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Impact of Investment on Agricultural Growth and Rural Development in Himachal Pradesh: Dynamics of Public and Private Investment

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I

INTRODUCTION

In India, agriculture is an integral part of general development system still supporting the heavy burden of working population (65 per cent) despite its declining share (19 per cent) in the gross domestic product (GDP). Slow growth in agricultural sector has become a major concern as it has profound implications on the other sectors of the economy. To overcome this inertia in agriculture, a need is felt that public and private sectors should learn to join together and assist in the overall economic development. Agricultural development is necessary for two reasons, as a source of raw materials for industries and food for people, respectively (Government of India, 1959, Anderson and Lorch, 1994) and as a means to achieve the goals of employment-led economic growth, poverty alleviation and self-reliance (Johnston, 1997; Desai and Namboodiri, 1998). Sustained agricultural growth, therefore, has been a central theme of our developmental planning since Independence, for simultaneously enhancing both availability of and access to food. In this context, Government of India (1998) observed that while private investment has been the principal source of agricultural growth, particularly in the recent past, and will continue to be so in future, public investment is essential to correct the existing infirmities and to impart added dynamism to this sector. Undoubtedly, poverty alleviation depends ostensibly on increasing agricultural productivity particularly among small farmers, and investment in agriculture has a major role to play (Alagh, 1997; Anderson and Lorch, 1999; Roy and Pal, 2002).

Realising the importance of investment, a number of studies have looked into *inter alia*, the trend, impact and complementarity between public and private investment. A substantial investment in agricultural sector during early 1960s that ushered in green revolution has paid off handsomely (Mishra, 1997). But, studies have observed that there has been a decline of public investment in agriculture during

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1980s' (Gulati and Bhide, 1993; Bhagwati and Srinivasan, 1993; Shetty, 1990; Kumar, 1992; Mallick, 1993; Chand, 2001). Public investment in agriculture has continuously declined even during 1990s', while private investment has increased persistently (Gandhi, 1996; Dhawan and Yadav, 1997; Namboodiri, 1998; Singh, 1997; Chadha and Sharma, 2005) though it has not fully compensated for the loss from falling public investment (Braun *et al.*, 2005). In juxtaposition to this pattern, few studies confirmed complimentarity between public and private investment in agriculture (Wagle, 1994; Dhawan and Yadav, 1995; Jairath and Purohit, 1996; Dhawan, 1996; Karmakar, 1998; Gulati and Bathla, 2002). A number of studies on investment in Indian agriculture have been researched at the country level, however, investment estimates of these studies are subjected to debate for their limited scope and narrow coverage of public sector agricultural investment as well as for ignoring the two way causation between investment, productivity and other macro-variables (Dev, 1997; Gulati and Bathla, 2001; Chand, 2001). Moreover, the results of behaviour of agricultural investment at the country level is of little utility to hill states like Himachal Pradesh, as the hill agriculture is entirely different from that of plains due to several mountain specificities. Therefore, an attempt has been made in this paper to investigate the behaviour of investment in agriculture and its impact on agricultural growth and poverty alleviation in Himachal Pradesh.

II

DATA AND METHODOLOGY

Nature and Sources of Data

An attempt was made in this study to construct broad series of public and private investment in agriculture by taking into account all important heads of investment for a period from 1969-70 to 2001-02 divided into three sub-periods, viz., Period-I (1969-70 to 1979-80) corresponds to Green Revolution Phase, Period-II (1980-81 to 1990-91) corresponds to Post-Green Revolution Phase and Period-II (1991-92 to 2001-02) corresponds to Post-Reform Phase for clarity and comparative study. Secondary data on various items of public investment was obtained from Financial Accounts of the State Government. Data relating to state level private investment in agriculture have been obtained from different issues of *All India Debt and Investment Survey Reports*. Since, this survey is conducted by Reserve Bank of India (RBI) in collaboration with National Sample Survey Organisation (NSSO) periodically at decennial intervals, the figures in the intervening years were arrived at by interpolating each variable between two decades following the approach advocated by many past studies (Roy and Pal, 2002; Chand, 2001; EPW Research Foundation, 1997). The secondary data with respect to various development indicators were collected from various published and unpublished sources like *Annual Draft Plans*, *Statistical Outline of Himachal Pradesh, Economic Review of Himachal Pradesh, Economic Survey of Himachal*

Pradesh, State Statistical Abstract of Himachal Pradesh, Fertiliser Statistics of India and UCO Bank Agenda Papers, etc.

THE MODEL: STRUCTURAL FORM AND SPECIFICATION

It is difficult to capture the complex phenomenon of rural development within a single equation approach (Van De Walle, 1985, Bell and Rich, 1994). To overcome the limitations of simultaneous bias of the single equation approach and to capture and quantify the direct as well as indirect effect of fiscal measures in agricultural growth and poverty reduction, a simultaneous equation model was developed in this study. Two Stage Least Squares (2SLS) procedure was employed to estimate the model. The model consists of five endogeneous variables, namely, per hectare public agricultural investment (PBINV), per hectare private agricultural investment (PRINV), per hectare agricultural gross domestic product (AGDP), per cent of rural population living below poverty line (POVT), and per cent of population engaged in non-farm employment. **S**tructural form of the complete system is given in equation (1) to (5).

$$PBINV_t = f(AGDP_{t-1},\ SUBS_t, SGDP_t, LIT_t, POP_{t-1},\ GRNTS_t) \quad \ldots.(1)$$

$$PRINV_t = f(PBINV_{t-6}, AGDP_{t-1}, TT_t, LIT_t, POVT_t, PCI_t, POP_{t-1}, MF_t, ROAD_t) \quad \ldots.(2)$$

$$AGDP_t = f(PBINV_{t-6}, PRINV_{t-1}, LIT_t,\ MF_t, POP_{t-1}, CI_t, HYVs_t, RDI_t, IR_t,) \quad \ldots.(3)$$

$$POVT_t = f(AGDP_{t-1}, PBINV_{t-6}, PRINV_{t-1}, NEMP_t, MF_t, RUDI_{t-5}, ALW_t, LIT_t, CRD_t, TT_t, POP_{t-1}) \quad \ldots.(4)$$

$$NEMP_t = f(AGDP_{t-1}, SOIL_{t-6}, RUDI_{t-5}, LIT_t, ROAD_t, IRI_{t-1}) \quad \ldots.(5)$$

Long lead time is required in transforming investment into productive capital asset (Fan *et al.*, 2000). Therefore, lags of investment were used (instead of current figure) to capture their lag lead time. Adjusted R^2 criterion was employed to find out appropriate lags of investment. Lags, which gave improved adjusted R^2 were used for estimation of the model.

Where,

PCI = Per capita income (Rs./annum)
ALW = Agricultural labour wages (Rs./day)
SOIL = Investment on soil and water conservation (Rs./ha)
IRI = Investment on irrigation and flood control (Rs./ha)
RUDI = Investment on rural development (Rs./ha)
GRNTS = Grant from central government (Rs./ha)
SUBS = Fertiliser subsidy (Rs./ha)
SGDP = State gross domestic product (Rs./ha)

TT = Terms of trade= ratio of agricultural and non-agricultural GDP deflators (per cent)
LIT = Literacy rate (per cent)
MF = Area under marginal holdings (per cent)
CRD = Institutional credit to agriculture (Rs./ha)
POP = Growth in population (per cent)
POVT = Population living below poverty line(per cent)
CI = Cropping intensity (per cent)
HYVs = Area under HYVs (ha)
IR = Irrigated area (per cent cropped area)
ROAD = Road density (Km/000sqkm)
RDI = Rainfall deviation index (per cent)

The rainfall deviation index was measured as under:

$$RDI = \sum_{i=1}^{n} (R_{it} x W_{it} / W_t)$$

Where,

R_{it} = $\{(A_{it} - N_{it})/N_{it}\}$ x 100
RDI = Rainfall deviation index in t-h 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_{it} = Net sown area of i-th district in t-th year,
W_t = Net sown area of the state in t-th year,
n = Number of districts in the state.

Identification and a careful specification of all these variables as well as cause-effect relationship among investment, productivity and poverty in a system approach is essential for a meaningful analysis to reach at realistic conclusions. Agricultural investment has direct effect on the upliftment of rural masses through employment generation and indirectly it affects poverty through growth in agriculture. Moreover, investment could itself be generated by increasing agricultural output with more efficient use of presently available resources. Improvement in gross domestic product was expected to have positive influence on public investment while increase in various subsidies possibly has negative effect on agricultural investment. Grants from the central government improve access of state government to more resources, which was also expected to improve public investment in agriculture. An improvement of prices of agricultural commodities in relation to non-agricultural commodities may attract more private investment in agriculture. Therefore, terms of trade variable has been included in the model. Improvement of agricultural labour wages and in turn per capita income improves the financial position of rural masses and those living below

poverty line. Increase in per cent area under marginal holdings may hinder use of machinery and big implements, which are the major items of private investment but from management point of view, it was expected to enhance the productivity by more intensive cultivation. Further, greater access to a piece of land was also expected to benefit the poor. Per hectare institutional credit was expected to increase the private investment and agricultural productivity through pumping more purchasing power among rural poor. Literacy rate was included in this model to capture the effects of human capital formation on agricultural productivity, ability to find jobs in non-agricultural sector and investment behaviour *per se*. Population growth was expected to have both negative and positive impact on productivity and investment. However, population growth is likely to accentuate the incidence of rural poverty due to increasing pressure on land. Agricultural productivity could be increased if agriculture is put on scientific lines, which requires use of modern inputs and rural infrastructure, therefore, cropping intensity and area under HYVs and per cent irrigated area were included in this model to capture the impact of technology and irrigation infrastructure on productivity. Weather is an important determinant of agricultural production. Around 82 per cent of cropped area in Himachal Pradesh is rainfed. Moreover, the pattern of rainfall varies considerably across districts within the state. Therefore, rainfall deviation index was included in the model as a proxy for agro-climatic variables. Construction of check dams, water harvesting structures, irrigation projects and rural development schemes provide employment opportunities to rural masses. Hence, investment on soil and water conservation, rural development and irrigation and flood control were specified separately in the model to capture their effect on non-farm employment. Road infrastructure was expected to improve non-farm employment through increasing connectivity of villages to near by towns and cities.

Marginal Impact of Investment

In order to find out the effect of additional investment on poverty, agricultural GDP, non-farm employment and private investment, elasticities and marginal impact were estimated. Elasticities were estimated by using relevant regression coefficient and mean values of exogeneous and endogeneous variables and the elasticities in reduced form of model after allowing for direct as well as indirect effects were arrived at by differentiating the entire system of equations (Fan *et al.,* 1999). The marginal effects of one lakh rupees of investment at 1970-71 prices were calculated by multiplying the relevant elasticities obtained in reduced form by the absolute figures of poverty, agricultural GDP, non-farm employment and private investment in 2001-02.

Incremental Capital-Output Ratio (ICOR)

To examine the efficiency of the capital used in agriculture in different periods and to find out the amount of additional investment required to increase agricultural output by one unit, Incremental capital-output ratio (ICOR) was estimated. The ICOR was calculated by taking investment and output at constant prices (1970-71) by using following method (Rangarajan and Kannan, 1994).

$$\text{ICOR (with out lags)} = \frac{I_o(1 + rt)}{Y_o g}$$

$$\text{ICOR (with lags)} = \frac{I_o(1 + (t - L)r)}{Y_o g}$$

Where,

ICOR = Incremental capital-output ratio,
I_o = Initial investment (Rs. in lakhs),
Y_o = Initial output (Rs. in lakhs),
r = Compound growth rate of investment (per cent),
g = Compound growth rate of output (per cent),
L = Lags (No.),
T = Time period (t = 1, 2, 3 …).

The estimates of ICOR with lags were not in line with our expectations, therefore, for the present study ICOR was estimated without considering lags in investment. Further, the estimates of ICOR calculated by employing the method without considering lags in investment gave consistent and expected results.

Marginal efficiency of capital (MEC) was estimated as:

MEC = 1/ICOR

III

RESULTS AND DISCUSSION

Structural Changes in Agricultural Investment in Himachal Pradesh

The estimates of public investment and private agricultural investment (excluding investment made by private corporate sector) deflated at 1970-71 prices have been presented in Table 1. Himachal Pradesh underwent many structural changes after Independence and attained statehood during 1971. Thereafter, the policies of the government were directed mainly for the development of agricultural sector and building of basic infrastructure. In view of this, government investment in agriculture

steadily increased from about Rs. 1,162 lakh (1969-70) to Rs. 2,541 lakh (1980-81). After this, it suffered a minor setback and the growing tempo of public investment witnessed some reversal during 1985-86. This was attributed to the shift of emphasis to other economic sectors like administrative services, health and social welfare, information and publicity, etc. This decline in public agricultural investment was also observed in different studies at country level. Researchers have attributed this decline to the shift of emphasis in Seventh Five Year Plan from agriculture to industrial research and development and communication and also to sharp protest environmentalists against construction of irrigation projects, etc at national level, (Mishra and Chand, 1995; Gulati and Sharma, 1997). However, during the 1990s this decline in public investment was arrested and more funds were allocated for agricultural development. Towards the end of Ninth Plan (i.e., during 2001-02), it again showed a decline and decelerated from about Rs. 3,381 lakhs (1995-96) to about Rs. 2,936 lakhs (2001-02).

TABLE 1. STATE LEVEL INVESTMENT IN AGRICULTURE AT 1970-71 PRICES

(*Rs. lakh*)

Year (1)	Public investment (2)	Private investment (3)	Total investment (4)
1969	1162	703	1865
1975	1276	474	1750
1980	2541	312	2853
1985	2279	563	2842
1990	3230	679	3909
1995	3381	1224	4605
2001	2936	1563	4499
CGR (per cent)	3.99***	3.79***	3.87***
	(0.35)	(0.60)	(0.24)

*** denotes significance at 0.01 level of probability.
Figures in the parentheses indicate standard error.

Private investment in agriculture also showed an inconsistent pattern. It showed a decline during 1970s from Rs. 703 lakhs (1969-70) to just Rs. 312 lakhs (1980-81), which indicated increased dependence of farmers on government sector during this period. There might also be a shift in emphasis of private sector towards new input technologies during period I (1969-79), which led to the decline in private investment in agriculture. But, later real private investment spurt towards the termination of Ninth Plan. It might be due to the fact the farmers had realised that agricultural productivity growth could not be achieved without increasing productive capacity of farms. The government incentives in the form of development subsidy, etc. might also be favouring private investment in agriculture. Persistent increase in private investment in Himachal Pradesh was consistent with studies conducted at the country level (Chand, 2001).

Growth and Intensity of Agricultural Investment

Using the time series data pertaining to different items of state agricultural investment, analysis was carried out at 1970-71 prices. Ratios were estimated to find out the growth and performance of agricultural investment over time.

Public Agricultural Investment

Item-wise per hectare public agricultural investment estimates presented in Table 2 revealed that real public agricultural investment on almost all items increased from Period I (1969-80) to Period III (1991-2001). Few items of public investment like minor irrigation, agricultural financial institution and dry land farming showed fluctuations attaining peak during period-II and then again declined during period-III. During Green Revolution era (1969-80), major emphasis of government policies was on development of agriculture, irrigation and improvement of land for cultivation.

TABLE 2. PUBLIC INVESTMENT IN AGRICULTURE AS PER HECTARE OF NET SOWN AREA AND AS PER CENT OF AGDP AT 1970-71 PRICES

	Public investment (Rs./ha)			Intensity (per cent AGDP)		
Item	Period-I (1969-80)	Period-II (1980-91)	Period-III (1991-2001)	Period-I (1969-80)	Period-II (1980-91)	Period-III (1991-2001)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Soil and water conservation	11.13	13.98	14.64	0.46	0.52	0.43
Agricultural research and education	6.83	9.99	25.01	0.28	0.37	0.73
Rural development	9.17	51.12	77.72	0.38	1.91	2.27
Irrigation and flood control						
Major and medium irrigation	6.01	8.64	13.43	0.24	0.32	0.39
Minor irrigation	18.18	48.17	40.70	0.74	1.80	1.19
Flood control and command area development	1.55	4.18	8.72	0.06	0.16	0.25
Rural infrastructure						
Rural electrification	3.15	5.32	3.69	1.34	1.95	1.06
Roads and bridges	10.60	14.73	22.75	4.49	5.40	6.55
Agricultural financial institutions	2.50	10.09	1.44	0.10	0.38	0.04
Market development	0.48	6.58	16.49	0.02	0.25	0.48
Crop husbandry						
Agriculture	24.89	26.02	37.00	1.01	0.97	1.08
Horticulture	15.75	18.73	20.41	0.64	0.70	0.60
Dry land farming	0.00	8.31	0.89	0.00	0.31	0.03
Fishery	1.01	2.66	5.81	0.04	0.10	0.17
Dairy development	4.78	4.05	5.15	0.19	0.15	0.15
Animal husbandry	7.89	10.93	20.32	0.32	0.41	0.59
Forestry	3.01	6.82	0.96	1.28	2.50	2.75
Total	126.93	250.32	315.13	11.59	18.20	18.76

Therefore, substantial investment was allocated to agricultural crop husbandry (Rs.24.89/ha) followed by minor irrigation (Rs. 18.18/ha), horticulture (Rs. 15.75/ha) and soil and water conservation (Rs. 11.13/ha).

Since, major thrust areas during period-II were removal of poverty, development of irrigation, modernisation, etc., thus, huge amount of funds were invested on rural development schemes (Rs. 51.12/ha), minor irrigation (Rs. 48.17/ha), agricultural crop husbandry (Rs. 26.02/ha), horticulture (Rs 18.73/ha) and for soil and water conservation (Rs.13.98/ha). During this period it was also realised that agricultural development would not be achieved in isolation without development of infrastructure (Singh *et al*., 2004). The resources were, therefore, deviated towards development and rehabilitation of basic infrastructure like rural electrification, roads and bridges. The investment in agricultural financial institutions and market development was also increased. In this period, although no special attention was paid to agricultural research and education but, the structure of funds were improved over this item. Per hectare investment on major irrigation, forestry and animal husbandry improved during this period.

Later in the Eighth and Ninth Plan periods (corresponding to period-III), the major emphasis was on improvement of work productivity, quality of life and skill development, etc. Therefore, investment on agricultural research and education increased from about Rs. 10 per hectare (Period II) to Rs. 25 per hectare (Period III). Rural development still remained a priority sector for upliftment of rural masses and self-reliance during Period III (1991-2001) and, hence, investment on rural development increased to about Rs. 78 per hectare during this period. Irrigation continued to enjoy a special status in terms of investment as investment and flood control and command area development almost doubled from Period II to Period III. Per hectare investment in agricultural financial institutions (that include debenture support to co-operatives and land development banks and share capital to agro-industries, etc. for their financial viability and rehabilitation, etc.) decreased towards Period III. Besides, there has been a constant increase in per hectare investment in crop husbandry, animal husbandry, fishery and dairy development during Period III.

The estimates of investment intensities revealed that during Period I, public investment as a whole was about 12 per cent of agricultural gross domestic product (AGDP), which in later years rose to more than 18 per cent. However, it remained almost stagnant during Period III. The intensities of the most of the public investment items increased toward Period III while, few investment items like soil and water conservation, minor irrigation, agricultural financial institutions and rural electrification showed fluctuating pattern that increased during Period II and then declined again towards Period III. Although the intensity of investment on agricultural research and education showed an increase over the years but its intensity has remained much lower than in developed countries (Pardey and Beintema, 2001).

The compound growth rates of public agricultural investment do not indicate any consistent pattern (Table 3). During Green Revolution period, there has been a spurt

TABLE 3. COMPOUND GROWTH RATES OF PUBLIC INVESTMENT IN AGRICULTURE AT 1970-71 PRICES

(*per cent*)

Particulars	Period I (1969-79)	Period II (1980-90)	Period III (1991-2001)
(1)	(2)	(3)	(4)
Soil conservation	7.95***	-7.02*	9.69***
	(2.18)	(3.76)	(1.48)
Agricultural research and education	10.93***	9.59***	5.14*
	(3.20)	(2.00)	(2.61)
Rural development	-1.55	2.96	11.94***
	(1.03)	(3.24)	(2.86)
Irrigation			
Major and medium irrigation	75.78***	0.51	13.03***
	(13.59)	(3.93)	(3.33)
Minor irrigation	17.71***	6.43*	-24.48***
	(1.72)	(3.25)	(5.61)
Flood control and command area development	29.31***	-1.07	12.20***
	(7.47)	(1.87)	(2.84)
Rural infrastructure			
Rural electrification	3.68	-2.71	-0.83
	2.19)	(2.77)	(7.01)
Roads and bridges	3.77*	0.62	3.80
	(1.99)	(1.57)	(3.25)
Agricultural financial institutions	38.11***	19.77*	-20.05**
	(8.69)	(9.32)	(7.66)
Market development	21.27***	40.06***	4.86
	(8.04)	(5.58)	(5.62)
Crop husbandry			
Agriculture	2.41	3.82	-6.61
	(1.74)	(5.24)	(4.41)
Horticulture	10.49***	-1.86	-1.84
	(2.05)	(1.92)	(2.96)
Dry land farming	0.00	-32.65***	-8.53
	(0.00)	(9.31)	(6.67)
Fishery	-3.07	9.99***	-7.39*
	(5.59)	(1.82)	(4.08)
Dairy development	12.31***	-9.12***	4.22
	(2.04)	(2.55)	(2.58)
Animal husbandry	13.86***	-2.57	3.51
	(2.81)	(3.31)	(4.54)
Forestry	7.01***	16.02***	-2.24
	(1.34)	(3.51)	(1.96)
Total	6.57*	2.94	2.12
	(1.42)	(1.42)	(1.95)

Figures in the parentheses indicate standard errors.
***, ** and * denote significance at 0.01, 0.05 and 0.10 level of probability, respectively.

in public agricultural investment. It increased at an annual growth rate of about 7 per cent. Public investment declined during period-II and grew at an annual growth rate of 2.94 per cent. However, its growth rate almost remained stagnant at 2.12 per cent during Period III. The declining trend of public investment in agriculture was also confirmed by the studies conducted at national level (Dhawan and Yadav, 1997; Shetty, 1990, Gandhi, 1996). The declining growth of public investment need to be

reversed immediately to achieve the desired growth rate of agricultural sector and state income *per se*. Investment on soil and water conservation showed fluctuating pattern. Firstly, it grew at an annual growth rate of about 8 per cent (Period I), then it showed negative growth rate of -7 per cent (Period II) but later during Period III, it registered higher growth rate of about 10 per cent per annum. Increase of investment over this component might be due to higher emphasis on construction of soil erosion structures, water harvesting structures, check dams, etc. Investment on agricultural research and education marked positive and significant growth during all three period although it grew at a slower growth rate towards Period III. Rural development investment showed negative growth rate (-1.55 per cent) during period-I but in post-reform era (1991-2001), there was a major shift of emphasis towards rural development as the investment showed rising trend and increased significantly at an annual growth rate of about 12 per cent. The growth rate of investment on minor irrigation declined drastically from about 18 per cent (Period I) to just 6 per cent (Period II) and later it marked negative growth rate during Period III. During Green Revolution period various medium irrigation schemes were started for developing agriculture sector. As a consequence the investment on major and medium irrigation grew at an alarming growth rate of about 76 per cent per annum during first period. There was a decline in the growth rate of this investment during period-II but, later it attained a rising trend and grew at an annual growth rate of 13 per cent. All items of rural infrastructure registered significant positive growth during period-I and period-II, which later showed declining growth during period-III. Investment on other items like fishery, dairy development, etc. showed a declining trend towards third period.

Private Agricultural Investment

Private investment in agriculture at 1970-71 prices was found to be Rs. 97 per hectare during Green Revolution phase (Table 4) which later declined to Rs. 92 per hectare during post-green revolution phase (1980-90). However, towards beginning of period-III, people started investing on irrigation structures and resources were diverted to lay new orchards. Allocations were also made over transport equipments. As a result of these investments, private investment as a whole rose to about Rs. 216 per hectare of net sown area. This indicates that the incentives for private investment were improved during post-reform period. Item-wise classification of private sector agricultural investment during 1991-92 indicated that investment on transport equipments enjoyed special status with an investment of over Rs. 47 per hectare, followed by investment on farm houses, orchards and plantations and construction/reclamation of land/buildings. Investment on irrigation structures amounted to Rs. 5 per hectare. The amount of investment on other items like fencing of newly laid orchards and farm furniture, etc. was meagre. Investment on all the items showed an appreciable increase during this period and private agricultural investment was found to increase three times during 2001-02 from 1991-92.

TABLE 4. PRIVATE INVESTMENT IN AGRICULTURE AS PER HECTARE OF NET SOWN AREA AND AS PER CENT OF AGDP AT 1970-71 PRICES

Period	Investment (Rs./ha)	Intensity (per cent AGDP)
(1)	(2)	(3)
Period I (1969-79)	97.09	3.97
Period II (1980-90)	92.07	3.44
Period III (1991-2001)	215.74	6.49

	Investment (Rs./ha)		Intensity (per cent AGDP)	
Item-wise classification	1991-2002	2001-2002	1991-2002	2001-2002
(1)	(2)	(3)	(4)	(5)
Improvement/reclamation of land/buildings	12.91	29.17	0.41	0.67
Orchards and plantations	14.74	38.89	0.47	0.89
Irrigation structures	5.33	17.53	0.17	0.40
Agricultural implements and machinery	9.03	35.34	0.29	0.81
Transport equipments	46.58	102.67	1.49	2.36
Farm houses	18.58	49.80	0.59	1.15
Others	2.43	8.43	0.08	0.19
Total	109.60	281.83	3.50	6.47

Private sector investment made in agriculture was about 4 per cent of agricultural gross domestic product (AGDP) and it almost remained stagnant during period-II as is evident from Table 4. The intensity of private investment almost doubled from first to third period. Increasing intensity of private agricultural investment might be due to liberal government policies and incentives in the form of power subsidies, credit, etc. that in turn enhanced private investment in agriculture.

It is evident from the Table 5 that real private investment in agriculture showed declining trend during period-I and decreased at an annual growth rate of about -7 per cent but with substantially higher level of private investment during the Period II and it registered an all time high annual growth rate of around 9 per cent. The rising trend of private investment was also perceived by number of scholars at country level (Gandhi, 1996). There was a minor decline in growth rate of private agricultural investment from about 9 per cent (1980-90) to 8 per cent (1991-2001). This decline in growth rate of private investment might be as result of decline in public investment in view of their complementary relationship.

TABLE 5. COMPOUND GROWTH RATES OF PRIVATE INVESTMENT IN AGRICULTURE AT 1970-71 PRICES

(*per cent*)

Period	CGR (per cent)
(1)	(2)
Period I (1969-79)	-6.83***
	(0.56)
Period II (1980-90)	9.15***
	(1.08)
Period III (1991-2001)	7.79***
	(1.11)

Figures in the parentheses denote standard error.
*** denotes significance at 0.01 level of probability.

Composition of Agricultural Investment

National Sample Survey Organisation-Reserve Bank of India (NSSO-RBI) estimates of state level private agricultural investment have been used in the present study, which does not include private corporate investment in agriculture. Therefore, public investment formed the main component of total investment in agriculture and its proportion almost remained constant in all the periods. The composition of public investment showed some fundamental changes based upon new priorities. During Green-Revolution major proportion of public investment was allocated to crop husbandry (32 per cent) and irrigation (20 per cent). On the other hand, only about 9 per cent and 7 per cent of investment was allocated to soil and water conservation and rural development, respectively. During Period II, irrigation and rural infrastructure were placed among priorities in the state plan and the percentage investment share on these items increased considerably. The share of rural development which was around 7 per cent during Period I increased by more or less three times during Period III. The percentage share of agricultural research and education increased to about 8 per cent during Period III. The percentage share of soil and water conservation and crop husbandry decreased continuously towards Period III. The percentage share of other items like animal husbandry, fishery, forestry and dairy development firstly decreased during Period II but, ultimately recovered the same share as in Period I.

Although the per cent share of private investment on transport equipments declined from about 43 per cent (1991-92) to 36 per cent (2001-02) but, it continued to be the main item of private investment in agriculture. The higher investment on transport equipments (which includes tractor and other power driven equipments) in both years might be due to the fact that farmers were keen to supplement their income by renting out these equipments besides replacing bullocks used for ploughing the land. Investment on farm buildings was followed by investment on orchards and plantations. About 5 per cent of private investment was spent on irrigation structures during 1991-92 which later increased to over 6 per cent during 2001-02. The increase in the proportion of investment on irrigation might be due to the apprehension about the role of irrigation in increasing productivity and also the adequate incentives extended to this component in terms of power subsidy and tubewell subsidy. The percentage share of other items (which include fixtures and furniture kept on farm) also showed an increase over the years.

Complementarity Between Public and Private Investment

It is clear from Table 6 that private investment showed significant positive association with agricultural gross domestic product, public investment, institutional credit to agriculture as well as terms of trade. The long term complementarity between private and public investment was in line with studies conducted at country level (Krishnamurty, 1985; Bhattacharya and Rao, 1988, Shetty, 1990). Some

scholars attributed this association to the inducement effect of public investment on private investment (Rath, 1989; Patnaik, 1987).

TABLE 6. ASSOCIATION BETWEEN PUBLIC INVESTMENT, PRIVATE INVESTMENT AND OTHER MACRO-VARIABLES AT 1970-71 PRICES

Variables	AGDP	PRINV	PBINV	TT	CRD
(1)	(2)	(3)	(4)	(5)	(6)
AGDP	1	0.779***	0.702***	0.337***	0.822***
PRINV		1	0.657***	0.471***	0.811***
PBINV			1	-0.012	0.806***
TT				1	0.086
CRD					1

*** denotes significance at 0.01 level of probability.

The positive correlation of private investment with agricultural gross domestic product and public investment indicated that agricultural growth may encourage private investment in agriculture and incentive in the form of increasing public investment further enhanced it. Agricultural gross domestic product showed positive association with institutional credit to agriculture. In this way improvement of agricultural productivity also attracted various institutions to advance credit to farmers, which in turn enabled them to invest over fixed capital in agriculture. Moreover, positive correlation of terms of trade with agricultural gross domestic product and private investment indicated that the improvement of agricultural prices in relation to non-agricultural prices not only catalyse the agricultural growth but also allure private sector to invest in agriculture.

Capital Use Efficiency in Agriculture

Incremental capital-output ratio (ICOR) and marginal efficiency of capital (MEC) were estimated with an intention to find out the efficiency of capital use in agricultural sector over the time. The calculated ICOR and MEC for the period-I turned out 4.62 and 0.22, respectively (Table 7). During period-II, various micro-irrigation schemes were funded which coupled with use of quality inputs and other production technologies during Green Revolution period resulted in efficient utilisation of resources, thereby, improving the crop productivity and calculated ICOR declined to 2.73. The improvement of capital use efficiency during second period was also reported by Mishra and Chand (1995) at national level. But later during period-III, calculated ICOR again increased to 4.46 indicating less efficient utilisation of resources.

The desired growth rate of investment since period-III onwards indicated that the agricultural investment was required to be increased at about 7.82 per cent growth rate, if we are to achieve target growth rate of 4 per cent per annum in output.

TABLE 7. CAPITAL USE EFFICIENCY IN AGRICULTURAL SECTOR AT 1970-71 PRICES

Period (1)	r (2)	g (3)	ICOR (4)	MEC (5)	Target growth rate (per cent) (6)	Desired growth rate in investment (7)
Period I	3.26**	1.23*	4.62	0.22	4.00	11.29
(1969-79)	(1.25)	(0.76)				
Period II	3.77***	3.33***	2.73	0.33	4.00	4.78
(1980-90)	(1.14)	(0.86)				
Period III	3.55**	1.92***	4.46	0.22	4.00	7.82
(1991-2001)	(1.53)	(0.68)				

r and g are the growth rates of investment and AGDP, respectively.
***, ** and * denote significance at 0.01, 0.05 and 0.10 level of probability, respectively.
Figures in the parentheses indicate standard errors.

Agricultural Growth and Pattern of Poverty

The average incidence of poverty, per hectare agricultural productivity and per capita income at 1970-71 prices during three different periods were examined. The results presented in Table 8 revealed that considerable improvement in agricultural productivity and the per capita income helped the state in alleviating poverty to a great extent. The role of agricultural development in poverty reduction was also advocated by researchers at national level (Ravallion and Dutta, 1996). Rural poverty declined from an average of about 27 per cent during period-I to about 20 per cent during period-III. Poverty was found much concentrated in rural areas.

TABLE 8. LEVEL OF AGRICULTURAL PRODUCTIVITY, PER CAPITA INCOME AT 1970-71 PRICES AND INCIDENCE OF POVERTY

Period (1)	AGDP Rs./ha (2)	Per capita income Rs./annum (3)	Poverty (per cent) Rural (4)	Urban (5)	Total (6)
Period I (1969-79)	2444	666	26.85	13.26	25.94
Period II(1980-90)	2678	734	18.76	9.07	17.98
Period III(1991-2001)	3325	1176	20.49	6.53	19.22

The incidence of the poverty was found much severe in rural areas in all the three periods as clear from the table. Rural population living below poverty line declined from about 27 per cent (Period I) to 20 per cent (Period III). Despite remarkable increase in per capita income, poverty still persists at a sizeable degree in some rural pockets of the state. This might be due to inequality in distribution of productivity asset and wealth. Beteille (2003) also reported that poverty and inequality did not change at the same pace, which again aggravates the conditions of poverty. Since, weaker sections of the state reside in rural areas and depend on agriculture for employment and living, therefore, if poverty is to be eradicated from the state due emphasis should be laid on development of agricultural sector along with the growth of non-farm sector.

Determinants of Investment and Agricultural Growth: Simultaneous Model

The results of the five equation simultaneous model estimated by employing Two Stage Least Square (2SLS) procedure are presented in Table 9. The high adjusted R^2 values for all the five equations implied that the model is a best fit and was successful in explaining systematic variations in agricultural investment (public and private), agricultural productivity, poverty and non-farm employment over the years. The estimated F-values for all the equations were significant at 0.01 level of probability.

Determinants of Public Agricultural Investment: The positive and significant coefficient of agricultural productivity in public investment model might be due to strong demand for agricultural commodities, which led to the allocation of more funds to support agricultural research, extension and other productivity enhancing items of investment such as irrigation, storage, road, market, etc. These results are consistent with studies on public funding of agricultural research (Huffman and Miranowski, 1987; Evenson and McKinsey, 1991; Pal and Singh, 1997). State income has an expected positive and significant effect on public investment. The literacy rate also improved public investment as education level cast inducement effect on public investment in agriculture. Literacy level improves the managerial capability of farmers and consequently attracts public investment. The coefficient of per hectare grants from central government (2.247) turned out positive as was expected. The central grants improve state government's access to the resources for agricultural development. However, expenditure on fertiliser subsidy negatively affects public investment by depleting state resources for this cause. This supported the view that farm subsidies were declining investment in agriculture (Gulati and Sharma, 1997, Fan *et al*.,2000). Population growth showed negative impact on public investment. The negative effect of population growth might be due to the fact that with increase in population, government has to divert funds towards public health, nutrition, urban area development, and industrial development, etc.

Determinants of Private Agricultural Investment: The analysis of Two Stage Least Square (2SLS) for private investment model indicated that it is highly dependent on lagged values of the per hectare public agricultural investment (PBINV). The positive coefficient of public investment indicated that this variable plays an inducement effect on private investment (Dhawan and Yadav, 1995). The coefficient of agricultural productivity (AGDP) also came out positive and significant indicating that it has contributed in the improvement of private investment over the years. Agricultural productivity enhanced private investment in agriculture by improving surpluses available for investment. As expected coefficient of per capita income (0.173) turned out positive and highly significant, implying thereby that this variable has a positive impact on private investment. Improvement of prices of agricultural commodities in relation to non-agricultural commodities (TT) also had

TABLE 9. ESTIMATES OF SIMULTANEOUS EQUATION MODEL

Equation	(1)		(2)	(3)	(4)	(5)	(6)
	$PBINV_t$	=	72.535	+ 0.130$AGDP_{t-1}$***	- 2.173$SUBS_t$**	+ 6.932$SGDP_{t-1}$***	+ 4.659LIT_t***
			(87.404)	(0.026)	(1.140)	(0.556)	(1.823)
			-106.426POP_{t-1}***	+ 2.247$GRNTS_t$**			
			(37.988)	(1.027)			
						Adj R^2 = 0.8780	F = 39.40***
	$PRINV_t$	=	-1138.47	+ 0.136$PBINV_{t-6}$**	+ 0.010$AGDP_{t-1}$**	+ 0.642TT_t**	+ 8.999LIT_t*
			(284.815)	(0.062)	(0.006)	(0.351)	(2.536)
			- 0.197$POVT_t$	+ 0.173PCI_t***	+ 374.774POP_{t-1}	- 4.546MF_t*	- 0.374$ROAD_t$
			(0.875)	(0.036)	(94.412)	(3.917)	(0.403)
						Adj R^2 = 0.9486	F = 66.62***
	$AGDP_t$	=	329.795	+ 5.037$PBINV_{t-6}$***	+ 10.539$PRINV_{t-1}$***	+ 166.657LIT_t***	+ 125.739MF_t*
			(1179.4)	(1.618)	(3.064)	(44.465)	(88.253)
			-507.057POP_{t-1}***	+ 10.055CI_t***	+ 0.007$HYVs_t$**	- 8.985RDI_t***	+ 115.244IR_t***
			(216.723)	(2.819)	(0.004)	(5.579)	(39.439)
						Adj R^2 = 0.6395	F = 7.30***
	$POVT_t$	=	290.047	- 0.025$AGDP_{t-1}$***	- 0.007$PBINV_{t-6}$***	+ 0.024$PRINV_{t-1}$	- 9.547$NEMP_t$***
			(281.93)	(0.001)	(0.001)	(0.052)	(1.387)
			- 1.839MF_t***	- 0.250$RUDI_{t-5}$***	- 4.145ALW_t**	- 3.496LIT_t***	- 3.009CRD_t***
			(0.519)	(0.075)	(1.806)	(1.323)	(1.115)
			+ 0.071TT_t	+ 0.713POP_{t-1}			
			(0.086)	(2.674)			
						Adj R^2 = 0.8939	F = 25.51***
	$NEMP_t$	=	25.461	+ 0.0015$AGDP_{t-1}$	+ 0.0200$SOIL_{t-6}$**	+ 0.006$RUDI_{t-5}$**	+ 0.047LIT_t***
			(0.225)	(0.007)	(0.011)	(0.003)	(0.019)
			+ 0.003$ROAD_t$***	+ 0.012IRI_{t-1}***			
			(0.001)	(0.003)			
						Adj R^2 = 0.9771	F = 228.98***

***, ** and * denote significance at 0.01, 0.05 and 0.10 level of probability, respectively.
Figures in parentheses indicate standard errors.

positive effect on private investment. The favourable terms of trade would facilitate the growth process by increasing private investment in agriculture (Misra, 1998). Per cent area under marginal holdings in the state showed negative and significant relation with private investment. This might be because, the small size of holding hinders mechanisation of agriculture and investment on implements and machines, which are essential items of capital formation in agriculture. The marginal farmers also have less surpluses with them and, hence, are also unable to invest in agriculture. This result supports the findings of Roy and Pal (2002). The positive and significant coefficient of literacy was as per our expectation as education level makes a farmer innovative and more aware about the possible benefits of investment. Poverty showed negative relation with private investment though not obvious because poverty limits the investing power of farmers, which leads to decrease in private investment in agriculture.

Determinants of Agricultural Productivity: The estimates of agricultural productivity model revealed that both public and private investment in agriculture significantly and positively influenced agricultural productivity. These results are consistent with the studies conducted by Anderson and Lorch (1999). The coefficient of literacy was positive and statistically significant indicating its crucial role in agricultural development. Thus, an educated farmer can avail the benefits of scientific practices and improved production techniques, which are instrumental in improving productivity. The key role of literacy was also reported long back by Duraisamy (1992) and Nadal (1972). The coefficient of per cent area under marginal holdings (125.74) came out positive, which was in line to our expectations. Marginal holdings are more intensively cultivated, which resulted in higher productivity. Sharma *et al.* (1992) also reported that returns were more on small farms due to better management and more input use. The number of crops taken up in a year (cropping intensity) also has positive effect on the overall productivity of agriculture. The area under high yielding varieties (HYVs) and per cent irrigated area (IR) also showed positive and significant relation with agricultural productivity. The irrigation came out to be the most critical factor for intensification of agriculture that justifies the need for expansion of expenditure on irrigation projects in view of its crucial role in improving productivity. As of now, weather is an important determinant of agricultural productivity in the state as more fluctuations in rainfall were associated with lower agricultural productivity. A significant negative coefficient of per cent deviation from normal rainfall indicated that fluctuations in rainfall have negative effect on agricultural productivity. Similarly, population growth (POP) has also negative effect on agricultural productivity indicating proverbial overcrowding in agriculture in the absence of other non-farm avenues of employment.

Determinants of Poverty: The results of poverty equation revealed that all the exogeneous variables except terms of trade and population growth rate showed

negative significant effect on poverty. The key role of agricultural productivity in reducing poverty has been identified by number of researchers (Desai and Namboodiri, 1998, Ahluwalia, 1978). Agricultural development is essential in helping the poor not only by directly increasing their income but, also by releasing labour and capital that can be used in non-agricultural enterprises and by stimulating the demand for non-agricultural goods (Johnson, 2000, Lanjouw and Lanjouw, 2001). Higher agricultural productivity improves consumption and surpluses with farmers and consequently improves their living conditions. Agricultural investment has both direct and indirect (mainly through gain in agricultural productivity) effect on reducing poverty. The role of public investment in alleviating the poverty through various development schemes and through improving agricultural production was also reported by Hazell and Fan (2003). Non-farm employment and agricultural labour wages have negative and significant effect on poverty. These variables improve the financial position of the farmer and shift them above the poverty line. The education is one of the effective instruments in reducing poverty. The role of education in poverty reduction was also reported by Sen (1997). The increase in investment on rural development and institutional credit flow to agriculture were also associated with the reduction in poverty ratio.

Determinants of Non-Farm Employment: The estimates of non-farm employment equation showed that lagged investment on soil and water conservation, rural development, irrigation and flood control turned out positive and significant, which indicated that these variables were strong determinants of non-farm employment. Large numbers of rural poor were able to get jobs in irrigation projects, construction of check dams and water harvesting structures, etc. Funding of various rural development schemes also generated direct non-farm employment in the state. The role of public investment in employment generation in off-farm sectors was also observed by number of research scholars (Sen, 1997, Fan *et al*., 1999). Road density has positive impact on non-farm employment. Construction of main and link roads increases connectivity of villages to nearby cities/towns and improves their access to avenues of non-farm employment. Education level also opens more opportunities and enables a person to make his way in to non-farm sector other than agriculture. However, agricultural productivity showed weak link with non-farm employment. These results are consistent with the findings of Hazell and Haggblade (1991). This weak relationship between agricultural growth and growth of rural non-farm activity in many parts of the country has become a teasing dilemma to planners and policy makers.

The estimates of elasticities presented in the Table 10 revealed that with few exceptions, the impact of additional investment in various variables was statistically significant. Some of the important components of public investment specified in the model like rural development, soil and water conservation and irrigation investment have significant incremental impact on non-farm employment though, the impact of

public investment as a whole was found statistically non-significant. Marginal effect indicated that an additional public investment of one lakh rupees may help in shifting 178 poor people above poverty line. Similarly, targeting rural poor by investment of additional one lakh rupees on rural development could have higher marginal impact on poverty. Private investment has comparatively higher marginal effect on agricultural GDP, additional private investment worth one lakh rupees may add over 6 lakh rupees to agricultural GDP. As far as the impact on non-farm employment is concerned, investment on irrigation has higher marginal impact as one lakh additional investment on this variable could provide employment to 104 persons in non-farm avenues. Public and private investment as a whole could help in generating non-farm employment indirectly by augmenting agricultural GDP. An attempt was also made to find out the marginal impact of additional public investment in agriculture on private investment, it was observed that one lakh additional investment by public sector would enhance private investment significantly by about 16 thousand rupees besides its favourable impact on poverty alleviation and agricultural GDP. The significant elasticity and marginal impact of public investment has also ascertained the complementary relationship between public and private investment in state agriculture.

TABLE 10. INVESTMENT ELASTICITY AND MARGINAL EFFECTS

	Elasticity				Marginal effect of one lakh rupees of investment at 1970-71 prices			
Investment variables (1)	POVT (2)	AGDP (3)	NEMP (4)	PRINV (5)	POVT (No.) (6)	AGDP ('000 Rs.) (7)	NEMP (No.) (8)	PRINV ('000 Rs.) (9)
PBINV	-1.30*	0.51*	0.054	0.30*	-178	327	17	16
	(0.01)	(0.14)	(0.08)	(0.12)				
PRINV	-1.42*	0.50*	0.067	-	-364	603	40	-
	(0.31)	(0.18)	(0.09)	-				
RUDI	-0.55*	-	0.008*	-	-869	-	29	-
	(0.14)	-	(0.004)	-				
SOIL	-0.083*	-	0.008*	-	-438	-	99	-
	(0.004)	-	(0.004)	-				
IRI	-0.19*	-	0.02*	-	-423	-	104	-
	(0.004)	-	(0.004)	-				

*Indicates significance at 10 per cent or better level of significance.
Figures in parentheses indicate standard errors.

IV

CONCLUSION AND POLICY IMPLICATIONS

The results of the study revealed that growth rates of public investment showed a widespread decline over the years in Himachal Pradesh. The highest decline was observed in the case of minor irrigation and rural infrastructure. The intensity of public investment also showed somewhat the same pattern. It increased from 1969-79

to 1980-90 but, remained stagnant in the later period (1991-2001). In contrast, private investment increased persistently, although, it showed some fluctuations during 1970s but registered higher growth rate since post-green revolution period onwards. The analysis also confirmed long term complementarity between public and private investment indicating thereby that the improvement of public investment would not only augment the level of capital but also attract more private investment in agricultural sector. A point of concern that emerged out of the estimates of ICOR and MEC is that the efficiency of capital use in agriculture has been declining over the years. It has been observed that there are instances where huge investment made on infrastructure in some areas ceased to serve its purpose due to lack of maintenance. Therefore, there is a need to keep the created capital stock functional so that it serves the intended purpose. Irrigation capacities should also be expanded to improve efficiency of investment in agriculture. The estimates of the simultaneous equation model revealed that agricultural productivity, state income, grants from union government and literacy level in the state were positive and significant determinants of public investment. However, allocation in the form of fertiliser subsidies and population growth has negatively affected public investment. On the other hand public investment, agricultural productivity, literacy level, terms of trade and per capita income have significantly contributed in the improvement of private investment. However, increasing proportion of marginal holdings was found to have negative and significant impact on private investment. Agricultural investment is instrumental in development of rural areas not only directly by alleviating poverty but, also indirectly by improving agricultural productivity and increasing non-farm employment. The estimates of marginal effect revealed significant role of public and private investment on poverty alleviation and agricultural growth. Moreover, the incremental impact of additional public investment on private investment reinforced positive association between these two types of investment. This finding is quite significant keeping in view the contemporary debate on economic liberalisation and structural reforms in the country.

Considering the direct as well as indirect role of investment on overall rural development, the declining trend in public investment needs to be reversed. Investment in agriculture technology development and its dissemination, rural infrastructure, irrigation, rural development, market development, soil and water conservation and other social overheads amounts to a "win-win" strategy for reducing rural poverty directly as well as through creation of avenues of employment and higher rural wages. Private investment in agriculture must also be encouraged by providing the necessary support like credit, cheap power, tubewell subsidy, etc. In the case of resource poor groups investment needs to be encouraged. Whatever subsidies are to be provided should be targeted to the poor and backward regions, where productivity is lower and farmers are unable to invest more in agriculture.

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