
DISSEMINATION OF KNOWLEDGE SERIES

-:1 :-

RESTORING THE ABUNDANCE

*Regeneration of Indian Agriculture to
Ensure Food for All in Plenty*

JITENDRA BAJAJ
M.D. SRINIVAS



INDIAN INSTITUTE OF ADVANCED STUDY
RASHTRAPATI NIVAS, SHIMLA-171005

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Foreword

The Indian Institute of Advanced Study is wedded to the noble task of research on fundamental themes of life relevant to humanity. The mandate given to us is tried to be fulfilled by intensive research by its resident fellows, lectures and talks by eminent visiting scholars and visiting professors as well as by seminars, conferences, workshops organised at Shimla and outside Shimla through its collaborative institutes and centres. The Institute has a distinguished record of publication of books, monographs, proceedings of seminars, symposiums, etc. It publishes two journals—*Summerhill—ILAS Review* and *Studies in Humanities and Social Sciences*. These publications go a long way in achieving the aims and ideals of the Institute.

The Institute has decided to launch a programme entitled “Dissemination of Knowledge” under which it is proposed to publish Occasional Papers on significant themes of knowledge relevant to society, nation and humanity. The Institute has undertaken the responsibility for publishing a critical research journal in Hindi entitled “Chetna” with this view in end.

It is a matter of satisfaction to note that the first Occasional Paper in this programme has been published under the title *Restoring the Abundance: Regeneration of Indian Agriculture to Ensure Food for All in Plenty* penned by Professor Jitendra Bajaj and Professor M.D. Srinivas of the Centre for Policy Studies, Chennai.

The paper brings into focus the need for going back to our perennial and natural resources for regeneration of Indian economy. I felicitate the learned scholars for their valuable presentation on a theme of national importance. I do hope that this analysis will be welcomed by scholars and policy planners in the country.

V.C. SRIVASTAVA
Director

I. INDIA: THE LAND OF ABUNDANCE

The Fabulous Geography of India

India is endowed with extraordinary natural and civilisational resources. Around the time of our Independence, the American scholar Kingsley Davis gave a glowing account of the fabulous geography of India, especially the great Indo-Gangetic plain:¹

India...is probably the third most gifted of the world's regions with respect to industrial capacity, and the second or third with reference to agricultural resources. But in sheer area it is big enough. The geographical traits of the subcontinent are fabulous and their description requires unblushing superlatives...

The great key to the regions peculiar geography actually lies more outside than inside the boundaries, although it has its main effects inside. This is the Himalayan range, the loftiest mountain barrier in the world, which shuts off the subcontinent from the rest of Asia. From 150 to 250 miles wide, this Roof of the World stretches over 1,500 miles across the north of India. It boasts of the three highest points on the earth's surface . . . fifty summits of 25,000 feet or more, and an average elevation of 19,000 feet...

The Himalayas contribute greatly to the soil, climate and the isolation of India...They are eroding rapidly and sending out rich loam to the plains below. Because high plateau lands lie to the north and the snow and rainfall come mostly from the south, the drainage runs toward India. The three main rivers of the subcontinent – Indus , Ganges and Brahmaputra – with most of their tributaries, all have their sources in the Himalayas and all bring down silt that has made the Indo-Gangetic plain, covering the whole of northern India, the most fertile area of its size in the world...

The most important of the plains is the Indo-Gangetic, noted for its size, fertility, depth, antiquity and flatness. . . . The entire plain, some 2000 miles long and 150 to 200 miles wide, is alluvial. A great part of its soil is renewed every year by floods, and the mud brought down from the hills is so fine that it is reputedly possible

to traverse the entire length of the plain “without finding a pebble however small”. The alluvium, in addition to being remarkably uniform over its entire extent of approximately 30,000 square miles, is extremely thick. The exact thickness has never been ascertained, but borings have penetrated it to a depth of 1,300 feet without reaching a rocky bottom. The plain is also exceptionally flat. Agra, half-way between the two deltas and 1,300 miles by river from the sea, is only 550 feet above the sea level. This flatness makes the rivers flow slowly, thus fertilising the country thoroughly and affording easy waterways and irrigation channels. This is one of world’s greatest expanses of rich, tillable soil, and thus one of the world’s greatest agricultural regions.

The Land of Abundance: Some Foreigners’ Accounts

Given its extraordinary geography, especially the fertile lands and the great perennial rivers, India has been a land of great agricultural abundance throughout her long history. Indian civilisation laid great emphasis on ensuring abundance of food, and sharing of food amongst not only men but also all other created beings, so that none within the polity remains hungry, as a primary principle of righteous public functioning, the *dharmā*, of India. All literature and historical records of earlier times indicate that the state and society in India deeply imbibed this principle of abundance and sharing, and created extensive institutional arrangements to ensure this discipline at all levels of the polity.²

From ancient times, the foreign observers who visited India have been deeply impressed by the natural resources of India and the genius of the people which continued to create a society of great affluence. More than two thousand years ago, the Greek observers, who visited India in the wake of the unsuccessful invasion by Alexander, were literally wonder struck with the land and the attainments of her people. They wrote about Indian agriculture in glowing terms and especially mentioned the fact that this country had never seen famines. The following extract presents a summary form of the view of India prevalent in the classical Greeco-Roman world:³

India, which is in the shape of a quadrilateral, has its eastern as well as its southern side bounded by the great sea, but on the northern side it is divided by mount Hemodos... while the fourth or western side is bounded by the river called the Indus, which is perhaps the largest of all rivers in the world after the Nile. The extent of the whole country from east to west is said to be 28,000 stadia, and from north to south 32,000. Being thus of such vast extent, it seems well nigh to embrace the whole of the northern tropic zone of the earth...

India has many huge mountains which abound in fruit trees of every kind, and many vast plains of great fertility, which are remarkable for their beauty and are supplied with water by a multitude of rivers. The greater part of the soil, moreover, is well watered and consequently bears two crops in the course of the year...

The inhabitants, in like manner, having abundant means of subsistence, are of unusual height and bulk of body. They are also found to be well skilled in the arts, as might be expected of men who inhale a pure air and drink the finest water. And while the soil bears on its surface all kinds of fruits which are known to cultivation, it has also under ground numerous veins of all sorts of metals, for it contains much gold and silver, and copper and iron in no small quantity, and even tin and other metals, which are employed in making articles of use and ornament, as well as the implements and accoutrements of war.

In addition to cereals, there grows throughout India much millet, which is kept well watered by the profusion of river streams, and much pulse of superior quality, and rice also, and what is called *bosporum*, as well as many other plants useful for food, of which most are native to the country. The soil yields, moreover, not a few other edible fruits fit for the subsistence of animals which it would be tedious to write.

It is accordingly confirmed that famine has never visited India, and that there has never been a general scarcity in the supply of nourishing food. For, since there is a double rainfall in the course

of each year – one in the winter season, when the sowing of wheat takes place as in other countries, and the second at the time of summer solstice, which is the proper season for sowing rice and *bosporum*, as well as sesamum and millet – the inhabitants of India almost always gather in two harvests annually... The fact is, almost all the plains in the country have a moisture which is alike genial, whether it is derived from the rivers, or from the rains of the summer season, which are wont to fall every year at a stated period, with surprising regularity...

But, further, there are usages observed by the Indians which contribute to prevent the occurrence of famine amongst them; for whereas among other nations it is usual, in the contests of war, to ravage the soil, and thus to reduce it to an uncultivated waste, among the Indians, on the contrary, by whom husbandmen are regarded as a class that is sacred and inviolable, the tillers of the soil, even when battle is raging in their neighbourhood, are undisturbed by any sense of danger...

India, again, possesses, many rivers both large and navigable, which, having their sources in the mountains which stretch along the northern frontier, traverse the level country and not a few of these after uniting with each other, fall into the river called Ganges. Now this river, which is 30 stadia broad, flows from north to south, and empties its waters into the ocean forming the eastern boundary of the *Gangaridai*, a nation which possesses the greatest number of elephants and the largest in size...

Another river, about the same size as the Ganges, called the Indus, has its sources, like its rival, in the north, and falling into the ocean forms the boundary of India; in its passage through the vast stretch of level country it receives not a few tributary streams which are navigable... Besides these rivers there are a great many others of every description, which permeate the country, and supply water for the nurture of garden vegetables and crops of all sorts. Now to account for the rivers being so numerous, and the supply of water so superabundant, the native philosophers and proficients in natural science advance the following reasons. They say that the

countries which surround India...are more elevated than India, so that their waters, agreeable to natural law, flow down together from all sides to the plains beneath, where they gradually saturate the soil with moisture, and generate a multitude of rivers...

Notwithstanding the large-scale plunder, wars and destabilisation that occurred when parts of India came under alien rule from about 1100 AD onwards, many regions of India continued to impress observers from all over the world with their flourishing agriculture and manufactured goods that were sought after throughout the world. For instance, the African Ibn Batuta, who visited many regions in both north and south India in the fourteenth century, notes the following about the state of Indian agriculture:⁴

When they have reaped the autumn harvest, they sow spring grains in the same soil in which autumn grains have been sown, for their country is excellent and the soil fertile. As for rice they sow it three times a year...

The fifteenth century accounts of the opulence of the Vijayanagara Samrajaya are of course well known. In the seventeenth century, the Frenchman Francois Bernier gave the following description of the legendary agriculture and manufacture in Bengal and its great system of canals:⁵

Egypt has been represented in every age as the finest and most fruitful country in the world, and even our modern writers deny that there is any other land so peculiarly favoured by nature: but the knowledge I have acquired of Bengal, during the two visits paid to that kingdom, inclines me to believe that the pre-eminence ascribed to Egypt is rather due to Bengal. The latter country produced rice in such abundance that it supplies not only the neighbouring but remote states. It is carried up the Ganga as far as Patna, and exported by sea to Masulipatam and many other ports on the coast of Coromandel. It is also sent to foreign kingdoms, principally to the island of Ceylon and the Maldives. Bengal abounds likewise in sugar, with which it supplies the kingdom of Golconda and the Karnatic...Bengal it is true, yields not so much of wheat as Egypt; but if this be a defect, it is attributable to the

inhabitants, who live a great deal more upon rice than the Egyptians and seldom taste bread. Nevertheless, wheat is cultivated in sufficient quantity for the consumption of the country... The three or four sorts of vegetables which, together with rice and butter [ghee], form the chief food of the common people, are purchased for the merest trifle...

There is in Bengal such a quantity of cotton and silks, that the kingdom may be called the common storehouse for those two kinds of merchandise, not of Hindoostan or the empire of the great Mogol only, but of all the neighbouring kingdoms, and even of Europe...

In describing the beauty of Bengal, it should be remarked that throughout a country extending nearly a hundred leagues in length, on both banks of the Ganges, from Rajamahar to the sea, is an endless number of channels, cut, in bygone ages, from that river with immense labour, for the conveyance of the merchandise and of the water itself, which is reputed by the Indians to be superior to any in the world. These channels are lined on both sides with towns and villages, thickly populated with Gentiles [Hindus]; and with extensive fields of rice, sugar, corn, three or four sorts of vegetables, mustard, sesame for oil, and small mulberry trees...

Even till late eighteenth century and early nineteenth century, there are several accounts on the excellence of Indian agriculture. For instance, the Scotsman Alexander Walker, who was a keen observer of the agriculture in west India, seems to have been highly impressed by the well-laid garden-like appearance of the agricultural fields of Gujarat, Walker declares:⁶

They are remarkably neat, kept clean, and well dressed. These fields have frequently broad grassy margins which are left for pasture... The whole world does not produce finer and more beautifully cultivated fields than those of Guzerat...

I must repeat that I have seen in India, the most abundant crops 'the corn standing as thick on the ground as the land could well bear it'; fields neat, clean and generally without a weed. Infinite

pains are taken to extirpate these, and several ingenious instruments have been contrived for this purpose.

On the excellence of the rice cultivation in Malabar, Walker notes:'

There is cultivated in Malabar, upwards of fifty kinds of rice. They are each distinguished by a separate name, by some peculiar quality, and different modes of cultivation are of course pursued...

The southern parts of Malabar are more fertile than the northern parts. The former in many situations are capable of producing three crops a year... In Malabar, the cultivation of rice may be seen at all seasons of the year, and at the same time in every stage of its progress. Nothing can be more rich and interesting than this picture.

The High Productivity of Indian Agriculture

All available accounts of Indian agriculture testify to the high levels of productivity that prevailed in India till recent times. A large number of inscriptions document the high levels of productivity in various parts of South India. For instance, inscriptions from the Thanjavur area from AD 900 to AD 1200, speak of lands paying revenue of the order of 100 *kalam*s of paddy per *veli* of land and sometimes even 120 *kalam*s per *veli*. The Chola kings of Thanjavur repeatedly professed their adherence to injunctions of classical Indian texts on *rajadharma*. And these texts lay down that the king is entitled to no more than one-sixth of the produce as tax, which is viewed as more or less like the wage of the king for rendering protection to the people. For the king to realise tax of 100 to 120 *kalam*s per *veli*, the produce on these lands must have been of the order of 600 *kalam*s to 720 *kalam*s per *veli*.⁸ Using the generally accepted measure of about 2.5 hectares for the Thanjavur *veli* and about 62 kg of paddy for the Thanjavur *kalam*, the productivity amounts to around 15 to 18 tonnes per hectare.⁹

There are also a few inscriptions, which record not the revenue, but the actual gross produce of the lands. For example an inscription

of around 1100 AD, records that lands in a village of South Arcot, produced around 580 kalams per veli, or about 14.5 tonnes of paddy per hectare. Another inscription of 1325 AD from Ramanathauram records as high a production as 800 kalams per veli, or 20 tonnes per hectare, of paddy.¹⁰

Early British observers report similarly high levels of productivity from many parts of the country in the eighteenth and early nineteenth century. In the regions around Allahabad, one British observer reported in 1803 that the productivity of wheat was about 111 Bushels per acre, which amounts to about 7.5 tonnes per hectare.¹¹ The later British administrators of the region kept referring to the high agricultural productivity prevalent till the early part of nineteenth century.¹²

There are several British accounts of high productivity of agriculture in South India. For instance, in 1807, the British administrators reported a productivity of 13 tonnes per hectare of paddy in Coimbatore area. Detailed information on the state of agriculture, in a fairly large region of South India, are available from the records of a survey, conducted by the British during 1767-74, of over two thousand localities of the Chengalpattu region adjoining the Madras city. The original Tamil palm-leaf accounts of the survey present detailed information on the land use and the production of different food grains for the five years 1762-66, as recorded by the *kanakkappillai* or the registrar of each village.¹³

From the data available, it is possible to estimate the production of about 200,000 *kanis* of land, which together produced about 20,00,000 *kalams* of paddy and other grains for a population of about 45,000 households. With the generally accepted measure of about half a hectare for the Chengalpattu *kani* and about 125 kg of paddy for the Chengalpattu *kalam*, the above data implies an average productivity of 2.5 tonnes per hectare in this relatively difficult region, in that period of extended war and great disturbance. Still the relatively better off lands showed a much higher level of productivity. Best of the lands in the Palar and other river basins produced as much as 35 kalams per kani or about 9 tonnes per hectare. And, the average productivity for 63 localities of relatively intense agriculture, which produced more than 5000 kalams of grains each, and accounted for one-sixth of the total cultivation and about a third of the total produce,

amounted to 18 kalams per kani, or 4.5 tonnes per hectare.

Total production of food grains in this region, covering about 45,000 households, was nearly 225,000 tonnes. Since the average household of the region was estimated to consist of about five persons, the per capita production turns out to be about 1 tonne a year. This is of the same order as the per capita production in some of the agriculturally advanced regions of the world today, and is five times the production per capita in contemporary India.

II. SCARCITY TAKES THE PLACE OF PLENTY

Decline in Productivity

The abundance turned to scarcity within decades of the onset of British rule. As the British began to dismantle the elaborate infrastructure and the administrative, and developmental arrangements of the Indian society, and began to extract unprecedented amounts of revenue from the produce of lands, vast areas fell out of cultivation and the productivity of lands began to decline precipitously. In the Chengalpattu region where the lands had yielded at least 2.5 tonnes of paddy per hectare on the average in the 1760's, and where average yields, according to the British administrative records, had remained round that figure up to 1788 in spite of the devastating wars of the period, productivity had declined to a mere 630 kg per hectare by 1798.¹⁴ Lionel Place, the British collector of the area at that time, attributed the decline in productivity to the sharp decline in the livestock population and poor maintenance of the network of *erys*, the famous reservoirs of the region, which constituted the ancient irrigation system of the area.

There is not much data on the yield and production of lands in different parts of India during the nineteenth century. But on the basis of scattered reports from various regions, most economic historians seem to conclude that the yields of lands in India continued to either decline or stagnate at a low level throughout the century.

From about 1890 statistical information about Indian agriculture began to be collected more regularly. The data show a continuing decline in productivity till the end of British rule. The yield per hectare declined from 1039 kg in 1900-1 to 851 kg per hectare in 1946-7 in

the case of rice and from 796 kg per hectare in 1900-1 to 646 kg per hectare in 1946-7 in the case of wheat.¹⁵

Decline in Availability of Food

Though there was some increase in the area under cultivation in the latter half of nineteenth century, it was hardly enough to offset the effects of decline in yields and increase in population. Availability of food per capita therefore came down. The decline was seen most visibly and tragically in the unending series of famines that stalked some part of India or the other from the very beginning of the British rule to its end.

The famine commission of 1880, estimated “the ordinary out-turn of food” for what it called the “British India” to be around 51 million tons on a food crop area of around 66 million hectares, for a population of 18.1 crores.¹⁶ Productivity had thus declined to less than 0.8 tons per hectare and the production per capita had come down to around 280 kg per year. Of the 51 million tons of foodgrains produced, only 38 million tons were estimated to be available for direct human consumption, so that the average per capita consumption was merely 210 kg. This, according to the calculations of the commission, was just sufficient to keep the Indian population above the famine level.

Estimates of production of food in the 1890's, when the first systematic data were collected, turned out to be much less than the 280 kg per capita estimated by the famine commission in 1880 and was reported to be around 200 kg. The level of production was at the same level of 200 kg per capita in 1931 and sharply fell thereafter to 160 kg per capita in 1946.

Destruction of Agriculture in the Indian Heartland

The effect of British rule was indeed debilitating on the entire Indian subcontinent. But starting from the great Bengal famine of 1770 when almost one third of the entire population got wiped out, it has been the heartland of India, the great Indo-Gangetic plain, which has witnessed unprecedented destruction.

In his classic work on the economic history of India, written in

1903, the great Indian nationalist scholar Romesh Dutt drew pointed attention to the fact that, against all expert advice, the British Government had willfully neglected the maintenance and development of irrigation and water transport in the heartland of India, and had instead incurred enormous expenses on the construction of railways during the second half of nineteenth century. Referring to the deposition of the noted engineer Sir Arthur Cotton before a select committee of the British Parliament in 1872, Romesh Dutt wrote:¹⁷

But the great point, which Sir Arthus Cotton made, was that railways were no protection against famines. “I am afraid we must reckon that out of the 40 million affected by the famine in Madras, Mysore, Hyderabad, and Bombay, 4 or 5 millions have perished, after spending 120 millions on railways besides incurring a debt of 50 millions sterling.” And he pointed out forcibly that railways did *not* provide food for man and beast; did *not* carry the whole traffic of the country; did *not* carry it cheaply enough; did *not* pay interest on cost and debt; did *not* drain the country and did *not* provide drinking water for the people. All this was and could be done by irrigation works.

Why then were irrigation and navigable canals neglected? If these canals provided cheaper means of transit, why did the Indian Government not construct them? “Because,” answered Sir Arthur Cotton, “it would stultify the railways, that is the sole point. Only think of a canal by the side of the Eastern Bengal Railway which carries some 200,000 tonne and swarming with passengers and goods. What a terrible affront to the railway that must be.”...

Describing the British neglect of irrigation and water transport in the Indian heartland as a great “geographical mistake”, Romesh Dutt wrote:¹⁸

Englishmen had not appreciated the peculiar needs of India for cheaper transit as well as for irrigation... Having already constructed a vast system of railways along the main lines of communications, they hesitated to venture on navigable canals which would compete with railways as a means of transit... Nature had provided India with great navigable rivers, which had been the high roads of trade from ancient times. And a system of canals, fed by these rivers,

would have suited the requirements of the people for cheaper if slower transit, and would at the same time have increased production, ensured harvests and averted famines. But the Englishmen made a geographical mistake. They needed few canals in their own country, and they therefore neglected canals in India.

The principal lines of navigation which Sir Arthur Cotton recommended were (1) from Calcutta to Karachi, up the Ganges and down the Indus; (2) from Kakinada to Surat, up the Godavari and down the Tapti; (3) a line up the Tungabhadra to Karawar on the Arabian Sea, and (4) a line up to Ponang, by Palghat and Coimbatore...

The great schemes suggested by Sir Arthur Cotton were never seriously considered. And the total outlay on irrigation works in India, down to March 1902, scarcely amounted to 24 millions sterling against 226 millions sterling spent on railways.

As regards water transport in the Ganga river basin, it may be noted that a survey in 1840s had reported that out of the 2.2 million tons of goods transported between Calcutta and Mirzapur (in Uttar Pradesh), about 94% was carried by over 50,000 country boats, 1% by Government steamers and only 4% was transported by road. It was also reported that a further 1 million tons of goods were shipped on the river between Mirzapur and Delhi.¹⁹ Later in 1876-77, it was reported that the country boat traffic registered at Calcutta was about 180,000 cargo boats, at Hoogly about 120,000 cargo boats and at Patna about 62,000 cargo boats.²⁰ As Romesh Dutt poignantly noted, the maintenance of this large system of riverine and canal transport system was largely neglected during the second half of the nineteenth century and the system itself was rendered defunct by the end of the century.

British Policy of restricting Agricultural Improvement to Western Punjab and Sind

Romesh Dutt also raised the issue of wilful neglect by the British Government of the upkeep and development of the irrigation system in the Indian heartland. The Irrigation Commission appointed by

the British Government had noted that in 1901, 88% of the net sown area was irrigated in Sind, 37% of the net sown area was irrigated in Punjab and only 29% of the net sown area in Uttar Pradesh and 10% of the net sown area in Bengal (which included Bihar and Orissa) were irrigated. Further, most of the irrigation in Sind, and a large part of it in Punjab, was by the state works constructed or maintained by public funds. On the other hand, only 6% of the net sown area in Uttar Pradesh and 1.2% of the net sown area in Bengal were irrigated by state works.

The first half of the twentieth century was to witness a further intensification of the policy of deliberate neglect of the Ganga river basin. In Table-1 we give a profile of irrigation in the Provinces of British India in 1938-9, towards the end of British rule in India. By then, almost 87% of the sown area in Sind, 56% of the sown area in Punjab was irrigated, and mostly by Government canals. Only 32% of the sown area in Uttar Pradesh, 22% in Bihar and about 8% in Bengal was irrigated. The amount irrigated by Government canals was only 10% in Uttar Pradesh, 3% in Bihar and almost none in Bengal. Within Uttar Pradesh, all the Government canals were in the division of Agra, what is now the western Uttar Pradesh; and none whatsoever in the division of "Oudh", which is the British way of rendering Avadh, corresponding to present day eastern Uttar Pradesh.

The average figures for 1945-47 reveal that while 48% of the net sown area in what was to become Pakistan were irrigated, less than 20% of the area sown in the Indian Union had any irrigation.²¹ One economic historian has summed up the British policy on irrigation as follows:²²

The colonial government made some contributions towards increased output through irrigation... A good deal of the irrigation work was in the Punjab and Sind. The motive here was to... build up population in an area which bordered on the disputed frontier with Afghanistan. These areas which had formerly been desert, became the biggest irrigated area in the world and a major producer of wheat and cotton, both for export and for sale in other parts of India.

This kind of sustained discrimination was to have disastrous

consequences on the Indian heartland. The impact of the policy may be clearly seen in the differential growth in the populations of those regions which were to become part of (West) Pakistan as compared to the rest of the subcontinent during the first half of the twentieth century. In Table-2 we give the populations of the regions which were to become the Indian Union, Pakistan and Bangladesh for the period 1901-1951. We find that the Pakistan area, which had 5.84% of the population of the subcontinent in 1901, experienced much higher growth and its proportion of the population of the subcontinent rose to 7.27% by 1941 and 9.07% by 1951.

Within the area that was to constitute the Indian Union, the relative population of the heartland states of Uttar Pradesh and Bihar decreased significantly between 1901 and 1951, as can be seen from Table-3. The State of Uttar Pradesh, which had 20.4% of the population of the Indian Union in 1901, suffered the maximum impact and was reduced to 17.5% of the population of the Indian Union in 1951. Bihar, which had 11.5% of the Indian population in 1901, was reduced to 10.7% by 1951.²³ The relative population of Bengal was more or less unchanged within the Indian Union during this period.

The Economic Decline of India under the British Rule

It is not merely the agriculture, but the Indian economy as a whole, which witnessed unprecedented destabilisation and decline during the two centuries of British rule. In the last two decades several institutions and groups of scholars in the West have taken up a detailed investigation of the economy of different regions of the world in the last two hundred years, much of which has been characterised by an unprecedented domination of the West over the rest of the world. All these studies show that in the eighteenth century and in the early part of the nineteenth century, India and China together contributed more than half of the world economic output. Of course, this is not granting these countries too much, as demographically also, China and India constituted more than half the world till early nineteenth century. The people of European stock, who were less than a sixth of the world population in 1500 are estimated to have grown to a fifth of the world population by early nineteenth century.

It is nineteenth century, which is the century of European

domination of the world. The people of the European stock grew to become a third of the world population by the end of the nineteenth century. The Chinese and Indian economies, which earlier contributed more than half of the world output, were reduced to less than a quarter of the world economy by the end of the nineteenth century. At the same time, Europe and USA had an unprecedented growth and increased their share to more than half the world economic output. This trend continued in the first half of the twentieth century and led to a state where the entire Asian economy became less than a fifth of the world economy, notwithstanding the significant growth achieved by Japan from the final decades of the nineteenth century onwards.

According to a recent study, conducted for the OECD by Angus Maddison, India which had about 20% of the world population and one sixth share of the world GDP in 1820, was reduced to 14.3% of the world population (taking also into account the reduction due to partition of the subcontinent) and 3.8% share of the world GDP in 1952, with an annual growth rate of 0.54% for this entire period.²⁴ The growth rate in per capita GDP was only 0.10%. China which had a third of the world population and a similar share of the world GDP in 1820, had only about a fifth of the world population and only 5.2% of the world GDP in 1952 with a growth rate of 0.22% in its GDP. The growth rate in per capita GDP of China was negative, -0.08% in this period. The prosperous Asian continent, which had over 70% of the world population and nearly 60% share of the world GDP in 1820, became 53.9% of the world population with only 18.4% share of the world GDP in 1952 with a growth rate of 0.75% in GDP and 0.26% in per capita GDP.

III. FOOD AND AGRICULTURE IN INDIA, ASIA AND THE WORLD: 1950-2000

How has Independent India Fared in Reversing the Decline?

The trends in world economy were to change significantly after the political liberation of the countries of Asia and Africa from direct European domination. What is striking about this period is the rapid

economic growth achieved by Japan, China and many other countries in East and Southeast Asia. In fact, according to the OECD study cited above, the Asian continent as a whole has achieved remarkable growth during 1952-1995, with its population rising from 53.9% to 59.2% of the world population and its share of world GDP going up from 18.4% to 37.2% in this period. It is clear that the continent of Asia is poised once again to regain its position as the pre-eminent region in world economy after a gap of about 150-200 years. The Asian average growth rate is somewhat reduced, because of the comparatively dismal performance of the Indian economy, and of the Indian subcontinent as a whole.

During 1952-78, the Indian growth rate of 1.81%, in per capita GDP, was much less than the world average of 2.56% and the average rate of 3.43% achieved by Asia as a whole. In the period 1978-95, India has done somewhat better and achieved a growth rate of 2.53% in per capita GDP which is better than the world average rate of 1.01%, but falls considerably below the Asian average rate of 3.36%. In 1995, India with a population of about 16.2% of the world had only 4.6% share of the world GDP. Per capita GDP in India was less than a third of the world average and was about half of the Asian average.

The important question is how and in what aspects have the other Asian countries achieved significant growth in relation to India and what can we learn from them. Much is said about the skilful use made by these countries of international market opportunities, by adopting suitable policies of liberalisation and reform from late seventies onwards. A closer look at the issue would reveal that prior to initiating any programme of liberalisation and reform, these countries had undertaken a serious and intensive national reconstruction effort. They had given high priority to strengthening their basic economy, especially agriculture and animal husbandry, so as to eliminate hunger and malnutrition and generate large-scale economic activity. They seem to have also concentrated on restoring the natural resources of their country and rebuild and develop the infrastructure that had got badly eroded during the period of foreign domination.

India's somewhat dismal performance in relation to rest of Asia is

because we are yet to take up the task of national reconstruction with any seriousness. The main failure of India has been in not undertaking any concerted effort at the regeneration of the Indian agriculture to restore the abundance that this country has always been famous for.

It is indeed true that, around the time when India achieved its independence, the Indian agriculture had reached an abysmally low state. In 1950-51, the production of food grains amounted to 51 million tonnes on a cropped area of 97 million hectares, corresponding to a productivity of 525 kg per hectare, and 140 kg per capita for a population of 36 crores. As most of the irrigated lands went to the share of Pakistan, only 18% of the gross sown area under foodgrains were irrigated.

In the following decade, there was a substantial improvement in our agriculture. In 1960-61, the foodgrains production was 82 million tonnes on a cropped area of 116 million hectares corresponding to a yield of 700 kg per hectare. With a population of 45 crores, this amounted to a production of around 180 kg per capita.

The growth rate achieved in production during the decade 1951-61 was about 5.0% per year, something that we have not matched in any of the succeeding decades.²⁵ The nation's attention and priorities moved away from agriculture within the first decade after independence into other areas; but we have not achieved anything substantial in those areas either, without first achieving significant growth in agriculture which remains the mainstay of most of our population even today.

In 1998, the foodgrains production was 197 million tonnes on a cropped area of 124 million hectares, which amounted to a yield of 1600 kg per hectare. With an estimated population of 98 crores, this amounted to a production of about 200 kg per capita. Thus, for more than hundred and fifty years, there has been almost no growth in the per capita production of food grains in India – with the production staying around 200 kg per capita, which the British administrators considered to be the minimal requirement for averting famines.

There is an urgent need for the nation's attention to return to the urgent task of agricultural regeneration. To get a better perspective on the Indian situation in food and agriculture today, we shall present

a comparative analysis of the growth in food consumption and agricultural production in India, Asia and the world during the last fifty years.

Food Consumption 1961-1998

In Table-4 we present the data on the average annual consumption of staple foods and average levels of nutrition achieved in India, China, Asia, Europe, USA and the world in 1961, 1981 and 1998. The average annual consumption of staple foods in India increased from 183.2 kg in 1961 to 194.6 kg in 1981. The average annual consumption stands at 209.3 kg in 1998,²⁶ which is 30% lower than the world average of 271.6 kg. The current average intake of 2466 of calories per day is also considerably lower than the world average of 2792 calories.

The average consumption of staple foods and the levels of calories intake per day in Asia as a whole, are of the same order as the world average in 1998. Those for China are considerably larger. In 1961, the figures for the Asian region were of the same order as India and considerably lower than world averages. But, while there was only a marginal improvement of these figures in the Indian case, by 1981 the Asian averages had improved substantially and were close to the world averages.

The figure of 200 kg per capita per annum of staple foods seems to be some sort of a fated figure for India, as the average Indian food consumption has hovered around that level for over a century and a half. In 1880s the Famine Commission appointed by the British Government had determined this to be the bare minimum level of food consumption to avoid large-scale famine deaths. The fact that by just maintaining this level of production, the Indian state seems to have avoided large scale famine deaths since 1920s has often been lauded as one of its main achievements and even hailed as a triumph of democracy in India.

Experts in nutrition have also determined that an intake level of 2100 calories in the urban areas and 2400 calories in the rural areas can be fixed as the absolute minimum level for one to survive and barely function in Indian conditions. This is also the determinant of

the so-called “poverty level” in India. Since our national average now stands only at 2466 calories, it is no wonder that a very large proportion of Indian population is highly malnourished. According to generally accepted statistics, 40% of Indian people do not have access to minimum number of calories required for survival, 63% of children under the age of five are malnourished and 88% pregnant women suffer from anaemia.

Foodgrains Production 1961-98

When one is confronted with figures of hunger and malnutrition in India, it is often said that this is not due to inadequate food production, but due to lack of purchasing power, failures of distribution system and the social inequities endemic to Indian society. The fact that there are about 20-30 million tonnes of foodgrains in the Indian public distribution system, lying unsold, is also adduced as evidence for this. But more than anything else, there is the widely prevalent belief that, in the decades following mid-1960s, India achieved great progress in food production and solved its food problem through the so called “green revolution”.

In Table-5, we present the data on the area sown, yield and productivity of rice, wheat and foodgrains for the years 1961, 1981 and 1998. The Indian production of foodgrains has increased from about 83 million tonnes in 1961 to 132 million tonnes by 1981 and to 197 million tonnes by 1998. Per capita production of foodgrains increased from 182.3 kg in 1961 to reach 187.3 kg in 1981, and 200.7 kg in 1998.

While the Indian production has risen by a factor of 2.4 in the period 1961-98, the total foodgrains produced in Asia has increased three-fold, from about 288 million tonnes in 1961 to about 849 million tonnes by 1998. The production in China has increased by a factor of four in the period 1961-98, from 99 million tonnes in 1961 to 397 million tonnes in 1998. In 1998, the average per capita production of foodgrains in Asia was 241.4 kg and that in China was 314.0 kg.

Such high growth in production has been achieved in the Asian region by striking increases in productivity. In 1961, productivity figures for India, China and Asia as a whole were similar. But by

1981, China had achieved productivity of 2.9 tonnes per hectare in rice and an overall productivity of 2.5 tonnes per hectare in foodgrains; by then, the Asian average productivity in rice was about 1.9 tonnes per hectare and the overall productivity in foodgrains was 1.6 tonnes per hectare. In 1998, the overall productivity of foodgrains in China is 4.1 tonnes per hectare, it is 2.5 tonnes per hectare in Asia as a whole, and it is only 1.6 tonnes per hectare in India.

We have seen the production and productivity figures for China. Several Asian countries have achieved similar large increases in productivity. For instance, Indonesia achieved an increase of over four times in production of foodgrains – from 10.6 million tonnes in 1961 to 43.9 million tonnes in 1998. During the war period, Vietnam could increase the production of foodgrains from 6.4 million tonnes in 1961 to only 8.8 million tonnes in 1981. However, by 1998 Vietnam had increased its production to 21.3 million tonnes, which corresponds to an increase of nearly 2.5 times in 17 years. Both Indonesia and Vietnam have achieved a productivity of nearly 3 tonnes per hectare in rice.

The Indian performance of the post-60s cannot be called a “green revolution”. We have indeed talked a great deal about having achieved a green revolution and solved the food problem of India. It is the other regions in Asia who have actually achieved a remarkable growth in their agricultural production leading to satisfactory levels of food consumption and nutrition of their population. It is also noteworthy that they have achieved this with conventional technologies only, without any major inputs from currently fashionable fields of biotechnology or genetic engineering.

Land Resources and Agricultural Inputs 1961-1998

In Table-6 we present data on the land resources and the growth in agricultural inputs during the period 1961-1998. This brings out the fact that India is specially endowed in land resources compared to most regions of the world. While, on the average, only a tenth of the land area in the world is suitable for agriculture, more than half the land of India is arable. In comparison, only about one-eighth of the land area in China, one-sixth of the land area in Asia as a whole, one-

fifth of the land area in the United States of America and one-fourth of the land area in Europe are arable.

In the past fifty years, India has done fairly well by way of providing inputs for agriculture. From Table-6, we see that, in 1998, the net irrigated area in India is about 59 million hectares. About 53 million hectares are irrigated in China and about 67 million hectares are irrigated in rest of Asia. In 1998, the Asian continent accounted for nearly sixty percent of world's irrigated lands.

In 1998, the total amount of fertilisers consumed in India is about 17 million tonnes, which is comparable to amounts consumed in the United States of America or Europe. China seems to be consuming twice the amount, but the rest of Asia has consumed around the same amount as India. The number of tractors in India is 1.6 millions, which is more than double the number of tractors in China.

State of Livestock 1961-98

Amongst the resources crucial for agriculture, India seems to have fared rather poorly in terms of its cattle wealth. When the food availability for humans is at the bare survival level, it is not surprising that animals in India have very little feed left for them. In Table-7, we present the state of livestock in India, Asia and the World during 1961-98. We have a total livestock of about 50 crores in 1998 (with about 21 crore cattle and 9 crore buffaloes), but the amount of feed assigned for them is meager – about 1.7 million tonnes of cereals, no roots, and 10.2 million tonnes of milk. Total livestock in the entire Asian region is about 190 crores for which the total feed assigned is 188 million tonnes of cereals and 76 million tonnes of roots and 19 million tonnes of milk.

From Table-7 we may also note that, concomitant with its rapid growth in agriculture, the total livestock in Asia doubled from about 95 crores in 1961 to 190 crores in 1998. The cattle population increased by nearly 40% from about 32 crores in 1961 to 44 crores in 1998. The number of pigs increased over four-fold from 12 crores to 50 crores in this period.

On the other hand, livestock in India increased only by about 50% from 33 crores in 1961 to 50 cores in 1998. Unlike in China, pigs do

not play a crucial role in Indian agriculture. The number of cattle, which is crucial for Indian agriculture, increased by barely 20% from 17.6 crores in 1961 to 21.2 crores in 1998. No wonder that in a situation of poor animal husbandry, the rate of growth of Indian agriculture could not have been substantial. A large part of the blame for this should squarely be placed at the Indian and international experts who raised the bogey of “surplus cattle” in India in the early 60s.²⁷

The Indian situation is indeed extraordinary. Our people and animals have been living at an average level of consumption that would be unacceptable anywhere else in the world, which is no better than what is considered to be sufficient in situations of famine. Any serious effort at national reconstruction in India has to first address this serious issue of inadequate agricultural production and widespread hunger.

IV. AGRICULTURE IN THE INDO-GANGETIC PLAIN 1950-2000

The task before independent India was indeed obvious: Initiate an intense national effort to reclaim the Indo-Gangetic plain, one of the greatest agricultural regions of the world, from the ravages of foreign rule and restore the high agriculture that our people had always practiced there for ages. Indeed foreign rule had destabilised this area for several centuries, but as we noted earlier, even as recently as in 1803 the Allahabad region reported a yield of 7.5 tonnes per hectare. We have earlier discussed the devastating effect of the British rule on this region, which should give us some idea of the magnitude of the task that the nation faced in 1947.

Development of Irrigation in the Indo-Gangetic Plain: 1950-2000

In order to understand how Independent India has fared in carrying out agricultural improvement in the Ganga and Brahmaputra basins we have compiled the data on the development of irrigation in the Indo-Gangetic plain during 1950-95 in Table-8. We see that by 1970-71, the percentage of gross cropped area irrigated had increased steadily to 77% and 45% in the case of Punjab and Haryana. However,

it was only 35% in Uttar Pradesh, 26% in Bihar, 22% in West Bengal and 20% in Assam. In 1995-96, the percentage was 95% in Punjab, 78% in Haryana, 66% in Uttar Pradesh, 46% in Bihar, 28% in West Bengal and 15% in Assam. The level of irrigation achieved in the various districts of these states are shown in Maps 1-5.

In Table-9, we present estimates of the irrigation potential of the Indo-Gangetic plain, and the utilisation achieved so far. We see that while over 99% percent of the potential has been utilised in Punjab and 70% in Haryana, only 36% has been utilised in Uttar Pradesh, 24% in Bihar, 17% in West Bengal and 2% in Assam.

Figures for Uttar Pradesh would also come down to the same order of magnitude as Bihar, if we disaggregate the data between western Uttar Pradesh and eastern Uttar Pradesh. The figures for western Uttar Pradesh are somewhat like those for Haryana and the figures for eastern U.P are of the same order as Bihar (see Maps 2-4). Thus independent India seems to have meticulously followed the fault-line drawn by the British and has failed to initiate any serious agricultural improvement in the fertile river basins of eastern Uttar Pradesh, Bihar, Bengal and Assam.

Food Production and Consumption in the Indo-Gangetic Plain: 1950-2000

The consequence of this continued skewed development can be seen in the large differentials in agricultural productivity across the Indo-Gangetic plain, as given in Table-10. In 1960-61, the productivity figures for Punjab are only slightly larger than those for the rest of the Indo-Gangetic plain, as also the all India average of 0.85 tonnes per hectare. By 1980-81, the productivity levels achieved in Punjab and Haryana are significantly higher than those achieved in the rest of the Indo-Gangetic plain. In 1997-98, Punjab recorded an average productivity of 3.45 tonnes per hectare in rice, 3.85 tonnes per hectare in wheat and 3.60 tonnes per hectare in foodgrains, the figures for Uttar Pradesh are 2.15, 2.50 and 2.03 respectively, and those for Bihar are 1.36, 2.00, 1.46 respectively.

In Table-11 we have given per capita food-grain production figures across the Indo-Gangetic plain. We find that the level was fairly high in Punjab already by 1970's and has reached 957 kg in 1990-3,

comparable to per capita foodgrains production levels prevalent currently in the developed world. Per capita foodgrains production in Haryana was 575 kg in 1990-3, while that in Uttar Pradesh was 252 kg, Bihar 121 kg, West Bengal 177 kg, Assam 147 kg. Again we should note that, on dis-aggregation, the values for eastern Uttar Pradesh and Bihar would perhaps be found to be of the same order.

The improvements in agriculture of the Punjab, Haryana and the western Uttar Pradesh regions, are among the most significant achievements of independent India, though there could be wiser counsel on the kind of techniques and methodologies employed. The level of poverty, both rural and urban, that is recorded in the states of Punjab and Haryana are consistently among the lowest in the country from 1970s onwards, as can be seen from Table-12. Also, these are the only states which have recorded average levels of nutrition, that in the 1980's, are above the malnutrition baselines of 2400 calories per day for the rural and 2100 calories per diem for the urban areas, as may be seen from the nutrition figures given in Table-11. However, the levels of poverty and malnutrition in the rest of the resource-rich Indo-Gangetic plains, as revealed in Table-11 and Table-12 are indeed appalling and call for urgent attention.²⁸

V. REGENERATION OF INDIAN AGRICULTURE

The Problem with our Vision

Agriculture is the key to the economic growth of India. Enhancing agricultural activity offers the only way of immediately and gainfully employing the people of India and putting to use the extraordinarily plentiful resources of land and water that we have been endowed with. This is also the way of removing hunger and poverty from the face of India. It is common economic wisdom that for a populous country like India, economic regeneration has to begin with agriculture. The enhanced economic resources and demand generated in agriculture then drives the growth in other sectors of economy.

India has however been trying to defy this common economic wisdom. We have let production of foodgrains grow at a rate barely sufficient to keep pace with the growth of population, while

concentrating our economic energies on achieving substantial growth only in services, and to lesser extent in manufacture. This is a policy guaranteed to perpetuate scarcity and hunger.

Per capita foodgrains production in India has stayed below 200 kg in the last two centuries and has reached 200.7 kg in 1998. Now, when our perspective planners plan for the food needs of India for 2015 or even 2030, they merely multiply the future projected population by the figure of 200 kg and present it as the desired target for India. They do not even deem it necessary (or possible) that the average per capita food production in India should at least grow to the current levels of world average, which is around 330 kg.

The Vision Documents of the 88th Session of Indian Science Congress held in January 2001 with the focal theme on “Food, Nutrition and Environmental Security”, also present a vision of India, which is not free from scarcity and hunger, with per capita food production stagnating at near-famine levels. The Preamble to the Vision Document of the Congress, recounting the achievements of independent India, states:

Thanks to the cutting edge of science and technology, we have moved from chronic shortages to an era of surpluses in most of the food products, leaving behind the famines and mass starvation.

It further sets forth the challenge before the nation as follows:

Food, nutrition and environmental security cannot be attained without containing population. To keep pace with the changing trends, we need around 5 million tonnes of additional food grains annually, besides, significant increase in the production of livestock, fish and horticultural products...

Thus, the Vision Document is presenting a production target of 350 million tonnes of foodgrains for the year 2030, an increase of about 150 million tonnes from the current production level. The invitation circulated on behalf of the Congress reduces this target further. It states:

At the present growth rate of 1.8%, our population will be 1.3 billion in the year 2030, needing additional 100 million tonnes of food grains to ensure physical, economic and ecological access to

household food and national security.

The “Theme” document of the Congress goes even a step further, and gives the following “vision of food security” for India by 2030:

Attaining food security has been a major challenge for the nation since independence. In order to meet the demand of ever-increasing population growing at the rate of 1.8%, we would need in 2030, 260-264 million tonnes of foodgrains, 130-152 million tonnes of milk, 151-193 million tonnes of vegetables, 84-106 million tonnes of fruits, 10-14 million tonnes of meat, 4-5 million tonnes of eggs, 10-14 million tonnes of fish and 12 million tonnes of edible oil to provide adequate nutrition to a population of 1.3 billion people.

According to the UN population estimates of 1996, the medium projections for the population of India are 121.2 crores in 2015 and 138.4 crores in 2030. If we restrict the Indian production to the current near-famine levels of 200 kg of foodgrains per capita, we would be setting a target of about 240 million tonnes to be achieved by 2015 and 275 million tonnes by 2030. It is absurd to project this as a “vision plan for ensuring food and nutrition security” of the Indian people.

Regeneration of Indian Agriculture: Through the Bounty of Ganga

With our population being estimated to reach around 120 crores by 2015, the *minimal goal* for India would be to achieve a target of 400 million tons in the production of foodgrains, which would ensure about 330 kg of foodgrains per capita, the current world average. Setting this minimal target would amount to doubling our current production in the next 15 years, which would require a moderate growth rate of 4.7% per year. Growing 400 million tons of foodgrains would also imply achieving an average productivity of about 3.2 tonnes assuming that there is no change in the gross area cropped under foodgrains which is currently around 124 million hectares.²⁹

Given our vast resources of land and water and our large farming community with a glorious tradition of agriculture, we can achieve much more than mere doubling of our food production over the

next fifteen years. We will have to make a firm national resolve to restore to agriculture the status and importance it always enjoyed in our civilisation. We will have to pay particular attention to restore the well being of our cattle population, which would not be difficult, as Indians have always known that good agriculture is not possible without *go-samrakshan*. And we will have to do everything necessary to restore the Indian heartland, the *Ganga Kshetra*, from the ravages of foreign rule and neglect of the last fifty years, and make it again one of the greatest agricultural regions in the world.

In 1997-98, the gross sown area in the Indo-Gangetic plain was about 62 million hectares, of which about 49 million hectares were under foodgrains. The gross irrigated area was about 37 million hectares, of which only about 27 million hectares were under foodgrains. The total amount of foodgrains produced in this region, in 1997-98, was about 105 million tonnes, which corresponds to an average productivity of around 2.2 tonnes per hectare. Any plan for the regeneration of Indian agriculture would have to have as an important component, the restoration of the traditionally high production and productivity of the Indo-Gangetic plain. We should plan to at least double the production from this region in the next decade. To achieve a total production of about 200 million tonnes, from the current cropped area of 49 million hectares under foodgrains, would require that we increase the average productivity to about 4 tonnes per hectare in this enormously fertile region.

While undertaking initiatives in agricultural improvement in Punjab and Haryana, and to some extent in the western Uttar Pradesh, we seem to have only marginally extended the available infrastructure, or finished the half finished projects, and so on. The energies of the nation have hardly been applied to the serious task of national regeneration based on the restoration of the entire Indo-Gangetic plain to a state of flourishing agriculture. Such a task may involve taking up extensive new development works involving land reclamation, development of canals, tube-wells and other irrigation works, livestock development, and so on. It may also involve giving up of disastrous projects such as the one of stopping the Bhagirathi at Tehri, and refashioning some of the completed projects to see that the great Himalayan rivers which are the lifelines of Indian

heartland support a large system of canal irrigation, water transport, micro power generation and so on.

Indeed the main challenge before the nation is that we should soon free ourselves from the prejudices against our perennial natural and civilisational resources. Such prejudices are the hallmark of foreign rule in India. If we can meet this challenge successfully, there is no reason why we should not see a regeneration of the Indian economy even within a decade or so, through the bounty of Ganga.

In the Mahabharata, in the Anusasanaparva, after recounting *Gangamahatmya*, the glory of Ganga, Bhishma pitamaha advises Yudhisthira:³⁰

Gangam abhyehi satatam prapyase siddhim uttamam

Oh Yudhisthira! Resort always to Ganga. You will indeed attain the greatest ends.

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2. For an exhaustive study of the classical Indian discipline of ensuring an abundance of food and sharing it in plenty, see Jitendra Bajaj and M.D.Srinivas, *Annam Bahu Kurvita: Recollecting the Indian Discipline of Growing and Sharing Food in Plenty*, Centre for Policy Studies, 1996.
3. From the *Bibliotheca Historica* of Diodorus Siculus (1st Century BC), cited from R.C.Majumdar, *The Classical Accounts of India*, Calcutta, 1960, pp. 233-4. Diodorus' account is said to be a summary of the work of Megasthenes, the Greek ambassador at the court of Chandragupta.
4. *The Rehala of Ibn Batuta*, Translated by Agha Mahdi Hussain, Baroda 1953, p.19
5. F. Bernier, *Travels in the Mogul Empire*, Ed. V.A.Smith, 1934, Delhi Rep 1989, pp. 437-42
6. Alexander Walker's note on Indian Agriculture, reproduced in Dharampal, *Indian Science and Technology in the Eighteenth Century*, pp. 239, 244
7. Walker, cited above, pp. 249-51
8. Traditional Tamil texts, from the Sangam period onwards, speak of the ideal of 'growing a thousand *kalams* per *veli*' – see for example, *Purananuru*, 391.
9. Taking the rate of revenue at 25%, and reducing the *kalam* to the smallest measure that may be supported by historical evidence, scholars occasionally bring down the productivity figure to between 4 to 5 tonnes per hectare – see for instance, L.B.Alaev in *The Cambridge Economic History of India*, Vol. I,

- Delhi 1984, pp. 231-2.
10. L.B.Alaev, cited above, p. 232.
 11. Dr. Tenant, *Indian Recreations*, 1803, cited in *Edinburgh Review*, Vol. 4, No. 8, July 1804, p. 323.
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 14. See K. Ratnam, *Agricultural Development in Madras State Prior to 1900*, Madras, 1966, p. 11.
 15. See G. Blyn, *Agricultural Trends in India 1891-1947: Output, Availability and Productivity*, University of Pennsylvania, Philadelphia, 1966
 16. *Report of the Indian Famine Commission*, London 1880; reprint Agricole, New Delhi, 1989, para 156, p. 50.
 17. Romesh Dutt, *The Economic History of India*, Vol. 2, New Delhi Rep. 1960, pp. 265-6.
 18. Romesh Dutt, cited above, pp. 266, 403.
 19. See for instance, T. Kissinger, in *The Cambridge Economic History of India*, Vol. 2, Delhi 1987, p. 258.
 20. Report of the National Transport Policy Commission, 1980, p. 284.
 21. Report of the Indian Irrigation Commission, Vol. 1, p. 69, 1972.
 22. A. Maddison, *Class Structure and Economic Growth*, London, 1971, p. 50.
 23. That there has been no serious reversal, during the last fifty years, of the British policy towards the Indian heartland, can be seen from the rest of the demographic trends in Table-3. We find that Uttar Pradesh, which had 17.5% of the population of India in 1951, came down to 16.1% by 1971 and has stayed around the same level at 16.4% in 1991. Bihar, which had 10.7% of the Indian population in 1951, came down to 10.3% in 1971 and stood at 10.2% in 1991. There has been a small increase in the relative population of West Bengal during 1951-1991.
 24. Angus Maddison, *Monitoring the World Economy 1820-1992*, OECD, Paris, 1995; Angus Maddison, *Chinese Economic Performance in the Long Run*, OECD, Paris, 1998. Maddison's estimates of the population and economic output of India in the eighteenth and early nineteenth century seem to be an underestimate.
 25. See, J.K. Bajaj, *Green Revolution in the Historical Perspective*, PPST Bulletin, Madras, Nov. 1982.
 26. The average Indian food basket in 1961 consisted of 143.7 kg of cereals, 10.4 kg of roots, 20.4 kg of pulses, 4.2 kg of meat and 1.9 kg of fish and seafood. In 1998 it became 168.4 kg of cereals, 19.7 kg of roots, 11.4 kg of pulses, 5.2 kg of meat and 4.6 kg of fish and seafood. Note that, in this period, the average annual intake of pulses is reduced by half, with no

significant increase in the meat consumption, either, to make up for the loss of proteins in the diet.

27. After a long period of stagnation under the British rule, the cattle population of India had an appreciable growth for the first time during the decade 1951-61, from 15.5 crores to 17.6 crores. As we have noted, this was also the only decade when our foodgrains production achieved an annual growth rate of 5.0 and increased from 51 million tonnes to 82 million tonnes. The talk of "surplus cattle" began immediately thereafter. The disastrous effect it had may be gauged from the fact in the period 1961- 1977 the cattle population of India almost remained stagnant, it changed from 17.6 crores in 1961 to 18.0 crores in 1977.
28. We should also note that the state of Kerala, notwithstanding its achievements in developing "social opportunities", has consistently recorded very low per capita foodgrains production, which has reached a low of 37 kg per capita in 1990-3 and is currently estimated to have further declined to around 20 kg per capita. Though the nutrition situation in the state is somewhat ameliorated by large off-takes from the public distribution system (to the tune of 50-60 kg per capita), the levels of nutrition recorded in Kerala are abysmally low – 1844 calories per diem in rural areas in 1983. Kerala also has high levels of rural and urban poverty, compared to the agriculturally advanced states of Punjab and Haryana, as may be seen from Table-12.
29. The gross cropped area under food grains was 75% of the total gross sown area in the country in 1970. By 1990's this came down to about 65%, though there has not been a noticeable change in the actual area sown under foodgrains.
30. Mahabharata: Anusasanaparva, 26.104.

TABLE 1

Irrigation in the Provinces of British India: 1937-8
(in million hectares)

	Punjab	Sind	Uttar Pradesh	Bihar	West Bengal	British India
Net Sown	11.05	2.08	14.64	7.82	10.01	86.43
Net irrigated	6.53	1.80	4.70	1.73	0.84	21.39
% irrigated	56.1	86.5	32.1	22.1	8.4	24.7
By Govt.						
Canals	4.53	1.19	1.55	0.25	0.08	9.98
% by Govt.						
Canals	41.0	57.2	10.6	3.2	0.1	11.5

TABLE 2

Relative Population of India and Pakistan 1901-51
(in millions)

Year	India	Bangladesh	Pakistan	Subcontinent
1901	238.363	28.928	16.577	283.868
% Subcontinent	83.97	10.19	5.84	100.00
1921	251.365	33.254	21.108	305.727
% Subcontinent	82.22	10.88	6.90	100.00
1941	318.717	41.999	28.282	388.998
% Subcontinent	81.93	10.80	7.27	100.00
1951	361.381	44.166	40.451	445.998
% Subcontinent	81.03	9.90	9.07	100.00

TABLE 3

Relative Population of Ganga River Basin: 1901-91
(in millions)

Year	Uttar Pradesh	Bihar	West Bengal	India
1901	48.63 (20.4)	27.31 (11.5)	16.94 (7.1)	238.36 (100.0)
1931	49.78 (17.9)	31.35 (11.3)	18.90 (6.8)	278.53 (100.0)
1951	63.21 (17.5)	38.78 (10.7)	26.30 (7.3)	361.38 (100.0)
1971	88.34 (16.1)	56.35 (10.3)	44.31 (8.1)	547.95 (100.0)
1991	139.11 (16.4)	86.37 (10.2)	68.08 (8.0)	846.30 (100.0)

Source: Census of India 1991. The numbers in bracket give the percentage population of the State in relation to the Indian Union.

TABLE 4

India, Asia and the World: Food Consumption 1961-1998

	India	China	Asia	Europe	USA	World
<i>Food Consumption 1961 (per capita per year in kgs)</i>						
Cereals	143.7	118.8	134.2	145.6	86.8	135.3
Roots	10.4	111.9	62.9	108.0	53.6	79.3
Pulses	23.0	10.9	12.0	3.6	3.8	9.4
Meat	4.2	4.0	5.9	54.6	90.7	24.5
Fish & Seafood	1.9	4.8	7.7	14.4	13.1	9.1
Total Staple Foods	183.2	250.4	222.7	326.2	258	257.6
<i>Nutrition 1961 (per capita per day)</i>						
Calories	2072.9	1641.4	1891.5	3026.0	2877.3	2255.2
Proteins (gms)	53.4	42.7	48.8	87.7	95.0	62.3
Fats (gms)	31.3	15.2	24.5	99.6	110.0	47.6

	India	China	Asia	Europe	USA	World
<i>Food Consumption 1981 (per capita per year in kgs)</i>						
Cereals	155.0	190.6	170.4	128.8	87.5	153.1
Roots	19.5	82.7	50.4	83.1	54.1	64.7
Pulses	12.8	4.6	6.6	2.8	2.6	6.5
Meat	4.2	15.8	12.7	83.7	110.1	32.2
Fish & Seafood	3.1	5.2	9.7	16.8	17.4	12.0
Total Staple Foods	194.6	298.9	250.3	315.2	271.7	268.0
<i>Nutrition 1981 (per capita per day)</i>						
Calories	2143.2	2358.4	2313.4	3301.7	3198.9	2563.4
Proteins (gms)	52.4	55.6	56.7	99.3	99.6	67.7
Fats (gms)	34.2	34.4	38.0	128.0	131.3	60.4
<i>Food Consumption 1998 (per capita per year in kgs)</i>						
Cereals	168.4	186.6	174.8	121.5	118.8	158.2
Roots	19.7	68.7	41.9	81.0	66.1	62.1
Pulses	11.4	1.7	5.5	3.7	4.2	5.9
Meat	5.2	48.5	27.1	87.7	123.5	39.4
Fish & Seafood	4.6	25.7	17.9	24.6	20.7	16.0
Total Staple Foods	209.3	332.2	267.2	318.5	333.3	271.6
<i>Nutrition 1998 (per capita per day)</i>						
Calories	2466.1	2973.3	2751.9	3370.0	3767.1	2791.8
Proteins (gms)	59.0	81.8	69.9	102.4	115.4	74.9
Fats (gms)	44.6	79.1	61.4	138.6	146.9	73.5

Source: FAO Database 2000. For the sake of comparison, we have retained the same definition of Asia and Europe all through, and have not included parts of former USSR in these continents.

TABLE 5

India, Asia and the World: Foodgrains Production 1961-1998
(Area sown in million hectares, production in million tonnes,
yield in tonnes/hectare and per capita production in kgs per year)

	India	China	Asia	Europe	USA	World
<i>Rice 1961</i>						
Area sown	34.7	27.0	107.0	0.3	0.6	115.5
Production	35.6	37.4	132.4	1.0	1.7	143.7
Yield	1.0	1.4	1.2	3.3	2.8	1.2
<i>Wheat 1961</i>						
Area sown	12.9	25.6	61.2	27.5	20.9	204.2
Production	11.0	14.3	45.8	51.2	33.5	222.4
Yield	0.9	0.6	0.7	1.9	1.6	1.1
<i>Total food-grains 1961</i>						
Area sown	116.0	100.3	310.7	80.4	65.8	711.9
Production	82.5	99.4	288.2	148.3	164.1	846.0
Yield	0.7	1.0	0.9	1.8	2.5	1.2
Production per capita	182.3	147.7	169.2	345.8	867.8	274.6
<i>Rice 1981</i>						
Area sown	40.7	33.9	129.4	0.3	1.5	145.3
Production	53.2	97.9	248.1	1.2	5.5	273.1
Yield	1.3	2.9	1.9	4.0	3.7	1.9
<i>Wheat 1981</i>						
Area sown	22.3	28.3	79.8	25.4	32.6	239.1
Production	36.3	59.6	139.0	92.6	75.8	449.6
Yield	1.6	2.1	1.7	3.6	2.3	1.9
<i>Total food-grains 1981</i>						
Area sown	127.7	98.0	340.7	72.0	78.9	788.7
Production	131.8	244.0	555.5	245.7	330.2	1537.4
Yield	1.0	2.5	1.6	3.4	4.2	1.9
Production per capita	187.3	239.7	210.9	506.6	1419.6	340.4

	India	China	Asia	Europe	USA	World
<i>Rice 1998</i>						
Area sown	44.6	31.6	136.3	0.4	1.3	152.0
Production	85.8	133.6	352.4	1.8	5.7	384.6
Yield	1.9	4.2	2.6	4.5	4.4	2.5
<i>Wheat 1998</i>						
Area sown	26.7	29.8	88.6	27.1	23.9	225.9
Production	66.3	109.7	242.0	138.6	69.3	592.3
Yield	2.5	3.7	2.7	5.1	2.9	2.6
<i>Total food-grains 1998</i>						
Area sown	123.7	95.7	345.2	66.9	62.6	763.3
Production	197.1	396.5	848.5	308.9	348.4	1943.7
Yield	1.6	4.1	2.5	4.6	5.6	2.5
Production per capita	200.7	314.0	241.4	607.7	1271.5	329.4

Source: FAO Database 2000. For the sake of comparison, we have retained the same definition of Asia and Europe all through, and have not included parts of former USSR in these continents.

TABLE 6

**India, Asia and the World: Land Resources and
Agricultural Inputs 1961-1998**

(Land area in million hectares, Fertilisers consumed in million tonnes,
Number of tractors in millions)

	India	China	Asia	Europe	USA	World
Total area	328.8	959.8	2756.8	489.2	936.4	13387.0
Land area	297.3	932.7	2678.2	472.7	915.9	13048.4
<i>Land Resources 1961 (million hectares)</i>						
Forests	56.8	156.5	591.2	142.5	307.7	4373.9
Arable land	155.8	103.4	409.7	137.7	180.6	1266.5
% land arable	52.4	11.1	15.3	29.1	19.7	9.7
Persons per arable hectare	2.9	6.5	4.2	3.1	1.0	2.4

	India	China	Asia	Europe	USA	World
<i>Agricultural inputs (1961)</i>						
Irrigated land	24.7	30.4	90.2	8.3	14.0	139.0
Fertilisers consumed	0.3	0.7	3.8	14.0	7.6	31.2
Number of Tractors	0.0	0.1	0.2	3.7	4.7	11.3
<i>Land Resources 1981 (million hectares)</i>						
Forests	67.4	134.2	548.6	155.6	293.3	4292.7
Arable land	162.9	97.5	423.5	126.2	188.8	1334.0
% land arable	54.8	10.5	15.8	26.7	20.6	10.2
Persons per arable hectare	4.3	10.4	4.8	3.8	1.2	3.4
<i>Agricultural inputs 1981</i>						
Irrigated land	38.8	45.0	134.0	14.2	20.6	213.1
Fertilisers consumed	6.1	15.2	31.7	31.4	19.4	115.1
Number of Tractors	0.4	0.8	3.6	8.7	4.7	22.3
<i>Land Resources 1998 (million hectares)</i>						
Forests (1991)	68.0	130.5	535.7	157.7	296.0	4316.1
Arable land	161.5	124.1	455.5	121.0	177.0	1380.2
% land arable	54.3	13.3	17.0	25.6	19.3	10.6
Persons per arable hectare	6.1	10.2	7.7	4.2	1.5	4.3
<i>Agricultural inputs 1998</i>						
Irrigated land	59.0	52.6	178.8	17.1	21.4	271.4
Fertilisers consumed	16.8	35.1	71.7	21.3	19.8	137.4
Number of Tractors	1.6	0.7	6.8	9.4	4.8	26.3

Source: FAO Database 2000. For the sake of comparison, we have retained the same definition of Asia and Europe all through, and have not included parts of former USSR in these continents.

TABLE 7
India, Asia and the World: State of Livestock 1961-1998

	India	China	Asia	Europe	USA	World
<i>Livestock 1961 (millions)</i>						
Cattle	175.6	49.5	318.7	116.5	97.7	941.4
Buffaloes	51.2	8.4	85.9	0.5	0.0	88.4
Sheep	40.2	61.6	232.1	133.7	32.7	994.1
Goats	60.9	51.3	197.5	15.2	3.5	347.8
Pigs	5.2	85.6	118.4	109.4	55.6	406.1
Total	333.1	256.4	952.6	375.3	189.5	2777.8
% of World	12.0	9.2	34.3	13.5	6.8	100.0
<i>Feed for Animals 1961 (million tonnes)</i>						
Cereals	0.9	3.2	17.6	91.8	112.2	273.3
Roots	0.0	10.0	13.3	55.3	1.0	95.7
Milk	2.7	0.2	5.9	50.1	1.2	91.8
<i>Livestock 1981 (millions)</i>						
Cattle	188.7	52.6	352.4	132.4	114.4	1227.6
Buffaloes	67.5	18.6	120.7	0.2	0.0	124.2
Sheep	46.4	106.6	329.6	124.7	12.9	1110.4
Goats	91.0	80.9	280.6	12.5	1.4	472.2
Pigs	9.6	310.7	369.7	174.2	64.5	780.5
Total	403.2	569.4	1453.0	344.0	193.2	3714.9
% of World	10.9	15.3	39.1	9.3	5.2	100.0
<i>Feed for Animals 1981 (million tonnes)</i>						
Cereals	1.3	44.8	89.5	167.1	133.4	579.2
Roots	0.0	36.8	38.9	55.7	0.2	131.4
Milk	4.5	0.5	9.9	40.9	0.9	98.1

	India	China	Asia	Europe	USA	World
<i>Livestock 1998 (millions)</i>						
Cattle	212.1	100.0	443.8	104.6	99.7	1334.4
Buffaloes	90.9	21.9	155.7	0.2	0.0	161.1
Sheep	57.1	120.9	364.2	140.4	7.8	1056.6
Goats	121.4	135.1	428.9	15.5	1.4	701.4
Pigs	16.0	408.4	501.9	167.7	61.2	875.2
Total	497.5	786.3	1894.5	428.4	170.1	4128.7
% of World	12.0	19.0	45.9	10.4	4.1	100.0
<i>Feed for Animals (million tonnes)</i>						
Cereals	1.7	116.9	188.1	170.0	165.7	679.9
Roots	0.0	74.3	75.8	27.0	0.3	135.0
Milk	10.2	1.0	18.7	25.1	0.5	73.6

Source: FAO Database 2000. For the sake of comparison, we have retained the same definition of Asia and Europe all through, and exclude parts of former USSR from these continents.

TABLE 8

The Irrigation Potential in the Indo-Gangetic Plain
(in million hectare meters)

	Punjab	Haryana	Uttar Pradesh	Bihar	West Bengal	Assam	India
Total replenishable ground water	1.80	0.85	8.05	3.38	2.07	2.35	45.22
Provision for drinking and other uses	0.27	0.13	1.21	0.51	0.31	0.35	6.94
Balance for irrigation	1.53	0.72	6.84	2.67	1.76	2.00	38.28
Utilisation	1.52	0.51	2.49	0.68	0.29	0.05	10.65
% Utilisation	99.38	70.16	36.48	23.55	16.54	2.20	27.82

TABLE 9
Irrigation in the Indo-Gangetic Plain 1950-95
 (in million hectares)

	Punjab	Haryana	Uttar Pradesh	Bihar	West Bengal	Assam	India
<i>1949-50</i>							
Gross area irrigated	2.85*		4.76	2.08	1.16	0.54	21.74
% of gross cropped area	37.1*		23.8	18.3	20.3	20.8	16.7
<i>1971-2</i>							
Net area irrigated	2.96	1.57	6.99	2.38	1.49	0.57	31.54
Gross area irrigated	4.38	2.28	8.09	2.79	1.54	0.57	38.43
% of gross cropped area	76.5	45.2	35.1	26.1	21.5	19.8	23.3
<i>1995-96</i>							
Net area irrigated	3.85	2.76	11.68	3.69	1.91	0.57	53.51
Gross area irrigated	7.38	4.67	16.98	4.58	2.49	0.57	71.51
% of gross cropped area	95.2	78.2	65.8	45.7	27.8	14.5	38.3
Ultimate irrigation potential	6.6	4.6	25.7	12.4	6.1	2.67	113.6

*Refers to the erstwhile state of Punjab which included Haryana and part of Himachal Pradesh.

TABLE 10

Agricultural Productivity in the Indo-Gangetic Plain 1960-2000(Area in million hectares, production in million tonnes
and yield in tonnes /hectare)

	Punjab	Haryana	Uttar Pradesh	Bihar	West Bengal	Assam	India
1960-1							
<i>Rice</i>							
Area	0.44		4.19	5.24	4.61	1.84	34.13
Production	0.41		2.81	4.06	4.87	1.56	34.58
Yield	0.93		0.67	0.77	1.06	0.85	1.01
<i>Wheat</i>							
Area	2.18		3.94	0.65	0.03		12.93
Production	2.35		3.52	0.40	0.02		11.00
Yield	1.08		0.89	0.61	0.68		0.85
<i>Food-grains</i>							
Area	6.89		18.38	9.93	5.53	1.94	115.58
Production	5.53		12.94	6.63	5.30	1.60	82.02
Yield	0.80		0.70	0.67	0.96	0.82	0.71
1980-1981							
<i>Rice</i>							
Area	1.18	0.47	5.29	5.55	5.17	2.28	40.45
Production	3.22	1.23	5.57	5.64	7.47	2.52	53.63
Yield	2.74	2.60	1.05	1.02	1.44	1.11	1.34
<i>Wheat</i>							
Area	2.81	1.48	8.11	1.76	0.28	0.10	22.28
Production	7.68	3.49	13.39	2.30	0.47	0.12	36.31
Yield	2.73	2.36	1.65	1.31	1.67	1.16	1.63
<i>Food-grains</i>							
Area	4.84	3.98	20.47	10.03	6.09	2.52	126.67
Production	11.90	6.04	24.95	9.91	8.28	2.71	129.59
Yield	2.46	1.52	1.22	0.99	1.36	1.07	1.02

	Punjab	Haryana	Uttar Pradesh	Bihar	West Bengal	Assam	India
1997-98							
<i>Rice</i>							
Area	2.28	0.91	5.66	4.98	5.90	2.49	43.42
Production	7.90	2.55	12.17	6.77	13.24	3.38	82.30
Yield	3.45	2.80	2.15	1.36	2.24	1.36	1.90
<i>Wheat</i>							
Area	3.30	2.06	9.22	2.08	0.37	0.08	26.69
Production	12.72	7.55	23.04	4.16	0.81	0.11	65.91
Yield	3.85	3.66	2.50	2.00	2.20	1.38	2.47
<i>Food-grains</i>							
Area	5.88	4.17	20.64	8.83	6.55	2.72	124.07
Production	21.15	11.33	41.83	12.90	14.35	3.58	192.43
Yield	3.60	2.72	2.03	1.46	2.19	1.31	1.55

TABLE 11

Per Capita Food-grain Production and Consumption 1970-90

	Punjab	Haryana	Uttar Pradesh	Bihar	West Bengal	Assam	Kerala	India
<i>Per capita annual production of Food-grains (Kilograms)</i>								
1970-3	564	444	209	155	166	145	63	189
1980-3	782	483	228	121	126	146	52	191
1990-3	957	575	252	121	177	147	37	201
<i>Calories per capita per day (1983)</i>								
Rural	2677	2554	2399	2189	2027	2056	1844	2221
Urban	2100	2242	2043	2131	2048	2043	2049	2089

TABLE 12

Percentage of Population below Poverty-line: 1970-2000

	Punjab	Haryana	Uttar Pradesh	Bihar	West Bengal	Assam	Kerala	India
<i>1973-74</i>								
Rural	28.21	34.23	56.53	62.99	73.16	52.67	59.19	56.44
Urban	27.68	39.58	59.48	51.75	34.50	37.16	62.24	49.23
Total	28.08	35.24	56.98	61.78	63.39	51.23	59.71	54.93
<i>1977-78</i>								
Rural	16.37	27.73	47.60	63.25	68.34	59.82	51.48	53.07
Urban	27.64	36.24	57.07	52.17	38.71	37.58	59.54	47.40
Total	19.36	29.48	49.19	61.95	60.65	57.63	52.93	51.81
<i>1983-84</i>								
Rural	13.20	20.56	46.45	64.37	63.05	42.60	39.03	45.61
Urban	23.86	23.48	50.27	50.42	32.21	26.38	48.65	42.15
Total	16.29	21.24	47.19	62.51	52.72	40.86	40.91	44.76
<i>1987-88</i>								
Rural	12.60	16.22	41.10	52.63	48.30	39.35	29.10	39.06
Urban	12.91	17.79	45.22	57.71	32.84	17.34	43.36	40.12
Total	12.70	16.63	40.99	53.37	43.99	36.84	32.08	39.34
<i>1993-94</i>								
Rural	11.95	28.02	42.28	58.21	40.80	45.01	25.76	37.27
Urban	11.35	16.38	35.39	34.50	22.41	7.73	24.55	32.36
Total	11.77	25.05	40.85	54.96	35.66	39.35	25.43	35.97
<i>1999-2000</i>								
Rural	6.35	8.27	31.22	44.30	31.85	40.04	9.38	27.09
Urban	5.75	9.99	30.89	32.91	14.86	7.47	20.27	23.62
Total	6.16	8.74	31.15	42.60	27.02	33.47	12.72	26.10

Map 1. Profile of Irrigation in Districts of Punjab: 1995



Note: The numbers 0–9 indicate the percentage of gross cropped area irrigated. 0 indicates that the percentage in that district is less than 10%. 1 indicates that the percentage in that district is between 10% and 20%, and so on.

Map 2. Profile of Irrigation in the Districts of Haryana: 1995



Note: The numbers 0-9 indicate the percentage of gross cropped area irrigated. 0 indicates that the percentage in that district is less than 10%. 1 indicates that the percentage in that district is between 10% and 20%, and so on.

Map 3. Profile of Irrigation in the Districts of Uttar Pradesh: 1995



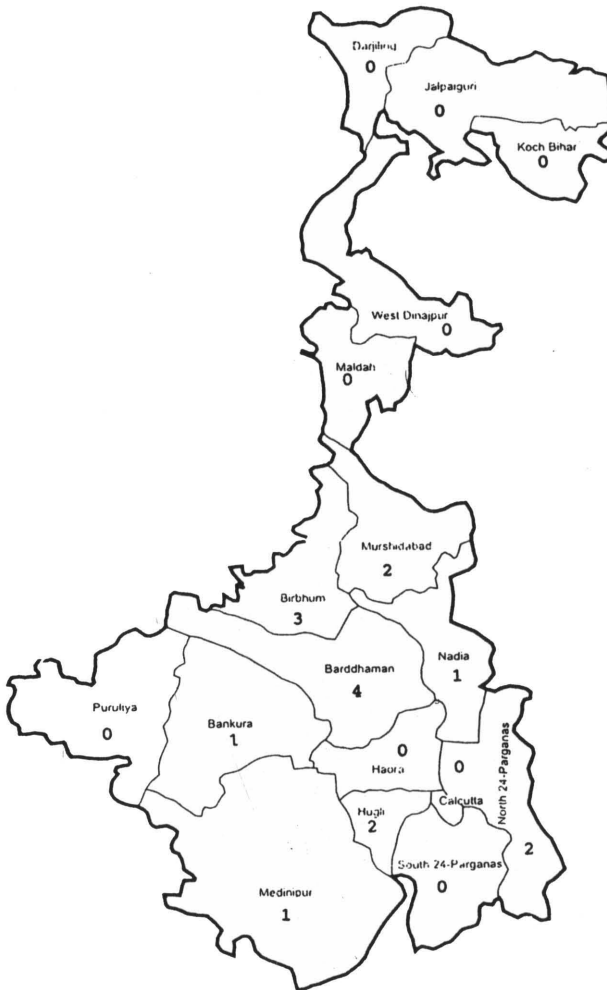
Note: The numbers 0–9 indicate the percentage of gross cropped area irrigated. 0 indicates that the percentage in that district is less than 10%. 1 indicates that the percentage in that district is between 10% and 20%, and so on.

Map 4. Profile of Irrigation in the Districts of Uttar Pradesh: 1995



Note: The numbers 0–9 indicate the percentage of gross cropped area irrigated. 0 indicates that the percentage in that district is less than 10%. 1 indicates that the percentage in that district is between 10% and 20%, and so on.

Map 5. Profile of Irrigation in the Districts of West Bengal: 1995



Note: The numbers 0–9 indicate the percentage of gross cropped area irrigated. 0 indicates that the percentage in that district is less than 10%. 1 indicates that the percentage in that district is between 10% and 20%, and so on.

