6.41	13.55	0.36	0.86	10.34	20.35	0.58	1.29
Sangrur	1.24	4.03	0.06	0.19	2.31	7.29	0.11	0.35
Ferozepore	3.85	9.00	0.10	0.21	5.84	13.42	0.15	0.32
Hoshiarpur	4.50	8.14	0.32	0.54	36.16	63.84	2.55	4.25
Rohtak	0.96	3.69	0.03	0.07	2.99	12.30	0.10	0.24
Ambala	2.22	6 78	0.19	0.67	22.00	62.65	1.91	6.22
Gurgaon	0.85	2.48	0.02	0.06	7.01	17.89	0.16	0.40
Amritsar	2.13	6.99	0.10	0.43	2.40	7.92	0.12	0.49
Kapurthala	2.99	7.78	0.30	1.20	4.06	10.81	0.41	1.67
Kangra	0.86	3.23	0.03	0.23	3.77	14.32	0.14	1.04
Gurdaspur	2.59	7.66	0.12	0.41	6.62	16.98	0.32	0.90
Punjab	2.04	5.46	0.13	0.38	4.82	12.29	0.31	0.86

Source : [27].

further increasing irrigation, is one of the ways of reducing water-logging and thereby increasing productivity. It is also the only means to raise productivity through irrigation in the districts with limited canal irrigation. Tube-wells and surface wells (with or without pump sets) as sources of irrigation may also be preferred to canal because of greater manoeuvreability of supply of water from the former in contrast to inconvenient location of outlets for canal water, uncertainty about assured supply of canal water, periodic canal closures, and the practice of charging full water rates even for low watering from canals. Studies conducted by the State Irrigation Department have revealed that several districts have ground water of excellent quality which can be used extensively for irrigation. Utilization of ground water is, however, expensive without electric pumps or oil engines. Increase in the number of electric pumps and oil engines for irrigation purposes may, therefore, be taken as a fair indicator of the extent to which the menace of water-logging was met and efforts were made to increase productivity by use of ground water (table 62). Increase in the number of electric pump sets, which are cheaper to operate than are oil-engines, is dependent on increase in rural electrification.

With the increase in rural electrification, the number of electric pumps increased all over the State. The increase in the number of electric pumps and oil-engines combined, was very substantial not only in those districts where water-logging was acute but also in those where increase in productivity was high. Farmers of Punjab have thus made the best use of the worst situation created by water-logging by resorting increasingly to well and tube-well irrigation which has been stimulated by increasing rural electrification.

Table 64

Punjab : Use of improved seeds, soil conservation and other land improvement measures, 1961-62 to 1964-65

Item of development	1961-62	1962-63	1963-64	1964-65
Area covered under improved seeds of foodgrains, 1,000 hectares	1,523.6	1,950.6	2.483.8	2,994.6
Additional area benefited by soil conservation of agricultural land, 1,000 hectares	1.2	3.6	8.1	13.4
Additional area benefited by dry farming, 1,000 hectares	—	—	10.5	5.7
Additional area benefited by land reclamation and development, 1,000 hectares	37.2	40.5	31.6	14.6
Urban compost, 1,000 tonnes	224	244	252	254
Rural compost, 1,000 tonnes	6,848	7.459	7,747	8,705

Source : [27].

Table 65

Punjab : Population attributes by districts, 1951 to 1971

Districts	Increase in population from 1951 to 1961	Rural population as percentage of total population in 1961	Agricultural workers as percentage of total workers in 1961	Rural population per 1000 hectares of cultivated area		Displaced persons as percentage of total population in 1951[1]	Literate males as percentage of total male rural population	
				1951	1961		1951	1961
	percent	percent	percent	number	number	percent	percent	percent
Bhatinda	34.09	78.8	68.6	1011	1298	7	6.7	21.4
Patiala	34.89	75.3	57.1	2037	1514	17	7.1	24.2
Hissar	47.33	84.4	79.4	730	1045	12	11.8	21.2
Karnal	38.34	82.9	67.3	1884	2236	23	9.5	19.8
Mahendragarh	23.65	90.3	80.9	1447	1689	1	3.2	28.4
Ludhiana	26.64	69.2	44.0	2143	2546	21	28.2	36.2
Jullundor	16.27	71.5	42.5	2753	2025	26	26.5	34.5
Sangrur	28.17	83.1	71.2	1424	1701	5	11.3	19.2
Ferozepore	26.97	79.9	66.2	1202	1493	27	15.7	23.9
Hoshiarpur	12.75	88.1	60.6	2625	3565	13	25.6	36.3
Rohtak	26.59	86.3	71.2	1974	2467	11	15.0	28.4
Ambala	35.02	68.0	46.3	2168	2580	20	13.9	27.4
Gurgaon	28.22	83.4	70.3	1791	2139	9	13.1	26.2
Amritsar	12.28	69.8	46.0	2509	2833	24	18.8	27.3
Kapurthala	16.51	77.0	54.7	2197	2169	29	5.8	31.3
Kangra	15.94	95.9	82.6	3919	4501	1	2.1	33.7
Gurdaspur	16.06	79.8	48.4	2698	3117	35	16.2	27.3
Punjab	25.86	79.9	63.9	1702	2036	19	11.4	26.9

Source : [27].

[1] Defined as persons moving into India from Pakistan after partition.

These ingenious farmers have also turned water-logging to their advantage in yet another way ; that is, by increasing the cultivation of crops like rice, sugarcane, and maize, which require greater moisture and can stand water-logging better than other crops. This was one of the factors responsible for the high rates of growth in output of these crops, achieved mainly in the old canal-irrigated districts most subject to water-logging.

Fertilizer Consumption

Fertilizer, in conjunction with irrigation has been one of the major contributors to increasing crop productivity. A comparative study of data on fertilizer consumption (table 63) and of data on irrigation, extension of cultivation, increase in cropping intensity, and realized rate of growth in area reveals that both the level of fertilizer use and increase in that level were high in the extensively irrigated districts. The use of both irrigation and fertilizer was low in Mahendragarh and Gurgaon. The former recorded increase in both irrigation and fertilizer use but the latter had an increase in only the latter. Hoshiarpur and Ambala also registered large increases in crop productivity and cropping intensity from fairly high and rising levels of fertilizer despite their low level of irrigation.

Among the extensively irrigated districts, Amritsar, Kapurthala, and Gurdaspur had larger fertilizer input and a larger amount of irrigated area. However, they had less growth in productivity than Patiala, Hissar, and Karnal. The lower output response to fertilizer use in Amritsar, Kapurthala and Gurdaspur can perhaps be explained by extensive water-logging and salinity and alkalinity of soil in these districts. The evaluation of the rabi crop campaign in 1958-59 in Punjab revealed that the increase in the quantity of fertilizers distributed in 1958-59 over that in 1957-58 was much higher in Hissar, which is relatively free from water-logging, than in Amaritsar and Ludhiana where water-logging is extensive. In 1958-59, the yield of wheat in Hissar also increased substantially over that in 1957-58 compared with little increase in Amritsar and Ludhiana.

Improved Seeds, Soil Conservation, Land Reclamation and Development.

Other factors contributing to the growth of crop output have been use of improved seeds, soil conservation, dry farming, land reclamation and development, and use of compost. District data on these inputs are not readily available ; however, state totals for 1961-62 to 1964-65 are shown in table 64.

The additional areas brought under improved seeds and soil conservation and the extent of use of compost increased from year to year. The amount of area benefited by dry farming and that reclaimed and developed for improving cultivation in the different years was also substantial.

Population Growth and Characteristics

Population increase has been an additional factor contributing to growth in crop output in Punjab. Population in the state increased 26 percent from 1951 to 1961 (table 65). This rate of increase was exceeded in Hissar, Karnal, Ambala, Patiala, Bhatinda, Gurgaon, Sangrur, Ferozepore, Ludhiana, and Rohtak. In all these districts except Ambala, Ludhiana and Patiala, more than 75 percent of the population in 1961 was rural and at least two-thirds of the workers were classed as agricultural workers (cultivators or agricultural labourers).

Availability of unexploited arable land, irrigation and scope for increasing intensive cropping helped to accommodate these population increases in most of these districts,

which had fairly large growth in cultivated area and multiple cropping. Furthermore, restrictions on absentee landlordism imposed by the land reforms, compelled the landlords, particularly those in the erstwhile PEPSU districts of Patiala and Mahendragarh, to dispose of land beyond what they could personally cultivate at relatively low prices. This attracted rich and experienced farmers from the water-logged and densely populated areas.

Large population increase in Ambala was stimulated by military growth and the shifting of the State Capital from Simla to Chandigarh; that in Ludhiana was stimulated by industrial growth. Population increases were low in Kangra and Amritsar, districts whose potentials for extending cultivation and increasing productivity were less fully exploited. In Kapurthala, Jullunder, and Mahendragarh, districts with comparatively higher rates of population increase, potentials for growth in area and/or productivity, were more fully used, leading to a moderate to high rate of output growth.

The peasant proprietor in the traditional agriculture of the Punjab is essentially an owner, worker and manager of his farm. Inputs of his family labour and managerial ability are major factors influencing his crop yields. While the average agricultural operator achieves optimum efficiency within the framework of resources of traditional agriculture, variation in the performance and achievement of the farmers is often striking because of differences in the ability to make decisions, personal care, initiative and industry, family cooperation, cultural attitudes, sociological backgrounds and the impact of education. Better farming experience and know-how, higher managerial ability and a spirit of innovation brought by the displaced persons from those area of West Pakistan, where farms were larger and more improved practices were used, are also believed to have contributed to the growth of crop output in Punjab. As these displaced persons left all their fortune behind, they put in maximum effort on their new farms.

Literacy of the rural population, particularly of the males, as a factor promoting spread of knowledge of improved techniques and practices of cultivation among farmers, may also be expected to be associated with the increase in crop output, especially the increase in crop productivity brought about, inter-alia by the application of modern inputs. Both the level of literacy in 1951 and the increase therein by 1961 (table 65 were relatively high in Ludhiana, Jullunder, and Hoshiarpur, which had high to very high rates of growth in crop output. Literacy increased from a low level in 1951 to a high level in 1961 in Patiala, Mahendragarh, Bhatinda, Kapurthala and Kangra. In the first three of these districts, productivity growth ranged from a high to very high level and the area growth from fair to very high.

Supply of Work Cattle, Mechanical Power and Other Farm Implements

Besides manual labour, other sources of supply of power for the cultivation of crops are working cattle and mechanical power (table 66). Barring Gurdaspur, all of the districts in which working cattle per thousand hectares of cultivated area increased by 15 per-cent or above, had high rates of growth in area or productivity or both. Except for Patiala and Mahendragarh, districts with smaller increases or decreases in this ratio had a lower or even a negative rate of growth in area or productivity. In 1951, Patiala had a very large proportion of working cattle to cultivated area (next to Jullunder and Kangra only.) Moreover, in the process of large extension of cultivation, some of its uneconomic cattle were eliminated by 1961. In Mahendragarh, on the other hand, the ratio of working cattle

Table 66

Punjab: Working cattle and specified farms implements per 1000 hectares of cultivated area, by districts, 1951 and 1961

Districts	Working cattle			Wooden ploughs			Iron ploughs			Tractors		
	1951	1961	Increase	1951	1961	Increase	1951	1961	Increase	1951	1961	Increase
	number	number	percent	number	number	times	number	number	times	number	number	times
Bhatinda	149	178	19.5	101.5	118.3	1.2	9.1	60.6	7	0.2	1.8	9
Patiala	487	301	-38.2	207.3	108.3	-0.5	3.6	96.0	27	0.4	1.1	3
Hissar	70	116	65.7	88.0	111.4	1.3	0.3	11.7	39	0.1	0.8	8
Karnal	356	418	17.4	216.3	171.8	-0.2	2.9	42.0	14	0.5	1.1	2
Mahendragarh	134	110	-17.9	153.2	179.6	1.2	0.4	0.4	10	0.15	0.2	14
Ludhiana	316	386	22.2	164.1	183.3	1.1	40.4	132.2	3	0.4	1.6	4
Jullunder	516	566	9.7	177.9	214.0	1.2	84.7	82.8	1	0.3	1.3	4
Sangrur	258	296	14.7	136.7	140.3	1	11.2	57.4	5	0.1	0.7	7
Ferozepore	276	270	-2.2	143.9	146.9	1	32.9	109.5	3	0.3	1.6	5
Hoshiarpur	436	557	27.8	223.3	266.6	1.2	24.4	78.8	3	0.1	0.5	5
Rohtak	281	331	17.8	182.2	293.2	1.6	2.0	5.3	3	0.1	1.3	13
Ambala	399	443	11.0	180.4	199.5	1.1	1.3	60.1	46	0.1	1.1	11
Gurgaon	292	306	4.8	169.7	175.5	1	0.4	1.2	3	0.1	0.4	4
Amritsar	427	459	7.5	165.0	193.2	1.2	13.6	87.5	6	0.2	0.6	3
Kapurthala	464	537	15.7	218.3	206.4	-0.1	12.2	75.3	6	0.3	0.8	3
Kangra	1077	1123	4.3	508.4	672.7	1.3	148.9	41.3	-0.7	0.02	0.02	1
Gurdaspur	486	578	18.9	211.0	233.3	1.1	124.6	210.7	2	0.1	0.4	4
Punjab	304	341	12.2	163.9	184.8	1.1	21.3	60.0	2.8	0.18	0.99	5.5

Source: [27]

to cultivated area was low in 1951 (next to Hissar only) ; this ratio had declined by 1961, perhaps, among other things, because of a sizeable increase in the use of tractors and iron ploughs.

Along with the decrease in the proportion of working cattle to cultivated area, the proportion of wooden ploughs to cultivated area also declined in Patiala. The ratio of wooden ploughs to cultivated area also declined in Karnal and Kapurthala. It remained more or less static in all other districts except Rohtak, Kangra, Hissar, Jullunder, Amritsar, Hoshiarpur, Bhatinda and Mahendrahgarh. The ratio of iron ploughs to cultivated area, on the other hand, increased about 25 to 45 times in Patiala, Hissar and Ambala, and 5 to 15 times in Sangrur, Amritsar, Kapurthala, Bhatinda, Mahendragarh and Karnal.

The number of tractors per thousand hectares of cultivated area also increased substantially in these districts. The increase in mechanization of ploughing operation, and the transition from the traditional to new methods of ploughing, although slow, were marked features of many of the districts which had fair to high rates of growth in area. This process was less evident in many of the districts having little expansion in crop area. As absentee landlordism was discouraged, large scale mechanized cultivation was undertaken by landlords in Patiala, Mahendragarh, Bhatinda, Sangrur, and Kapurthala,

Table 67.

Punjab : Cooperatives by districts, 1963-64

District	Societies	Membership	Business turnover	Villages covered	Population covered
	number	lakhs	crores of Rs.	percent	percent
Bhatinda	1,622	1.09	20.48	100.0	49.2
Patiala	1,799	1.20	29.75	88.8	54.3
Hissar	2,184	1.26	14.52	97.0	38.0
Karnal	2,345	1.30	39.77	98.0	43.0
Mahendragarh	832	0.53	9.76	95.0	46.7
Ludhiana	1,885	1.59	40.79	100.0	79.6
Jullunder	2,476	2.38	61.60	100.0	92.0
Sangrur	1,987	1 56	15.32	100.0	93.3
Ferozepore	2,784	1.73	49.56	99.8	51.2
Hoshiarpur	3,146	2.68	33.90	100.0	100.0
Rohtak	1,793	1.14	27.27	99.8	38.0
Ambala	3,327	2.57	48.85	99.5	92 0
Gurgaon	2,303	1 16	11.70	98.0	45.0
Amritsar	2,337	1.41	30.80	100.0	42.3
Kapurthala	911	0.69	10.18	99.0	98.8
Kangra	2,340	1.99	29.09	100.0	89.7
Gurdaspur	2,318	1.44	33.93	100.0	69.0
Apex societies	9	0.04	—	—	—
Punjab	36,587	25.94	508.40	99.0	61.0

Source : [27].

which consequently had much growth in area.

District Institutional Differences

Data on institutional features by districts of Punjab are limited to only a few items. However, similarities in institutional structures are more pronounced than are differences. For example, the organization of the state departments of agriculture and of irrigation and power is not essentially different from that in other states of India. The pattern of organization and administration of publically supported agricultural functions is much the same way from one district to another within the Punjab, except in Ludhiana District which was chosen as a special demonstration project under the Intensive District Agricultural Progarm, often referred to as the Package Program. The one institutional item for which data are available for this study relates to cooperation (table 67).

Almost all villages in Punjab were covered by cooperative societies by 1963-64. At least half of the total population was served by these societies in the high growth districts of Bhatinda, Patiala, Mahendragarh, Ludhiana, Jullunder, Sangrur, Ferozepore, and Hoshiarpur. A high percentage of the population was also covered by the cooperative societies in Ambala, Kapurthala, Kangra, and Gurdaspur, where the output growth was, however, retarded. Less than half of the population was brought under the cooperative fold in the fair to low output growth districts of Rohtak, Gurgaon and Amritsar. Cooperative did not embrace a sizeable proportion of population in Hissar and Karnal, which also had high output growth.

* * *

Within limits of data thus far developed it has not been possible to quantitatively break down district crop output increases into their respective input components, namely land, water, labor and other capital items. The statististics available, however, make it clear that increased inputs of water, fertilizers, labour, power, land development, and better farming practices have made direct contributions of importance to recent crop output growth in Punjab districts. Population growth, improvements in roads, rural electric power facilities and cooperatives have been demonstrably dynamic elements expanding farmers' needs, opportunities and incentives to use more and better inputs. Improvements in sources of supply of fertilizers, farm credit facilities, and agricultural extension activities have been additional kinds of structural changes not examined in this report.

Finally, Punjab's progress reflects the existence among its people of an outlook on life induced by their frequent confrontation with outside invaders and associated traders and travellers introducing new ideas, a spirit of drive and enterprise, an esteem for manual labor, and a capacity for organization unexcelled in most of India.

CHAPTER 8

District Crop Output Growth Rates in Madras*

Some General Features of the State

The State of Madras, now officially called Tamil Nadu, extends to the southern tip of India and is bounded on the west by Kerala, on the north by Mysore and Andhra Pradesh, on the east by the Bay of Bengal and on the south by the Indian Ocean. It is made up of 13 administrative districts : Madras, Chingleput, South Arcot, Tanjore, Ramanathapuram, Tirunelveli, Kanyakumari, Madurai, Coimbatore, Salem, North Arcot, Tiruchirappalli, and the Nilgiris. Apart from Kanyakumari, the State is closed off on its western side by the rugged Western Ghats, reaching through larger part of their range heights of 4,000 to 8,000 feet [70].

Its climate like that of most of India is heavily influenced by the South-west monsoons coming from June through September. All of its districts except Salem and North Arcot, however, normally receive more rain from the North-east monsoons, which come from October through December [70].

The State has two major natural regions, the temperate sub-tropical region of the Nilgiris, and other mountainous areas and the tropical region comprising the larger part of the State [70]. The tropical region has four major parts:

1. The delta area of Tanjore, Tiruchirapalli and South Arcot districts, a vast expanse of paddy fields irrigated from the Cauveri System.
2. The northern zone made up of North Arcot, Chingleput and a part of South Arcot districts, which is fairly well watered by both the South-west and the North-east monsoons and in which over 40 percent of the cropped area is irrigated.
3. The region lying south of the delta area where the North-east monsoons are normally very active. Ramanathapuram, Tirunelveli, Kanyakumari, and parts of Madurai and Tiruchirappalli districts lie in this zone.
4. The rest of the plains portion to the west of the delta comprising Coimbatore, Salem and parts of North Arcot,

* This chapter is based on a larger manuscript by R. Giri and W.E. Hendrix on the State's crop growth patterns.

Tiruchirappalli and Madurai districts. This zone normally has a low rainfall. A relatively small percentage of its crop area is under irrigation.

Paddy is the State's main crop. Its production is carried on in three main growing seasons: the Kar season from June to October; the Pishanam from October to January; and the Navarai from January to June. In some districts, however, some sowing and harvesting are done in every month of the year. The kinds of paddy grown are legion; several hundred distinct botanical varieties have been identified.

Millets and pulses are other important food crops. Oilseeds, cotton, tobacco, and sugarcane are principal industrial crops; tea and spices are important in some parts.

Among population groups in agriculture, members of the Vellalas "community" are the most numerous. Found in all districts, its members are educationally advanced and many are in non-agricultural occupations. They are recognized for their enterprise and thrift. Other communities of considerable numerical importance that are also recognized for their enterprise and economic aggressiveness include the Vanniyas and the Thevars [70]. The chief landless classes are the Pallas and the Pariahs or Harijans.

Some Features of Crop Output Growth

All Crops Combined

The All State Record: Madras increased its crop output from 1952-53 to 1964-65 by an annual compound rate of 4.17 percent compared with the all-India rate of 3.01 percent. Its crop growth has been note-worthy for three other main reasons: (1) its year to year consistency in growth; (2) high growth rate of food-grains crops; and (3) high rate of growth per unit of crop area.

Table 68

Madras : Crowth of crop output, area and productivity, by districts, 1952-53 to 1964-65

District	All—Crops		
	Output	Area	Productivity
	percent	percent	percent
Ramanathapuram	6.25	2.22	3.94
North Arcot	5.30	1.88	4.02
Madurai	4.70	1.09	3.57
Tirunelveli	4.67	1.32	3.25
Tanjore	4.38	1.15	3.21
Coimbatore	4.01	—0.20	4.21
Chingleput	3.23	0.35	2.84
Salem	3.16	0.83	2.33
Tiruchirappalli	2.95	0.66	2.26
South Arcot	2.12	0.19	1.93
Nilgiris	0.58	—0.08	0.66
All-state	4.17	1.10	3.04

Source : [28].

Although third among states of India in rate of crop output growth from 1952-53 to 1964-65, Madras was first in foodgrain output growth rate. It was fourth highest in its nonfoodgrain output growth rate, one of six states above the all-India average.

More important, it was first among the states of India in both its all-crop and foodgrain output growth rates per capita of total population. It had a per capita crop output growth rate of 2.88 percent (compound) per year compared with 1.90 percent for Punjab and 1.89 percent for Gujarat, the next highest states in per capita output growth.

Although more consistant than most of India in its crop output growth, the State's crop output from 1952-53 to 1964-65 exhibited four fairly distinct growth periods as follows:

A two year period of very rapid growth;
A five year slow growth period;
A second two years of rapid growth; and
A later four year period of slow growth.

District Crop Output Growth: A few of the State's districts have had very high rates of growth in crop output; others have lagged below the all-India rate. Two districts had compound growth rates of more than 5 percent per year: Ramanathapuram, 6.25 percent and North Arcot, 5.30 percent (table 68). Four other districts had growth rates of more than 4 percent per year.

Interestingly, the two highest growth districts, Ramanathapuram and North Arcot, have together about one fifth as many farmers as does the whole United States.

All districts in the State had much higher rates of growth in productivity (yield) than in area of crops. The State's two highest districts in output growth, Ramanathapuram and North Arcot, however, also had high crop area growth rates.

Table 69

Madras : Compound rates of growth of crop output, area and productivity by districts, 1952-53 to 1964-65

District	Foodgrains			Nonfoodgrains		
	Output	Area	Productivity	Output	Area	Productivity
	percent	percent	percent	percent	percent	percent
Ramanathapuram	5.80	140	4.34	7.11	4.98	2.03
North Arcot	5.30	1.62	4.19	6.12	2.52	3.51
Madurai	3.87	0.15	3.71	6.27	3.65	2.57
Tirunelveli	3.99	1.19	2.77	6.39	1.65	4 66
Tanjore	4.47	1.11	3.33	3.15	1.90	1.23
Coimbatore	6.30	—0.47	6.80	2.85	0.35	2.48
Chingleput	2.84	—0.51	3.37	6.66	7.14	—0 44
Salem	3.00	0 42	2.56	3.53	2.12	1.40
Tiruchirappalli	3.17	0.39	2.78	2.52	1.77	0.74
South Arcot	2.77	0.20	2.56	0.89	0.23	0.66
Nilgiris	0.93	1.11	—0.17	0.58	—0.33	0.92
All-state	4.17	0.75	3.39	4.17	2.24	1.90

Source [28].

Table 70.

Madras : Compound growth rates of output, area and productivity of individual crops by districts, 1952-53 to 1964-65

District	Rice			Bajra			Ragi			Total cereals		
	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity	Output	Area	Productivity
	Percent											
Ramanathapuram	8.41	4.61	3.63	2.83	—2.49	5.46	—1.87	—2.18	0.31	5.83	1.74	4.42
North Arcot	7.32	6.35	0.91	—0.26	—4.38	4.31	—2.25	—4.86	2.84	6.00	2.04	3.88
Salem	3.43	2.09	1.31	1.95	—2.53	4.60	2.99	1.26	1.70	3.10	0.54	2,57
Madurai	5.06	2.57	2.42	5.16	—2.73	8.10	—1.66	—1.63	—0.03	3.94	0.46	3.46
Tirunelveli	4.32	3·85	0.46	4.02	—1.09	5.16	0.53	—0.21	0.74	4.05	1.26	2.76
Tanjore	4.55	1.25	3.26	—0.93	—6.14	5.55	—3.09	—4.70	1.69	4.50	1.19	3.27
Coimbatore	10.48	9.25	1.13	1.41	—6.82	8.83	0.81	—2.49	3.38	6.48	—0.30	6.62
Chingleput	3.34	1.27	—11.32	—0.50	—6.98	6.96	—2.09	—4.74	3.10	2.86	—0.51	3.38
Tiruchirappalli	3.18	1.94	1.22	7.91	—0.65	8.62	—0.48	—1.88	1.42	3.28	0.54	2.72
South Arcot	3.95	2.62	1.30	—0.14	—1.98	1.87	—3.20	—4.70	1.58	2.81	0.26	2.54
Nilgiris	1.21	0.91	0.30	—	—	—	0.43	1.42	—0.98	0.93	1.11	—0.17
All-state	4.84	2.84	1.99	3.52	—2.53	6.00	0.34	—0.68	1.03	4.25	0.89	3.33
All-India	3.37	1.26	2.09	2.23	1.01	1.20	2.80	0.53	2.26	3.16	1.22	1.92

(**Table 70** *Continued*)

(**Table 70** *Continued*)

District	Oilseeds			Cotton		
	Output	Area	Productivity	Output	Area	Productivity
	. . . . .	. . . . .	. . . . .	percent	. . . . .	. . . . .
Ramanathapuram	7.24	6.56	0.64	6.46	3.56	2.80
North Arcot	6.10	2.47	3.55	3.27	—2.16	5.55
Salem	3.59	1.31	2.25	10.55	6.48	3.83
Madurai	6.66	5.88	0.74	3.48	0.07	3.42
Tirunelveli	7.29	4.28	2.89	4.91	0.56	4.33
Tanjore	1.48	1.67	—0.18	—6.23	—9.51	3.62
Coimbatore	0.52	—0.16	0.69	2.12	0.05	2.08
Chingleput	7.52	7.32	1.36	2.04	—0.55	2.60
Tiruchirappalli	2.23	1.69	0.53	4.16	0.90	3.23
South Arcot	0.81	0.26	0.56	5.64	—5.29	11.54
Nilgiris	2.26	— 0.24	2.50	—	—	—
All-state	4.07	2.47	1.56	4.56	1.14	3.38
All India	3.20	2.55	0.64	4.44	2.42	1.97

(**Table 70** *Continued*)

(**Table 70** *Continued*)

District	Tea			Sugarcane			Tobacco		
	Output	Area	Product-tivity	Output	Area	Product-tivity	Output	Area	Product-tivity
	. . . . .			. percent		. .	. . . . .		
Ramanatha-puram	—	—	—	9.88	10.57	—0.63	—6.13	—9.62	3.85
North Arcot	—	—	—	8.41	6.39	—	—4.84	—5.86	1.08
Salem	—	—	1.91	4.65	5.98	—1.25	—1.66	—1.12	—0.70
Madurai	9.98	1.30	8.57	6.83	3.85	2.88	2 69	—0.04	2.73
Tirunelveli	11.00	7.05	3.68	9.92	13.37	—3.05	10.89	10.79	0.09
Tanjore	—	—	—	11.52	11.17	0.31	—0.79	—1.69	0.91
Coimbatore	2.89	0.10	2.78	11.04	12.02	—0.88	1.48	0.00	1.47
Chingleput	—	—	—	17.93	14.40	2.75	—	—	
Tiruchirappalli	—	—	—	4.80	6.10	—1.22	1.40	—2.33	0.95
South Arcot	—	—	—	1.06	1.93	—0.84	—5.48	—5.60	0.12
Nilgiris	2.86	0.12	2.74	0.00	—0.82	0.83	—2.29	—2.24	—0.05
All-state	3.21	0.28	2.92	7.68	7.63	0.04	0.70	0.26	0.44
All-India	2.01	0.52	1.48	4.59	3.26	1.29	2.69	1.78	0.90

Source [28].

Productivity growth rates were above the all India rate of 1.77 percent per year in all except Nilgiris. They ranged from a low of 1.93 percent a year in South Arcot to a high of 4.21 percent per year in Coimbatore district. They were above 3.5 percent in three other districts, North Arcot (4.02 percent), Ramanathapuram (3.98 percent) and Madurai (3.57 percent).

Nonfoodgrains excelled foodgrains in rate of output growth in 6 districts, Ramanathapuram, North Arcot, Madurai, Tirunelveli, Salem and Chingleput (table 69). In the other five districts, foodgrain growth rates were larger. (District output, area and productivity growth rates for individual crops are shown in table 70).

Major Sources of Change of Output Growth

This section further examines area and productivity as major sources of crop output growth, breaking the latter down between yield increases and crop pattern changes.

Area Changes :

In absolute terms, the gross sown area in the State increased from 15,093,655 acres in 1952-53 to 17,461,238 acres in 1964-65, a total increase for the period of 2,367,583 acres or of 15.7 percent (table 71). This increase has come from both :

1. Diversion of land from non-crop to crop uses; and
2. Increases in multiple cropping, or the production of two or more consecutive crops (or crop mixtures) per year on the same land.

Net sown area of all crops in the State as a whole increased from 13,103,309 acres in 1952-53 to 14,905,042 acres in 1964-65. This

Table 71

Madras : Area and changes in gross sown area by districts, 1952-53 to 1964-65

District	Area		Change	
	1952-53	1964-65	Area	Percentages
	acres	acres	acres	percent
North Arcot	1,384,784	1,684,364	299,580	21.6
Ramanthapuram	1,192,548	1,496,326	303,778	25.5
Madurai	1,330,397	1,579,143	248,746	18.7
Tirunelveli	1,214,903	1,334,564	119,661	9.8
Salem	1,987,892	2,331,792	343,900	17.3
Tanjore	1,587,613	1,913,034	325,421	20.5
Coimbatore	2,141,245	2,163,742	22,497	1.1
Chingleput	839,295	1,104,735	265,440	31.6
Tiruchirappalli	1,708,522	2,045,790	337,268	19.7
South Arcot	1,597,525	1,689,083	91,558	5.7
Nilgiris	108,931	118,665	9,734	8.9
All-state	15,093,655	17,461,238	2,367,583	15.7

Source : [28].

Table 72

Madras : Area and changes in net sown area by districts, 1952-53 to 1964-65

District	Area		Change	
	1952-53	1964-65	Area	Percentages
	acres	acres	acres	percent
North Arcot	1,107,183	1,294,354	187,171	16.9
Ramanathapuram	1,122,042	1,459,040	336,998	30.8
Madurai	1,202,618	1,396,117	193,499	16.1
Tirunelveli	1,047,554	1,120,966	73,412	7.0
Salem	1,795,276	2,029,816	234,540	13.0
Tanjore	1,361,120	1,471,117	109,997	8.1
Coimbatore	1,870,278	1,832,673	—37,605	—4.3
Chingleput	604,992	819,763	214,771	35.5
Tiruchirappalli	1.536,150	1,809,802	273,652	17.8
South Arcot	1,353,485	1,355,637	2,152	0.2
Nilgiris	103,610	116,768	13,158	12.7
All-state	13,103,309	14,806,053	1,662,744	12.7

Source : [28].

Table 73

Madras : Changes in intensity[1]/ of cropland use by districts, 1952-53 to 1964-65

District	Intensity[1]		Change
	1952-53	1964-65	
	ratio	ratio	percent
North Arcot	1.25	1.30	4.0
Ramanathapuram	1.06	1.03	—2.8
Madurai	1.11	1.13	1.8
Tirunelveli	1.16	1.19	2.6
Salem	1.11	1.15	3.6
Tanjore	1.17	1.30	11.1
Coimbatore	1.14	1.18	3.5
Chingleput	1.39	1.35	—2.9
Tiruchirappalli	1.11	1.13	1.8
South Arcot	1.18	1.25	5.9
Nilgiris	1.05	1.02	—2.9
All-state	1.15	1.19	3.5

Source : [28].

[1] Ratio of gross to net sown area.

was an increase of 1,662,744 acres, or 12.7 percent. It accounted for about 70 percent of the increase in gross sown area. Increase in multiple cropping, or intensity of crop land use, accounted for the remaining 30 percent. These increases in net sown area came mainly from decreases in fallow area, both current and other, and from decreases in cultivable waste (table 72).

The best available measure of multiple cropping is the ratio of gross to net sown area, which ratio is commonly referred in Indian reports as "intensity of crop land use". The all-State ratio of gross to net sown area increased from 1.15 in 1952-53 to 1.19 by 1964-65, or by only 3.5 percent (table 73).

In 1952-53, Chingleput, North Arcot, South Arcot, Tanjore, and Tirunelveli were above the All-State level in extent of multiple cropping. Chingleput had an intensity ratio of 1.39. Between 1952-53 and 1964-65, Tanjore was the State's only district that achieved a marked increase in extent of multiple cropping, an increase of 11.1 percent from its initial intensity ratio of 1.17.

More than 40 percent of the State's net sown area is irrigated (table 74). This percentage set alongside the State's intensity index of only 1.19 suggests that farmers in the State have hardly more than begun to exploit their multiple cropping potentials as a source of crop output growth.

Yield and Crop Pattern Changes

The productivity component of output growth, as shown in tables 68 and 69, is made up of growth from crop pattern changes as well as from yield increases. In all districts of the State except North Arcot, yield changes contributed more to crop output growth than did either crop area changes or crop pattern changes (table 75). In North Arcot, area growth

Table 74.

Madras : Percentage of area under irrigation by districts, 1952-55 and 1962-65

District	Net sown area irrigated		Multiple sown area irrigated		Gross sown area irrigated	
	1952-56	1962-65	1952-55	1962-65	1952-55	1962-65
	percent	percent	percent	percent	percent	percent
North Arcot	36.6	44.3	61.2	73.9	41.7	50.9
Ramanathapuram	37.3	32.4	97.8	64.2	36.4	38.1
Madurai	31.8	32.9	80.7	86.3	37.8	39.5
Tirunelveli	27.1	33.7	77.8	89.3	34.7	43.3
Salem	16.8	18.2	65.2	50.5	23.4	22.2
Tanjore	84.8	85.1	59.0	59.0	80.5	79.2
Coimbatore	23.8	35.0	37.9	59.8	26.0	38.8
Chingleput	62.3	68.7	73.4	76.0	65.4	70.7
Tiruchirappalli	26.9	29.5	61.3	87.7	31.8	36.3
South Arcot	41.7	48.3	42.7	66.6	41.9	51.7
Nilgiris	—	0.9	—	12.0	—	1.2
All-state	35.6	40.5	60.9	78.2	39.5	46.1

Source : [28].

was the most important source of output increase and crop pattern changes involving relatively large increases in sugarcane, oilseeds and rice, were a more important source of output growth than were yield increases.

Farm Input Basis of output Changes

Increasing agricultural output is a many dimensional problem, technical, economic, social and institutional. However, agricultural production is first a function of differences and changes in amounts and kinds of production inputs used by cultivators. Other factors are important only as they influence such input uses.

With enough accuracy and detail of data on year to year variations in amounts and kinds of production inputs, it would be relatively easy to indicate the amount of output imputable to each of the many different kinds of inputs used, district by district and on an all—State basis.

However, only general qualitative information is available concerning several important capital inputs such as seeds of particular crop varieties. Quantitative data for other inputs are available on a district basis for only a few years. Only broad qualitative distinctions can be made with respect to important attributes of both land and human resources.

Table 75

Madras : Area, yield, and crop pattern changes as sources of crop output growth by districts, 1952-53 to 1964-65

District	Crop output growth rate	Distribution of crop output growth by soutce				
		Area change	Yield change	Crop pattern change	Interaction	Total
	percent	percent	percent	percent	percent	percent
Ramanathapuram	6.25	35.91	37.45	25.30	1.34	100.00
North Arcot	5.30	35.85	29.77	33.93	0.45	100.00
Madurai	4.70	23.81	49.39	25.72	1.08	100.00
Tirunelveli	4.67	29.51	34 39	33.26	2.84	100.00
Tanjore	4.38	26.74	70.15	2.41	0.70	100.00
Coimbatore	4.01	—5.78	58.74	45.09	1.95	100.00
Chingleput	3.33	11.91	69.35	18.20	0.54	100 00
Salem	3.16	22.01	48.58	28.32	1.09	100.00
Tiruchirappalli	2.95	23.47	47.99	27 95	0.59	100.00
South Arcot	2 12	10.28	46.31	42.69	0.72	100.00
Nilgiris[1]	0 58					
All-state	4.17	35.32	45.58	8.90	10.20[2]	100.00

Source :- [28].

[1] Sources have not been computed for Nilgiris.

[2] The interaction effect at the All-state level of aggregation reflects effects of locational factor including possibly the location of a larger part of the increases in crops in districts having high yields.

Table 76

Madras : Specified resources attributes by districts[1]

Districts	Changes in Net sown area	Changes in Intensity of crop-land use	Changes in irrigation of Gross sown area	Changes in irrigation of Net sown area	Changes in irrigation of Multiple sown area	Oil engines with pumpsets for irrigation 1951	Oil engines with pumpsets for irrigation 1961	Electric pumpset 1951	Electric pumpset 1961	Oil engines and electric pump per 10000 hectares of gross irrigated area 1951	Oil engines and electric pump per 10000 hectares of gross irrigated area 1961	Villages electrified 1965-66	Change in rural persons in per unit of cultivated land	Changes per 1000 hectares in Iron plows	Changes per 1000 hectares in Wooden plows	Number of tractors in 1961 per tractor in 1951	Nitrogen fertilizer used per hectare 1964-65	Increase in working cattle 1951-61
	percent					number						percent				number	kgs.	percent
Ramanathapuram	30.0	-2.8	4.7	4.9	-34.4	227	929	603	3569	29.8	71.4	41.3	-5.8	3.9	0.9	20.2	4.03	2.4
North Arcot	16.9	4.0	22.1	7.7	-11.9	1648	4755	1291	19519	59.4	364.6	77.7	1.4	2.1	1.1	2.9	4.18	29.1
Madurai	16.1	1.8	4.5	1.1	6.9	548	1814	747	8822	23.5	159.6	67.1	-0.7	7.9	0.9	2.8	4.07	18.8
Tirunelveli	7.0	2.6	24.8	6.6	14.8	486	1078	419	5054	17.9	101.2	65.7	1.4	7.7	1.0	1.5	7.12	16.3
Tanjore	8.1	11.1	-1.6	0.3	—	472	1611	243	283	10.5	24.6	4.9	8.3	4.2	1.0	8.7	6.52	8.6
Coimbatore	-4.3	3.5	4.92	1.2	57.8	1826	3599	6937	25534	109.7	328.2	85.2	10.1	1.8	1.1	3.4	10.75	12.7
Chingleput	35.5	-2.9	8.1	6.4	3.5	2990	2788	898	11477	124.8	308.6	72.2	-4.0	4.5	1.0	4.0	4.05	45
Salem	13.0	3.6	-5.1	1.4	-22.5	1446	5097	1343	13725	38.0	199.3	30.8	-9.4	1.4	2.1	1.8	2.15	21.6
Tiruchirappalli	17.8	1.8	14.2	2.6	43.1	893	5187	562	3005	20.2	102.9	22.8	3.7	3.4	1.0	1.4	1.07	8.5
South Arcot	0.2	5.9	23.4	6.6	44.5	3305	9823	1499	7492	79.1	238.3	41.9	12.0	4.9	1.2	10.3	4.65	42.6
Nilgiris	12.7	-2.9	—	0.9	—	9	1	1	0	2.3	0.2	75.7	7.1	1.1	0.1	13.2	N.A	23.4
All-state	12.7	3.5	14.3	4.9	28.4	17223	36832	13937	98481	53.7	187.8	49.4	-0.3	3.5	1.0	5.4	4.90	21.[illegible]

Source : [28]

[1] Unless otherwise indicated, the chages relate to the period 1952-53 to 1964-65.

District-wise and all-State data on changes in land inputs, irrigated area, persons per 1000 acres of cultivated land, uses of plows and tractors and on nitrogen fertilizers used per hectare of cropped area in 1963-64 are shown in table 76. Among these inputs, changes in gross sown area is the only one that is closely correlated to rate of change in output. Growth in land inputs as measured by gross sown area, however, accounted for only about 35 percent of the State's crop output growth, with productivity gains accounting for the rest.

Productivity growth rates, in contrast to total output growth rates, do appear to have been influenced by increases in percentage of gross sown area under irrigation and by use of chemical fertilizers.

However, fairly large yield increases in Ramanathapurum and Madurai districts, neither of which had large increases in irrigation and use of fertilizers, suggest that simple practice improvements, including such things as improved use of water and better weeding of crops, may have contributed significantly to yield increases. Simple practice improvements cannot long provide basis for continuously rising yields, but are relatively cheap sources of such additional output as they are capable of yielding.

Other Factors

Crop Area Expansion Potentials

In 1952-53, all districts in Madras State had relatively large land expansion potentials

Table 77.

Madras : Potentials[1] and achieved growth of area by districts, 1952-55/1962-65

District	All crops area growth rate	Percentage of arable land in net area sown		Intensity of cropping[2]	
		1952-55	1962-65	1962-55	1962-65
	percent	percent	percent	ratio	ratio
Ramanathapuram	2.36	55.9	61.9	1.07	1.04
North Arcot	2.04	68.1	75.0	1.26	1.27
Tirunelveli	1.37	52.8	51.9	1.18	1.27
Tanjore	1.20	78.2	81.8	1.20	1.28
Madurai	1.13	55.5	60.7	1.14	1.16
Salem	0.82	66.3	79.1	1.16	1.14
Turchirappalli	0.65	64.2	50.7	1.17	1.14
Chingleput	0.34	49.6	56.7	1.39	1.38
South Arcot	0.19	72.4	72.8	1.21	1.23
Nilgiris	—0.08	40.8	45.3	1.05	1.03
Coimbatore	—0.22	67.9	69.7	1.19	1.21
All-state	1.13	63.1	68.0	1.18	1.20

Source : [28].

[1] Estimate of arable land are used as a measure of crop area potentials.

[2] Ratio of gross to net sown area.

through extension of cultivation to arable land not already in crops and through increased multiple cropping (table 77). Districts with high crop output growth rates were not more favorably situated with respect to such expansion potentials than were those in which crop output growth rates have been relatively low. From 1952-53 to 1964-65, the percentage of arable land in crops increased from 63.1 percent to 68.0 percent in the State at a whole and increased in all districts except Trichichirappalli and Tirunelveli. Despite the increases made, however, all districts in the State still have considrable potential for extending crop production to new land. No district has very fully exhausted its potential for increasing land inputs through multiple cropping.

Level of Output Per Person and Per Acre

The capacity for savings and new investment and thereby for economic growth is influnced by income levels. Data on the value of crop output per agricultural worker and per acre of crop area by districts, however, reveal no close relationship between either of these values and rates of growth in crop output, crop area, or crop productivity during the 1952-53 to 1964-65 (table 78) period.

Incentives

Available data on farm harvest prices of rice indicate some price differences among districts but little if any differences in trends (table 79). The price differences reported in

Table 78

Madras : Average annual value of crops per agricultural worker and per acre of gross sown area by districts, 1952-55 and 1962-65

District	Output growth rate	Value per agricultural worker 1962-65	Value per acre of gross sown area		
			Amount		Change 1952-55 to 1952-65
			1962-55	1962-65	
	percent	rupees	rupees	rupees	percent
Ramanathapuram	6.25	307	262	427	63.0
North Arcot	5.30	370	427	561	31.4
Madurai	4.70	366	383	554	44.6
Tirunelveli	4.67	390	415	603	45.3
Tanjore	4.38	536	521	692	32.8
Coimbatore	4.01	635	549	796	50.0
Chingleput	3.23	436	393	561	42.7
Salem	3.16	249	198	388	96.0
Tiruchirappalli	2.95	322	315	465	32.5
South Arcot	2.12	325	445	541	21.6
Nilgiris	0.58	1256	1774	2147	21.0
All-state	4.17	410	390	561	43.8

Source : [28].

Table 79

Madras : Farm harvest prices of rice per maund[1] by districts, 1949-50 to 1959-60

District	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60
	—	—	—	—	—	—	rupees	—	—	—	—
Ramanathapuram	13.52	13.52	13.51	—	18.25	17.94	19.01	—	16 83	22.70	22.27
North Arcot	12.19	12.19	12.19	21.13	19.00	12.81	17.19	20.12	17.80	17.58	18.61
Madurai	12.28	12.28	12.82	25.80	16.47	16.44	—	—	—	19.64	18.72
Tirunelveli	12.30	12.30	12.30	24.10	20.10	17.24	17.52	—	—	20.63	20.05
Salem	13.20	13.20	13.20	24.38	29.56	28.44	20 74	20.72	18.33	17.80	21.31
Tanjore	11.77	11.77	13,88	—	—	—	17.24	—	—	17.82	—
Coimbatore	13.11	13.41	13.41	23.32	18.33	17.49	20.06	20.31	17.97	18.28	—
Chingleput	12.11	12.11	12.11	24.06	18.00	—	18.81	18.42	16.30	19.85	—
Tiruchirappalli	11.98	11.98	11.98	22.19	16.38	—	16.75	19.86	17 57	18.40	17.94
South Arcot	11.80	11.80	11.80	28.13	17.50	15.31	16 90	19.21	17.00	17.86	17.94
Nilgiris	15.61	15.61	16.45	27.19	19 40	16 00	17.00	17 00	15.04	20.33	—
All-state	12.79	12.79	13.06	24.23	19.30	17.71	17.87	18.82	16.83	18 70	19.26

Source : [28].

[1] 82 3 pounds.

Table 80

Madras : Specified population attributes by districts for iudicated years

District	Increase in population 1951 to 1961			Ratio of rural to total population 1961	Change in rural population per hectare of net sown area	Ratio of Agri-workers to total workers 1961	Agricultural workers per hectare of cultivated area, 1960-1961	Ratio of landless to total agricultural workers of age group 15-59 1961	Literacy of rural population, 1961	
	Total	Rural	Urban						Male adult	Female adult
	percent	percent	percent	percent	percent	percent	number	perce:	percent	percent
Ramanathapuram	16.3	18.1	11.3	75.2	-5.8	67.5	1.098	21.3	51.0	9.0
North Arcot	8.5	6.1	19.5	79.9	1.4	68.5	1.772	24.9	39.5	6.9
Madurai	11.1	5.2	26.1	68.4	-0.7	59.1	1.287	33.6	47.3	8.4
Tirunelveli	9.0	10.8	5.1	68.9	1.4	51.3	1.080	31.7	53.6	17.4
Tanjore	8.8	7.5	14.5	79.6	8.3	69.0	1.532	47.9	52.3	12.1
Coimbatore	12.8	0.2	62.8	71.0	10.1	46.1	0.855	33.4	41.1	8.4
Chingeput	12.2	7.6	34.2	79.3	-4.0	60.5	1.472	42.5	40.7	9.2
Salem	12.9	9.9	31.0	83.8	-9.4	67.5	1.389	18.4	27.2	4.7
Tiruchirappalli	8.4	6.4	16.3	78.7	3.7	71.2	1.372	22.6	43.6	7.1
South rcot	9.8	7.6	19.8	87.1	12.0	78.1	1.827	36.7	42.1	6.7
Nilgiris	31.3	3.0		56.1	7.1	30.0	1.037	37.0	51.3	11.9
All-state	11.9	8.4	22.6	73.3	-0.3	60.5	1.333	30.5	43.6	9.6

Source : [28].

Table 81

Madras : Position of cooperatives in agriculture by districts, 1954-55 and 1961-62

District	Agricultural Societies		Members		Share capital		Deposits by members and non-members		Loans made	
	1954-55	1961-62	1954-55	1961-62	1954-55	1961-62	1954-55	1961-62	1954-55	1961-62
	number	number	thousand	thousand	thousand rupees	thousand rupees	thousand rupees	thousand rupees	thousand rupees	thousand rupees
Ramanathapuram	459	1,234	52	221	696	3,451	31	464	1,487	17,649
North Arcot	559	1,456	47	292	694	10,666	42	3,657	695	40,766
Madurai	720	1,733	63	350	1,108	7,926	25	1,717	3,165	33,294
Tirunelveli	595	1,106	81	264	688	12,026	60	633	1,374	28,648
Tanjore	594	1,759	80	408	1,061	7,656	110	2,181	3,224	37,502
Coimbatore	520	1,134	72	271	1,912	13,189	254	1,911	4,265	38,837
Chingleput	596	1,302	49	171	713	8,751	83	2,009	2,197	34,097
Salem	802	9,084	105	530	1,281	10,604	34	2,626	2,539	76,952
Tiruchirappalli	892	1,154	94	256	2,011	6,909	288	9,031	5,125	37,636
South Arcot	520	1,568	36	263	431	4,669	22	2,341	5.714	27,682
Nilgiris	172	198	23	38	908	1,682	74	648	3,995	4,871
All-State	6,429	13,552	702	3,064	11,503	87,479	1,023	27,218	28,780	377,934

Source : [28]

any one year probably reflects as much as anything else inter-district differences in the kinds and therefore in quality of the rice grown. They reflect also differences in the degree of self-sufficiency in rice production. The farm harvest price of rice in Tanjore District, which normally produces a larger volume of rice than does any other district in India, is generally below the All-state average. That in Nilgiris, which produces very little of the rice which its population consumes has sometimes been above the All-state level.

Selected Population Attributes

Total population growth rates appear to have been less closely associated with crop output and productivity growth than was growth in urban population (table 80). There was little association between other attributes (such as ratio of landless cultivator to total agricultural worker and literacy rates) and rates of growth in crop output and productivity.

Institutional Features

Available data on major institutional features by districts are limited to those on agricultural cooperatives (table 81). However, the general organization of agricultural services and administrative facilities is much the same from one district to another except in Tanjore, the district chosen for inclusion in the Intensive Agricultural District Program (IADP), a demonstration programe in which technical assistance and other inputs have been provided since 1960-61 on a fairly large scale basis. Substantial increases in the number of agricultural cooperatives have been made in all districts except Nilgiris and Salem and substantial increases in cooperative loans have been made in all districts except Nilgiris.

North Arcot and South Arcot District Comparisons

Comparisons between North Arcot and South Arcot districts are of particular interest because they are contiguous districts having important similarities in their physical characteristics while differing greatly in their rates of growth in crop output, area and productivity. The former had growth rates of 5.30 percent. 1.88 percent and 4.02 percent in crop output, area and productivity, respectively, from 1952-53 to 1964-65. In contrast, South Arcot had growth rates of only 2.12 percent, 0.19 percent and 1.93 percent in these three items, respectively.

Initially North Arcot had only a slightly larger area expansion potential than South Arcot, their ratios of net sown area to arable area being 68.1 percent and 72.4 percent, respectively, in the 1952-55 period (table 77). By 1962-65, arable land used for crop had increased to 75.0 percent in North Arcot district and to 72.8 percent in South Arcot.

Crop patterns in 1957 were not markedly different as between the two districts. However, during the 1952-53 to 1964-65 period, North Arcot made much larger gains in the area devoted to rice, groundnuts, oilseeds and sugarcane, all crops with a fairly high value of output per unit of land. The area devoted to jowar, bajra, ragi, small millets, pulses and tobacco decreased in both districts but by larger amounts in north Arcot. The area in chillies and cotton decreased appreciably in north Arcot while increasing or remaining the same in South Arcot.

These differences in changes in cropping patterns are significant from two points of view. First, it appears that North Arcot has been shifting land increasingly from crops having a low value of output to ones having a relatively high value of output per unit of land.

Secondly, in so doing, North Arcot has been moving progressively toward increasing specialization in its agricultural production. This shift is not fully reflected in percentages in table 76 on relative importance of crop pattern changes as a contributor to crop output growth in the two districts. However, because of the smaller crop output growth rate in South Arcot, crop pattern changes alone increased crop output in South Arcot at a compound rate of only 0.91 percent per year compared with 1.58 percent (compound) per year in North Arcot.

The kinds of crops accounting for the larger rate of output growth in North Arcot suggests a trend towards increasing production for market, which is a distinctive characteristic of successful agricultural development. A second major characteristic is that of agriculture's increasing dependence on nonagricultural sectors for inputs.

Table 82

Number of wells and oil engines used for irrigation in North Arcot and South Arcot Districts, 1905-51 to 1959-60

District and year	Wells			Oil engines
	Government	Private	Total	
	number	number	number	number
North Arcot				
1950-51	628	150,954	151,582	1,422
1951-52	628	151,112	151,740	1,422
1952-53	231	154,202	154,433	2,076
1953-54	231	157,516	157,747	2,899
1954-55	229	157,041	157,270	3,083
1955-56	229	162,286	162,515	4,748
1956-57	229	162,443	162,672	2,909
1957-58	229	162,990	163,219	5,251
1958-59	229	166,524	166,753	5,196
1959-60	278	172,701	172,979	5,169
South Arcot				
1950-51	3,049	65,875	68,924	2 881
1951-52	3,102	68,783	70,885	3,023
1952-53	2,977	59,574	62,571	3,123
1953-54	2,996	59,754	62.750	3,233
1954-55	2,027	51,555	53.582	3 379
1955-56	1,941	51,888	53 829	3,847
1956-57	1,941	52,043	53,984	3,847
1957-58	1,944	61,590	63,534	3,964
1958-59	1,944	62 300	64,244	4,527
1959-60	1,944	63,285	65,229	4,721

Souree : [28].

Data in regard to inputs from nonfarm sectors are limited to fertilizers, iron plows and pumpsets. The rate of fertilizer use per hectare in 1964-65 was somewhat larger in North Arcot than in South Arcot district. The number of electric pumpsets, however, has increased much more rapidly in North Arcot district (table 76) and the number in use in 1961 was al + 2.5 times as large in North Arcot as in S. Arcot district. Percentage increases in iron plows and tractors were larger in South Arcot (table 82); however, neither district had many tractors in either 1951 or 1961.

Interestingly, the larger growth in electric pumpsets in North Arcot is not associated with a larger increase in area under irrigation, However, the increased use of pumpsets to energize tube-wells, as has been done on a much larger scale in North Arcot, is believed to be associated with considerable improvement in the quality of irrigation and in the efficiency of use of irrigation water.

Table 83

Selected social and economic indicators, North Arcot and South Arcot districts, 1961

Item	North Arcot	South Arcot
Total land areas, *square miles*	4,942	4,202
Population		
Total, *thousand persons*	3,146	3,057
Rural, *thousand persons*	2,515	2,656
Population per square mile		
Total, *number*	637	725
Rural, *number*	508	632
Population increase 1951 to 1961, *percent*	8.5	9.8
Proportion of population urban, *percent*	20.1	12.9
Workers in rural areas in *teritary* activities, *percent*	12.6	9.8
Proportion of work force in agriculture, *percent*	68.5	78.1
Landless agricultural laborers per 100 cultivators, *number*	33.2	57.9
Scheduled castes as a proportion of total population *percent*	19.7	26.3
Literacy rates		
Total population, *percent*	24.7	26.7
Rural population,		
Males, *percent*	39.5	42.1
Females, *percent*	6.9	6.7
Black top roads per 1000 square miles of area, *miles*	155.4	138.7
Per capital income, *rupees in 1955-56*	207	196
Governmental expenditures on irrigation work, *thousand rupees*	3,754	1.893
Wages of agricultural workers, per day, *rupees*	1.25	1 14

Source : [28].

North Arcot appears to have had some advantage over South Arcot in respect to population density (especially in density of its rural population), degree of urbanization, per capita incomes, and percentage of agricultural workers classified as landless laborers (table 83). These and other factors account for slightly higher agricultural wage rates in North Arcot.

While the data are not conclusive, it appears that the more rapid rate of growth in North Arcot district reflects more than anything else the advantage that it has had as a result of its closer proximity to the rapidly growing urban center, city of Madras, and to the associated larger improvement in its electric power facilities, roads and transport facilities and other infrastructures serving the Madras metropolitan area. Its other advantages in size of farms, per capita income levels, and tenure patterns have helped its cultivators to capitalize on the build up of electric power lines and improved roads feeding into Madras.

CHAPTER 9

Potentials, Problems and Policy Needs

Indian agriculture has emerged from the worst two consective years of drought of this century. In doing so, it has not merely moved back to its pre-drought *norms*. Instead, as a result of recent technological advances, the drought years of 1965-66 and 1966-67 marked the divide between what can become two recent epochal periods in India's agricultural development. The first, begun with Independence in 1947, is notable for progress achieved. The second, born in drought years, is notable for progress already achieved and for its promise of more rapid progress in the years ahead.

India's Earlier Agricultural Progress in Retrospect

India's agricultural progress in the earlier period has been somewhat obscured because of its worsening, chronic food shortages during that time. This period, however, was marked by the most rapid rate of increase in agricultural output that had then ever been achieved in India's recorded history. While it was also marked by an unprecedented high rate of population growth, the anomaly of growing food shortages paralleling progress was not a case of population increasing faster than agricultural output. Rather, it came about from increases in per capita income generated by India's small but nevertheless growing prosperity and wealth.

The story of India's agricultural gains since Independence is one of progress in broadenning the bases of its social and economic organization, or the economic arena within which its people are related to one another in their production efforts; of the increasing role of state and government in the economic life of its cultivators, villages and towns and conversely of their increasing participation and involvement in affairs of state and economy; and of the increasing relatedness among people of differing regions and industries to each other and to the people of other nations through their marketing of increases in output and their purchases of increased amounts of both farm inputs and consumer goods. In is in part, also, the story of emergence of new non-market directed forms of international collaboration involving the introduction of new ideas, techniques and resources and reflecting the interests of people from other nations in India's development as a viable and economically independent member of the world community of free nations.

A New Era in Indian Agricultural Development

A new era in India's agricultural development began late in 1965 with the enunciation of what has come to be known in India as "The New Agricultural Strategy". It had its beginning when foodgrain prices were at a new record high level and when already considerable progress had been made over the past decade and a half in building up the Nation's agricultural extension and credit services; its agricultural universities and research institutions, and other important foundations of agricultural production, in large part with U.S. financial and technical assistance. Recent varietal breakthroughs together with sharp increases in foodgrain prices provided hitherto missing essentials to rapid growth in the Nation's agricultural production.

Available information indicates that new varieties of wheat, rice and other cereals are much superior to traditional ones under normal monsoon conditions and that they also have much larger capacity for economically using fertilizers, water, and other inputs [31, 34, 35, 36 and 65]. By the same token, however, the realization of their full potentials will require changes in nearly all components of Indian foodgrain production technology. Indeed, some of India's agricultural leaders regard the new high-yield varieties of cereal crops as an important catalyst for inducing a whole complex of changes in the Nation's cereal production technology, including increased use of fertilizers, water, pesticides, and improved implements as well as increased attention to weed and pest controls, land preparation, and other production practices.

As a result of the combined influence of area increases and of the new cereal crop varieties and associated increases in the use of fertilizers, water, pesticides, and other yield increasing inputs, India's crop output increased from the earlier record high index of 159.4 in 1964-65 to 161.0 in 1967-68. Its output of foodgrains increased from 89 million metric tons in 1964-65 to 95.1 million tones in 1967-68. In 1968-69, several parts of India suffered drought condition, hence its production of foodgrains dropped to 94.0 million tons.

In all of India's northern wheat growing states, average yields in 1967-68 were substantially above their previous all-time record high. Of the Nation's increase in wheat production from 1964-65 to 1967-68, 31.1 percent came from an increase in area sown to wheat; the other 68.9 percent came from larger uses of yield increasing inputs. Despite promising new varieties, however, rice yields for the Nation as a whole were still lower in 1967-68 than in 1964-65. Only three states-Madras, Mysore and Andhra Pradesh-had higher average yields in 1967-68 than they had previously achieved. Yields in most states were still substantially below earlier record highs.

Other crops for which high yielding varieties are now available are maize, bajra and jowar. The average yield of maize was 11 percent higher in 1967-68 than in 1964-65; that for bajra was 7.6 percent above the 1964-65 level; and the average yield of jowar was the same as in 1964-65.

Future Needs and Problems

Input and Other Production Needs

The above facts suggest that realization of India's hope for rapid large increases in agricultural output during the next few years will require an even more massive effort than has yet been undertaken along each of several different lines. It will require much more research to improve still further the varietal and other technological basis of its agricultural production; increased tempo of development of its agricultural input production and distribution facilities and services; large improvements

in its agricultural extension and credit services, especially to serve its million of operators of small-sized farms; and much more developments of its irrigation potentials, rural electric power production and distribution facilities, rural roads, and other supporting facilities and services.

Price Incentives

Sustaining a rapid rate of increase in output will also require vigilant attention to the provision of incentives at levels not merely covering costs of production but at levels enabling the Nation's rural people to share equitably in benefits of growth in its output of consumer goods and services like radios, newspapers, motor scooters, bicycles, education, medical service, and many others. Without these, the efforts and risks that rural people must incur to increase their production would soon seem to them devoid of worthwhile purpose. The precise level of incentive needed will change with development and can be gauged only on the basis of much further study than is possible here.

Closely related to the provision of adequate incentives is the need to keep open to cultivators in all parts of the Nation the largest possible size of market for their products; also the need to maintain price relationships among states and regions that will encourage each to adopt crop combinations consistent with its respective comparative advantage or to such regional specialization as will maximize output and productivity of both foodgrains and non-foodgrains for the nation as a whole.

Distribution Problems

Investment in the provision of inputs and other means of production coupled with the provision of adequate incentive to farmers is perhaps procedurally the simplest known method of integration India's thousands of highly self-contained village economies into its larger national economy. It can also provide markets for the services of both capital and labor in nonfarm sectors.

An India increases its agricultural production through the use of high-yielding crop varieties and larger amounts of complementary inputs, however, new economic and social problems may emerge. One of the most important of these will likely be that of an increasing disparity between (a) its many small farm owners, tenants, landless laborers, and other rural service workers, and (b) its relatively small number of farmers who are already in a relatively favorable economic position. The latter have a distinct advantage in their ability to finance the improved methods of farming. Their advantage will in time be accentuated by the tendency to capitalize increases in productivity into land values. Unless checked, however, such tendencies can easily lead to increase in rents and to increasing pressures on heavily indebted small farm owners to either pay off their indebtedness or give up their farms.

Where land is so important as a source of employment to hundreds of millions of people, and where the rural population is growing as rapidly as it is in India (faster than the development of nonform employment opportunities) the ensuing income disparity or polarization can at its extremes easily take the form of increasing economic displacement of many of agicultural's poorer people before the development of commensurate employment opportunities elsewhere. To the extent that this happens, it will cut short at below optimal levels or capacity (taking account of all agricultural people) agriculture's demand for nonfarm produced inputs; its capacity to supply foods and farm produced raw materials to rest of the economy; and agriculture's contribution to rest of the economy as a source of markets for nonfarm produced consumer goods and services.

In these and other ways, failure to achieve a more equitable distributions of income and economic opportunity within agricultural villages will inhibit realization of the full growth generating potentials for both agricultural and non-agricultural sectors of India's now emerging technological improvements and of the improvements now underway in its input industries, infrastructures, and other agricultural development bases.

India's still critical food needs dictate at this stage in its economic development that it assign top priority to improving its agricultural input industries, infrastructures, credit, incentives, and other essentially technological foundation of its agricultural economy. It is not too early, however, for India's leaders and social science research institutions to begin careful study of the extent of such distribution problems and of how to alleviate them in ways that will complement both India's objective of becoming a much more productive nation and achievement of the modern humanitarian ideals so eloquently proclaimed in its Constitution. Fortunately, these needs have been recognised as evidenced by the recent establishment of the Small Farm Development Council which is undertaking concerted programs of assistance to small farmers in selected districts, an experimental program extending the concept of adaptive research to institutional reforms as well as to agronomic practices. Increasing emphasis is also being put on the agricultural development problems of India's dry-land farming areas.

Population Controls

Whether, even with needed distributive innovations coupled with the best that physical scientists can do to improve technologies, India or any other nation with as high a population growth rate as it now has can formulate and implement a development model capable of yielding a sharp long-sustained upturn in its per capita output of goods and services is still an unanswered question. Being an unanswered question, it suggests the need for large scale crash programs boldly conceived and energetically pursued in the population control field to parallel India's other economic development policies and programs.

Roles of Governments

India, like the United States, has a mixed economy comprising both governmental and private (corporate, cooperative, individual, family, partnership, etc.) producing units, with differences ones of degree of dependence and emphasis on governmental versus private sectors. India is additionally characterized; (a) by the extent to which custom and tradition reinforced by religious ideology and large socio-economic class distinctions influence the economic organization of its agriculture and of the village economies of which its agriculture is a part; (b) by extreme poverty and low levels of education of the masses of its rural people; and (c) by its inability with even rapid rates of industrial growth to develop employment opportunities outside of rural areas for a large part of the normally large annual increases in its rural labor force. These factors, together with the need (as much for social and political as for economic reasons) to telescope large progress within a short prriod of time, place on government (as opposed to the market mechanism) a much larger part of the burden of economic development than has ever been required in western economically advanced nations.

At the same time, India has a large amount of private enterprise, notably in its agriculture, small industry, and trade sectors. Hence, unlike in either the socialistic system of the USSR or the highly developed market-directed economy of the United States, it faces the difficult task of evolving policies that will enable both its government and its private

sectors to become simultaneously much more effective agencies of economic development.

Limited as it necessarily is in respect to the checks and controls provided by both a highly competitive market economy and a well informed general populace, India in its development efforts will at best be subject to allocative and distribution errors as inevitable costs of its economic development. But vastly more costly errors will be those of governmental inaction and indecision or lack of boldness in imagination and action in both the formulation and the implementation of its development plans.

Fourth Five Year Plan Approaches to Agricultural Development

What India proposes to do in the next few years to sustain a high rate of growth in agricultural production is outlined in considerable detail in its new Fourth Five Year Plan for the years 1969-1974 [67]. Draft of this plan, released in March 1969, indicates relative to earlier plans both an increased recognition of the importance in the Nation's general economic development strategies of improving the performance of agriculture and fuller recognition of what this will require in increased investments in agriculture, agricultural input industries, rural infrastructures, and other supporting facilities and services. Draft of this plan also indicates an acute awareness of need for vigilant attention to the provision of favorable farm production incentives and of need to broaden distribution of the Nation's newly emerging agricultural development opportunities. The second and third Five Year plans recognized that increasing agricultural production was

Table 84.

India : Agricultural production targets for selected commodities Fourth Plan Period

Commodity	Unit	Base level production	Estimated production 1973-74	Percentage change
		number	number	percent
Foodgrains	mil. tons	98	129	32
Oilseeds	,, ,,	8.5	10.5	24
Sugarcane (gur)	,, ,,	12	15	25
Cotton	mil. bales	6	8	33
Jute	,, ,,	6.2	7.4	19
Tobacco	mil. kgs.	380	480	26
Coconut	mil. nuts	5600	6600	18
Cashewnut	thous. tons	160	236	48
Pepper	,, ,,	23	42	83
Lac	,, ,,	35	52	49

Source : [67].

[1] The base period estimates are trend determined estimates for 1968-69. For most commodities, they are slightly higher than actual 1968-69 production estimates.

important for achieving the Nation's general economic development objectives. However, they failed in a measure to assess its full importance. They also underestimated requirement for achieving the projected needs for growth in agricultural production.

By contrast, in the new Fourth Plan Report agriculture's importance in the achievement of a projected rate of growth of about 5.5 percent per year in national income with stability is fairly well documented. This importance is viewed as turning on the fact that "nearly 60 percent of total household consumption and 85 percent of the commodity consumption of households is comprised of agricultural products or manufactures based principally on agricultural raw materials". Hence, in the plan view, the degree of stability essential to achieving the growth target is "almost entirely a function of the prospective growth of agricultural production" [67].

An overall rate of growth in agricultural production of 5.0 percent per year is, therefore, projected as an essential goal. This, in specific terms, envisions increases in foodgrains from 95.6 million tons in 1967-68 to 129 million in 1973-74 and more or less comparable percentage increases in sugarcane, oilseeds,

Table 85.

India : Selected targets for agricultural inputs and services for Fourth Plan Period

Item	Unit	1968-69 estimated	1973-74 targets
		number	number
High yielding varieties	mil. ha.	8.5	24.1
Consumption of fertilizers			
Nitrogenous (N)	thous. tons	1400	3700
Phosphate (P_2O_5)	,, ,,	400	1800
Potassic (K_2O)	,, ,,	180	1100
Total	,, ,,	1980	6600
Production of fertilizers			
Nitrogenous (N)	,, ,,	550	3000
Phosphatic (P_2O_5)	,, ,,	220	1500
Plant protection area covered	mil. ha.	54	80
Area irrigated			
Major and medium	mil. ha.	17	21.2
Minor	,, ,,	19	22.2
Agricultural pumpsets energized	thous.	1069	1240
Short and medium terms loans advanced by primary credit cooperatives	Rs. crores	450	750
Long-term loans advanced	,, ,,	100	700[1]

Source : [67].

[1] This is estimate for the Fourth Plan period as a whole. It excludes loans of about Rs. 200 crores on schemes refinanced by the Agricultural Refinance Corporation.

cotton, jute, tea, tobacco, spices and other commodities (table 82).

These targets are to be achieved in part, according to the Plan report, by about a three fold increase over 1968-69 estimated levels in area planted to high yield varieties of cereals and in fertilizer consumption and by an increase from 54 million to 80 million hectares in area of crops covered by plant protection measures (table 83). Expansion of high yield varieties will be achieved by their further extension to area already under irrigation, by increases in irrigated area, and by sizeable increases in multiple cropping. Increases in number of energized pumpsets is viewed as an important contributor to increases in irrigation.

Toward the achievement, of these objectives, the Fourth Plan calls for outlays for agriculture and allied sectors-including animal husbandry, forestry and fisheries-of Rs. 2,217 crores compared with Rs. 1,089 in the Third Plan period and with Rs. 1,166 during the three years 1966-68 to 1968-69. These include Rs. 510 crores for agricultural production (including schemes of the Indian Council of Agricultural Research relating to research and education) ; Rs. 476 crores for minor irrigation ; Rs. 151 crores for soil conservation ; Rs. 65 crores for warehousing, marketing, and storages ; Rs. 263 crores for central support of agricultural finance institutions ; Rs. 151 crores for cooperatives ; and Rs. 125 crores for buffer stock of agricultural commodities.

Efforts will be made to strengthen the Food Corporation and the State Trading Corporatoin to facilitate the building up of buffer stocks in the amounts needed to stabilize yearly variations in supplies and prices caused by the vagaries of India's monsoon climate. Strengthening of the Indian Council of Agricultural Research, viewed as the apex organization for sponsoring, coordinating and directing agricultural research and education, is recognized as a basic need.

The new Plan puts considerable emphasis upon helping small farmers and landless laborers to share more fully in the Nation's expanding agricultural opportunities. Some specific proposals include ones for increased public investments in community projects, including one for developing tanks and tubewells for small farmers ; steps for reorienting loan policies of cooperative institutions in favour of small farmers ; creation of a "small farmers' development agency" to assist small farmers on land development, marketing, credit and other problems ; and more effective implementation of land reform measures previously initiated. The various agricultural development programs are expected to create new employment opportunities in rural areas.

Other Considerations

Available information on agricultural production responses to high yielding varieties, fertilizers, irrigation, pesticides and other inputs indicate that with realization of the projected increases in these inputs, the Nation's Fourth Plan agricultural production targets appear reasonably modest. Their actual attainment, however, will likely strain India's financial resources and its organizing, administrative, and professional technical competence for more than have the gains that it has already made through its New Strategy programs.

The New Strategy gains already made have been cheaply made because of a prior backlog of irrigation works, rural electric power, institutional credit facilities, administrative competence and professional agricultural production expertise-the product of development investments made over a long period of time.

Increasingly in the future, however, success of the New Strategy will require large new investments in the further expansion and improvement of the Nation's irrigation and rural electric power facilities, roads, marketing, storage and distribution systems, credit institutions, agricultural education, extension, research and organizing and administrative competence as well as large new investments in the build-up of its agricultural input production industries. Increasingly, too, it will require extension of the new inputs into geographic areas and onto farms where-because of less favorable ecological conditions, more limited managerial and financial ability of farmer and scale or size of farm disadvantages-the productivity of such inputs may become progressively lower and increments of output progressively more costly.

Meantime, every gain that is made in increasing per capita output will likely lead to increasing downward pressure on prices of agricultural commodities-hence the likelihood of both rising costs and falling prices of each increment of output.

These postulated product demand and price trends can be forestalled only through large increases in agricultural exports or phenomenally rapid growth in national employment and per capita income levels, or by some combination of these two factors.

Large expansion of India's agricultural exports will require that its farmers not only be able to increase their output but that costs of their increases be low enough for them to become competitively competent in world markets.

The possibilities of India's farmers competing in world markets are affected by the facts (a) that the new technologies can be about as easily adopted in other developing countries as in India ; and (b) that India's projected investments in research to produce cost reducing technologies are but a small fraction of that being invested by economically advanced nations-not to mention relatively large limitations in India's capacity, financial and otherwise, for rapid application of such outputs of knowledge.

For a few years, the substitution of India's increases in agricultural output for its hitherto large imports of agricultural commodities will help to hold up prices of its agricultural products. This way of sustaining price levels, however, will become progressively less effective as India approaches its self-sufficiency goal. As India achieves self-sufficiency in agricultural production a more rapid rate of growth in its non-agricultural sectors than has yet been projected will be required to maintain its present farm price levels under conditions of rapid increases in its per capita output of agricultural commodities.

If India were predominantly an industrial nation with three fourths or more of its population employed in non-agricultural sectors, a 5 percent rate of growth in its non-agricultural sector would generate considerable growth in demand for agricultural commodities, especially farm produced raw materials, notwithstanding low income elasticities of demand. At its present stage of development, however, India has little alternative than to depend on improvements operating on the supply and cost side of agricultural production as the principal dynamic elements for sustaining a rapid rate of increase in its agricultural production and marketing.

Possible supply improvements include such things as further varietal breakthroughs applicable to both cereals and other crops and to dry-land areas; technological advances in fertilizer production; increasing efficiency in marketing and distribution of inputs and in assembly, transport, storage and marketing of agricultural products; and reducing crop losses from plant diseases, insects and rodents.

For all of these kinds of improvements, the continued rapid development and strengthening of its research competence is a first basic requirement.

Indis now has many things going that will facilitate the achivement of its agricultural production objective. The problems which it must yet resolve, however, are numerous and complex. Moreover, they are so closely inter-related that failure to resolve any one of them could lessen the effectiveness of the advances that it makes in a solution of all others.

Hence, instead of complacency growing out of the impressive grains of the last few years, India cannot afford to relent in its agricultural efforts and in continuing vigilance in the design and implementation of efforts along each of many closely inter-related lines. India's existing potentials are large enough to meets its Fourth Five Year Plan's high agricultural production targets. This will require, however, large scale education and promotional efforts to close an existing large gap between the current performance and the current potentials of its agricultural sector. Meeting its longer-run agricutural production needs will require futher extensive development along each of many lines to raise its agricultural production potentials to still higher levels.

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Appendix I

Glossary

Kilogram	Equals 2.0463 pounds.
Hectare	Equals 2.47109 acres.
Crore	Ten Million (10,000,000), written 1,00,00,000.
Lakh	One hundred thousand (100,000) written 1,00,000.
Rupee (100 paise)	The monetary unit equivalent to 13.33 U.S. cents. Prior to June 6, 1966 it was valued at 21 cents.
Maund	Usually 82-2/7 pounds (the railway maund) but varies in weight. More recently the metric maund or 40kg. (88.2 lbs).
Quintal	100 kilograms or 220.5 pounds.
Kharif crops	Include crops which are harvested in the fall or winter. The principal kharif crops are rice, jowar, bajra, corn, sugarcane, cotton, jute, sesamum, peanuts.
Rabi crops	Include crops that are harvested in the spring, The principal rabi crops are wheat, barley, chickpeas, peas, linseed, mustard, rapeseed, potatoes, tobacco.
Foodgrains	Usually used to denote all grains and pulses most of which are consumed directly as stapple foods.
Jowar	Milo or grain sorghum.
Bajra	spiked millet or pearl millet.
Gram	Chickpeas
Tur	Pigeonpeas.
Groundnuts	Peanuts.

Gur	Farm-made unrefined brown sugar which comes in irregular shapes or solid masses.
Zamindary	A system of land ownership in which the cultivator or tenant pays rent to the Zamindar or landlord who in turn is responsible for paying land taxes to the Government.
Paddy.	Rough rice.
Mandi	A local grain marketing center.
Taccavi loans	Government loans to farmers for production.
Kuruvai	Short-term first paddy crop.
Cropping intensity	Ratio of gross to net sown area, a difference related to the growing or 2 or more successive crops on the same land per year.
Crop productivity	Output per hectare of gross sown area.

Appendix II

Methods of Computing Sources of Crop Output Growth

Let a, y, q, p, and r stand for area, yield-rate (per unit area), output, price, and rate of growth respectively for a crop ; A, V and R stand for area, value and rate of growth for all crops included ; n be the total number of crops included, and suffix i indicate an individual crop i, suffix o indicate the base year and suffix I year I.

Then for base year, for the ith crop,

$$\text{area} = a_{oi} \quad \ldots \quad (1)$$

$$\text{yield rate} = y_{oi} \quad \ldots \quad (2)$$

$$\text{output} = q_{oi} = a_{oi} \times y_{oi} \quad \ldots \quad (3)$$

Let r_{ai}, r_{yi} and r_{qi} be the percent per annum rates of growth (compound) of area, yield-rate and production respectively of ith crop, then the estimated values in year I will be

$$aIi = a_{oi}\left(\frac{100+r_{ai}}{100}\right) \quad \ldots \quad (4)$$

$$yIi = y_{oi}\left(\frac{100+r_{ai}}{100}\right) \quad \ldots \quad (5)$$

$$qIi = aIi \times yIi = q_{oi}\left(\frac{100+r_{qi}}{100}\right) \quad \ldots \quad (6)$$

Value of all crops in base year,

$$V_o = \sum_{i=I}^{n} q_{oi} P_i \quad \ldots \quad (7)$$

Value of all crops in year I

$$V_I = \sum_{i=I}^{n} qI_i \quad p_i \qquad \ldots \qquad (8)$$

Increase in output from increase in area (A) alone may be expressed as

$$dV^A = V_o \left(\frac{100+R_A}{100} \right) - V_o$$

$$\frac{R_A}{100} \quad V_o \qquad \ldots \qquad (9)$$

Increase in output from increase in yield-rate (Y) alone may be expressed as

$$dV^Y = \sum_{i=I}^{n} a_{oi} \quad Y_{Ii} \quad p_i \quad - V_o \qquad \ldots \qquad (10)$$

Increase in output from changes in crop pattern (C) alone may be expressed as

$$dV^C = \sum_{i=I}^{n} \frac{a_{Ij} \; Y_{oi} \; P_j}{R_A} \quad - V_o \qquad \ldots \qquad (11)$$

Increase in output from interaction (I) may be expressed as

$$dV^I = V_I - V_o - dV^A - dV^Y - dV^C \qquad \ldots \qquad (12)$$

The break-up of growth rate of total crop output according to the components, area alone (A_R), yield-rate alone (Y_R), changes in cropping pattern alone (C_R) and interaction between then (I_R) may be expressed as follows :

$$A_R = \frac{dV_A}{V_o} \times 100 \qquad \ldots \qquad (13)$$

$$Y_R = \frac{dV^Y}{V_o} \times 100 \qquad \ldots \qquad (14)$$

$$C_R = \frac{dV^C}{V_o} \times 100 \qquad \ldots \qquad (15)$$

$$I_R = \frac{dV^I}{V_o} \times 100 \qquad \ldots \qquad (16)$$

Appendix III

Major Projects Supported by U. S. Governmental Foreign Assistance Program

The United States government, under its Point Four program, provided its first technical assistance to India in 1950. By the end of 1951 it had sent four specialists to India. These included an agricultural engineer, a biologist, an agricultural information specislist and a farm management expert. Also, in 1951 it provided an emergency wheat loan of $189.7 million dollars (repayable in dollars) to help alleviate serious food shortages caused by widespread crop failures in 1950.

The Indo-U.S. Technical Cooperation Agreement concluded on January 5, 1952, however, marked the begininng of broadguaged programs of U S. economic and technical assistance to India. Under this agreement, supplemental agreements have been entered into between the governments of the United States and India for more than 150 projects in agriculture, industry, transportation, education, health and other fields. About a fourth of these projects have been directed specifically to agriculture, home economics, and river valley development. Several others have been directed to improving roads, building electric power production and distribution systems, eradicating malaria, and other activities of inestimable value to agriculture and rural people. The agricultural projects undertaken with U.S. assistance indicate some of the specifics of India's own agricultural development strategies as well as the scope of U.S. assistance activities [44].

Several projects directed to increasing agricultural production by the introduction of modern inputs, development of water resources, initiation of field experiment and research on uses of these inputs, and improvements in the Nation's agricultural extention services were initiated in 1952. The first of these (Agreement No. 1] provided for the acquisition and distribution of then relatively new fertilizer materials in India. It provided for an initial import of about 75,000 tons of ammoniun sulfate and smaller amounts of other materials for field trials on fertilizer yield responses to popularize the use of fertilizers and to test package materials for the storage and transportation of fertilizers under Indian conditions.

Project Agreement No. 2 provided for the acquisition and distribution of steel for use in improving agricultural implements and equipment such as steel-point plows, spike-tooth harrows, steel cart tires, irrigation devices and storage facilities. Project Agreement No. 3, directed to "locust control and plant protection' ',was

a forward step in the introduction of modern plant protection materials and insect control method into Indian agriculture. Project agreement No. 4 provided for the initiation of soil surveys, for the establishment of 24 soil-testing laboratories in widely scattered parts of India, and for fertiliser trials under Indian field conditions to be carried on under direction of the Indian Council of Agricultural Research and its affiliate research institutions. It provided also the service of a U. S. soil scientist to assist in the planning and conduct of soil and fertilizer research. Project Agreement No. 5 was one for modernization and expansion of inland and marine fisheries. Project Agreement No. 6 was directed to the development of improved systems of irrigation in localities where flow sources of water were not available. As a result of this project by the end of March, 1955, nearly 2,000 tubewells had been installed in Punjab, Bihar and Uttar Pradesh. This innovation has now become of large importance in increasing India's output of foodgrains and other crops.

Project Agreement No. 7 provided assistance for establishing and strengthening of agriculture and home science extension programs. It initially envisaged the setting up of 59 Extension Training Centers with 41 Home science Units, the setting up of 97 agricultural schools to provide a 12 month course for village level workers not having technical training in agriculture, the provision of duplication facilities for the publication of agricultural information materials, and the provision of foreign training opportunities for extension officials.

Project Agreement No.8 was directed to the strengthening of India's Community Development program. It provided up to the end of 1958 roughly $14 million for the import of equipment including jeeps to enable state and district extension and community development officers to reach villages, tractors for use in road building, and other equipment for audiovisual aid, well-drilling, health and other purposes.

Project Agreement No. 9 related to a national Program for the Control of Malaria. Malaria had been one of India's most serious diseases affecting the health and work efficiency of its rural people. It has been virtually eradicated under this and subsequent malaria control programs. Project No. 10 on forest research and project 12 for ground water explorations were other early projects relating directly to agriculture.

The next major project directed specifically to agriculture was the now well known Operational Agreement No. 28 for assistance to agricultural research, education and extension organizations. The U. S. assistance provided under this agreement and later supplements to it, coupled with assistance by the Rockefeller Foundation, in the setting up of three Indo-American Teams for the evaluation and planning of agricultural education needs, has culminated in the establishment of 9 states agricultural universities combining resident teaching, research and extension training somewhat as in American land-grant universities. The development of these universities has constituted a major, if not an essential step toward the further development of indigenous research competence. At the same time, it has helped to develop the competence of personnel needed in national and state departments of agriculture and in agricultural industries, trade and financial fields. Research units in these universities, although relatively new, have begun to produce new knowledge of inestimable value in increasing India's agricultural output and productivity.

Other projects initiated between 1954 and 1960 included ones for improving foodgrain storage (No. 31), increasing fertilizer supplies (No. 32), provision of agricultural communication equipment and training (No. 34), strengthening of agricultural economic research (No.

36), flood control (No. 37), animal husbandry research (No. 38), home science education and research (No. 41), water resource survey and minor irrigation research (No. 41), hybrid maize research (No. 45 begun in 1956), rural electrification (No. 48), provision of tubewell casing (No. 49), assistance to the Irrigation Research Institute at Roorkee in the U. P.(No. 54), provision of technical books and printing equipment to the Central Water and Power Commission (No. 56), assistance for developing the Calcutta Milk Scheme (No. 60), dairy production, marketing and processing development (No. 61), and soil and water conservation (No. 94).