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ARTICLES

Investment, Agricultural Productivity and Rural Poverty in India: A State-Level Analysis

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I

INTRODUCTION

Sustainable agricultural growth has been a central theme of our development planning. The massive investment in irrigation, rural infrastructure and institutions, research, and extension has helped to attain impressive growth in agriculture leading to self-sufficiency in food production. However, the pattern of growth is uneven across the regions, and the growth is not sufficient enough to make a dent on rural poverty in some regions. Investment in agriculture in real terms (at 1980-81 prices) went up from Rs. 13 billion in 1950-51 to Rs. 68 billion in 1998-99 [Central Statistical Organisation (CSO) various issues], but it is observed that there has been a deceleration in public investment in agriculture during the 1980s when gross domestic investment in the economy has more than doubled. Thus it is often argued that agriculture did not receive due attention it deserved in terms of allocation of public resources in the 1980s (Rath, 1989; Shetty, 1990; Kumar, 1992; Alagh, 1997; Gulati and Bathla, 2001). Consequently, the growth of agriculture has also tended to slacken during the 1990s. The declining public investment and inadequate incentives for the private investment may not be compatible with the growth target of 4.5 per cent for meeting food demand and alleviating poverty (Government of India, 1998). The question then arises whether there is persistent decline in the public investment? If so, what are the possible factors and how that affects agricultural productivity? Several factors have been identified using the country-level estimates (Gandhi, 1990; Misra and Hazell, 1997; Gulati and Sharma, 1997; Karmakar, 1998; Chand, 2000). These estimates, however, are subject to debate for their limited scope and narrow coverage of public sector agricultural investment as well as for ignoring the simultaneity among investment and productivity (Rao, 1994; Kurian, 1987; Dev, 1997; Gulati and Bathla, 2001).

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Also, targeting agricultural investment simply to stimulate agricultural growth is not sufficient; it should also reduce poverty. In spite of considerable investment on poverty alleviation programmes since Independence, the incidence of poverty is quite high in some regions. The question then arises why the incidence of poverty is greater in some states than in others? How do investment and growth relate to poverty reduction? What policies relating to resource allocation, technological change in agriculture, and agricultural prices will be most effective in reducing rural poverty? The available literature on poverty has mainly centred around the role of agricultural output growth and prices on rural poverty (Ahluwalia, 1985; Srinivasan, 1986; Ghose, 1989). However, to explain poverty, analysis of the growth in agriculture as well as its determinants becomes important. Some of these determinants include institutional, infrastructural, and technological factors.

The above questions can be addressed by an in-depth statewise analysis of the investment, productivity and poverty. However, such an analysis is constrained by non-availability of time-series data on agricultural investment by states. This paper is an attempt in this direction using alternative data sources such as *All India Debt and Investment Survey* by Reserve Bank of India and National Sample Survey Organisation (RBI-NSSO) and *Finance Accounts* of the Union Government and State Governments. The specific questions addressed in this study are: (i) What are the temporal and regional trends in public and private investment in agriculture when all possible investment items are included?; (ii) what are the determinants of public and private investment in agriculture?; and (iii) what is the impact of agricultural investment on agricultural productivity and rural poverty?

II

METHODOLOGY

Construction of the Investment Series

Capital investment in agriculture is made by individual households, private corporate sector as well as by the government departments. The first two categories comprise private investment while the third one is public investment. Private corporate sector comprises firms and co-operatives in sugar, milk, poultry, bee-keeping, plantations, horticulture, floriculture, and other small and cottage agricultural enterprises. Since the CSO series on public sector agricultural investment has limited coverage, we have constructed a new series of public investment that includes all possible items of investments relevant for agriculture. The heads of items included are crop husbandry, animal husbandry, dairy development, fisheries, forestry and wildlife, plantations, soil and water conservation, special area programme, food-storage-warehousing, agricultural research and education, investments in agricultural financial institutions, co-operation, land reforms, rural development programmes, drainage and flood control, command area development, minor irrigation, medium and major irrigation, rural electrification, rural roads and

fertiliser industries. The sources of data are the *Finance Accounts* of the Union Government and State Governments. Time-series information on private investment is provided by the CSO but only at the country-level. However, the RBI-NSSO has been conducting country-wide survey (*All India Debt and Investment Surveys)* at decennial intervals to assess debt and investment of the household sector since 1951-52. These surveys give rich information on fixed capital expenditure by rural and urban households. But these do not contain private corporate investment, whereas the CSO series consists of household as well as corporate investment. In order to prepare a statewise time-series data on private agricultural investment that contain both the components, the study used both the data sets. While absolute values were taken from the country-level CSO estimates, the share of individual state is obtained from the RBI-NSSO data. In order to arrive at figures in the intervening years within each decade, each state's share was intrapolated between two decadal years, and extrapolated for 1991 onwards. This approach has its own limitations but can be justified on the ground that the nation-wide RBI-NSSO surveys are reported to be the basis for preparing the CSO estimates on private agricultural investment (EPW Research Foundation, 1997; Gulati and Bathla, 2001). In this way statewise investment data and related statistics were compiled for the period 1965-66-1998-99. The data set has been prepared for all the 17 major states, north-eastern states (NES) and Union Territories (UTs). For the sake of clarity we have classified the entire period into three sub-periods coinciding with the phases of agricultural development and changes in accounting classification in the public finance accounts. These periods were: (i) Period I: 1965-66-1973-74, which was characterised by the early Green Revolution period, (ii) Period II: 1974-75-1986-87, which was considered to be the Green Revolution period, and (iii) Period III: 1987-88-1998-99, which was viewed as saturation or the post-Green Revolution period. These three sub-periods also witnessed distinct patterns in agricultural investment.

Determinants of Agricultural Investment, Productivity and Rural Poverty

Identification of agro-climatic, socio-political, economic and institutional determinants of agricultural investment is very crucial, so that realistic policy prescriptions can be suggested. A meaningful analysis must involve a careful specification of all these variables, as well as causality relationships among investment, productivity and poverty in a systems approach.

Model specification

Considering the nature of agricultural production and resource allocation decisions in the planning process in India, it is realistic to assume that a set of socio-economic, political, institutional, and agro-ecological factors influences agricultural investments, productivity and rural poverty. In a democratic country like India, where political considerations sometimes overrule economic capacity, political-economy speci-

fication is perhaps appropriate. These factors have been used considerably in the recent years to study the determinants of agricultural growth and research investments (see Aron, 2000; Fox, 1987). Pal and Singh (1997) recently used political-economy model to explain the spatio-temporal changes in agricultural research and extension investment in India. The present study has further extended the model. Specific variables included in the model are discussed below.

Economic variables: Per hectare agricultural gross domestic product (AgGDP), per hectare public investment and per hectare private investment are important variables in this category. It is expected that the agricultural investment not only influences agricultural productivity growth and hence poverty alleviation, but also the investment itself gets influenced by agricultural growth. Agricultural investment has direct effect on poverty through employment generation and indirectly through growth in agriculture. We also expect some association between public and private investment in agriculture.

Economic-political variables: These variables are per hectare grants-in-aid received by states for agriculture, per hectare government revenue, per hectare subsidy, and terms of trade. Government's access to resources and the competing claims on the resources by various pressure groups are the important factors influencing public investment. While an improvement in government access to resources is expected to have positive influence on public investment, an increase in subsidy burden reduces the investible resources. However, input subsidies can have positive effect on the productivity, which, in turn, influences the private investment. The possible effect of input subsidy *per se* on rural poverty is not clear beforehand. However, it is expected to benefit the poor from the productivity gain. Another important variable in this category is the terms of trade. The administered price policies for a large number of agricultural commodities as well as the level of domestic protection enjoyed by different industrial and agricultural commodities have definite influence on the terms of trade. It is argued that agricultural growth and the flow of resources to agriculture would be encouraged by a favourable terms of trade as an incentive to investment. While the terms of trade may not be so important for public investment as it is not driven by profit motive, it is expected to induce private investment and hence productivity. An improvement in the terms of trade is expected to affect the poor in the short run, but it is also expected to benefit the poor in the long run through productivity gains.

Political-institutional variables: Rural literacy rate was included in the model to ascertain the effects of human capital on agricultural productivity, farmers' investment behaviour, and his ability to find a better job in the non-agricultural sector, thereby increasing his incomes which ultimately results into reduction in rural poverty. It is expected to accelerate adoption of new farm technology and to form farmers' interest group to influence allocation of public resources in favour of agriculture. The share of marginal holdings (per cent of net sown area) is another variable in this category representing the structure of the agrarian economy. But its

impact on the productivity and poverty is rather vague. It is expected to have positive effect on agricultural productivity on the assumption that the small and marginal farms are more intensively cultivated. At the same time, it limits the scope for adoption of capital intensive technologies, such as farm mechanisation. Larger area under marginal holdings is also a proxy for more egalitarian distribution of land, which is expected to benefit the rural poor through greater access to land. Agricultural investment may also be influenced by the growth in population, which will increase the demand for food and its prices, which in turn, will induce more investment and raise agricultural productivity. Government can also allocate more resources to agriculture to meet the increase in the demand for food. However, population growth is likely to accentuate the incidence of rural poverty. Per hectare institutional credit to agriculture is another variable in this category which is expected to increase the private investment and agricultural productivity.

Technological-infrastructural variables: Agricultural productivity is highly dependent on the use of modern inputs and rural infrastructure development. The important technological variables are high-yielding variety (HYV) seeds and chemical fertilisers. Since these two variables are highly correlated, their effect as well as those of other technological variables (like crop management) is captured through cropping intensity. Rural infrastructural variables included in the model are density of rural road and market, irrigation intensity, and extent of available storage facility. However, the effect of irrigation is probably captured by the variable cropping intensity. Some of these infrastructure variables, particularly roads, markets and village electrification are expected to have direct impact on rural poverty.

Agro-ecological variables: Weather is an important determinant of agricultural production, particularly in marginal areas having high incidence of rural poverty. Year-to-year and intra-year fluctuations in rainfall cause intermittent and prolonged drought leading to either crop failure or drastic fall in crop yields in many parts of the country (Roy and Shiyani, 2001). Moreover, the pattern of rainfall varies considerably across districts even within the state. To take care of these factors a rainfall (deviation) index is included in the model as a proxy for agro-climatic variables. The index of zero is taken as normal and is measured as follows:

$$R_{jt} = \sum_{i=1}^{n} (R_{jit} \times W_i/W_j)$$

where $R_{jit} = |\{(A_{jit}-N_{jit})/N_{jit}\}| \times 100$,

R_{jt} = Rainfall index of j-th state in t-th year,

A_{it} = Actual rainfall in i-th district in t-th year,

N_{it} = Normal rainfall in i-th district in t-th year,

W_i = Net sown area of the i-th district in j-th state,

W_j = Net sown area of j-th state,

n = Number of districts in j-th state.

Model estimation

Agricultural productivity, rural poverty and investment at any point of time are the outcome of complex, multiple decision-making processes. Some factors are determined by the economic system, while others are political or purely exogenous. Further, within the economic variables, e.g., investment and productivity, principles of multiplier and accelerator operate simultaneously, and thereby making a significant impact on poverty. Therefore, we consider it appropriate to model agricultural productivity, investment and rural poverty in a simultaneous equation system. This approach has the added advantage of helping to identify any weak links between investment and productivity and between investment and poverty. The model includes four endogenous variables, namely, per hectare AgSDP (PROD), per cent of rural population below poverty line (POVR), per hectare public agricultural investment (PUBINV), and per hectare private agricultural investment (PVTINV). The structural form of the complete system is given in equations (1) to (4), and the exogenous variables are defined below:

$$PUBINV_t = f(PROD_{t-1}, SUBSG_t, GOVREV_t, GRANTS_t, POPGR_t, LITR_t) \quad ....(1)$$

$$PVTINV_t = f(PUBINV_{t-n}, TOT_t, CREDIT_t, LITR_t, SUBINP_t, POVR_{t-1}, PROD_{t-1}, POPGR_t, MARGINAL_t, ROAD_t, MKT_t, VE_t) \quad ....(2)$$

$$PROD_t = f(PUBINV_{t-n}, PVTINV_{t-m}, RAIND_t, POPGR_t, LITR_t, MARGINAL_t, TOT_t, CI_t, VE_t, MKT_t, ROAD_t, STORE_t, CREDIT_t, SUBTOT_t) \quad ....(3)$$

$$POVR_t = f(PROD_{t-1}, PUBINV_{t-1}, PVTINV_{t-1}, POPGR_t, MARGINAL_t, LITR_t, VE_t, TOT_t, RDEXP_t, ROAD_t, MKT_t, VE_t, CREDIT_t, SUBTOT_t) \quad ....(4)$$

The subscript 't' represents the t-th year and 'n' and 'm' are the length of lags for public investment and private investment respectively. Appropriate lag lengths for these two key variables were determined using adjusted R^2 criteria of the concerned equation. A lag of six years for public investment and one year for private investment gave the best fit to our model. These lags are also consistent with some of the earlier studies (Rangarajan and Kannan, 1994).

Definition of variables

SUBSG = State Government agricultural subsidy (Rs./ha),
SUBINP = Total input subsidy (Rs./ha),
SUBTOT = Total subsidy (Rs./ha),
GRANTS = Grants for agriculture received from the Union Government (Rs./ha),
GOVREV = Government revenue (Rs./ha),
RDEXP = Total expenditure under poverty alleviation programmes (Rs./ha),
CREDIT = Institutional credit to agriculture sector (Rs./ha),

TOT = Terms of trade: ratio between agricultural and non-agricultural GDP deflator (per cent),
LITR = Rural literacy (per cent),
POPGR = Population growth rate (per cent),
MARGINAL = Per cent area under marginal holdings (per cent),
VE = Village electrified (per cent),
ROAD = Road density (km per thousand hectare),
MKT = Rural market density (number of markets per thousand hectare),
STORE = Storage capacity (tonnes/ha),
CI = Cropping intensity (per cent),
RAIND = Rainfall deviation index (per cent).

All monetary variables in the model are at 1980-81 prices and the unit per hectare means per hectare of net sown area. The investment series at 1980-81 prices have been prepared by deflating the current price series by implicit price deflator used by the CSO for capital formation in agriculture sector. The interstate price variation, however, remains uncorrected in this procedure.[1] But the same is not true for AgSDP series. The real AgSDP are obtained by deflating the nominal series by state specific AgSDP deflator. Further, the variables are not converted into stock as cross-section data are included, and the focus of this study is not on precise computations of rates of returns to investments.

The model was estimated pooling cross-section state-level and time-series data from 1970-71 to 1998-99. The pooling of data poses some estimation problem. Literature on the topic suggests two methods, namely, error component model (ECM) and dummy variable model (DVM). The choice between the two depends upon the number of cross-section units (N), the length of the time-series (T), and possible relationship between unmeasurable individual attributes and measurable time-varying attributes. In order to obtain efficient and consistent estimates, the ECM requires that $T \geq 3$ and $N-K \geq 9$, where K is number of parameters to be estimated, excluding dummy variables (Judge *et al.*, 1988). In our case $T = 34$, $N = 19$ and $K = 18$, i.e., $N-K < 9$. Also, some association between unmeasurable state attributes and time-varying attributes cannot be ruled out in our data set. Thus we find the DVM suitable for this study where state dummy variables are used taking Uttar Pradesh as control (base) since this is an average state in India, among all the states, with reference to agricultural productivity, investment and rural poverty. Another problem in the estimation was simultaneity bias. The Hausman Specificat-ion test is used to test the simultaneity between different pairs of endogenous variables. The test confirmed simultaneity between different pairs of endogenous variables, and therefore, the equations were estimated simultaneously using Two Stage Least Squares (2SLS) estimation procedure.

III

RESULTS

Trends in Public and Private Sector Investment in Agriculture: All-India

Our estimates of public and private investment in agriculture (hereafter new series), along with the CSO series on the public investment, at 1980-81 prices are presented in Table 1. The new series shows that the total public investment in agriculture steadily grew till 1984-85, except for abrupt changes in two years. In 1974-75 and 1975-76, there was a sudden rise in the investment mainly because of manifold increase in the investment on food, storage, co-operation, special area programmes and on other rural development programmes by the Union Government. The tempo, however, could not be maintained in the subsequent years and the investment registered a declining trend in the late eighties. The real investment came down from a peak of Rs. 49 billion in 1984-85 to Rs. 31 billion in 1989-90. The cause of this decline seems to be many. Important among them are the shift in emphasis in the Seventh Five Year Plan (1985-86-1990-91) away from agriculture, particularly towards industrial research and development (R & D) and communication; populist policies adopted by several State Governments made considerable inroads into the resources available for agricultural investments; and sharp protest by environmentalist groups against construction of large irrigation projects (Mishra and Chand, 1995; Gulati and Sharma, 1997). However, the declining trend in the public investment seems to have been arrested in the nineties, but it could not be restored to the levels of the early eighties. The estimates of private agricultural investment reported here pertain to the CSO definition of private investment. Unlike the public investment, private agricultural investment at constant prices showed a persistent growth, markedly since the mid-seventies, registering a more than three-fold increase in real terms during the last three decades. In fact, the growth in private agricultural investment, by and large compensated the decline in the public investment.

The gross under-estimation of public sector agricultural investment by the CSO is clearly evident from Table 1 as also from Figure 1. The figure and the table show that the CSO series on public investment in agriculture has limited coverage largely consisting of investment in irrigation. Attention to this fact has already been drawn by a few scholars (Rao, 1994; Chand, 2000). The working group on savings and capital formation under the chairmanship of K. N. Raj also pointed out at the gross under-estimation of public sector capital formation in agriculture (EPW Research Foundation, 1997). The ratio of CSO series to the new series varies from 2[illegible]47 per cent, indicating that the CSO series has under-estimated the public sector agricultural investment to the tune of 53 to 79 per cent. During the period 1965-66 to 1998-99, the public investment reported by the CSO covers only 37 per cent of the total public investment in agriculture. Another important feature is that while the CSO series on the public investment was rising till 1980-81 and followed a declining trend thereafter, the new series on the public investment reached peak level of investment

(Rs. 49 billion) in 1984-85 and declined thereafter. This negates the view that the declining trend in the public investment in the recent years is merely because of the limited coverage of the CSO series (Rao, 1997). The public investment for agriculture, which includes all major heads like rural roads, rural electrification, storage and warehousing, etc., has also declined. However, the rate of decline in the new series incorporating investment on these heads is comparatively less.

TABLE 1. PUBLIC AND PRIVATE SECTOR INVESTMENT IN AGRICULTURE AT 1980-81 PRICES: ALL-INDIA

(Rs billion)

Year	New series (Public)		Private investment	New series total	CSO series Public	Col. (6) as per cent of col.(2)	Col. (6) as per cent of col. (3)
	Irrigation	Total					
(1)	(2)	(3)	(4)	(5)=(3)+(4)	(6)	(7)	(8)
1965-66	10.20	19.96	16.29	36.25	8.49	83	43
1966-67	8.99	19.79	17.46	37.25	7.40	82	37
1967-68	9.46	22.94	19.76	42.70	7.38	78	32
1968-69	9.36	24.16	20.19	44.35	8.19	88	34
1969-70	9.06	21.27	21.98	43.25	8.18	90	38
1970-71	9.26	21.76	20.51	42.26	8.33	90	38
1971-72	10.53	22.75	21.58	44.33	9.01	86	40
1972-73	12.27	27.05	22.26	49.31	10.91	89	40
1973-74	10.03	22.00	23.20	45.19	10.32	103	47
1974-75	9.18	41.60	21.67	63.27	9.56	104	23
1975-76	10.21	52.08	24.72	76.80	10.84	106	21
1976-77	12.95	36.50	30.15	66.65	14.42	111	40
1977-78	15.65	36.70	26.77	63.47	16.04	102	44
1978-79	17.16	38.37	36.73	75.10	17.74	103	46
1979-80	17.44	45.00	35.64	80.64	18.50	106	41
1980-81	17.35	46.10	29.72	75.82	19.37	112	42
1981-82	18.12	48.22	28.65	76.87	18.97	105	39
1982-83	17.33	46.35	30.13	76.48	18.63	107	40
1983-84	17.48	48.11	25.28	73.39	19.01	109	40
1984-85	17.17	49.09	30.66	79.75	18.41	107	38
1985-86	16.01	47.22	30.04	77.26	16.57	104	35
1986-87	17.41	46.94	28.16	75.10	16.15	93	34
1987-88	14.49	37.06	32.02	69.08	15.76	109	43
1988-89	14.51	33.62	32.52	66.14	14.82	102	44
1989-90	14.02	31.48	34.90	66.38	13.01	93	41
1990-91	13.28	35.07	37.61	72.68	13.13	99	37
1991-92	13.18	34.83	40.77	75.60	11.35	86	33
1992-93	11.23	32.00	46.94	78.94	11.85	106	37
1993-94	13.64	40.01	43.02	83.03	12.99	95	32
1994-95	15.53	42.59	48.06	90.65	14.48	93	34
1995-96	13.15	34.15	56.77	90.92	14.44	110	42
1996-97	13.21	34.28	63.29	97.57	13.35	101	39
1997-98	14.43	36.56	64.12	100.68	12.56	87	34
1998-99	14.24	39.01	66.22	105.23	12.67	89	32
Overall (1965-66 to 1998-99)	461.52	1,214.61	1,127.79	2,342.40	452.84	98	37

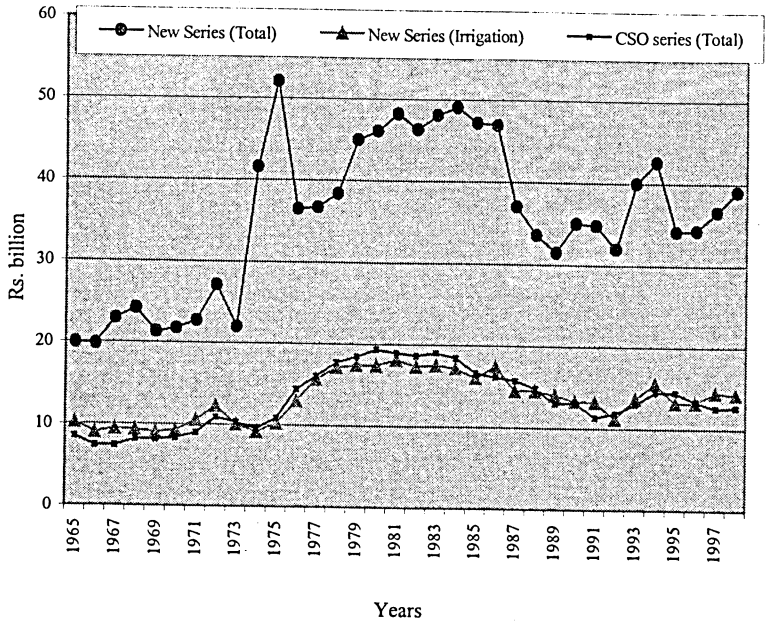

Figure 1. Public Sector Investment in Agriculture at 1980-81 Prices: All-India

Growth and Intensity of Agricultural Investment by States

The analysis is carried out using the state-level investment series at constant prices. For the sake of brevity, state-wise annual compound growth rates of the total investment and the intensity ratios (measured as per hectare real investment, and real investment as per cent of AgGDP) are computed and presented in Tables 2 and 3 for the three periods defined earlier.

Public Investment

Table 2 indicates that in nine out of 17 major states, the per hectare real public investment is lower than that for the country as a whole in all the three periods. These states are Andhra Pradesh, Bihar, Gujarat, Karnataka, Madhya Pradesh, Orissa, Rajasthan, Tamil Nadu, and West Bengal. On the other hand, Himachal Pradesh, Jammu and Kashmir, Kerala, Punjab, north-eastern states (NES) and Union Territories (UTs) have per hectare public investment higher than the all-India average in all the three periods. The per hectare public investment was the lowest in Gujarat in Period I and in Rajasthan in Periods II and III, whereas Jammu and Kashmir

showed the highest per hectare public investment closely followed by NES and UTs. These states enjoy special status and receive special central assistance for various agricultural development projects. Moreover, the size of the agricultural sector is relatively smaller in the otherwise resource rich UT. Thus funding agricultural investment does not face much constraints. The intensity of agricultural investment, measured as public investment in agriculture as per cent of AgGDP, showed a fluctuating pattern in all the states, except Jammu and Kashmir and Rajasthan. In general, the intensity of public investment was the highest in the second period.

TABLE 2. GROWTH AND INTENSITY OF PUBLIC INVESTMENT IN AGRICULTURE (AT 1980-81 PRICES) BY STATES

States	Investment (Rs./ha)			Investment as per cent of AgGDP			Growth rate (per cent)		
	1965-73 Period I	1974-86 Period II	1987-99 Period III	1965-73 Period I	1974-86 Period II	1987-99 Period III	1965-74 Period I	1974-87 Period II	1987-99 Period III
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Andhra Pradesh	146	190	240	6.11	6.22	5.06	-10.63**	3.72*	0.48
Assam	188	280	216	4.94	6.54	3.84	4.60	4.55*	-6.18*
Bihar	154	282	200	4.87	7.28	3.30	-1.39**	6.53**	-11.00*
Gujarat	91	221	244	5.09	7.68	7.46	3.72	-0.43**	1.56
Haryana	209	307	238	6.77	6.60	2.73	18.39*	4.16*	3.01
Himachal Pradesh	283	433	408	5.63	7.13	4.99	-3.29	1.09	0.00*
Jammu and Kashmir	333	1,293	1,369	6.79	18.60	19.08	6.87	0.37	0.88**
Karnataka	87	169	165	4.10	6.43	4.70	6.08***	2.08	5.28**
Kerala	188	387	340	3.04	5.87	3.60	-4.59**	1.89*	2.36
Madhya Pradesh	60	118	119	3.81	6.55	4.23	3.44	7.35**	-4.95
Maharashtra	155	358	367	10.92	16.18	9.78	10.27	1.11*	1.39***
Orissa	92	235	207	4.21	8.66	6.20	2.91*	6.15	-1.68
Punjab	291	811	543	7.78	14.81	4.97	0.24	2.04**	10.89**
Rajasthan	98	99	109	8.64	6.15	4.16	5.15	1.08**	2.91
Tamil Nadu	137	167	174	4.12	4.47	3.10	-3.61	0.16**	0.64
Uttar Pradesh	109	404	325	3.40	9.59	5.26	7.43**	4.14	0.11
West Bengal	143	202	206	3.03	3.46	2.08	3.94**	0.78	0.76**
North-Eastern States	201	950	1,132	5.05	20.21	18.44	10.29	7.93***	-1.08
Union Territories	307	1,005	1,007	5.20	12.37	10.87	3.06**	0.38**	-2.36*
Union Government	37	53	21	1.43	1.51	0.35	2.92**	-3.97	-0.95*
All-India	162	315	265	6.16	9.36	5.13	3.62**	1.64*	0.43*

***, **, * Significant at 1, 5 and 10 per cent level respectively.

The public investment in the country as a whole was 6.16 per cent of AgGDP during the first period, which rose to 9.36 per cent in the second period. However, it declined to 5.13 per cent in the third period. The contribution of Union Government to agricultural investment in the country was about 1.51 per cent of AgGDP in the second period, which drastically reduced to 0.35 per cent during the third period. This is a matter of serious concern as the Union Government's investments are, by and large, targeted to the backward regions and toward agricultural research and extension. Thus a fall in the Union Government's investment will have wider implications in the long run. Among the states, Maharashtra invests the highest proportion of AgGDP on agriculture in all the three periods. A decline in the investment intensity in the third period is observed for most of the states, particularly so in the case of Punjab and Haryana which were the front-runner states in terms of investment intensity till the early eighties. These two states are known as high productivity states, and thus there is a need for higher agricultural investment to sustain the productivity level. The investment intensity is particularly low in the eastern states, except Orissa, in all the three periods, with West Bengal remaining at the bottom. This should be corrected for faster development of these states. The declining trend in the public investment has, however, reversed in a number of states in very recent years.

The periodwise growth rates of the real investment do not indicate any consistent pattern. The growth of investment was positive for most of the states in the first period, except Andhra Pradesh, Bihar, Himachal Pradesh, Kerala and Tamil Nadu. For majority of the northern and western states, the growth was more than 4 per cent per annum and the growth was remarkably high in the states of Haryana (18.39 per cent), NES (10.29 per cent) and Maharashtra (10.27 per cent), whereas the growth was fairly high in Uttar Pradesh (7.43 per cent), Jammu and Kashmir (6.87 per cent), Karnataka (6.08 per cent) and Rajasthan (5.15 per cent). In the second period, most of the states showed positive growth in the public investment, but the Union Government's investment registered a sharp decline. The southern and eastern states have shown better growth in the public investment during the second period. However, in the recent period, the growth in the public investment became negative in the resource poor states, notably, Bihar, Assam, Madhya Pradesh and Orissa. This declining trend in these low productivity states is a matter of concern.

Barring few special category states, on the whole, there appears to be an unmistakable evidence of intensity of public investment in agriculture decreasing temporarily during the late 1980s and the early 1990s. However, our analysis with more recent data does not lend support to the view that 'all the states show declining trends' in public investment in agriculture as expressed by some researchers recently (Chand, 2000). On the contrary, a few states showed improved growth during the 1990s. However, for the country as a whole, there is deceleration in the growth of real public investment in agriculture.

Private Investment

Impressive growth in the real private investment is evident from Table 3. As seen from this table, private agricultural investment has shown considerable growth over time both in terms of intensity ratios and compound growth rates. The per hectare private investment in the recent period was the highest in UTs (Rs. 1,034) followed by Kerala (Rs. 591), Tamil Nadu (Rs. 564), and Himachal Pradesh (Rs. 531). The investment was extremely low in the eastern states, particularly in Orissa (Rs. 49), Assam (Rs. 59) and Bihar (Rs. 86). The investment was moderate in large states like Uttar Pradesh (Rs. 337), Madhya Pradesh (Rs. 313), Maharashtra (Rs. 311) and Karnataka (Rs. 409). This demonstrates wide variations in the intensity of private investment across the states. The investment intensity when measured as per cent of

TABLE 3. GROWTH AND INTENSITY OF PRIVATE INVESTMENT IN AGRICULTURE (AT 1980-81 PRICES) BY STATES

States	Investment (Rs./ha)			Investment as per cent of AgGDP			Growth rate (per cent)		
	1965-73 Period I	1974-86 Period II	1987-99 Period III	1965-73 Period I	1974-86 Period II	1987-99 Period III	1965-74 Period I	1974-87 Period II	1987-99 Period III
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Andhra Pradesh	64	197	216	4.20	5.45	5.85	-5.72*	3.55**	6.10**
Assam	142	119	59	4.60	2.89	2.34	-5.06**	-1.66*	1.66
Bihar	88	100	86	2.76	2.47	2.31	2.66**	-1.37	2.65**
Gujarat	273	237	183	10.92	8.55	9.12	-0.26	0.50	5.56**
Haryana	345	325	407	7.95	7.74	7.00	15.94**	-1.91	8.97**
Himachal Pradesh	563	258	531	7.75	7.79	7.70	14.98**	-3.38	6.87**
Jammu and Kashmir	132	219	146	3.98	3.32	4.36	-4.55	0.63	7.43*
Karnataka	173	190	409	10.10	10.37	12.67	-0.48	1.26	6.18**
Kerala	172	530	591	3.73	6.11	7.41	-1.74*	5.18**	5.85**
Madhya Pradesh	85	92	313	4.86	6.22	10.28	5.70**	1.62*	10.82*
Maharashtra	121	187	311	8.62	7.62	9.87	0.96**	2.58	8.93**
Orissa	48	45	49	2.64	1.80	1.97	-3.34	-0.74**	2.77*
Punjab	572	657	397	11.52	11.73	8.97	11.91**	-1.38**	9.45*
Rajasthan	78	129	272	6.70	7.56	10.04	3.77***	2.61**	10.06*
Tamil Nadu	269	331	564	8.73	9.79	10.57	0.91**	-0.12	7.22**
Uttar Pradesh	191	299	337	5.84	6.99	6.72	4.09**	1.12*	5.18*
West Bengal	120	144	147	2.14	2.51	2.04	6.69**	-0.29	7.06**
North-Eastern States	160	148	229	3.41	3.36	4.20	8.92**	0.22	6.91*
Union Territories	475	1,134	1,034	6.55	11.27	11.70	11.57***	3.61**	2.90*
All-India	154	202	288	5.60	6.08	6.75	2.98*	0.98*	7.44***

***, **, * Significant at 1, 5 and 10 per cent level, respectively.

AgGDP also revealed similar disparity between the states. The investment intensity in the eastern states was not only low but also showed very slow growth or stagnated over time. In contrast, the investment intensity continued to rise in the southern states which have achieved higher intensity in the first period itself. But the notable development is that all the states, irrespective of their size, are now showing increasing trend in private investment in agriculture. This indicates that the incentive for private investment in agriculture had improved during the post-liberalisation period. The periodwise growth rates indicate that for the country as a whole the private investment, in real terms, grew at the rate of 2.98 per cent during Period I. However, the series grew much faster in the recent years. After showing some deceleration in Period II, the private investment grew at a rate more than 7 per cent per annum. It is important to note that the growth of the private investment was low to moderate in the eastern states, except West Bengal, resulting in the low intensity. This coupled with low intensity of the public investment is expected to slow down agricultural growth in this region.

Composition of Agricultural Investment[2]

There has been a marked change in the composition of agricultural investment over time. The share of private sector in total agricultural investment, which was around 50 per cent in the first period, reduced to less than 40 per cent during the second period. However, impressive growth in private investment particularly in the post-liberalisation era and decline in the public investment during the late eighties raised the private sector's share at more than 60 per cent in the recent years. The composition of public investment in agriculture also underwent a fundamental change. Though irrigation projects continued to remain as the most important item of public sector investment in agriculture, the focus has been shifted away from major and medium irrigation projects towards minor irrigation. Rural infrastructure, particularly storage, market, road, electrification and credit institutions, claimed second largest share in the total public sector investment in agriculture. The share of these items went up from 22 per cent in Period I to 37 per cent in Period II. Thereafter, it suffered a minor setback possibly due to diversion of funds towards rural development programmes whose share has increased from 10 per cent in Period I to 24 per cent in Period III. On the other hand, allocation to other minor heads came down drastically from 20 per cent in Period I to only 4 per cent in Period III. Agricultural research and education received very little attention but the share is rising in the recent years.

Private sector investment in agriculture has two major sources of finance, household investment and private corporate investment. The share of corporate sector investment hovered around 60 per cent of the total private investment in all the three periods. Unfortunately, the components of private corporate investment are not published by the CSO. But in all probability it can be assumed that private corporate investments are directed to the items like private industries in seed, fertiliser,

pesticides, machinery and agro-processing as well as in plantations, dairying and poultry. The household sector investment can be grouped into five broad heads of expenditures, namely, land improvements, machinery and implements, irrigation structures, orchards, and farm buildings. There has been manifold increase in private household investment but the composition remained more or less unchanged except for a decline in the share of farm buildings from 12 per cent in Period I to 7 per cent in Period III. Farm machinery and implements is the largest single item of private household investment in all the periods with a share ranging between 44 and 47 per cent. The share of irrigation structures increased from 26 per cent in Period I to 30 per cent in Period III perhaps due to the incentives extended to this component in terms of power subsidy and subsidy for tubewells. The proportion of household investment in agriculture devoted to land improvements has declined from 16 per cent to 14 per cent during the same period.

Pattern of Agricultural Growth and Rural Poverty

Statewise triennium averages in the incidence of rural poverty and per hectare agricultural productivity (AgSDP/ha) at 1980-81 prices during three different points of time along with annual growth rate in agricultural output (AgSDP) during the 1990s are presented in Table 4. The idea is to see the regional pattern of agricultural growth and rural poverty. It can be seen from the table that there is considerable variability in the level of agricultural productivity as well as in the incidence of rural poverty across states. Punjab and Haryana, which were below Assam and Bihar in terms of per hectare agricultural productivity in the mid-1960s, showed remarkable performance and became the richest states in India. The performance of West Bengal and Kerala among high productivity states, and that of Rajasthan and Maharashtra among low productivity states also deserve special mention. On the other hand, NES and four of the major states Assam, Bihar, Orissa and Uttar Pradesh, which together account for nearly two-thirds of the rural poor in the country, fared very poorly both in terms of agricultural growth and poverty reduction. It can also be seen from the table that in 12 out of 17 major states as well as in the UTs and NES, the growth rate in AgSDP is lower than that for the country as a whole during the 1990s. More perturbing is the negative growth in AgSDP in Bihar, Orissa and UTs where the incidence of rural poverty is still one of the highest. And, if the present trends are to continue, the number of states going to experience negative growth in agriculture is more likely to increase (Roy and Pal, 2001). The possible addition, by the Tenth Plan period, to this group is likely to be Assam and other north-eastern states. This will further widen regional disparity in agricultural development and thus calls for immediate attention.

TABLE 4. LEVEL OF AGRICULTURAL PRODUCTIVITY AT 1980-81 PRICES AND INCIDENCE OF RURAL POVERTY: BY STATES

State	AgSDP (Rs./ha)			Rural Poverty (per cent)			AgSDP growth (per cent per annum)#
	1965-68	1980-82	1996-98	1965-68	1980-82	1996-98	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Andhra Pradesh	2,262	3,427	5,598	55.8	30.3	19.7	2.57
Assam	3,182	4,243	5,359	55.9	48.3	46.6	1.46
Bihar	3,007	4,059	4,855	70.2	64.1	58.9	-1.38
Gujarat	1,465	2,899	4,230	64.0	33.5	35.7	2.19
Haryana	2,924	5,004	10,007	46.6	22.9	23.9	2.87
Himachal Pradesh	4,620	6,334	9,435	30.4	23.5	26.9	2.47
Jammu and Kashmir	3,937	7,093	8,127	25.1	31.9	31.8	2.28
Karnataka	2,071	2,607	4,009	57.8	40.2	38.2	3.48
Kerala	5,576	6,806	10,965	77.1	43.2	21.1	4.33
Madhya Pradesh	1,262	2,022	3,175	62.5	53.5	44.4	3.18
Maharashtra	1,269	2,303	5,166	53.0	51.4	45.3	5.07
Orissa	1,773	2,982	2,685	71.8	69.2	59.8	-2.22
Punjab	3,005	5,699	11,160	36.8	14.3	12.0	2.97
Rajasthan	988	1,506	3,583	64.9	34.3	33.2	4.52
Tamil Nadu	3,008	3,480	6,091	68.7	55.1	34.5	2.93
Uttar Pradesh	3,247	4,398	6,577	57.1	46.9	48.9	2.47
West Bengal	4,915	5,407	12,165	65.4	64.8	44.5	5.06
North-Eastern States	3,481	4,699	6,064	74.6	48.6	48.9	1.82
Union Territories	5,341	8,580	9,214	22.2	35.1	33.4	-2.80
All-India	2,353	3,431	5,727	57.7	47.8	33.6	3.19

For the period triennium ending 1991-92 to triennium ending 1998-99. All the growth rates are statistically significant at 1 per cent level, except for Bihar (significant at 5 per cent level) and Union Territories (significant at 10 per cent level).

Determinants and Impacts of Agricultural Investment

The results of 2SLS model are presented in Table 5. The high R^2 values for all the four equations imply that the model is successful in explaining inter-state differences in agricultural investment, productivity, and rural poverty. With some exceptions, variables included in the models also have expected signs.

Determinants of public investment

The agricultural productivity, population growth, rural literacy, and government revenues and grants have positive and significant impact on the public investment in agriculture. This supports the proposition that population pressure induces productive investment in agriculture to raise the productivity level (Simon, 1977). The positive and significant coefficient for per hectare AgGDP also supports this proposition. This implies that a state which has strong demand for agricultural commodities, did provide more funds to support agricultural research, extension, and to other productivity enhancing items of investment such as irrigation, storage, road, market, etc. These results are not only consistent with similar studies on public funding of agricultural research (Huffman and Miranowski, 1981; Evenson and McKinsey,

1991; Pal and Singh, 1997), but also show that Griliches (1957) and Hayami-Ruttan's (1985) market-demand induced innovation hypotheses are also applicable to other productivity enhancing items of agricultural investment.

Rural literacy has a very strong and positive effect on public investment in agriculture. Government's access to resources has an expected positive and statistically significant effect on public investment in agriculture. Thus, *ceteris paribus*, the states with more revenue did spend larger amount on agricultural investment. The resources available from the Union Government, as grants-in-aid for agriculture, have also a strong and positive effect. In fact, its effect was much higher than that of the total revenue of the governments. This shows that increased allocation for agriculture by the Union Government was mainly spent towards capital formation in agriculture. The competing claims on the available resources are expected to have negative effect on agricultural investment. Thus the negative and statistically significant coefficient of per hectare subsidy burden of the states is consistent with our expectation. This supports the widely debated view that farm subsidies are crowding out the investment in agriculture (Rao, 1994; Gulati and Sharma, 1997).

Determinants of private investment

The 2SLS results for the private investment model show that it is highly dependent on the lagged values of the public investment. The positive and statistically significant coefficient for this variable, along with the results obtained from the Hausman Specification test for simultaneity (Roy, 2001), clearly confirms the complementarity between the public and private investment in agriculture. The findings are in variant with some recent observations based on the country-level CSO series that there is no relationship between the public and private investment in the long run (Mishra and Chand, 1995; Chand, 2000). These results support the view that the debate over complementarity has arisen due to limitation of the CSO data. If the public investment on all the major heads like irrigation, agricultural research and education, rural roads, rural electrification, storage and market are taken into consideration with appropriate lag, there is a strong case for the complementarity at the national as well as at the state level (Rao, 1997). As in the public investment model, the coefficient for agricultural productivity is positive and statistically significant in the private investment model. It is consistent with our assumption that the higher the level of productivity, the greater will be the surpluses available for investment. The incidence of rural poverty has negative and significant impact on the private investment. This means that the intensity of investment in agriculture is higher in the states with lower incidence of rural poverty. This is very logical as higher incidence of poverty reduces the surplus with the households for investment in agriculture. The positive and significant coefficient of rural literacy is also on the lines of our expectation. Education influences farmer's investment behaviour as it makes him aware about the possible benefits of investment as well as opportunities

for investment. The negative and significant coefficient of the area under marginal holdings is also expected as it limits the scope for farm mechanisation - the important item of private investment. Marginal farmers are also unable to invest much on farm assets. The terms of trade turned out to be an important and significant determinant of private investment in agriculture as it acts as an incentive for raising productivity through higher investments. A strong and positive coefficient for per hectare input subsidy in agriculture is an interesting finding. It challenges the contention that agricultural subsidies in general are bad for investment in agriculture. There is no denying the fact that the subsidies compete for public resources, but subsidies, particularly input subsidies, have very strong and positive influence on the private investment. However, non-significant coefficient of per hectare institutional credit to agriculture is contrary to our expectation. A possible explanation for this may lie in the component of the private corporate investment, which contributes nearly 60 per cent of the total private investment in agriculture. But our credit variable does not include the institutional credit advanced to such corporate bodies. Thus under-estimation of agricultural credit variable might have resulted in statistically non-significant coefficient. The positive and significant coefficient for rural road clearly indicates that an improvement in rural infrastructure does induce private investment in agriculture. It was difficult to estimate the model with other infrastructural variables as hypothesised, namely, extent of village electrification and rural market density because of multicollinearity problem. Therefore, the model was estimated excluding these two infrastructural variables.

Determinants of agricultural productivity

The results presented in Table 5 (column 4) for the per hectare AgGDP model indicate that all the coefficients, except for rural road density, have expected signs and are statistically significant. Both the public and private investments are significantly and positively related with agricultural productivity. This supports the for higher rate of agricultural growth, and further make a strong case for increased hypothesis that the higher rate of capital formation in agriculture lays the foundation investment in agriculture. The growth in rural population has a positive and highly significant effect on agricultural productivity. The positive effect was expected on the ground that an increased growth in rural population raises the demand for agricultural commodities. This increased demand, coupled with widespread unemployment, necessitates more intensive farming, raising the productivity. The effect of other institutional variables, namely, rural literacy and proportion of area under marginal holdings, are positive and statistically significant. Education helps capitalise on new technologies for higher productivity, whereas improved input use efficiency leads to higher productivity on marginal farms. It is expected that rural infrastructure has a positive effect on agricultural productivity. This did not seem to be the case with rural road density; its effect on agricultural productivity turned out to be negative, but

TABLE 5. 2SLS ESTIMATES FOR THE SIMULTANEOUS EQUATION MODEL

Variables	Equations			
	PUBINV	PVTINV	PROD	POVR
(1)	(2)	(3)	(4)	(5)
Intercept	4144.952***	-272.164***	-1304.541	57.872***
	(11.147)	(3.567)	(1.276)	(15.296)
PUBINV		0.089***	0.837**	-0.006
		(3.368)	(2.182)	(0.365)
PVTINV			0.997***	-0.009***
			(2.763)	(3.002)
PROD	0.033***	0.007**		-0.006*
	(3.831)	(1.977)		(1.925)
POVR		-1.950***		
		(3.367)		
POPGR	42.561***	2.836	166.236***	0.784**
	(3.393)	(0.377)	(3.096)	(1.987)
LITR	1.979***	0.308*	7.633***	-0.079***
	(7.409)	(1.673)	(5.843)	(6.426)
MARGINAL		-3.794**	75.256***	-0.683***
		(2.295)	(6.141)	(5.951)
GOVREV	0.007***			
	(3.688)			
GRANTS	0.526***			
	(3.673)			
SUBSG	-0.169***			
	(4.0647)			
SUBTOT			0.509**	0.003
			(2.413)	(1.532)
SUBINP		0.181***		
		(7.167)		-0.172***
RDEXP				(5.341)
TOT		4.206***	20.770***	0.115***
		(6.022)	(4.059)	(5.908)
CREDIT		0.072	1.975***	-0.016***
		(1.127)	(4.986)	(4.264)
ROAD		4.171***	-4.179	-0.091*
		(5.818)	(0.810)	(1.905)
CI			8.861*	
			(1.949)	
STORE			14.245***	
			(5.595)	
RAIND			-30.745***	
			(10.403)	
Andhra Pradesh	-327.484***	-118.071***	-50.011	-19.931***
	(7.409)	(3.854)	(0.173)	(9.406)
Assam	316.537***	-195.350***	886.807***	1.277
	(5.849)	(7.592)	(4.407)	(0.684)
Bihar	182.954***	-185.602***	-9.111	15.157***
	(4.023)	(7.935)	(0.053)	(9.281)
Gujarat	-601.485***	-102.912**	430.263	-20.784***
	(8.748)	(2.553)	(1.116)	(7.370)
Haryana	-178.115***	37.459	1,457.356***	-32.051***
	(4.587)	(0.872)	(5.251)	(11.450)
Himachal Pradesh	488.000***	117.936***	2,862.572***	-16.035***
	(7.107)	(3.490)	(10.016)	(7.295)

(Contd.)

TABLES 5 *(Concld.)*

Variables (1)	Equations			
	PUBINV (2)	PVTINV (3)	PROD (4)	POVR (5)
Jammu and Kashmir	578.174*** (12.305)	-109.544*** (3.486)	2607.136*** (11.787)	-7.766*** (3.395)
Karnataka	-528.528*** (9.058)	-20.292 (0.566)	140.753 (0.388)	-14.210*** (5.528)
Kerala	27.919 (0.625)	89.543* (1.896)	1545.745*** (4.634)	-16.144*** (5.019)
Madhya Pradesh	-206.583*** (4.738)	-146.660*** (3.993)	-448.229 (1.301)	-7.025*** (2.577)
Maharashtra	-636.853*** (7.609)	-165.761*** (4.257)	-206.479 (0.516)	-6.723** (2.387)
Orissa	254.262*** (4.926)	-242.232*** (9.432)	-802.705*** (4.197)	13.562*** (7.262)
Punjab	-125.798** (2.428)	238.334*** (4.640)	1742.100*** (5.071)	-42.992*** (13.095)
Rajasthan	-207.314*** (4.648)	-134.674*** (3.147)	-370.466 (1.058)	-26.147*** (9.007)
Tamil Nadu	-768.758*** (11.626)	39.071 (1.611)	-475.377** (2.170)	6.600*** (3.873)
West Bengal	-551.895*** (10.804)	-163.452*** (5.681)	1,585.126*** (8.112)	18.904*** (9.960)
North-Eastern States	681.741*** (16.512)	-377.344*** (8.074)	1,302.916*** (3.996)	13.511*** (3.940)
Union Territories	-2,334.613*** (8.371)	-337.111** (2.508)	3,585.051*** (4.036)	-1.337 (0.149)
Adjusted R^2	0.832	0.898	0.941	0.846
F-value	110.10***	174.85***	292.09***	105.58***
D-W statistics	1.857	1.815	2.081	1.861

***, **, * Significant at 1, 5 and 10 per cent level respectively.
Figures in parentheses are 't' values.

statistically non-significant. This might be due to the fact that though the density of road is higher in many states, particularly where agriculture is less developed (Fan *et al.*, 2000), the quality of roads is very low (Government of India, 1998). However, the other infrastructural variable, per hectare storage capacity, has a positive and

highly significant coefficient. Rural market and electricity consumption variables could not be included in the model because of multicollinearity problem with storage and rural literacy variable respectively. The effect of irrigation infrastructure and modern seed-fertiliser technology was captured through cropping intensity, which has a positive and significant coefficient. This also points out the untapped potential of the low productivity states which can be exploited through increased adoption of these technological variables. Agricultural subsidy has a positive and significant impact on agricultural productivity, thereby challenging the claims that agricultural subsidies are wasteful expenditure (Gulati and Sharma, 1997). The findings thereby are consistent with some of the earlier findings that subsidies are very powerful in stimulating agricultural growth (Sirohi, 1984; Sirohi *et al.*, 1984). The terms of trade are found to be another important determinant of agricultural productivity; its positive and highly significant coefficient indicates that the favourable terms of trade has raised agricultural productivity. It is a known fact that Indian agriculture was not protected throughout the plan periods. But in the process of economic liberalisation the favourable terms of trade had contributed to increase in agricultural productivity significantly. Also, as expected, the per hectare institutional credit to agriculture, exerted positive and significant impact on agricultural productivity. Our results indicate that weather is still an important determinant of agricultural productivity in India. Year-to-year fluctuations in rainfall were associated with lower agricultural productivity. A positive and highly significant coefficient for the rainfall variable (per cent deviation from normal rainfall) indicates that long-term average productivity is considerably lower in the states prone to drought and/or flood.

Determinants of rural poverty

The estimated poverty equation shows that while private investment in agriculture has played a very significant role in reducing rural poverty in India, the same is not true for the public investment. Agricultural investments affect rural poverty directly and indirectly. While the indirect effects arise mainly through gain in agricultural productivity, direct effects arise through wage earnings opportunities of such investments. The results revealed that increased public investment in agriculture did not have significant direct impact on poverty reduction, though it promoted agricultural productivity. The finding is consistent with another recent study where it was observed that government expenditure in agriculture does not directly reduce poverty (Fan *et al.*, 2000). An improvement in agricultural productivity has a significant impact on reducing rural poverty. This supports the view that agricultural growth as such contributes to the reduction of rural poverty possibly through raising employment and wages. Also, increased marginalisation of land holdings and its positive effect on productivity might have led to lower incidence of poverty. The result is consistent with our experience with Punjab, Haryana, and other states where poverty has declined considerably after appreciable growth in agricultural

productivity. It is evident from the results that population growth is a major drag on the efforts to reduce rural poverty. This is why the poverty is so deepening in the states like Bihar, Orissa, Assam and NES compared to Kerala. In the situation of inadequate growth in employment opportunities, higher rate of population growth will aggravate the problem of unemployment thereby increasing the incidence of rural poverty. As expected, the coefficient for rural literacy was found to be negative and highly significant. This implies that education is one of the most effective instruments in reducing rural poverty. This reaffirms Amartya Sen's argument of empowering rural masses in order to eradicate rural poverty, and also is consistent with development experience of Kerala (Sen, 1997). It is not at all surprising that the estimated coefficient for terms of trade is positive and statistically significant at 1 per cent level. Since most of the rural poor are net buyers of agricultural produce, the positive sign of the estimated parameter is justified. Similarly, the positive coefficient (though non-significant) for agricultural subsidy requires cautious interpretation. Subsidies, *per se*, do not promote equity. But when their indirect benefits are measured through productivity gain and reduction in food prices, the net effect is substantial. Poverty alleviation through rural development programmes has been a strategy of the government. Therefore, a negative and statistically significant coefficient of the expenditure on rural development programmes is expected. The results, thus, justify continuation of public expenditure on rural development programmes for poverty alleviation. The development of rural roads and increased credit flow to agriculture are also associated with the lower poverty ratio. While roads help people reach new job, access to institutional credit reduces dependence on village moneylenders and helps the unemployed to get self-employed.

The coefficients of most of the state dummy variables are significant in all the models, indicating the importance of unmeasurable state attributes. These coefficients can be explained taking Uttar Pradesh as base. Significant coefficients for the dummy variables for states in all the four models lend a very strong support to our analysis using state-level data.

IV

CONCLUSION

The new series on the public and private investments by states, constructed for the period 1965-66 to 1998-99, includes all possible items of investment relevant for the agricultural sector. A comparison of the CSO series with our series indicates a gross under-estimation of the public investment in the CSO series. For many years, it does not even cover the actual investment on irrigation alone. However, the new series also indicates a decline in public capital outlays for agriculture since the mid-1980s, and the decline is not confined to investment in irrigation projects alone. On the whole, there are evidences of decline in the intensity of public investment in the 1980s, though there are enough indication that the declining trends are now being arrested and public investment in agriculture again started to rise in most of the states,

except UTs, NES and some states of the eastern India. In contrast to the public investment, the private investment continued to rise in all the states, albeit at varied pace. This is more so in the post-liberalisation period. But the intensity of agricultural investment, both public and private, has been uneven across the states and it is particularly low in Rajasthan, Madhya Pradesh, Karnataka, Bihar, Orissa and Assam.

Few important policy conclusions can be drawn from the findings of this study. First, agricultural productivity growth is central to alleviating poverty, and infrastructural and technological changes are, in turn, central to this process. This requires not only changes in institutional policies but also to enhance public and private investment in agricultural research and rural infrastructure, including roads, markets, storage and irrigation. Because of the constraints of inadequacy of capital, the investment patterns in agriculture will inevitably have to be a blend of public and private investments. While the private investment has been the principal source of agricultural growth, particularly in the recent past, and will continue to be so in the future, the public investment is essential to correct certain existing infirmities and to impart added dynamism to this sector (Government of India, 1998). Second, investment is a better instrument than subsidisation. This does not necessarily mean that agricultural subsidies are wasteful expenditure. What the result shows is that marginal benefit from one rupee investment in agriculture is higher than spending it on subsidy. But our analysis showed that subsidies have very strong positive influence on private investment and productivity. Since public investment in agriculture has larger productivity enhancement effect than subsidy, as evident from their coefficients in the productivity equation, the State Governments should restrain themselves from diverting resources to subsidise agriculture at the cost of more productive investments. However, just reducing the subsidy will not serve any purpose. The entire exercise is not merely a matter of reducing subsidy burden but also of effective deployment of resources. The reduction in subsidy will have to be planned in a judicious manner in view of the various sensitivities involved. The planners need to ensure that the additional savings from reduction in the subsidy bill will be ploughed back as investment in agriculture. Without this it will have a regressive effect on agricultural productivity and rural poverty. At the same time, whatever subsidies to be provided it should be targeted to the poor and to backward regions, where productivity is very low and farmers are unable to invest more in agriculture. Third, the role of human capital and agrarian reforms are critical, as these have direct and indirect effect on agricultural productivity and rural poverty. Fourth, recognising the fact that an immediate increase in the public sector investment may not be possible because of fiscal austerity measures adopted by the governments, the stress must be on increase in the private investment. For this, incentives like terms of trade must be made favourable for the private investment. In the short run, it may harm the rural poor but the benefit from productivity growth will compensate them in the long run. Targeted subsidies will also protect the poor from an increase in the terms of trade. Finally, it is important that the gains of agricultural productivity are

equitably distributed across the regions in order to promote social justice. These require that resources for agricultural development should be allocated in such a manner that these help achieve balanced growth of different states. The incremental capital will give higher return in the eastern and southern states as compared to the northern and western states. These states would require special emphasis, because of their higher capital use efficiency (Roy and Pal, 2001), high incidence of rural poverty and untapped potential for agricultural developments (Government of India, 1998). Thus allocation of incremental investment to the eastern and southern states would generate larger efficiency and equity benefits.

A beginning can perhaps be made with evolving a series of short and medium-term strategies that would easily merge into a long-term policy framework mostly guided by emerging economic scenario. The overall national goal should be to firmly move towards household food and nutritional security. There are five things that could have a profound impact on the future of rural India. First, India needs to give a big push to public investment in agriculture. This can happen only if there is larger devolution of resources to the states for agricultural development, and a good sense of economic rationality prevails with the states to check populist measures. Once the public investment is ensured, the private investment will definitely follow it. Second, India has been faltering on its commitments to the rural poor and backward regions. There are ample evidences that both regional disparity in agricultural development and disparities in income and land distribution across classes have increased over time (Ahluwalia, 2000 and Kurian, 2000). Investment in the backward states has greater productivity-enhancement effect than investment in the favoured regions, since the scope for productivity growth and poverty reduction in the backward states is now greater (Roy, 2001). Therefore, the investment must be strategic to ensure balanced regional development. Third, it is time to have a serious thinking on the national population policy. The government, so far, remained soft on this aspect. The high rate of population growth has virtually taken away the gains of the productivity growth and became a drag on the efforts to reduce rural poverty. Fourth, in view of the impact of human capital on agricultural productivity and poverty alleviation, the emphasis on rural literacy programme is of paramount importance. An agrarian economy cannot be vibrant unless it is supported by strong human capital. Development literature worldwide and our experience with Kerala, Himachal Pradesh, Punjab and Haryana support this. Finally, land reforms now need to be pursued seriously. The results of this study clearly show the potential impact of an egalitarian distribution of land on the growth of agricultural productivity and reduction of rural poverty.

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NOTES

1. This is a limitation with the present study and assumes markets are integrated across states. The best way is to use state-level deflator for items of capital formation in agriculture, which is not available. An alternative could be use of state-level NSDP deflator, though the inter-sectoral price variation remains uncorrected. The same was also tried but it failed to bring any significant change in the estimates.

2. For details, see Roy (2001).

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