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ARTICLES

Infrastructure, Cost and Labour Income in Agriculture

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The structural adjustment programme in agriculture is intended to go hand in hand with infrastructure creation. Such a programme, it is envisaged, will promote a sound communication system in the rural sector and will confer an element of openness to agriculture by facilitating free flow of labour, product and knowledge. But like other sources of openness emerging in the global economy, this too has far-reaching implications for resource use across sectors.

Our concern in this study is the possible impact on human resources. Development of communication system will bring to the producers greater access to lower cost inputs including labour if available. It also makes alternative technologies available that can affect the demand for such inputs. While such effects might mean greater competitiveness and quicker transmission of market signals for resource allocation across sectors, in the short run and in regional economies the burden of adjustment may not be easy so far as human resources are concerned.

The study characterises 15 major states in India by a composite indicator of communication facilities while having a focus on regions dominated by rice and wheat. Using cost of cultivation data it then looks for the possible implication of such opening up will have on the income earned by the labour force engaged in agriculture.

I

BACKGROUND

Much of the literature on agricultural production centres on the role of agro-climatic attributes and technological development in production practices. However, although these factors will continue to play decisive roles in agricultural operations, the revolutions taking place in communication technology and the government's growing willingness to carry the benefits to rural precincts demand some emphasis on factors that work behind stage in every aspect of productive activity. In general studies incorporating the effect of communication technology have been sparse in the past.

Infrastructure is often viewed in literature as a factor of production that works by raising the efficiencies of other inputs. The measurable effects of infrastructure on productive activity are usually taken as growth of output or factor productivity and decline in costs. In cross-country studies at the macro level, several scholars (Baffes

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and Shah, 1992; Canning and Fay, 1993; Queiroz and Gautam, 1992; Easterly and Rebelo, 1993; Hardy and Hudson, 1981) found significant impact of public expenditure and individual facilities like road length and telephone lines on output growth. At the sectoral level too, Chibber (1988), Antle (1983) and Binswanger *et al.* (1987, 1989) found beneficial effect of these non-price factors on agriculture. The studies conducted by Binswanger *et al.* (1989) on India and Ahmed and Hussain (1990) on Bangladesh highlighted the significance of increased marketing efficiency and reduced transport costs that a sound infrastructure can offer to agriculture. At a different level, Fan *et al.* (2000) found that public expenditure on infrastructure served to alleviate rural poverty in India through direct and indirect ways.

The empirical evidences from India and elsewhere establish that infrastructure-based communication facilities benefit productive activity in agriculture. The results of recent studies (Malik *et al.*, 2000; Kapse *et al.*, 2000; Srivastava and Vardhan, 2000) published in this journal confirm that communication does influence rural life and production decisions in India through word of mouth at the local level still carry some weight. The results of such influences are in general expected to show up in higher value of output and lower costs of inputs. It is the latter possibility that draws our attention. While all this is a gain for the producer, for the section working as agricultural labour, the consequences are not so unambiguous.

What emerges is that the development of communication facilities is likely to bring down input cost of cultivation through easier transit, fewer inventories, better bargaining power and improved technology which are all conferred on the producer. However, the consequences of all this to labour cost depend on demand and supply conditions prevailing in the greater economy opened up by the process. Better product marketing opportunity can push up wage and labour demand especially if the demand scenario is bright. Similar effect on wage can also come through greater job opportunities opened up in other areas and also in other sectors. In contrast, inflows of unemployed labour from adjoining areas or a labour replacing change in technology can have an adverse effect on labour income of the regional economy. The latter impact can be quite deleterious for the welfare of the people if the affected regions are less developed to start with and if the crop system of the region is the main source of livelihood for the working population of the region. In fact the consequences of communication development on agricultural labour force deserve special attention because of its inextricable link with the prevalence of poverty and deprivation.

II

OBJECTIVES AND DATA

In order to address the main objective of establishing a relation between communication development and labour income generated, we will look at certain development indicators in the states dominated by one or other of the two crops and the role of each crop in absorbing labour. Broadly, the objectives of this study are as follows: (a) to identify any association that may exist between crop dominance and the development of the states, (b) to find out the relative role of the crops in absorbing labour, (c) to characterise the states' communication facilities by a single composite indicator, and (d) to look for any favourable or adverse effect of the development of communication as measured by this indicator on labour income. The analysis is based on the experience of the major states under study.

Data

The present study involves and collates two different aspects of development during the decade of the nineties, namely, agricultural performance and communication facilities. The data required are therefore drawn from disparate sources.

Taking communication first, data on railways, roads, post office and telephone lines are taken as reported by the Centre for Monitoring Indian Economy (CMIE) (2001). Limited information on rural sector provided by the Planning Commission (Government of India, 1998) is used to compute an indicator of rural level access to communication facilities. The various indicators are normalised with respect to state populations before arriving at the indicators.

The study on agriculture is based on state level data published by the Ministry of Agriculture, Government of India in its publication *Cost of Cultivation of Principal Crops in India 2000* (COC). The information is available for limited states only and the coverage in uneven over time. To look for uniformity and recency we dwelt on the years 1994-95, 1995-96 and 1996-97 for which data are reported in largest number of cases albeit with some omissions. Table 1 provides the configuration of the data on costs used in the analysis. The COC gives the value of output and the break-up of the cost as operational and capital costs. Labour cost in which our interest lies consists of casual, attached and family labour. Although the report provides different specifications of labour cost, for our purpose the relevant cost is the actual cost incurred or imputed (for family labour). The value of output is taken as the value of main product. The variables used are all on per hectare basis.

TABLE 1. AVAILABILITY OF DATA ON COST OF CULTIVATION

Crop (1)	States (2)	Years (3)
Paddy	Andhra Pradesh	1994-95,1995-96,1996-97
	Assam	1994-95,1995-96,1996-97
	Haryana	1994-95, 1996-97
	Madhya Pradesh	1994-95,1995-96,1996-97
	Orissa	1994-95,1995-96,1996-97
	Punjab	1994-95,1995-96,1996-97
	Uttar Pradesh	1996-97
	West Bengal	1994-95,1995-96,1996-97
Wheat	Gujarat	1995-96,1996-97
	Haryana	1994-95,1995-96,1996-97
	Madhya Pradesh	1994-95,1995-96,1996-97
	Punjab	1994-95,1995-96,1996-97
	Rajasthan	1994-95,1995-96,1996-97
	Uttar Pradesh	1995-96,1996-97

Source: Government of India (2000).

III

CROP DOMINANCE AND DEVELOPMENT OF STATES

Agriculture is still the dominant sector in India in terms of employment. Rice and wheat are the major crops claiming the lion's share in the area, water and budgetary allotments, besides being the dominant staples in the dietary habits of the people. The dominance of one or other of the cereals and the changes in their production environment are likely to have a profound effect on the development scenario and the welfare of the people of an area.

Table 2 presents for the major states in India some indicators of development as demonstrated by employment, expenditure and poverty in association with the shares of the two crops in the cropping patterns. Rural expenditure gives the monthly average per capita expenditure (NSSO, 1996), which is presented in lieu of rural income. Column 6 of the table presents the share of agricultural workers in total workers (Census 1991). Poverty estimates are as per Planning Commission figures (Government of India, 1998).[1] A measure of village connected is worked out as the

TABLE 2. DOMINANCE OF CEREALS AND SOME DEVELOPMENT INDICATORS (1994-95)

State (1)	Rice/ gross cropped area (per cent) (2)	Wheat/ gross cropped area (per cent) (3)	Density/ sq.km (4)	Rural expenditure (Rs.) (5)	Agricultural workers (per cent) (6)	Poverty (per cent) (7)	Rural poverty (per cent) (8)	Non-farm employment (per cent) (9)	Villages connected (per cent) (10)
Andhra Pradesh	27.84	0.08	256.44	288.70	65.13	22.19	15.92	21.70	67.52
Bihar	48.16	21.00	534.48	218.30	74.44	54.96	58.21	15.70	25.07
Gujarat	5.57	5.68	223.71	303.32	47.74	24.21	22.18	21.30	81.04
Haryana	12.82	33.82	400.50	385.01	53.43	25.05	28.02	28.10	94.66
Karnataka	7.64	1.90	246.97	269.38	57.80	33.16	29.88	18.80	59.43
Kerala	16.92	0.00	784.55	390.41	34.29	25.43	25.76	33.60	100.00
Madhya Pradesh	20.98	16.28	159.61	252.01	66.22	42.52	40.64	10.20	41.65
Maharashtra	7.27	3.45	273.84	272.66	54.51	36.56	37.93	17.40	59.03
Orissa	46.60	0.05	216.19	219.80	63.75	48.56	49.72	19.10	35.18
Punjab	28.52	43.42	423.06	433.00	53.82	11.77	11.95	25.30	93.36
Rajasthan	0.75	11.18	138.06	322.39	55.97	27.41	26.46	20.10	42.53
Tamil Nadu	32.61	0.00	443.96	293.52	56.05	35.70	32.48	29.50	79.33
Uttar Pradesh	21.15	35.03	501.33	273.83	66.66	40.93	42.28	20.00	35.42
West Bengal	66.59	3.47	812.17	278.78	49.74	35.66	40.80	36.70	38.00
Assam	65.03	2.02	307.31	258.11	54.44	40.86	45.01	20.80	46.62

Note: The poverty figures relate to 1993-94 and employment figures to 1991.

Source: Computations are based on data reported by Government of India (Ministry of Agriculture and Planning Commission); Registrar General (Census), NSSO and CMIE.

weighted average percentage number of villages with access to roads, public telephone and post office. The weights used are the shares of central budgetary allocation in the Ninth Plan outlay going to sectors roads, telecommunication and posts to get the perception of the relative importance attached to each indicator in the current scenario. This indicator however considers only a minimum access with no regard for quality of service and population covered.

The correlation coefficients across the variables in Table 2 are shown in Table 3. The dominance of agriculture as a source of employment is, as expected, found to be associated with lower level of development as denoted by lower expenditure levels, higher levels of poverty and even lower achievements in terms of non-farm employment generated and communication facilities created. Non-farm employment goes with better communication and there appears a distinct bias in village connectivity towards better-off states in terms of expenditure and poverty.

TABLE 3. CORRELATION COEFFICIENTS AMONG INDICATORS

State	Rice/ gross cropped area (1)	Wheat/ gross cropped area (2)	Density (3)	Rural expen- diture (4)	Agricul- tural workers (5)	Poverty (6)	Rural poverty (7)	Non- farm employ- ment (8)	Villages connec- ted (9)
1	1	-0.142	0.42	-0.37	0.19	0.45*	0.53	0.24	-0.42
2		1	0.08	0.44*	0.25	-0.21	-0.12	-0.10	0.11
3			1	0.27	-0.39	-0.001	0.12	0.75*	0.15
4				1	-0.64*	-0.87*	-0.78*	0.54*	0.84*
5					1	0.58*	0.49*	-0.69*	-0.68*
6						1	0.97*	-0.43	-0.80*
7							1	-0.32	-0.78*
8								1	0.50*

* Significant at 5 per cent level (one sided test).

Between the crops, the prevalence of rice is positively associated with poverty and negatively with income (expenditure) level. The rice growing states however show greater orientations to non-farm activities (possibly a search for alternative) but poor achievement by villages connected. The corresponding associations displayed by wheat are weaker (except for expenditure) and often in the opposite direction. On the whole, what is striking is that rice dominant states are found to be lagging in development which calls for special attention as against wheat.

IV

COMMUNICATION FACILITIES: A SEARCH FOR A COMPOSITE INDICATOR

Table 4 provides a comparative view of the achievements of states in providing selected communication facilities. The array covers a limited group of facilities as compared to the wide and fast expanding variety of facilities that are thrown up to the country. However, to this day not all facilities have been made useful for rural India or of significance to the agricultural sector. We picked up only the broad indicators of communication facility that also influence the effective spread and use of other facilities. This is particularly true for roads, the dominant support for physical communication, which encourage and promote a flood of other activities that include other communication media too. Moreover, in rural economies roads also play a dominant role in knowledge transfer through greater mobility of humans and increased face to face interactions. The components of roads, namely, national and state highways and district roads have their own separate significance in agricultural marketing at the national and local levels. Other facilities considered include railways, post and telephones. The variables are considered at the state level.

TABLE 4. SOME STATISTICS ON COMMUNICATION FACILITIES, 1994-95

State (1)	Railway density (2)	Road length (total) (3)	Road length (district) (4)	Road length (N. high-ways) (5)	Telephone DEL (number) (6)	Post offices (number) (7)	COM (Index) (8)
Andhra Pradesh	18.44	2.43	1.91	0.04	11.26	0.22	102.42
Bihar	30.43	0.96	0.66	0.02	3.06	0.13	100.21
Gujarat	27.15	1.93	1.11	0.04	20.57	0.20	103.32
Haryana	32.84	1.51	1.08	0.04	16.35	0.14	101.71
Karnataka	16.29	2.89	2.01	0.04	16.24	0.20	102.65
Kerala	27.10	4.56	0.51	0.03	22.31	0.16	101.14
Madhya Pradesh	13.49	2.92	1.13	0.04	8.62	0.15	101.56
Maharashtra	17.75	2.65	1.77	0.03	11.62	0.15	102.35
Orissa	12.90	6.22	0.28	0.05	4.92	0.24	101.26
Punjab	42.12	2.61	1.64	0.05	26.12	0.18	102.54
Rajasthan	17.34	2.69	1.10	0.06	10.22	0.21	102.54
Tamil Nadu	30.79	3.49	0.89	0.03	11.45	0.20	101.33
Uttar Pradesh	30.33	1.31	0.30	0.02	5.31	0.13	100.15
West Bengal	42.99	0.94	0.54	0.02	2.18	0.12	100.00
Assam	30.11	2.82	1.09	0.09	4.43	0.16	100.16

Notes: Route lengths in kilometres; Railways as density per sq.km of area. Other variables are expressed per thousand population.

Source: Computation based on data reported by CMIE (2001).

A moderate to high degree of variation is marked across states in respect of most indicators. However, the diversity in endowment within the multiple indicators considered makes comparison difficult and a single indicator would certainly make things clearer. As a way out, we looked for the underlying dimension that may be driving the data through a principal components analysis. The rationale for such a technique-driven solution is as follows. The development of communication network and the infrastructure that makes it operable is a result of the effort put in by the governments (past or present) and the private individuals in planning, implementing and drawing investments to the states. Thus, the individual indicators are likely to be correlated to this underlying measure of effort that is captured by the indicator we compute.

Principal Components Analysis (PCA)

This statistical technique is conducted to bring together the multiple indicators through suitable weights (Gulati, 1996) and generate a one-dimensional indicator of facilities. To start with, the six broad indicators, namely, national and state highways (NHY and SHY), district roads (DISTRD), railways (RLY), post offices (PO) and telephone lines (TEL), all normalised by population, are considered, but we faced the following problem. Railways and highways are often competitive means of transport across the country and the relation showed up in a negative weight or loading or RLY taken separately in the structural (first) component. This obviously makes our composite indicator less meaningful. It is desirable that a principal component used to measure the latent dimension corresponding to the selected individual indicators must be monotonically increasing in each such indicator. As an alternative it makes sense to add up route lengths of national highways and railways to indicate the long distance communication facility (TRAN).

Left with five indicators (TRAN, SHY, DISTRD, PO, TEL), the structural component vector (Appendix Table 1) was evolved accounting for 46 per cent of the variation in data. It may be noted that the relative weights of this principal component for each of the communication measures are not widely different with slightly heavier weights for roads in the district and state highways categories. The elements of the principal component (p_i) that represented the coefficients of the linear combination of the data, then helped to generate weights to weave together the data and arrive at the final indicator COM. The computation is as follows:

The component vector P (structural or first component) consists of k elements corresponding to the k indicators chosen. Matrix Z is the data matrix obtained after due standardisation representation the n states in terms of the chosen k indicators. The derivation of a one dimensional indicator vector M and the final scaled indicator COM is outline below:

$$M'(t) = (P'P)^{-1} P'Z(t)$$

where P is (k × 1) vector of components and Z is a (n × k) standardised[2] data matrix and M is the (n × 1) vector of indicators weaved out. Any element of M which gives a composite value of the indicators for each state takes a value around zero with the states at the lower end showing negative values. For the sake of convenience, the elements of M are scaled upwards through simple additive scaling such that the state at the minimum end shows a value of 100 which forms a base. This leads to the final and scaled composite indicator given by variable COM that assigns positive and relative values to the states in accordance with the facilities enjoyed. While there is no strict theoretical interpretation of the elements of COM nor of the parameter corresponding to such a variable in a regression analysis, the variable is valuable in itself and acts as an analytical tool. It reveals the relative positions of states overcoming a maze of diverse indicators that are related among themselves and in indicating the impact of these variable through a single equation rather than through a number of equations of limited significance.

Taking the five indicators (k=5) and 15 states (n=15) for the base year 1994-95, the weights used in the exercise are derived and applied to the Z matrix obtained for the same year to get COM as presented in Table 4. The same method can be extended over other years by applying the base year weights on the relevant year's Z matrix and the scaling done over the whole period covered. Such a PCA based method is used to generate the variable COM for use in regression analysis in the next section.

Table 4 shows achievements of states in various aspects of communication facilities. Taking all roads (including urban), the southern states and the two eastern states of Orissa and Assam are ahead of the others but the achievements are more uniform in respect of long distance communication indicators railways and national highways as also in posts. The composite indicator that considers only select components of facilities bring out the lead taken by west-north western states like Gujarat, Rajasthan, Punjab and Haryana and some of the southern states but most of the eastern states such as West Bengal have lagged behind. West Bengal took the last place in the year 1994-95.

V

EMPIRICAL ANALYSIS

What is income to labour class engaged in agriculture appears as labour cost to producers of agricultural commodities. Labour cost is a component of the broad category of operational cost that includes items such as fertiliser, pesticide, fuel, fodder, seeds and irrigation charges. All these costs are likely to be affected by an opening up through better communication, which impacts on their prices, availability and demand.

However, labour occupies a special place among these constituents predominantly because it is directly linked to welfare of rural people. Secondly, labour also constitutes a significant part of the total operational cost incurred and the value generated. Figures A and B based on the limited information available from COC suggest that labour constitutes a larger portion of the total value per hectare of paddy compared to wheat. In fact, at the average about half of the total operational cost of paddy is accounted for by labour. There is however marked regional variation due to unequal degrees of mechanisation with eastern and southern states showing greater labour intensity. In fact for Punjab the gap is considerably narrow between paddy and wheat. This highlights the role of paddy in labour absorption, which, coupled with the close association found between paddy dominance and development indicators of states, reinforces the cause of such regions in development programmes.

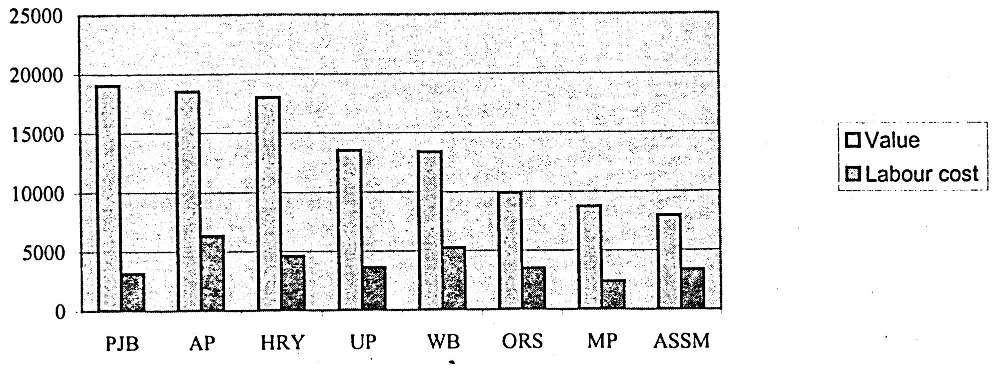

Figure A. Value and Labour Cost in Rs. per hectare: Paddy

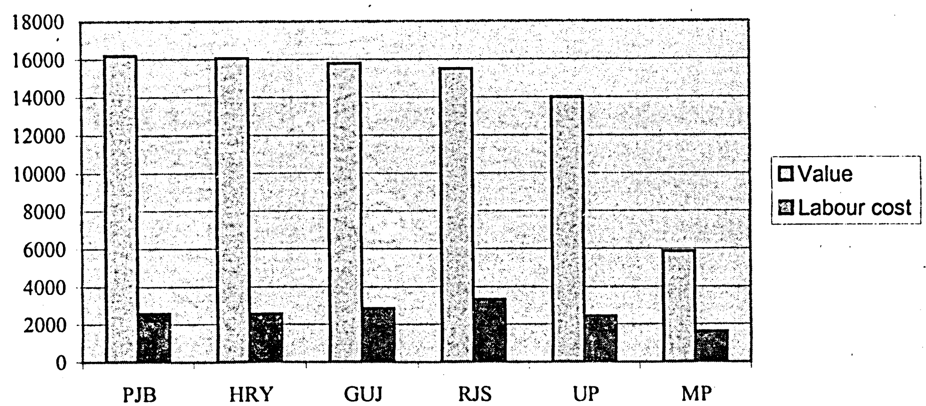

Figure B. Value and Labour Cost in Rs. per hectare: Wheat

Regression Analysis

Finally, we look for a possible remedy coming through the opening-up process initiated by the communication revolution. While we expect such a change would bring down cost of cultivation and improve the competitive edge of agricultural product, we also look for an increase in the income of the labour engaged in the activity and who make a bulk of the rural lot.

A regression analysis is conducted to study the impact of communication development on cost through three different specifications. The data base is formed by pooling the individual years and states as given in Table 1. Because of uneven coverage of years by the COC the data base presents an unbalanced panel. The dependent variable (DEP) is the relevant cost variable. To extract the direction of impact of the variable of interest, i.e., communication, other (control) variables of relevance too have to be included in the specification. The equation estimated is as follows:

$$DEP_{itsj} = a_{1i} + \Sigma\beta_{ij} D_j + a_{2i} VALUE_{itsj} + a_{3i} PRICE + a_{4i} Z_{tsj} + a_{5i} COM_{tsj}$$

where the three specifications are (i) equation 1: DEP = LABCOST; equation 2: DEP = OPCOST; equation 3: DEP = WAGE and

LABCOST = Labour cost in Rs. ('000) per hectare,
OPCOST = Total operational cost in Rs. ('000) per hectare,
VALUE = Value of crop output in Rs. ('000) per hectare,
PRICE = Price level as index,
COM = Communication indicator,
D = Dummy variable for agronomic region,
WAGE = wage rate in rupees per man-hour,
Z = Any other relevant exogenous variable,
Subscripts are i = crop, t = year, j = region, s = state,

and the parameters are a and β. The specifications and other details are explained in the following paragraph.

Cost of production in any activity is expected to vary with the value of output (VALUE) following directly from the input-output relation. Normally this would apply for any component of the operational cost too depending on the substitutability with other inputs. The primary aim of this analysis is to identify the effect of communication on cost for any given level of value realised from land. However, since cost figures are at nominal prices and since the data base includes time-series as well as cross-section information, the effect of changes in price level has to be accounted for. For this purpose, the general price level (PRICE) depicted by the wholesale price index (all commodities) is included as an explanatory variable. This variable is taken only at the all-India level to avoid simultaneity effect between cost and price level at the regional level. Finally, the communication variable is captured by the variable COM, which is derived from principal components analysis conducted over individual facilities and scaled or indexed over the entire data space as mentioned in the earlier section. Rural literacy (RLIT) and rainfall (RFALL) or weather are also tried as additional variables for their impacts. For rural literacy (per cent) the data used is based on NSSO findings reported by Government of India (*Statistical Abstract*, 2001) but a positive effect is not indicated in our results although expected. However, this may merely reflect a limitation of the model to tackle simultaneity (low farm income can encourage acquiring higher qualification for non-farm employment) or multicollinearity problem rather than a possible negative effect on farm employment. Weather is a possible extraneous effect on cost incurred as between years and between states, with unfavourable weather condition likely to be cost enhancing (greater expenditure on irrigation or drainage). The variable taken is rainfall index computed over the state level normal.

Apart from variations in the above factors across time or space, in the context of agriculture one needs to take account of the diverse geographical endowments in terms of soil and irrigation infrastructure. In other words, given the same advantage in terms of price level and weather and other facilities, states endowed with certain soil properties and irrigation facilities may realise the same value of crop at lower costs than others. It is therefore necessary to characterise the states by their agronomic properties in terms of soil condition and irrigation intensity of the states, which seem greatly heterogeneous. Considering soil first, we looked at dominant and other soil types (Singh, 1997) found in the states and then we further classified the states by their irrigation intensities. Using both attributes we arrived at 12 different regions[3] by agronomic considerations. Dummy variables are used to represent the regions that arise in each case.

One may note that the dependent variable cost is a composite variable, a product of quantity and price of input. In the case of labour the cost is a product of wage rate and employment, which have an intervening relationship as defined by the forces of demand and supply in the economy. Our principal interest lies in the composite variable, which incorporates both effects and determines the share of labour in value realised. However, since individually the variables are of relevance the impact of communication on wage is also explored through equation 3.

Further, the variables wage and employment and hence the composite variable are an outcome of demand and supply forces interacting simultaneously in the input and also output market. The variable VALUE, which impacts labour market through the demand side, is an outcome in the output market which again is impacted by the labour market forces. As a result, there arises a problem of endogeneity to be resolved. An instrumental variable method is employed where the independent variables used for value of output include rainfall (RFALL) and communication (COM) along with the agronomic dummies, all of which work on the product market and are non-stochastic to the model. Electricity use in kWh per hectare (ELEC), per capita state income (PCNSDP) in Rs. ('000) and price level (PRICE) are additional exogenous variables tried and retained if the results are meaningful [if absolute (t)>1]. Variable COM is treated as the exogenous effect on output value via its impact on input use and input prices apart from technology and product price all of which are treated as endogenous.

VI

RESULTS

Tables 5(A) and 5(B) present the equations with three specifications for labour cost, total operational cost and the component variable wage rate for paddy and wheat respectively. Both crops show expected and favourable impact of communication on operational cost taken as a whole, which augurs well for the competitive strength of the two products as also for welfare of the consumers. But the picture is diverse when labour cost alone is considered.

TABLE 5(A). REGRESSION EQUATIONS FOR PADDY

Equation	1		2		3	
DEP	LABCOST		OPCOST		WAGE	
Variables	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	161.9	2.77	271.10	2.995	120.6	2.52
VALUE	0.477	8.39	0.962	11.71	0.397	5.95
PRICE	0.079	4.457	0.132	4.371	0.083	3.49
RFALL	1.404	1.979	2.290	2.073	1.610	2.64
COM	-1.836	-2.94	-3.086	-3.175	-1.44	-2.66
R^2	0.78		0.86		0.91	
F-value	8.86		14.9		24.73	
D-W	1.8		1.6		2.2	
Observations	21		21		21	
Regional effects						
Region						
1	Base		Base		Base	
2	-3.405	-4.423	-3.808	-3.329	0.052	0.135
3	-2.657	-2.052	-5.039	-2.498	-2.20	-2.14
4	-0.541	-1.150	0.465	0.652	0.767	2.20
5	1.172	2.439	1.534	2.216	2.79	7.04
6	-4.008	-4.060	-6.528	-4.145	-2.48	-2.76

TABLE 5(B). REGRESSION EQUATIONS FOR WHEAT

Equation	1		2		3	
DEP	LABCOST		OPCOST		WAGE	
Variables	Coefficient	t-statistic	Coefficient	t-statistic	Coefficient	t-statistic
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept	-4.557	-0.403	29.188	1.974	-22.16	-2.364
VALUE	-0.009	-0.151	0.078	0.756	0.015	0.363
PRICE	0.017	2.022	0.056	5.586	0.023	3.944
COM	0.013	0.101	-0.397	-2.522	0.19	1.835
R^2	0.93		0.90		0.98	
F-value	16.24		19.6		135.46	
D-W	2.6		2.4		2.1	
Observations	16		16		16	
Regional effects						
Region						
4	Base		Base		Base	
2	1.041	1.532	1.793	1.673	2.958	7.045
11	1.789	2.918	2.278	2.306	1.190	3.028
7	1.132	1.601	2.509	2.376	-0.137	-0.0296
6	0.750	1.485	1.024	1.095	0.261	0.681

For paddy the value of output influences the cost, for any price level, which means that larger revenue comes with greater input use. But in the case of wheat, value has an insignificant but positive coefficient and it is the price level that primarily drives the cost of output. An above normal rainfall pushes up cost in paddy cultivation, especially the labour cost.

The region effects show that for paddy the effects on labour cost and operational cost are similar which is not surprising since labour is the dominant constituent of the cost. States like Punjab, Haryana and Uttar Pradesh and West Bengal show less cost than the base states Andhra Pradesh and Orissa due to their regional advantage. For wheat, Rajasthan (Region 11) has relatively high labour cost while Punjab and Haryana (Region 2) has even higher wage rate corrected for other variables. It is notable that the intercept term for labour cost is insignificant at the base level reflecting the unimportance of labour as a constituent of cost vis-a-vis other productive inputs.

Communication variable COM has a negative significant effect on labour cost as well as total operational cost of paddy cultivation whereas for wheat the coefficient of labour cost is positive but insignificant. This might mean that opening up of market via communication networking would bring down the income of agricultural labour in paddy cultivation. Since the information and mobility offered by communication are symmetric the change in labour income can come from all directions and will reflect the actual market forces that get hidden by market imperfections. Similar result with variable WAGE suggests that a greater influx of unemployed labour from adjoining areas or changes in technology and demand reflecting on farm labour demand may be possible reasons for the adverse result. For wheat the indications are contrary. Market pulls and pushes balance the effect of labour income and in fact a positive impact of communication on wage is a sign that labour is not adversely affected by development and a shift in employment pattern may be in process.

The reduced form equations (Appendix Table 2) for generating instrumental variables show that income (PCNSDP) has a strong effect on value of output, especially for paddy. Communication, which acts from both demand and supply sides of the product market, has no significant effect on value of output per unit area although it brings down cost.

The central variable of study COM helps to bring out the composite effect of connectivity on labour cost. However, despite the simplicity conferred, as a mere statistical tool it lacks practical interpretability and also hides the constituent facilities whose effects may be diverse and even contrary. For practical purposes, therefore, the individual effects may carry greater relevance. Table 6 gives the elasticities with respect to individual facilities obtained from log-linear regressions on the constituent variables of COM. Consistent with the regression results with COM, the individual effects are also not significant for wheat and bear low elasticities but for paddy too the individuals effects are not always significant. Most significantly, the variable SHY has a positive effect suggesting that mobility at a more regional level may benefit labour through greater flexibility. The effect of telephone is weak for paddy also though roads have a strong effect.

TABLE 6. ELASTICITIES WITH RESPECT TO SPECIFIC COMMUNICATION FACILITIES

	Paddy		Wheat	
Dependent (1)	LABCOST (2)	WAGE (3)	LABCOST (4)	WAGE (5)
RLY	-2.32**	-0.82*	0.04	0.11
NHY	-0.046	-0.04	0.01	0.06
SHY	1.04**	0.46**	-0.015	-0.05
DISTRD	0.53	0.24*	0.014	0.06
PO	-2.46**	-1.15**	0.034	0.13
TEL	-0.62*	-0.26	0.001	0.05

** and * Significant at 5 and 15 per cent respectively.

VII

POLICY IMPLICATIONS

Agricultural development and the welfare of rural people are greatly restrained by imperfect mobility and asymmetrical information that afflict those engaged in agriculture leading to incompetitiveness and poor income. There is now a long awaited motivation to end this bias through public programmes such as credit schemes like Rural Infrastructure Development Fund and plans on rural telephony and rural roads. The econometric exercise carried out suggests that while an opening up of the agricultural economy through better communication networking is likely to make agriculture more cost effective, there is at the same time some cause for concern as far as labour income is concerned. This is because the cost economy can come via labour as also other items of cost. This is particularly evident in the case of leading cereal, paddy, which is a major absorbant of labour in the rural economy, especially in states that lag behind in development.

The depressive effect of a technological development is nothing new and the high yielding technology (Schuh and Barghouti, 1988) itself had raised alarms for the developing world and called for a drive towards diversification of rural economy. The protective mechanisms that have been distorting the market were largely an answer to such complications. In the present context, the development coupled with market reforms will expose the true picture of market forces and agrarian technology. In the rural labour market, it is likely to end the autarky syndrome marking a move towards greater integration while picking up signals of market favourable or otherwise. The favourable fall-out of the opening up will no doubt be much more widespread and longer term and the difficulties if any are likely to be transitory and local or at best regional in nature. The insignificant effect shown in the case of wheat demonstrates how the conflicting impacts of opening up on the market cancel out and in fact has a favourable effect on wage rate. However, the importance of paddy in the agricultural economy and particularly the lag in development shown by the paddy regions draw attention once again to the need for diversification.

The communication breakthrough only reinforces the case for rural diversification with a regional emphasis in the current scenario of market reforms and it will possibly also facilitate diversification whether within agriculture or away from agriculture. Such a consequence will prevent large pockets of low income and poverty ridden labour force from developing and spilling out to urban neighbourhoods. However, considering the importance of paddy to rural workforce of the country and the state of development that characterises the regions dominated by this cereal, it is desirable that the state plays a focussed and proactive role alongside the market to strengthen skill formation, diversification and safety net for the poor to face the changes.

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APPENDIX TABLE 1. COMPONENT MATRIX

TRAN	0.645
DISTRD	0.753
SHY	0.734
PO	0.608
TEL	0.572

APPENDIX TABLE 2. REDUCED FORM EQUATIONS FOR INSTRUMENTAL VARIABLE (DEPENDENT VARIABLE IS VALUE)

Variables	Paddy		Wheat	
	Coefficient	t-statistic	Coefficient	t-statistic
(1)	(2)	(3)	(4)	(5)
Intercept	17.374	0.530	227.88	1.103
PCNSDP	10.08	12.74	8.190	1.781
RFALL	-2.523	-1.845	-0.277	-0.083
COM	-0.199	-0.625	-2.706	-1.187
PRICE			0.138	1.308
R^2	0.95		0.51	
F-value	50.51		3.02	
D-W	1.32		2.6	

NOTES

1. Figures used by Fan *et al.*. (2000) give similar results for Table 2.
2. The standardised Z matrix is obtained by the following way: $Z_i = (X_i - \mu)/\sigma$ where Z_is and X_is are the elements of the standardised and original data matrices so that Z_i are variables with expected values of zero and unit variance.
3. We used the soil mapping provided by Singh (1997) to arrive at the following nine regions: RS-1 (Andhra Pradesh, Orissa, Tamil Nadu). RS-2 (Haryana, Punjab, Uttar Pradesh), RS-3 (Madhya Pradesh), RS-4 (Rajasthan), RS-5 (Maharashtra), RS-6 (Kerala), RS-7 (Karnataka), RS-8 (Gujarat) and RS-9 (West Bengal). The states are then subjected to classification by irrigation intensity given as gross irrigated area divided by gross cropped area. The range between zero and cent per cent irrigation is divided into four equal classes (0 to 25 per cent, 25 to 50 per cent, 50 to 75 per cent and 75 to 100 per cent). The regions are RI-1 (Karnataka, Kerala, Madhya Pradesh, Maharashtra),

R1-2 (Andhra Pradesh, Bihar, Gujarat, Orissa, West Bengal), R1-3 (Tamil Nadu, Uttar Pradesh) and R1-4 (Haryana, Punjab). Taking both into account we have R-1 (Andhra Pradesh, Orissa), R-2 (Haryana , Punjab), R-3 (Bihar, West Bengal), R-4 (Madhya Pradesh), R-5 (Assam), R-6 (Uttar Pradesh), R-7 (Gujarat), R-8 (Karnataka), R-9 (Kerala), R-10 (Maharashtra), R-11 (Rajasthan). R-12 (Tamil Nadu).

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