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ARTICLES

Irrigation and Rural Poverty Nexus: A Statewise Analysis

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I

INTRODUCTION

The importance of irrigation in the development process of agriculture has been clearly brought out by both the micro- and macro-level studies in India (Gadgil, 1948; Dhawan, 1988; Rath and Mitra, 1989; Vaidyanathan *et al.,* 1994). Development of irrigation not only increases the use of yield increasing inputs (high-yielding variety seeds, fertilisers, etc.), cropping intensity and productivity of the crops but also helps to provide additional employment opportunities and push up the wage rates for agricultural labourers (Dhawan, 1991; Ray, 1992; Vaidyanathan, 1994 a, b; Reddy, 1995). Impact of irrigation on poverty can be perceived through three different routes. Firstly, the enhanced local availability of food and the resultant affordability due to lower prices reduces the quantum of poor. Secondly, increased labour absorption and consequent rise in wage rates and income make it possible for the poor at margins to cross the poverty barriers. Thirdly, the secondary effects of irrigation in terms of increased service opportunities, better quality of life and consequent industrialisation increase the tempo of economic activities in the irrigated regions and consequently poverty ratio drops down.

In the literature, irrigation has been recognised as a crucial factor in explaining the growth in agriculture as well as in rural development, but it has not been used as one of the principal explanatory variables in the poverty related studies in India.[1] Of course, the explanation of cross-section variations in poverty has been sought through agricultural growth (Ahluwalia, 1978), average value of agricultural output per hectare (Sundaram and Tendulkar, 1988) or through output per hectare (Datt and Ravallion, 1996; Ravallion and Datt, 1996). However, the use of irrigation as an explanatory factor has not been attempted. It is well recognised that irrigation is one of the principal causative factors behind the temporal changes in agricultural growth (represented by per hectare output and per capita output) and hence directly using irrigation as an explanatory factor is preferred here. In this study, an attempt has

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been made therefore to bring forth and test the relationship between the incidence of rural poverty and the development of irrigation across the major states in India.

II

A FOCUS ON POVERTY RELATED STUDIES

A large number of studies have attempted to analyse as well as to measure the level of poverty for different periods in India. These poverty related studies can be categorised into two broad groups, viz., (i) the studies involving measurement of poverty (Ojha, 1970; Dandekar and Rath, 1971 a, b; Bardhan, 1973; Tyagi, 1982; Rath, 1996) and (ii) the studies analysing the factors which determine the incidence of poverty (Sundaram and Tendulkar, 1988; Dev, 1988 and 1995; Kakwani and Subbarao, 1990; Nayyar, 1991; Singh and Binswanger, 1993; Ghosh, 1993 and 1996; Dasgupta, 1995; Vyas and Bhargava, 1995; Parthasarathy, 1995; Sharma, 1995; Hirway, 1995; Sagar, 1995; Bhalla, 1995; Kannan, 1995; Tendulkar and Jain, 1996; Datt and Ravallion, 1996). Before the publication of Ahluwalia's study of 1978, most of the studies dealt mainly with the estimates of rural and urban poverty and methodology of such estimation. Ahluwalia's (1978) study was one among the first attempts in explaining the variation in rural poverty. Generally, for explaining the variations in the level of poverty, so far researchers have considered variables like per capita consumption expenditure, per capita availability of foodgrains, consumer price index of agricultural labourers, state domestic product (SDP) of agriculture per head of rural population, productivity of agricultural labourers, land holding size of different class of farmers, income of the agricultural labour households, number of days worked by the agricultural labourers, real wage rate and current-day status of unemployment rate among rural males. Similarly, land-man ratio, productivity of rainfed land, inequality in land distribution, incidence of wage labour, average value of privately owned assets per household and extent of diversification in rural employment were also used as explanatory factors. These are of course inter-connected in quite a complex process in impacting rural poverty and therefore, it is rather difficult to map such process easily. Sundaram and Tendulkar (1988) make reference to these arguments. These existing studies have arrived at two broad conclusions relating to the incidence of poverty: while some studies have asserted an inverse relationship between agricultural growth and the incidence of rural poverty (Ahluwalia, 1978; Saith 1981; Ghosh 1993, 1996 and 1998), others have raised some doubts about the existence of trickle-down process in India (Bardhan, 1984 and 1986; Mundle, 1983).

Although it may seem that we intend to look into the validity of trickle-down hypothesis in India, our concern here is to bring forth the role of irrigation as an explanatory variable in the poverty nexus. There are two main reasons why irrigation should be considered as an important explanatory variable. Firstly, since the provision of irrigation through its production-augmenting and wage-enhancing effects substantially improves the flow of income, the inclusion of irrigation as an

explanatory factor becomes necessary. Secondly, almost all the variables used by the earlier studies for testing the trickle-down process are one way or the other connected or determined by the level of irrigation. It is important to underscore some of these variables which have high sensitivity to the availability of irrigation.[2] As mentioned earlier, the interconnections between these variables goes through a complex process. But approaching to seek explanation through irrigation could be the first step in seeking such explanation. While it is essential to bring out the role of irrigation in explaining rural poverty at a point of time in a strict static sense, the dynamic aspect of such relationship has a larger policy relevance. The questions like the long-run relationship of irrigation and poverty will give rise to the asymptotic behaviour of the poverty-irrigation curve[3] tapering-off on the irrigation axis and creating a poverty trap explainable only through variables other than irrigation. In order to attempt this we have tried to locate the changing role of irrigation as an explanatory factor over a few points of time. We seek to search for an answer to the question whether irrigation is becoming increasingly less important as a determinant of poverty. In this connection, therefore, it is essential to trace and map the role of irrigation as an important variable in determining the incidence of rural poverty.

III

OBJECTIVES AND DATA

The main objectives of the study are: (1) to demonstrate the importance of irrigation as an impacting policy intervention on other variables which were used by the earlier studies for analysing the incidence of rural poverty, (2) to analyse the changing scenario of rural poverty at the state level, and (3) to analyse the relationship between the level of rural poverty and irrigation across the states.

As the study aims at the analysis of explaining the variations in poverty ratio across the states, we intend to cover only 14 major states of India.[4] The percentages of rural population below poverty line officially released by the Planning Commission for four different points of time (1972-73, 1977-78, 1983-84 and 1987-88) were used as the main data source for this study (Government of India, 1993 a). The other variables considered for the analysis are statewise data relating to percentage of gross irrigated area to gross cropped area (GIA/GCA)[5], irrigated area (ha) per thousand rural population (IAPTRP), real wage rate (Rs.) of agricultural labourers (RWAL), productivity (kg) of foodgrains (PFG), state domestic product (Rs.) of agriculture per head of rural population (SDAPHRP), cropping intensity (CI) and foodgrains production (kg) per head of rural population (FPPHRP). These data have been compiled/calculated from the various issues of *Indian Agricultural Statistics, Area and Production of Principal Crops in India* (both are published by the Ministry of Agriculture, Government of India, New Delhi), *Census of India, Fertiliser Statistics* (published by the Fertiliser Association of India) and also from some of the recent published materials.

IV

IRRIGATION AND RURAL POVERTY RELATED VARIABLES NEXUS

As a first step of our analysis, we consider the impact of irrigation on other variables which were used by the earlier studies for analysing the incidence of poverty in rural India. As mentioned earlier, variables like RWAL, SDAPHRP, FPPHRP, consumer price index, etc., have been mainly used by the earlier studies to understand the relationship between the incidence of poverty and the growth of agriculture. There are no problems in using these variables to study the incidence of rural poverty because these variables one way or the other determine the level of poverty. But these variables at best can be treated as the second layer impact variables dictated by the availability of irrigation. The reason for considering them as secondary variables to irrigation is that these variables cannot act independently and are highly influenced by the level of irrigation. If the level of irrigation declines due to monsoon failures or any other reasons, it causes an adverse impact on these variables. This can be easily discerned through the analysis of the impact of irrigation on these variables empirically using the data of 14 major states of India. For this, we have computed correlation and regression using both traditional and non-traditional variables[6] (IAPTRP, RWAL, PFG, SDAPHRP, CI and FPPHRP) at four points of time considered for studying the incidence of poverty. However, since regression results give both the strength of association and its magnitude, we have presented only the results of regression computed treating IAPTRP as independent variable to show the impact of irrigation on the other variables (Table 1).

The impact of irrigation on each of the traditional variables is taken up here. As mentioned earlier, RWAL has been considered as one of the important variables for studying the incidence of rural poverty by some earlier studies (for example, Ghosh, 1996). State level data show that this is positively influenced by the development of irrigation (Parthasarathy, 1996). Needless to emphasise here that the development of irrigation increases the intensity of cultivation which in turn increases the demand for agricultural labourers. This process not only helps to increase the money wage rates and number of days of employment for agricultural labourers but also increases the total earnings of agricultural labourers. On the other hand, because of intensive cultivation, the production of agricultural commodities would increase, as a result, the price of essential commodities would go down. This whole process ultimately helps to increase the real wage rates of agricultural labourers. This is also corroborated by the results of our exercise as the values of regression coefficients computed treating IAPTRP as an independent variable and RWAL as dependent variable show that irrigation has a positive and significant relationship with RWAL at all four time points: 1972-73, 1977-78, 1983-84 and 1987-88 (see Table 1).[7]

Another important variable used by the earlier studies for studying the incidence of rural poverty is SDAPHRP. In fact, a most recent study by Ghosh (1996) has used SDAPHRP as the only variable for analysing the incidence of poverty across 14

TABLE 1. LINEAR REGRESSION RESULTS: IMPACT OF IRRIGATION ON OTHER RELATED VARIABLES

Dependent variable (1)		Independent variable: IAPTRP			
		Constant (2)	Slope (3)	R^2 (4)	N (5)
1972-73					
RWAL	=	2.20	0.009[a]	0.54	14
		(0.36)	(0.002)		
PFG	=	671.08	2.29[b]	0.33	14
		(146.51)	(0.94)		
SDAPHRP	=	221.21	1.32[a]	0.89	14
		(20.13)	(0.129)		
CI	=	113.67	0.078[b]	0.36	14
		(4.66)	(0.030)		
FPPHRP	=	87.99	1.41[a]	0.88	14
		(23.81)	(0.15)		
1977-78					
RWAL	=	2.66	0.007[a]	0.45	14
		(0.37)	(0.002)		
PFG	=	805.64	2.64[a]	0.46	14
		(135.39)	(0.83)		
SDAPHRP	=	274.72	1.43[a]	0.82	14
		(31.64)	(0.19)		
CI	=	116.81	0.078[b]	0.34	14
		(5.14)	(0.031)		
FPPHRP	=	99.19	1.66[a]	0.89	14
		(27.61)	(0.17)		
1983-84					
RWAL	=	2.80	0.007[a]	0.43	14
		(0.44)	(0.002)		
PFG	=	884.89	3.26[a]	0.62	14
		(131.20)	(0.73)		
SDAPHRP	=	261.19	1.49[a]	0.83	14
		(35.05)	(0.196)		
CI	=	119.13	0.093[a]	0.38	14
		(6.10)	(0.034)		
FPPHRP	=	73.74	2.02[a]	0.92	14
		(29.76)	(0.169)		
1987-88					
RWAL	=	3.22	0.006[b]	0.29	14
		(0.50)	(0.003)		
PFG	=	787.95	4.125[a]	0.52	14
		(202.30)	(1.138)		
SDAPHRP	=	185.33	1.99[a]	0.87	14
		(36.43)	(0.205)		
CI	=	120.06	0.092[b]	0.33	14
		(6.67)	(0.038)		
FPPHRP	=	16.45	2.14[a]	0.85	14
		(47.03)	(0.265)		

Sources: Government of India (1993 a, b; 1994), *Census of India*, Office of the Registrar General, Ministry of Home Affairs, Government of India, New Delhi (various years), and Ghosh (1996).

Notes: a and b indicate significance level at 1 and 5 per cent respectively.

Figures in parentheses are standard errors.

major states of India for the same years: 1972-73, 1977-78, 1983-84 and 1987-88. The study concludes that "rural poverty is found to be inversely associated with agricultural production per head of rural population in all the time points". There are no two opinions about the fact that state domestic product of agriculture determines the level of rural poverty. However, it is important to investigate as to where the SDAPHRP is higher and what are the facors determining the level of SDAPHRP? Certainly one can assert that SDAPHRP is mainly determined by the level of irrigation of a state. As the availability of irrigation determines the production and productivity of crops, the value of SDAPHRP of a state will be higher when the availability of irrigation is higher in any state. This is also confirmed by the results of regression at all the four points of time. Importantly, the regression results also show that the strength of the relationship between IAPTRP and SDAPHRP has become stronger between the early seventies and the late eighties. For instance, while the slope of IAPTRP with respect to SDAPHRP was 1.32 in 1972-73 and 1.49 in 1983-84, the same value was 1.99 in 1987-88. All these clearly show that SDAPHRP is highly influenced by the level of irrigation (IAPTRP).

As in the case of RWAL and SDAPHRP, the earlier studies have also considered FPPHRP as one of the important variables to find out its influence on the level of rural poverty. Several studies have recorded the inverse relationship between FPPHRP and rural poverty. As in the earlier case, here also the availability of irrigation determines the level of FPPHRP. It is quite obvious that in any state where the level of irrigation is higher, the production of food-grains as well as the availability of food-grains per head of rural population will also be higher. The regression computed treating IAPTRP as an independent variable (FPPHRP as dependent variable) precisely shows this relationship. The value of regression coefficients turns out to be as 1.41, 1.66, 2.02 and 2.14 respectively for the years 1972-73, 1977-78, 1983-84 and 1987-88 (Table 1). Furthermore, the strength of the relationship between the two variables has been increasing over the period. These all undoubtedly confirm that irrigation is the main factor that determines the availability of foodgrains per head of rural population. Therefore, irrigation should be considered as primarily important variable in the analysis relating to rural poverty not only for its role as infrastructure *per se* but also its inherent relationship with other determining variables of rural poverty.

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V

INCIDENCE OF POVERTY AND CHARACTERISTICS OF THE STATES

So far we have demonstrated that how irrigation has significantly influenced the variables which are traditionally used in explaining poverty in the earlier studies. In this section, we try to analyse the states which are above the national average (ANA) and below the national average (BNA) in terms of percentage of population below the poverty line and their irrigation related characteristics at all four points of time: 1972-73, 1977-78, 1983-84 and 1987-88.

Although the percentage of rural poverty has declined by 20.7 percentage points at the national level (from 54.10 per cent in 1972-73 to 33.40 per cent in 1987-88) between the early seventies and the late eighties, the reduction is not the same across the states. While the rate of reduction is significant (over 20 percentage points) in states like Andhra Pradesh, Gujarat, Kerala, Orissa, Rajasthan, Tamil Nadu and West Bengal, it is less than the national level average in other states (see Appendix). With regard to individual states, despite a significant reduction in the level of poverty between 1972-73 and 1987-88, states like Orissa, Bihar, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, Maharashtra and Karnataka continued to have higher percentage of population below the poverty line. In fact, the share of population living below poverty line of these seven states to the total poverty population of India has increased from 64.20 per cent in 1972-73 to 71.42 per cent in 1987-88 (Government of India, 1993 a). Out of these seven states, barring Tamil Nadu and Uttar Pradesh, the level of IAPTRP is lower than the national level average in the remaining states. On the other hand, the percentage of rural poverty is not only less in the states of Punjab, Haryana, Gujarat and Rajasthan but also declined significantly between 1972-73 and 1987-88 mainly because of higher IAPTRP. This shows the importance of IAPTRP in reducing the poverty in rural areas.

Since the level of poverty is determined by many factors and their complex interactions, as mentioned earlier, we have grouped the states into two in terms of percentage of poverty as the states which come above the national average and below the national average at four time points to understand the characteristics of these groups. As in the earlier section, here also we intend to see the importance of irrigation in determining the incidence of poverty. For analysing the characteristics of

ANA and BNA states, we have taken into account all the variables (IAPTRP, RWAL FGP, SDAPHRP, CI and FPPHRP) which are considered in the earlier section.

The states which are coming under ANA group and BNA group in terms of percentage of poverty and their characteristics are presented in Table 2. Our expectation here is that BNA group of states will have significantly higher IAPTRP than ANA group of states. As expected, IAPTRP is significantly higher for the group of BNA states when compared to the group of ANA states at all four points of time considered for the analysis. While the average IAPTRP was about 159 ha for the group of BNA states in 1972-73, it was only about 65 ha for the group of ANA states. Similarly, for the year 1987-88, while the average of IAPTRP was about 188 ha for the group of BNA states, it was only about 80 ha for the states belonging to the group of ANA states, showing a significant difference. This is also very much true for the two remaining points of time, i.e., 1977-78 and 1983-84 (see Figure 1). As far as other characteristics of the ANA and BNA states are concerned, as shown in the earlier section, the average values of RWAL, SDAPHRP and FPPHRP are much lower for the group of ANA states than those of the BNA states group. The implication of this is that irrigation is the main factor which plays a significant catalytic role in increasing the real wage rate of the agricultural labourers, SDAPHRP and FPPHRP. All these variables were considered as important determinants of poverty in the earlier studies.

Figure 1.
Irrigated Area Per Thousand Rural Population for ANA and BNA Group of States in terms of Rural Poverty

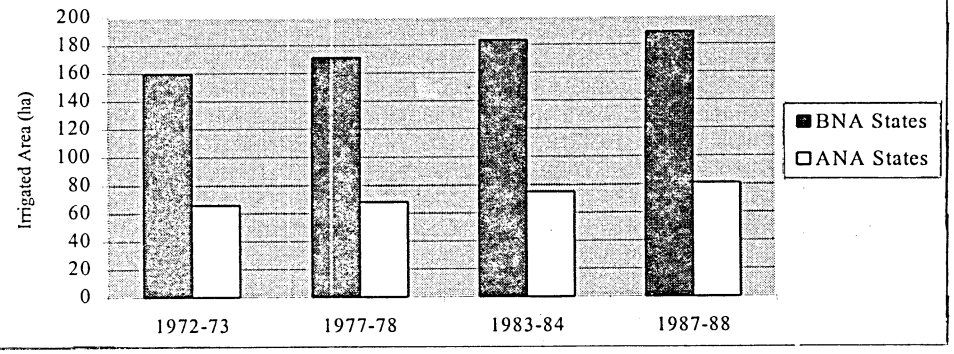

TABLE 2. STATES HAVING ABOVE NATIONAL AVERAGE (ANA) AND BELOW NATIONAL AVERAGE (BNA) IN RURAL POVERTY AND THEIR CHARACTERISTICS

Year	States	IAPTRP (ha)	RWAL (Rs./day)*	FGP (kg/ha)	SDAPHRP (Rs. at 1970 -71 prices)*	CI (per cent)	FPHRP (kg)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1972-73							
ANA states	Andhra Pradesh; Bihar; Kerala; Madhya Pradesh; Orissa; Tamil Nadu; West Bengal.	65.72	2.89	1,016.43	319.38	123.31	200.48
BNA states	Gujarat; Haryana; Karnataka; Maharashtra; Punjab; Rajasthan; Uttar Pradesh.	159.69	3.20	841.71	421.51	121.61	294.03
1977-78							
ANA states	Bihar; Karnataka; Madhya Pradesh; Maharashtra; Orissa; Tamil Nadu; West Bengal.	68.06	2.85	1,009.86	376.38	123.17	253.49
BNA states	Andhra Pradesh; Gujarat; Haryana; Kerala; Punjab; Rajasthan; Uttar Pradesh.	170.88	4.16	1,232.86	515.38	129.20	342.58
1983-84							
ANA states	Bihar; Madhya Pradesh; Maharashtra; Orissa; Tamil Nadu; Uttar Pradesh; West Bengal.	74.95	2.89	1,144.57	348.61	131.99	249.01
BNA states	Andhra Pradesh; Gujarat; Haryana; Karnataka; Kerala; Rajasthan.	183.01	4.60	1463.86	559.55	130.26	424.01
1987-88							
ANA states	Andhra Pradesh; Bihar; Karnataka; Madhya Pradesh; Maharashtra; Orissa; Tamil Nadu; Uttar Pradesh.	80.84	3.13	1,102.25	330.24	126.29	223.64
BNA states	Gujarat; Haryana; Kerala; Punjab; Rajasthan; West Bengal.	188.72	5.19	1,591.83	581.79	139.12	377.39

Source: * Ghosh (1996); others computed from Government of India (1993 a, b) and *Census of India* (various years).

VI

IRRIGATION AND POVERTY

Although irrigation has been an important factor in determining the level of rural poverty in almost all the states, it has never been considered as an important factor in the poverty related studies in India. In this section, we try to bring out the role of irrigation in determining the level of poverty in rural India. Correlation values have been computed using both irrigation and non-irrigation related variables and the regressions have been computed using only irrigation (IAPTRP) as a dependent variable determining the incidence of rural poverty. Let us first turn towards the results obtained out of the correlations presented in Table 3. As expected, all the seven variables have shown a significant negative relationship with the percentage of population below poverty line at all four points of time, indicating that the level of poverty is lower in the states where RWAL, PFG, SDAPHRP, CI and FPPHRP are higher. As far as the irrigation related variable is concerned, a very strong inverse relationship can be observed between IAPTRP and PRP at all four time points. This clearly shows that irrigation is an important factor associated with the level of poverty in rural India.

TABLE 3. CORRELATION VALUE: PERCENTAGE OF RURAL POVERTY WITH OTHER ASSOCIATED VARIABLES

Variable	1972-73	1977-78	1983-84	1987-88
(1)	(2)	(3)	(4)	(5)
GIA/GCA	-0.62[a]	-0.69[a]	-0.58[b]	-0.55[b]
IAPTRP	-0.85[a]	-0.86[a]	-0.77[a]	-0.69[a]
RWAL	-0.74[a]	-0.81[a]	-0.86[a]	-0.86[a]
PFG	-0.29[a]	-0.55[a]	-0.70[a]	-0.60[b]
SDAPHRP	-0.79[a]	-0.82[a]	-0.78[a]	-0.69[b]
CI	-0.44[a]	-0.42[a]	-0.41[b]	-0.31
FPPHRP	-0.71	-0.70	-0.68[a]	-0.54[b]

Notes and *Sources:* As in Tables 1 and 2.

In order to estimate the impact of irrigation on the rural poverty and further to strengthen our analysis, we have also computed regressions using ordinary least squares method involving IAPTRP as an explanatory variable for all four time points. The estimated regression equation is:

$$PRP = a + b_1 \, IAPTRP \qquad \ldots.(1)$$

Although factors like SDAPHRP and FPPHRP have significant influence on the level of poverty, we have excluded these variables while computing regression equation mainly due to three reasons. Firstly, our main aim here is to demonstrate the impact of irrigation on rural poverty and not to explain total variation in poverty across states. Secondly, as mentioned earlier, these variables are not the major independent variables because the level of irrigation highly influences these variables. Thirdly, there is a possibility of multicollinearity when these two variables are included with IAPTRP as we have observed high correlation between IAPTRP and these variables (correlation value between IAPTRP and these variables ranges from 0.92 to 0.96). Due to these reasons, therefore, we have computed regression using only irrigation (IAPTRP) as a single explanatory variable of the level of poverty in rural India. The regression results are presented in Table 4. The results show that there is a clear evidence of a significant inverse relationship between the level of rural poverty and the density of irrigated area standardised by population (irrigated area per thousand rural population). Another set of regression equations computed taking percentage of gross irrigated area to gross cropped area as an explanatory variable also shows a significant inverse relationship with percentage of rural poverty. These results are not presented here for the purpose of brevity.

TABLE 4. IMPACT OF IRRIGATION (IAPTRP) ON RURAL POVERTY: LINEAR REGRESSION RESULTS

Year (1)	Dependent variable (2)	Results arrived using the data of 14 states: Constant (3)	Slope (4)	R^2 (5)	N (6)
1972-73	PRP =	64.32	-0.11[a]		
		(7.93)	(0.02)	0.72	14
1977-78	PRP =	61.81	-0.12[a]		
		(8.20)	(0.02)	0.74	14
1983-84	PRP =	46.47	-0.08[a]		
		(8.23)	(0.02)	0.59	14
1987-88	PRP =	38.97	-0.07[a]		
		(9.38)	(0.02)	0.47	14
		Results arrived excluding the data of Kerala and West Bengal			
1972-73	PRP =	64.08	-0.11[a]		
		(3.72)	(0.02)	0.71	12
1977-78	PRP =	63.92	-0.13[a]		
		(3.56)	(0.02)	0.79	12
1983-84	PRP =	49.74	-0.09[a]		
		(2.77)	(0.01)	0.77	12
1987-88	PRP =	43.67	-0.08[a]		
		(2.91)	(0.02)	0.77	12

Notes and *Sources:* As in Tables 1 and 2.

Though the results undoubtedly confirm that the development of irrigation reduces the rural poverty, the strength of the regression coefficients along with R^2 has declined consistently from 1972-73 to 1987-88. For instance, while one hectare increase in IAPTRP reduced about 0.112 per cent of rural poverty in 1972-73, it was only 0.066 per cent in 1987-88 when all 14 states were considered for regression analysis. Our results confirm the theoretical hypothesis of irrigation having positive impact on rural poverty. Nevertheless, such impact cannot be unidirectional in the sense that reduction in the pace of irrigation may not increase poverty or reduce the pace of poverty reduction. The reasons are obvious and this can be explained with the help of growth in agriculturally dependent population, relationship between agricultural and non-agricultural income and elasticities of such relationship as well as growth in real wages. What we see from the empirical exercise presented here is that a consistent decline of relationship between poverty and irrigation from 1972-73 to 1987-88. As an alternative, the elimination of West Bengal and Kerala[8] (having different and consistent politico-economic regime) on an *a priori* speculation of dampening the relationship did not confirm the explanation. However, the strength of regression coefficients reducing over time can be attributed to a few important factors. Firstly, as confirmed by studies (Vaidyanathan, 1994 b; Visaria and Basant, 1994; Nayyar, 1996), the rural non-agricultural income (earnings) has been growing faster than agricultural income especially for agricultural labourers during the last two decades. This possibly could have weakened the relationship between irrigation and poverty. Secondly, revisited from another angle, the relationship might have depressed due to the intensity of various anti-poverty programmes taken in the late seventies and increased by pace in the mid-eighties. A quality change in the anti-poverty programmes towards employment generation also could have made the difference. Probably, the strength of relationship between agricultural and non-agricultural income weakening over the years appropriately explains dampening of the relationship between poverty and irrigation. This along with the another hypothesis of weakening the relationship between per capita rural consumption expenditure (at constant prices: 1973-74) and SDAPHRP were put to test. Our results indicate that the relationship between the per capita rural consumption expenditure and SDAPHRP is neither strong nor stable across the years. The result, however, does not indicate any theoretical stand but appears to be mainly due to the variation in per capita consumption expenditure over the cross-section. On the whole, one can say from the above that the decline of relationship between rural poverty and irrigation is possibly more due to significant increase of rural non-agricultural income than due to agricultural income during the last two decades.[9]

VII

CONCLUDING REMARKS

Despite several attempts made by the researchers for analysing the causes for the rural poverty, analysts have not explicitly brought out the importance of irrigation in

reducing the level of rural poverty. In this study, an attempt is made to understand the role of irrigation in the reduction of the level of rural poverty in India taking cross-section data of 14 major states at four points of time. While analysing the importance of irrigation empirically, the study shows through correlation and regression analyses that there is a clear significant inverse relationship between the incidence of rural poverty and the irrigated area per thousand rural population at all four points of time. However, the relationship between the two weakens over time which could be possibly due to relatively faster growth of rural non-agricultural income than that of agricultural income during the last two decades. The massive steps taken by the government in the eighties to combat rural poverty through various programmes could also have weakened the relationship.

Although well established poverty alleviation programmes such as Integrated Rural Development Programe (IRDP) etc., have conferred some benefits on the poor section of the rural society, the surveys conducted by the government and other agencies show that not even 15 per cent of the beneficiaries have been able to rise above poverty even after spending a huge amount of money on these programmes (Rath, 1985). The experiences also show that it is very difficult to achieve a sustained reduction in the level of rural poverty through anti-poverty programmes. As the present study finds, in a recent paper Rath (1996) while recommending policies for alleviating rural poverty has indicated that "the first and most important task would be to extend irrigation in farming areas that would have the most significant impact on productive employment. In most states where today the incidence of poverty is high, irrigation is on the low side, with significant potentiality for its extension" (Rath, 1996, p. 106). Therefore, as the development of irrigation not only increases the production and productivity of agricultural commodities but also helps to reduce the level of poverty through percolation effect, a long-term judicious policy should be formulated to utilise untapped irrigation potential wherever possible on priority basis.

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APPENDIX

DATA ON RURAL POVERTY, IRRIGATED AREA AND RANKS OF EACH STATE

States (1)	Rural poverty (per cent)*				GIA to GCA (per cent)**				IAPTRP (ha)†			
	1972-73	1977-78	1983-84	1987-88	1972-73	1977-78	1983-84	1987-88	1972-73	1977-78	1983-84	1987-88
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1. Andhra Pradesh	57.70	45.40	38.70	33.80	29.00	34.90	37.80	35.40	98.44	111.47	116.73	92.72
	(6)	(10)	(8)	(8)	(5)	(5)	(5)	(6)	(6)	(6)	(5)	(6)
2. Bihar	55.80	57.80	51.40	42.70	25.90	32.70	34.80	39.30	50.90	65.11	54.63	57.20
	(7)	(5)	(1)	(2)	(6)	(6)	(6)	(5)	(10)	(9)	(12)	(11)
3. Gujarat	43.90	43.10	27.60	21.20	14.80	18.60	25.20	26.30	75.88	87.36	113.89	111.73
	(12)	(11)	(11)	(11)	(11)	(9)	(7)	(8)	(7)	(7)	(6)	(5)
4. Haryana	21.50	23.20	15.20	11.70	47.80	51.10	63.20	82.90	287.14	290.83	333.15	331.63
	(13)	(13)	(13)	(13)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
5. Karnataka	52.30	53.20	37.50	35.90	12.70	15.40	16.90	18.80	60.62	68.78	69.95	77.39
	(10)	(7)	(9)	(7)	(12)	(11)	(10)	(10)	(9)	(8)	(9)	(9)
6. Kerala	57.80	47.40	26.10	16.40	20.90	12.10	13.80	13.60	33.72	17.84	18.94	18.54
	(5)	(9)	(12)	(12)	(8)	(12)	(11)	(12)	(14)	(14)	(14)	(14)
7. Madhya Pradesh	61.40	61.60	50.30	41.50	8.50	10.40	12.70	15.10	48.66	56.55	65.21	71.50
	(4)	(2)	(2)	(3)	(14)	(14)	(12)	(11)	(11)	(12)	(10)	(10)
8. Maharashtra	53.90	60.40	41.50	36.70	8.60	11.90	12.20	12.20	41.14	61.81	55.42	53.98
	(8)	(3)	(7)	(6)	(13)	(13)	(13)	(13)	(13)	(11)	(11)	(12)
9. Orissa	71.00	67.90	44.80	48.30	18.20	18.30	21.00	22.70	60.78	64.95	81.85	78.78
	(1)	(1)	(4)	(1)	(9)	(10)	(9)	(9)	(8)	(10)	(8)	(8)
10. Punjab	21.50	13.10	10.90	7.20	76.70	81.30	89.90	91.70	425.45	447.77	490.58	492.49
	(13)	(14)	(14)	(14)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
11. Rajasthan	47.50	33.50	36.60	26.00	16.70	18.70	21.30	30.00	119.79	125.16	137.86	136.95
	(11)	(12)	(10)	(10)	(10)	(8)	(8)	(7)	(4)	(3)	(3)	(3)
12. Tamil Nadu	63.00	56.30	44.10	39.50	47.70	47.90	46.80	43.80	124.60	118.78	92.26	83.00
	(3)	(6)	(5)	(4)	(3)	(3)	(4)	(4)	(3)	(4)	(7)	(7)
13. Uttar Pradesh	53.00	49.80	46.50	37.20	37.10	42.90	48.50	57.00	107.79	115.76	125.08	132.14
	(9)	(8)	(3)	(5)	(4)	(4)	(3)	(3)	(5)	(5)	(4)	(4)
14. West Bengal	64.00	58.30	43.80	30.30	21.70	19.60	25.20	22.70	42.91	40.45	46.15	41.00
	(2)	(4)	(6)	(9)	(7)	(7)	(7)	(9)	(12)	(13)	(13)	(13)
All-India	54.10	51.20	40.40	33.40	24.10	26.80	30.00	33.00	85.61	92.31	97.09	94.45

Sources: * Compiled from Government of India (1993 a). ** Compiled from Government of India (1993 b). † Computed from Government of India (1993 a, b) and *Census of India* (various years).

Note: Figures in parentheses are ranks.

NOTES

1. Datt and Ravallion (1996) have used initial irrigation rate (IRR), i.e., percentage of operated area which was irrigated in 1957-60 as one of the variables having negative coefficient while explaining poverty. But the use of this is in the study was more as an indicator of infrastructure (see Datt and Ravallion, 1996, p.14).

2. It is worth noting here that real wage rate of agricultural labourers, per capita production of foodgrains to rural population, state domestic product (SDP) in agriculture per head of rural population, average working days of the agricultural labourers, etc., are mainly determined by the availability of irrigation facility. In this regard, a recent study (Parthasarathy, 1996) conducted covering all the major states of India has found that a faster increase of real wage rate in the irrigated areas as compared to the unirrigated areas, suggesting the relevance in irrigation infrastructure for influencing wage rate.

3. The poverty-irrigation curve is defined by taking rural poverty ratio on Y axis and irrigation on X axis. Theoretically, we perceive that the curve will have an asymptotic with X axis. In other words, it is difficult to perceive a point of zero poverty at any given level of irrigation.

4. The names of the states considered for this study are given in the Appendix. These 14 major states altogether accounted for around 96 per cent of the total population below poverty line in rural India both in the early seventies (1972-73) and in the late eighties (1987-88) (Government of India, 1993 a).

5. We tried to ascertain the relationship of poverty with the ratio of irrigated area (GIA/GCA) as well as with IAPTRP. However, the ratio of irrigated area had a weaker relation in explaining the variation in rural poverty when compared with IAPTRP. Among the two, IAPTRP is more meaningful in explaining poverty as this variable has population as base (standardised by population to eliminate that effect). The author is grateful to the anonymous referee of the Journal for suggesting to drop out the results relating to GIA/GCA. These results are available with the author.

6. Since the variables such as RWAL, SDAPHRP, FPPHRP, etc., have been traditionally used by the studies, we refer them as traditional variables. The variables introduced in this study such as IAPTRP, PFG and CI are non-traditional variables.

7. Although the overall relationship is positive and significant between GIA/GCA and RWAL as well as between IAPTRP and RWAL, this is not true especially for Kerala and West Bengal. Despite a very low availability of irrigation per thousand rural population, the real wage rate of agricultural labourers is higher in these two states.

8. The reason for excluding Kerala and West Bengal from regression estimate is that despite low availability of irrigation in these two states, the poverty has declined significantly from 1972-73 to 1987-88. Moreover, as the agricultural labourers are the most vulnerable section of the rural society, the Government of Kerala has introduced social security scheme for this group. Under this scheme, pension is provided for the agricultural labourers above the age of 60 as well as for the physically disabled (Parthasarathy, 1996). A study conducted in this regard confirmed that as on 1986-87, one person out of every labour household got pension (Kannan, 1990).

9. The growth of non-agricultural rural employment and its impact on earnings (income) and on rural poverty has been brought by some studies. See Vaidyanathan (1994 b); Visaria and Basant (1994) for more details in this regard.

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