MODERNIZATION OF AGRICULTURE AND ECONOMIC DEVELOPMENT

The Indian Experience

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Introduction

The world has witnessed spectacular increases in agricultural output during the twentieth century, particularly in its latter half. This achievement is mainly ascribed to the improved agricultural practices leading to higher productivity of land and labour. The contribution of extensive cultivation has not been significant of late. Bringing more land area under agriculture is becoming more and more difficult in most countries. Since prosperous agriculture is considered to be the most crucial base for economic development particularly in the less developed countries (LDCs), the only viable option for them is to continue to enhance the productivity of land and labour in agriculture. Increased productivity in agriculture has been achieved in several parts of the world mainly by modernizing agriculture. Modernization consists largely of using improved seeds, modern farm machinery such as tractors, harvesters, threshers, etc., chemical fertilizers and pesticides in an optimal combination with water. The present study proposes to examine the role of modernization of agriculture in the overall economic development of the LDCs. It addresses itself to the following specific questions:

(a) What is the role of agriculture in the economic growth of LDCs?

(b) What is the impact of moderniza tion of agriculture on the produc tivity growth?

(c) What role can the governments in LDCs play to promote moderniza tion of agriculture?

In the next section, we examine the first of the above-mentioned questions with the help of data for the period of 1965-87 on selected 43 developing countries. Since the next two questions require detailed investigation with a lot more statistical evidence to support the arguments, an indepth study of the Indian experience focussing on aspects is presented. The third section deals with

the process of modernization of Indian agriculture in terms of a few acknowledged indicators like use of improved seeds, fertilizers, etc. In the fourth section, detailed estimation of the contribution of factor inputs vis-a-vis total factor productivity growth in the Indian agriculture is attempted for different sub-periods carefully selected to delineate various phases of modernization of agriculture. The fifth section is, then, devoted to the discussion of the role of government in promoting modernization in Indian agriculture. Some lessons for the modernization of agriculture in LDCs from the Indian experience are drawn in the concluding section.

Role of Agriculture in Economic Growth of LDCs

Agriculture is a predominant activity in most developing countries. As economic growth and development take place, importance of agriculture tends to decline according to the famous hypothesis. The declining share of agriculture is, however, a slow phenomenon and is felt only over a relatively long time horizon. The implication is that growth of total income exceeds that of agricultural income over a long time.

In an international cross-sectional perspective, the role of agriculture in economic growth is generally examined by considering the extent to which agricultural growth explains variations in the growth of total income among different countries. The growth of total income in a country is basically an average of the growth of income originating in agriculture, industry and service sectors. In order to estimate the relative importance of these three broad sectors in explaining the variations in the growth of total income, the following multiple regression is run:

$$G_Y = a_o + a,G_A + \hat{}G, + a.,0, + U \ldots. (1)$$

where G represents annual trend rate of growth; subscripts Y, A, I and S represent total GDP, GDP in agriculture, GDP in industry and GDP in services, respectively; U is a randon error term and a's are the parameters to be estimated.

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Equation (1) is estimated by using the cross section data on the trend rates of growth of GDP by sectors, available from the World Development Report 1989 for the selected developing countries *(see Appendix 1).* The regression is run for two time periods: (a) 1965-80 and (b) 1980-87. The choice of the year 1980 is again dictated by the ready availability of data on trend rates of growth by sectors. The results of the two regressions are:

(a) For the period 1965-80:

$$G_T = -0.3787 + 0.5064G_A + 0.2187G, + 0.4160G_S$$

t-values: (-1.869)(9.889) (8.973)(9.192) R-square = 0.9597; R-bar-square = 0.9566 F-statistic (3,39) = 309.597

(b) For the period 1980-87:

$$G_Y = 0.2456 + 0.1677G_A$$

$+0.4687G,+0.2243G_S$

t-values: (1.085)(2.401) (10.136X3.365) R-square = 0.9070 R-bar-square = 0.8999 F-statistic (3,39)= 126.834.

The results of this exercise are quite interesting. Both the equations are statistically highly significant. They clearly show the importance of the growth of agricultural income in determining the variations in the growth of total GDP in developing countries. The growth of incomes in all the three broad sectors are individually significant in both the periods in explaining the growth variation across countries. Agriculture, however, is the most dominating sector during the period 1965-80, whereas it is the industrial sector which dominates the scene during the eighties. The results of the two regression equations imply that the contribution of the growth of agricultural income to the growth of total income on the margin has fallen considerably from 44.4% during 1965-80 to 19.5% during 1980-87 (2). As against this, the marginal contribution of the growth of industrial income has gone up from 19.2% during 1965-80 to 54.5% during 1980-87. These trends, however, have to be interpreted in the context of the overall growth trends over the two sub-periods. *Table I* presents the summary trends in the overall and sectoral growth rates in the selected 43 LDCs.

It can be readily seen from *Table I* that out of 43 countries considered here, 35 countries experienced a decline in their trend rates of growth over the two sub-periods. Out of these 35 countries, 10 countries experienced increase in the growth of agricultural incomes, whereas only 5 and 2 countries experienced increased growth of income in industry and services, respectively. Thus, in the overall context of the retardation of the growth of GDP in the LDCs, industry and services seem to have contributed much more than agriculture. This is reflected in the declining marginal contribution of agriculture and increasing contribution of industry in our regressions.

Some Aspects of Modernization of Indian Agriculture

Since the inception of National Economic Planning in India in 1951, sustained efforts have been made by the planners to accelerate the pace of agricultural development in the economy. However, the main emphasis during the early stages of planning was on broadening the industrial base through rapid development of basic and capital goods industries. It was only in mid-Sixties, when the economy suffered a major setback due to two consecutive years of drought, that a shift in the development strategy focussing on rapid agricultural development became necessary. In fact, the impact of two consecutive drought years (1965-66 amd 1966-67) was so severe that it almost nullified the effect of more than a decade of agricultural development and in its aftermath brought about a severe industrial recession. As a result, planners were forced to have a *'plan holiday'* for a period of three years from 1966 to 1969. It was during this period that a new strategy of agricultural development focusing on modernization of agriculture

and improvement in farm productivity was launched. This strategy for modernization of agriculture, widely referred to as the *'Green Revolution'*, has been pursued vigorously in Indian economy since 1967. The term *'Green Revolution'* indicates a package for modernization of agriculture consisting of *"large scale application of modern science and technology to agriculture"* involving *"extensive and intensive use of improved production technology and high yielding varieties of seeds"* (CSSC, 1974). Stated briefly, the main components of the Green Revolution technology are the introduction of high yielding varieties of seeds for several major crops, creation and utilization of energized well irrigation and lift irrigation facilities, use of high doses of fertilizers and pesticides, and extensive use of farm machinery directed at improving farm productivity.

To examine some aspects of modernization of Indian agriculture, it would be useful to divide the post-Independence period into two sub-periods: (a) the period of planned economic development preceding Green Revolution (1950-51 to 1966-67); and (b) the period of Green Revolution from 1966-67 to 1988-89, the latest year for which the relevant data are available. Moreover, since there has been a significant acceleration in the overall rate of economic growth in Indian economy during the Eighties, we may further divide the period of Green Revolution into two sub-periods: 1966-67 to 1980-81 and 1980-81 to 1988-89. The basic data on the relevant aspects on Indian agriculture relating to the four benchmark years, viz., 1950-51,1966-67,1980-81 and 1988-89, are presented in *Appendix 2*, while some indicators of extent of modernization in Indian agriculture derived from these data are presented in *Table 2*.

It is evident from the information given in *Appendix 2* that the period of Green Revolution was marked by spectacular increases in the area under high yielding varieties (HYV), extent of fertilizer use and extent of irrigation. Thus, during the period 1966-67 and 1988-89, the area under HYV increased from less than two million ha. to more than 62 million ha., the extent of fertilizer use increased from around one million tonnes to 11 million tonnes, theextent of irrigation increased from less than 27 million ha. to around 60 million ha., the number of tractors increased from 54 thousand to 1,205 thousand and the extent of double cropping increased from 15% to 25% of net area sown. By 1988-89, more than one-third of the gross cropped area was covered by irrigation and use of HYV, while the average dose of fertilizer had increases from less than 7 kg. per ha. in 1966-67 to more than 62 kg. per ha. Such large scale modernization of agriculture led to significant improvements in the productivity of land as well as labour. Land productivity, which had increased at an average rate of only 0.8% per annum during the pre-Green Revolution period, increased at an average rate of 2.5% per annum during the subsequent period. Similarly, labour productivity, which had been more or less stagnant till 1966-67, increased at an average rate of 1.12% per annum during 1966-67 to 1988-89. The period of Green Revolution was also marked by a significant increase in capital investment in agriculture, with the capital investment per ha. increasing at an average rate of

2.9% per annum during 1966-67 to 1988-89, as compared to the average growth rate of 1.7% observed during the earlier period.

Impact of Modernization on Productivity Growth

On the basis of an analysis of various indicators presented above, we can identify three distinct phases of development of Indian agriculture. Phase I consists of the period from 1950-51 to 1966-67, which was marked by a significant increase in the net area brought under cultivation through a sustained process of land reclamation and land improvements. This period was marked by only marginal improvements in labour and land productivity and a decline in capital productivity. By the end of the Sixties, most of the existing potential for expansion of net area available for cultivation was already tapped and it was evident that the future growth of agriculture would have to depend more and more on non-land resources. The period from 1966-67 to 1980-81 represents Phase II of agricultural development, which was marked by widespread modernization of agriculture coupled with a significant increase in capital investment. In fact, during this period the gross capital formation as a proportion of gross domestic product in agriculture increased sharply to more than 9% from the average level of around 6% observed during the pre-Green Revolution period. The period after 1980-81 represents Phase III, which is marked by simultaneous and significant improvements in the productivity of land, labour and capital. During the Eighties, the average annual growth rate of land productivity has been 3.1%, of labour productivity 1.9% and capital productivity around 1%. During this period there has been a significant improvement in the utilization of the basic infrastructure and growth potential created during the earlier phase of modernization. Thus, for instance, it has been observed in the latest issue of Economic Survey (Government of India, March 1990) that, in the years 1986-87 and 1987-88, the achievement in the utilization of irrigation potential was more than the targetted level of utilization.

Having examined the impact of modernization of agriculture on partial factor productivity, we may now examine its impact on total factor productivity. The growth of partial factor productivity (such as labour productivity or land productivity) indicates the combined effect of changes in factors of production and technical progress. To estimate the pure effect of technological change, it is necessary to eliminate the effect of changes in factors by constructing total factor input (TFI) as a weighted average of the three factors inputs, viz., land, labour and capital. The total factor productivity (TFP), which is generally used as a broad indicator of the extent of technical progress, is then derived as the difference between the NDP in agriculture and the TFI.

Our estimates of the growth rates of total factor input and total factor productivity in Indian agriculture are presented in *Table 3,* while the estimated break-up of the overall growth rate of agriculture in terms of the specific contributions made by various sources is given in *Table 4.* It is evident from *Table 3* that there has been a marginal decline in the growth rate of labour input

and a significant decline in the growth rate of land input during the period 1966-67 to 1988-89. However, the growth of capital input shows a marked acceleration during the sub-period 1966-80 followed by a deceleration during the Eighties. Recent studies by Patnaik (1987), Rath (1989) and Shetty (1990) have analyzed this phenomenon of deceleration in the growth of ag-ricultural investment during the Eighties. The main conclusion emerging from these studies is that private investment in agriculture is affected by public sector investment in agriculture and the growth of the latter has declined steadily during the Eighties.

The observed trends in the growth of individual factor inputs have resulted in a decline in growth of the aggregate supply of factor inputs to agriculture especially during the Eighties. The average growth rate of total factor input has declined from 1.55% during the pre-1966-67 period to 1.47% during the subsequent period and further to 1.20% in the period after 1980-81. As against this, the growth of NDP in agriculture has accelerated significantly during the post-Green Revolution period as compared to the earlier period. The average growth rate of net agricultural output (NDP) increased sharply from 1.72% during pre-1967 period to 2.36% during the subsequent period and further to 3.27% during the Eighties. This phenomenon of a significant acceleration in the growth of agricultural production during the Eighties has been analyzed in a recent study of Mahendradev (1987) based on detailed state level data on the growth of food grains production. The general conclusion emerging from Mahendradev's study is that the Eighties have witnessed a significant increase in the growth of food grains production in many states including the hitherto low growth states such as Rajasthan, Madhaya Pradesh and West Bengal, and that this acceleration in the growth of production could be attributed to the spread of bio-chemical technology to these states during the first half of the Eighties. It may be mentioned here that this study covers the period up to 1984-85 and there has been a significant increase in the level of food grains production in almost all the states during the subsequent period (1984-85 to 1988-89).

Mahendradev's study has also examined the relationship between growth and instability of agriculture and its conclusion is that during the last two decades the degree of instability has declined significantly in both high growth states as well as low growth states, which indicates a negative rather than a positive relationship between growth rates and the degree of instability. Thus, the Indian experience of agricultural growth does not support the hypothesis of high rates of growth causing high instability. In fact, the ability of agriculture to withstand the adverse effects of successive run of poor monsoons for three years culminating in the severe drought of 1987-88, without experiencing any major reduction in food grains production, clearly indicates that the Indian agriculture had acquired a remarkable degree of resilience during the Eighties. This has been achieved partly by the spread of modern technology and partly on account of the protective benefits of irrigation. A recent study by Dhawan (1987) shows that the output elasticity with respect to rainfall declines from 1.6 in low rainfall states and

1.0 in medium rainfall states without irrigation to the levels of 0.2 and 0.5, respectively, with irrigation. Thus, the acceleration in the growth of agricultural production brought about by the Green Revolution has actually reduced the degree of instability experienced by Indian agriculture and thereby made it less dependent on the weather conditions.

Given the significant acceleration in the growth of net agricultural output and the simultaneous deceleration in the growth of total factor input, it is hardly surprising to observe that the post-Green Revolution period witnessed a phenomenal increase in the growth of total factor productivity in the agricultural sector. It is interesting to note that during the pre-Green Revolution period TFP was almost stagnant, its average growth rate being only 0.17%. As against this, the average annual growth rate of TFP increased to about 0.9% during the period 1966-67 to 1980-81, and it went up to 2.05% during the period 1980-81 to 1988-89. Thus, the modernization of Indian agriculture during the period of Green Revolution has succeeded in bringing about major technological transformation as indicated by the high and rising growth rate of TFP in the agricultural sector.

The contribution made by growth of TFP to the overall growth of Indian agriculture can be seen from the analysis of sources of growth presented in *Table 4.* During the pre-1967 period, more than 90% of the growth of agricultural NDP was contributed by the growth of total factor input, while the growth of TFP accounted for less than 10%. This position has changed dramatically during the period 1966-67 to 1988-89 with growth of TFI accounting for 51% and growth of TFP accounting for 49% of the growth of net agricultural output. In fact, during the Eighties, growth of TFP has accounted for 63 % of the growth of net output, and, as a result, despite a decline in the growth of TFI, the overall growth of agricultural NDP has shown a significant increase.

It is interesting to examine the impact of accelerated growth of TFP in the agricultural sector on the growth of the economy in general and agricultural sector in particular. According to our estimates, if the growth of TFP in agriculture had occurred at the same rate during the post-1967 period as in the pre-1967 period, the level of real NDP in agriculture in the year 1988-89 would have been lower by about 122.3 billion rupees, which indicates adecline of 21.9% over the level actually achieved. The direct impact of the lower level of agricultural NDP on the overall NDP would have been to reduce its level in 1988-89 by 9.3%. This would have resulted in a decline in the growth rate of the economy as a whole from the observed level of 4.3% per annum to 3.9% per annum during the period 1966-67 to 1988-89. More specifically, the significant acceleration in the overall economic growth experienced by the Indian economy during the Eighties would have been considerably reduced if the total factor productivity in agriculture had not shown a remarkable acceleration during this period. If the growth of TFP in agriculture during the period 1980-81 to 1988-89 would have been at the same rate as during the pre-1967 period, the overall growth rate of the economy during this period would

have declined from the observed level of 5.5% per annum to 4.9% per annum. Thus, the acceleration in the TFP growth in agriculture has made a significant contribution to the acceleration in the overall growth of the economy during the Eighties.

Role of Government in Modernization of Agriculture

Government intervention for the development of the agricultural sector is a common feature in most LDCs. In India, the government has played a major role in promoting agricultural development in general and its modernization in particular. Of the various aspects of government intervention in Indian agriculture, the following two aspects deserve special mention: (a) direct intervention in the market mechanism through price support/procurement policy; and (b) subsidization of major agricultural inputs.

The Indian government follows administered price policy in respect of several agricultural commodities by fixing their procurement/support prices. The government announces the procurement or minimum support price for each season for each crop and also arranges for the corresponding procurement or price support operations through public, cooperative and other state-designated agencies. In fixing the agricultural prices, various factors such as the cost of agricultural inputs, trends in market prices, inter-crop price parity, etc. are taken into account. It is now well recognized that the government's price policy has played a crucial role in protecting the farmers from market uncertainties and it has also been instrumental in encouraging the adoption of high yielding varieties which has contributed to the speeding up of the process of modernization.

Information on the trends in the minimum support/procurement prices of selected agricultural commodities in India is provided in *Table 5*. It is evident that the minimum support prices announced by the government for various agricultural commodities have increased significantly during the period 1980-81 to 1988-89. It is interesting to observe that the government intervention in the form of administered prices has not been at the cost of economic efficiency. In a recent study, Gulati (1989) has shown that investment programmes aimed at increasing the production of wheat, rice and cotton had high economic rates of return during the Eighties.

The strategy of modernizing agriculture is likely to succeed only to the extent to which the individual farmers actually use modern agricultural inputs. In India the government, therefore, adopted the policy of providing a wide range of incentives to the farmers in the form of specific subsidies on modern agricultural inputs. Thus, the subsidies have been provided to the farmers to encourage the use of chemical fertilizers, irrigation facilities, electricity and also to avail credit facilities. Ashok Gulati (1989a) has estimated the magnitude of different types of subsidies enjoyed by the farmers during the period of the Eighties. *Table 6* brings out the trends in input subsidies in Indian agriculture. It can be seen from this table that each of the four major types of input subsidies has increased significantly during the period 1980-81 to 1986-87.

Total input subsidies increased from the level of 64.1 billion rupees in 1980-81 to 127.2 billion rupees in 1986-87. In relative terms, total input subsidies represent 15% of NDP in agriculture in 1980-81 and this proportion has risen to 17% by 1986-87. Thus, the rapid pace of modernization of Indian agriculture has been sustained to a considerable extent by a significant subsidization of agricultural inputs.

Lessons from the Indian Experience

Based on the above analysis of the Indian experience of modernizing agriculture, the following conclusions may be drawn:

1. Modernization of agriculture leads to an increase in the total factor productivity in agriculture.

2. Higher the pace of modernization, higher is the growth of TFP in ag riculture.

3. Acceleration in TFP more than compensates for the deceleration in factor inputs, especially land, and thereby leads to acceleration of the output of agriculture. Whether the emergence of a major thrust for modernization of Indian agriculture at a time when the expansion of net area sown almost petered off, was a mere coincidence or a likely se quence in the process of agricultural development that could recur in other LDCs is a question requiring indepth research.

4. The early stages of modernization requires significant stepping up of investment in agriculture. Gross capital formation as a proportion of net domestic product in agriculture has to rise considerably as this appears to be the precondition of modernization.

5. Modernization of agriculture leads to resilience of agriculture and makes it less sensitive to weather conditions and fluctuations in rainfall.

6. Since the success of modernization depends on the farmers switching over to modern inputs, the govern ment is required to intervene primarily in the form of ensuring remunerative prices of crops and providing direct incentives for the use of modern inputs.

At this stage, it is important to recognize • that modernization of agriculture has significant implications on the balance of payments (BOP) of the country. In as much as LDCs are unlikely to be self-sufficient in the production of fertilizers, pesticides and farm machinery, modernization of agriculture would necessarily have a high degree of import intensity which would put severe strain on the county's BOP. In the Indian case, however, adverse impact of modernization of agriculture on BOP has been mitigated largely on account of the highly diversified industrial base thanks to the 15 years of planned development that preceded the advent of the Green Revolution in

the country. In fact, Indian industry could (a) meet the growing demand of modern agricultural inputs to a large extent, especially after the mid-Seventies. Thus, the precondition for successful modernization of agriculture imposed by the BOP considerations is that the country should have either (i) a reasonably sound industrial base or (ii) readily available export market for its agricultural products. India meets the first of these conditions but not so much the second. But an LDC not having an industrial base but assured of export markets for its agricultural products can still overcome the BOP (b) problem in modernizing agriculture.

Another significant impact of modernization of agriculture on BOP is through the reduction of the import bill over time. The Indian modernization of agriculture has been of an import substituting nature, especially during the frequently occurring drought years. The average import bill on food grains during the drought years in India has declined significantly since the mid-Sixties. This is the major advantage of modernization of agriculture. It brings food security and food self-sufficiency in the country, so that the scarce foreign exchange can be spared for more productive developmental needs of the economy.

The Indian experiment of modernizing agriculture had the primary objective of step- (c) ping up the growth of agricultural production and of making the country self-reliant in food grains. To a large extent this objective is achieved. However, some of the other effects of the Green Revolution that should be considered are:

Employment effect of the new technology is positive on the balance (Chadha & Khurana, 1989; Basant, 1987). Studies in this field have shown that the structure of employment tends to shift in favour of hired labour and against the family labour. Similarly, the seasonal fluctuation in the farm employment also tends to decline with modernization of agriculture. (Basant, 1987).

The spread of new farm technology is always uneven in terms of regions and crops leading to imbalances in the initial period (Mruthyunjaya and Kumar, (1989). The Indian experience shows that the initial breakthrough in the technology is limited to one or two crops and one or two regions. The causes for this could be in terms of (i) location of infrastructure, (ii) farmers' attitudes $_f$ depending inter alia on socio-cultural environment and (iii) weather-related factors. If these problems are tackled carefully and systematically in the short run, the goals of balance could then be achieved in the long run.

The Green Revolution in India has a serious effect on the inequalities in the distribution of income, land and assets in the rural area. Whereas Dhanagare (1987) and SatyaPaul (1989) argue that the new agricultural technology has adverse effects

on land distribution and income disparity among farm families, Chadha and Khurana (1989) find empirical support to "dispel the belief that gains of rapid economic growth in general and agricultural transformation in particular, wherever achieved, have not percolated to the poor." They found that fast and sustained growth led to percolation of the gains to the poor in the case of Punjab. However, in the case of slow and unsteady growth, as in Bihar, such gains bypassed the poor. Thus, the inequality and poverty alleviating effects of the agricultural modernization seem to be related to the intensity of the process.

REFERENCES

1. Basant Rakesh (1987): "Agricul tural Technology and Employment in India: A Survey of Recent Research," Economic and Political Weekly, Vol.22, No.32, August 8.

2. Bhalla, G.S. and Tyagi, D.S. (1989): "Patterns in Indian Agri cultural Development: A District Level Study," New Delhi: Institute for Studies in Industrial Develop ment.

3. Chadha, O.K. and Khurana, M.R. (1989): "Backward Agriculture, Unrewarded Labour and Economic Depreviation: Bihar's Contrast **with Punjab," Economic and Political Weekly, Vol.24, No.47, November 25.**

CSSC (1974): "Green Revolution: The Unfinished Task," Calcutta: Minerva Associates.

Dhanagare, D.N. (1987): "Green Revolution and Social Inequalities in Rural India," Economic and Political Weekly, Vol. 22, Nos.19-21, Annual Number, May.

Dhawan, B.D. (1987): "How Stable is India Irrigated Agriculture?" Economic and Political Weekly, Vol.22, No.39, September 26.

Gulati, Ashok (1989): "Structure of Effective Incentives in Indian Agriculture: Some Policy Implicaations," Economic and Political Weekly, Vol.24, No. 39, September 30.

_____ (1989a): "Input Subsidies in Indian Agriculture: A State-wise Analysis," Economic and Political Weekly, Vol.24, No.25, June 24.

Mahendradev, S. (1987): "Growth and Instability in Food Grains Production: An Inter-State Analysis," Economic and Political Weekly, Vol.22, No.39, September 26.

10. Mruthyunjaya and Kumar, P. (1989): "Crop Economics and Cropping Pattern Changes," **Economic and Political Weekly,** Vol.24, Nos.51-52, December 23-30.

11. Patnaik, Prabhat (1987): "Recent Growth Experience of the Indian Economy: Some Comments," **Economic and Political Weekly,** Annual Number, Vol.22, Nos. 19-21, May.

12. Rath, Nilakantha (1989): "Agri cultural Growth and Investment in India," **Journal of Indian School of Political Economy, Political Economy,** Vol.1, No.l, January-June.

13. Satya, Paul (1989): "Green Revolution and Income Distribution Among Farm Families in Haruama. 1969-70 tp 1982-83," **Economic and Political Weekly,** Vol.24, Nos. 51-52, December 23-30.

14 Shetty, S.L. (1990): "Investment in Agriculture - Brief Review of Recent Trends," **Economic and Political Weekly, Vol.25, Nos. 7 & 8, February 17-24.**

TABLE 1

CLASSIFICATION OF THE NUMBER OF LDCs ACCORDING TO THEIR GHOWIH PATTERN

	Over the Periods 1965-80 to 1980-87, Countries Experiencing								
Growth/	Decrease in Gy			Increase in Gy			Constant Gy		
	Agri.	Ind.	Serv.	Agri.	Ind.	Serv.	Agri.	Ind.	Serv.
Decrease	24	30	33	2	2	11			
Increase	10	5	2	5	5	7			1
Constant	1	-	-	-	-	-	-	-	
Total	35	35	35	7	77	11	1		

Source: Appendix I •

TABLE 2

SONE INDICATORS OF THE EXTENT OF MODERNISATION IN INDIAN AGRICULTURE

Indicator	Units	1950-51	1966-67	1980-81	1988-89
Proportion of Area Irrigated	Per cent	17.1	17.1	28.7	33.8
Proportion of Area Under HYV	Per cent		1.2	24.9	35.4
Intensity of Fertilizer Consumption	kg. per ha.	1.14	6.99	31.89	62.37
Cropping Intensity	Per cent	111	115	123	125
Land Productivity	Rs. pr ha. at 1980-81 prices	1994	2265	3072	3927
Labour Productivity	Rs. per worker at 1980-81 prices	1927	1943	2145	2485
Capital-Labour Ratio	Rs. per worker at 1980-81 prices	2218	2581	3306	3578
Capital-Land Ratio	Rs. per ha. at 1980-81 prices	2296	3010	4735	5655
Capital-Output Ratio		1.15	1.33	1.54	1.44
Labour -Land Ratio	No. of workers per ha.	1.03	1.17	1.43	1.58

Source : Appendix 2 .

TABLE 3

GROWTH OF FACTOR INPUTS AND TOTAL FACTOR PRODUCTIVITY IN INDIAN AGRICULTURE

(Average Annual Growth Rates in Per cent)

Factor	1950-51 - 1966-67	1966-67 - 1980-81	1980-81 - 1988-89	1966-67 - 1988-89
Labour	1.67	1.64	1.39	1.55
Capital	2.64	3.45	2.40	3.07
Land	0.91	0.15	0.15	0.15
Total Factor Input	1.55	1.47	1.20	1.37
Total Factor Productivity	0.17	0.88	2.05	1.30
NDP in Agriculture	1.72	2.36	3.27	2.69

Source: Appendix 2.

TABLE 4 SOURCES OF GROWTH OF INDIAN AGRICULTURE

Relative Contribution (Per cent)

Source of Growth	1950-51 - 1966-67	1960-67 - 1980-81	1980-81 - 1988-89	1966-67 - 1988-89
Labour	54.7	41.5	25.4	33.8
Capital	18.0	19.1	10.4	15.6
Land	17.4	2.1	1.2	1.9
Total Factor Input	90.1	62.7	37.0	51.3
Total Factor Productivity	9.9	37.3	63.0	48.7
Growth Rate of NDP	100.0	100.0	100.0	100.0

Source: Appendix 2.

TABLE 5 MQOMJM SUPPORT/PROCUREMENT PRICES OF AGRICULTURAL COtODITIES

(Rupees per Quintal)

Cccirrodity	1980-81	1988-89	Percentage Increase
Wheat	117	173	48
Paddy	105	160	52
Pulses	200	360	60
Groundnut	206	430	SO
Cotton	304	500	64

Soruce: Economic Survey 1985-86 and 1989-90, Government of India.

TABLE 6 TRENDS OF INPUT SUBSIDIES IN INDIAN AGRICULTURE

(Rs. Million at Current Prices)

	1980-81	1988-89	Percentage Increase
Fertilizer Subsidy	5,050	11,873	135.1
Irrigation Subsidy	49,537	84,386	70.3
Electricity Subsidy	3,530	14,570	312.7
Credit Subsidy	5,955	16,414	175.6
Total Input Subsidies	64,072	127,243	98.6

Source: Ashok Gulati (1989a).

APPENDIX 1

ANNUAL COMPOUND GROWTH RATES OF INCOME AND AGRICULTURAL INPUTS IN SELECTED DEVELOPING COUNTRIES

(Per cent)

Country	Growth of Total GDP		Growth of GDP in Agri.		Growth of GDP in Indus		Growth of GDP in Serv.	
	65-80	80-87	65-80	80-87	65-80	80-87	65-80	80-87
1	2	3	4	5	6	7	8	9
Ethiopia	2.7	0.9	1.2	-2.1	3.5	3.8	5.2	3.5
Bangladesh	2.4	3.8	1.5	2.4	3.8	3.7	3.4	5.2
Mali	3.9	3.4	2.8	0.3	1.8	9.8	7.6	5.9
Uganda	0.8	0.4	1.2	-0.5	-4.1	1.4	1.1	3.0
Burundi	3.5	2.6	3.3	1.7	7.8	4.9	2.7	3.5
Tanzania	3.7	1.7	1.6	3.8	4.2	-2.4	6.7	0.8
Togo	4.5	-0.5	1.9	0.8	6.8	-1.6	5.4	-0.7
Niger	0.3	-1.9	-3.4	2.8	11.4	-4.3	3.4	-8.0
Cent. African Rep.	2.6	2.0	2.1	2.4	5.3	2.2	2.0	1.6
India	3.7	4.8	2.8	0.8	4.0	7.2	4.6	6.1
China	6.4	10.4	3.0	7.4	10.0	13.2	7.0	7.6
Kenya	6.4	3.8	4.9	3.4	9.8	3.0	6.4	4.4
Zambia	1.9	-0.1	2.2	3.2	2.1	-0.7	1.5	-0.6
Sierra Leone	2.6	0.7	2.3	1.6	-1.0	-2.3	5.8	1.3
Sudan	3.8	-0.1	2.9	0.8	3.1	2.1	4.9	-1.3
Pakistan	5.1	6.6	3.3	3.4	6.4	9.1	5.9	7.1
Ghana	1.4	1.4	1.6	0	1.4	0.1	1.1	4.2
Sri Lanka	4.0	4.6	2.7	3.0	4.7	4.2	4.6	5.7
Senegal	2.1	3.3	1.4	4.2	4.8	4.3	1.3	2.4
Liberia	3.3	-1.3	5.5	1.2	2.2	-6.0	2.4	-0.8
Phillippines	5.9	-0.5	4.6	1.8	9.0	-2.8	5.2	0
Morocco	5.4	3.2	2.2	2.7	6.9	5.5	9.4	8.1
Bolivia	4.5	-2.1	3.8	2.5	3.7	-6.6	5.6	-1.1
Nigeria	8.0	-3.2	1.7	1.4	13.4	-5.1	8.8	-4.0
Dominican Rep.	7.3	1.6	4.6	1.0	10.9	1.0	6.7	1.3
Honduras	5.0	1.3	2.0	1.7	6.8	1.2	6.2	1.1
Egypt	6.8	6.3	2.7	2.7	6.9	5.5	» 9.4	8.1
Nicariqua	2.6	-0.3	3.3	-0.2	4.2	0.4	1.4	-0.9
Thailand	7.2	5.6	4.6	3.7	9.5	5.9	7.6	6.4
El Sanvador	4.3	-0.4	3.6	-1.6	5.3	0	4.3	0.2
Botswana	14.2	13	9.7	-7.8	24.0	19.2	11.5	9.5
Jamaica	1.3	0.4	0.5	1.4	-0.1	-0.4	2.7	0.8
Cameroon	5.1	7.0	4.2	2.4	7.8	11.0	4.8	6.9
Congo	6.4	5.5	3.1	1.5	10.3	10.9	4.7	-1.9
Paraquay	6.9	1.3	4.9	2.0	9.1	-0.3	7.5	1.9
Peru	3.9	1.2	1.0	3.0	4.4	0.5	4.3	1.4
Turkey	6.3	5.2	3.2	3.3	7.2	6.7	7.6	5.0
Tunisia	6.6	3.6	5.5	-4.2	7.4	2.7	6.5	4.1
Ecuador	8.7	1.5	3.4	3.6	13.7	1.4	7.6	0.9
Colombia	5.6	2.9	4.3	2.0	5.5	5.2	6.4	2.0
Chile	1.9	1.0	1.6	3.6	0.8	1.5	2.7	0.3
Costa Rica	6.2	1.8	4.2	1.7	8.7	2.0	6.0	1.7
Syria	8.7	0.3	4.8	-1.1	11.8	1.5	9.0	0.3

APPENDIX 1 (cont'd.)

ANNUAL COfOUND GROWTH RATES OF DJCCfE AND AGRICULTURAL INPUTS IN SELECTED DEVELCPING COUNTRIES

(Per cent)

Country	Growth of Lab. Prdty (1965-80)		Growth of Ha. Under Irriq.		(irowtn o No. of Tractors		Consn ./H	Fert.
	Total	Agri.	66-80	76-86	69-76	76-86	70-80	80-86
1	10	11	12	13	14	15	16	17
Ethiopia	0.6	-0.41	1.4	11.4	5.8	0.5	25.9	8.7
Bangladesh	0.5	0.37	8.6	4.0	13.8	3.	12.5	6.4
Mali	2.2	1.41	6.1	8.0	8.9	3.	7.5	18 5
Uganda	-2.2	-1.41	0	8.4	5.1	8.5	-22.6	14 2
Burundi	2.3	2.17	2.3	29.8	12.9	2.	4.8	19 2
Tanzania	0.9	-0.74	2.7	8.9	5.9	1.	8.7	1.8
Togo	1.9	-0.35	0	8.8	11.2	1.	25.9	17 3
Niger	-1.5	-4.91	0	17.5	25.8	9.	23.1	-2
Cent. African	1.4	2.24	0	0	12.8	3.	-7.6	-5
India	2	1.38	2.6	2.6	15.8	1.	10.5	10 8
China	4	1.22	0.8	0.2	7.6	1.	14.9	2.0
Kenva	2.8	1.71	9.5	-0.5	0	3.	1.6	12 0
Zambia	-0.8	0.04	0	25.9	6.5	0.	8.3	-0
Sierra Leone	1.7	2.3	7.2	22.3	2.8	1.	-2.6	14 0
Sudan	1.4	1.48	0	5.9	10.5	7.	7.7	0.5
Pakistan	2.5	1.29	1.2	1.7	10.1	1.	11.4	9.7
Ghana	-0.5	0.28	5.2	-8.8	3.5	1.	16.9	-5
Sri Lanka	1.8	0.87	2.9	1.4	3.8	5.	4.5	4.7
Senegal	-1	-1.53	3.5	3.3	4.5	2.	6.i	1.8
Liberia	0.7	3.35	34.9	0	7.2	2.	5.3	-9
Phillippines	3.4	2.84	4.1	0.1	4.4	6.	4.6	3.9
Morocco	2.5	1.22	5.3	10.3	10.0	4.	0.4	18 9
Bolivia	2.5	2.88	4.8	2.9	10.8	1.	2.1	3.8
Nigeria	5.0	-0.91	1.4	49.7	21.2	3.	34.2	8.7
Dominican Rep.	4.5	3.49	1.2	4.0	2.3	-.	1.7	-3
Honduras	2.2	-0.06	1.9	0.8	9.7	1.	-1.4	8.0
Egypt	4.6	1.71	0.2	-1.1	3.8	7.	6.1	5.4
Nicariqua	-0.3	1.71	14.5	1.7	16.6	6.	6.9	6.9
Thailand	4.4	2.78	3.3	4.8	23.3	1.	7.9	6.5
El Sanvador	1.0	2.46	5.1	13.0	3.2	1.	-1.6	0.3
Botswana	11.8	8.93	-6.7	7.2	3.0	1.	-3.3	-9
Jamaica	-0.7	-0.30	2.9	0.6	6.7	1.	-2.9	-
Cameroon	3.4	3.89	4.8	10.6	12.7	1.	6.2	6.6
Congo	4.4	1.52	14.9	25.9	1.2	0.	-23.2	39 3
Paraguay	3.7	2.49	3.2	1.7	4.2	1.	-5.5	9.5
Peru	1.0	-0.38	0.6	0.6	2.9	3.	0.9	-6
Turkey	4.6	3.23	2.9	0.8	16.7	8.	9.5	6.0
Tunisia	3.8	4.98	5.0	7.2	6.0	-.	5.1	0
Ecuador	6.0	3.03	1.0	0.6	12.0	2.	8.5	6.1
Colombia	3.0	3.60	1.7	5.1	1.3	3.	5.6	0.2
Chile	-0.3	2.50	1.5	-0.2	1.9	2.	-4.C	1.1.3
Costa Rica	2.4	3.24	0	15.5	1.9	0.	3.3	T.
Syria	5.4	4.79	0.7	1.8	11.3	9.9	12.6	12 j.

Sources: 1. FAO Production Yearbook, 1977 & 1978
2. Statistical Yearbook, 1979-80
3. World Development Report, 1988 &

APPENDIX 2

BASIC STATISTICS RELATING TO INDIAN AGRICULTURE

Variable	Units	1950-51	1966-67	1980-81	1988-89
NDP (All Sectors)	Rs.b. at 1980-81 prices	406.81	668.53	1101.39	1688.70
NDP in Agriculture (3 -year average)	Rs.b. at 1980-81 prices	236.73	310.98	431.03	557.58
Capital Stock in Agriculture	Rs.b. at 1980-81 prices	272.49	413.24	664.33	802.94
Working Force in Agriculture	Million persons	122.84	160.09	200.96	224.38
NDP in Agriculture	Rs.b. at current prices	49.05	132.24	664.33	1730.90
Capital Stock in Agriculture	Rs.b. at current prices	159.92	337.76	1639.94	2927.62
Value of Labour in Agriucltural Income	Per cent	55.2	55.6	57.4	58.7
Share of Capital in Agricultural Income	Per cent	10.5	12.5	12.3	15.4
Share of Land in Agricultural Income	Per cent	34.3	31.9	30.3	25.9
Net Area Sown	Million ha.	118.7	137.3	140.3	142.0
Gross Cropped Area	Million ha.	131.9	157.4	173.1	177.0
Gross Irrigated Area	Million ha.	22.6	26.9	49.6	59.8
Area Under HYV	Million ha.		1.9	43.1	62.2
Fertilizer Consumption	Million tons	0.15	1.10	5.52	11.04
Stock of Tractors	Thousands		54.0	391.0	1205.0

Sources:
1. Economic Survey (various issues from 1970-71 to 1989-90): Government of India.
2. National Accounts Statistics (Jan. 1987, March 1989 & June 1989)- Central Statistical Organization, Government of India.
3. All India Debt and Investment Survey, 1971-72 and 1981-82, Reserve Bank of India.
4. Census of India (1961, 1971, 1981), Government of India.
5. National Sample Survey (27th Round, 32nd Round £ 38lh Round): Ministry of Planning, Government of India.
6. Indian Agriculture in Biref (various editions), Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.
7. Dholakia, Bakul H. (1974): The Sources of Economic Growth in India, Good Companions, Baroda.
8. Jugdishkumar et. al. (Nov. 21 , 1987) "Estimates of Fixed Capital Stock and Consumption of Fixed Capital in India," The Economic and Political Weekly, Vol. 22, No. 47.