Agricultural Economics Research Review
Vol. 23 January-June 2010 pp 29-40

Agricultural Productivity, Rural Poverty and Nutritional Security: A Micro Evidence of Inter-Linkages from Karnataka State[§]

V.R. Kiresur[a#], V.P. Melinamani[b], V.S. Kulkarni[b], Pushpa Bharati[b] and V.S.Yadav[b]
[a]International Crops Research Institute for the Semi-Arid Tropics (ICRISAT),
Patancheru-502 324, Andhra Pradesh
[b]University of Agricultural Sciences (UAS), Dharwad-580 005, Karnataka

Abstract

The inter-linkages amongst agricultural productivity, rural poverty and nutritional security have been analysed based on a study of Bagalkot district of Karnataka state using primary data for the agricultural year 2005-06 obtained from 120 farm households. The data have been processed using ratios, frequencies, percentages, regression analysis and probit model. Agricultural productivity has negatively and significantly influenced rural poverty at the farm level. Low agricultural productivity is the root cause of rural poverty. Household size and number of dependents therein have positively influenced rural poverty. Optimization of household size or increase in the number of earning members of the household would reduce poverty. Nutritional security is greatly influenced by the level of rural poverty. To upgrade the nutritional status of households, the study has suggested that effective poverty alleviation programmes aimed at enhancing agricultural productivity through transfer of productive assets instead of consumer goods to the poor, should be launched and effectively monitored. Agricultural credit being an important aspect of productivity, appropriate steps should be taken to increase the access of rural households to financial institutions.

Introduction

India accounts for one-sixth of the global population and it is growing so fast that, probably, she will soon become the most populous nation in the world. The pressure on land is increasing day-by-day, while agricultural productivity is not keeping pace with the population growth. The level of agricultural productivity has serious implications on rural poverty in India and poverty, in turn, has a bearing on food and nutritional security of the people. Presently, 72 per cent of India's population and 75 per cent of the country's poor live in rural areas. The poor in the country remain disproportionately rural, with most employed or self-employed in agriculture. Nearly two-thirds of the Indian population still depends on agriculture for its livelihood.

Growth in agricultural productivity is certainly driven by investment in agricultural research via technology development on one hand and development of infrastructure, particularly irrigation, on the other. Though there has been a substantial increase in agricultural productivity over the past two decades, the incremental growth has been declining. The compound annual growth rates of productivity of all the crop groups have declined drastically between the period 1980-90 and 1990-2000 (FAI, 2002). This has had a serious impact on the poverty level in the country, owing to the fact that agriculture has been the main occupation of the rural population in the country.

* Author for correspondence,
Email: icrisat@cgiar.org

§ Paper is based on and an extension of the M.Sc. thesis entitled "Inter-Linkages among Agricultural Research Investment, Agricultural Productivity, Poverty and Food and Nutritional Security in Karnataka: A Socio-Economic Analysis" submitted by the second author under the supervision of the senior author to the University of Agricultural Sciences (UAS), Dharwad, Karnataka, India.

Views are personal and not of the institute presently affiliated with.

During the past three decades, poverty ratio was showing a declining trend because of the economic development brought about by significant development in various sectors of the economy. During 1977-78, the poverty ratio was 51.3 per cent which decreased to 26.1 per cent during 1999-2000 (GOI, 2002). The projected poverty ratio for 2007 is 19.3 per cent (21.1 per cent for rural and 15.1 per cent for urban areas). Even as of now, as many as 220 million people were below the poverty line. The poverty line for the country as a whole in terms of monthly income was Rs 358.03 for rural population as against Rs 540.40 for urban population.

Poverty has serious effects on food and nutritional security as it contributes to low agricultural productivity via poor access to productivity-enhancing agricultural inputs. Low agricultural research investment is also a serious threat to food security via agricultural productivity and hence poverty. There is no doubt that agricultural research investment contributes to the increase in agricultural productivity and hence reduction in poverty. This, in turn, has far reaching implication on food and nutritional security. However, the intricacies of inter-linkages among agricultural productivity, rural poverty and nutritional security are much less known. In this context, the present study attempts to analyse these inter-linkages amongst agricultural productivity, rural poverty and nutritional security in India using micro level case study undertaken in Bagalkot district of Karnataka State.

Methodology

The Study Area

The Karnataka State, which is one of the states of peninsular India, is blessed with a variety of agro-eco regions enabling cultivation of a variety of crops. However, like for the country as a whole, a major chunk of cultivated land in the state falls under dry farming zone. The poverty line for the state stands at Rs 324.17 and Rs 603.50 per month for rural and urban populations, respectively (GOI, 2008).

The Data

The study was mainly based on primary data. The requisite primary data were collected from the selected households through well structured and pre-tested schedule by personal interview method. Multi-stage sampling procedure was adopted in selecting households. In the first stage, Bagalkot district was purposively selected because the proportion of Below Poverty Line (BPL) households to the total households in the district was 26.24, which was closer to the average of Karnataka state (23.93). In the second stage, out of six talukas in the Bagalkot district, two talukas — one agriculturally forward or progressive area (PA) and the other agriculturally backward or the less progressive area (LPA) — were purposively selected (Table 1). From each of the selected talukas, ten villages were selected at random in the third stage. Lastly, from each sample village, six households were randomly chosen. In all, the sample consisted of 120 households spread across 20 villages in two talukas of Bagalkot district in the Karnataka state.

Analytical Tools

The data were processed using tabular analysis, multiple linear regression model and probit model.

Poverty Response Function at Farm Level

To identify and estimate the determinants of poverty at farm level, the multiple linear regression model [Eq.(1)] was used.

$$POV_i = b_0 + b_1\, PRODY_i + b_2\, DEP_i + b_3\, CST_i + b_4\, FMGTYP_i + b_5\, HOLD_i + b_6\, IRRIG_i + b_7\, FEM_i + b_8\, LOAN_i + u_i \quad \ldots(1)$$

where,

POV_i = Poverty measured as poverty line minus per capita annual income (Rs),

$PRODY_i$ = Average value of agricultural productivity across all crops and enterprises (Rs/ha),

DEP_i = Number of dependents in a household (No.),

CST_i = Caste [1=SC, 2=ST, 3=OBC, 4=General],

$FMGTYP_i$ = Type of farming [0=Specialised; 1=Diversified],

$HOLD_i$ = Size of holding (ha),

$IRRIG_i$ = Area under irrigation (ha),

FEM_i = Number of females in a household (No.),

Table 1. Agricultural economy of the study area: 2005-06

Particulars	Hungund Taluka	Mudhol Taluka	Bagalkot District
Total geographical area (ha)	1,35,358	95,450	6,58,877
Population (No.) as per 2001 Census	2,87,086	2,75,174	16,51,892
Literacy (%) as per 2001 Census	60.15	54.11	57.81
Normal Rainfall (mm)	597.3	542.3	562.3
Fertilizer use (kg/ha)	33	194	95
Short-term and medium-term cooperative credit to agriculture (Rs/ha)	1,175	4,042	3,489
Long-term cooperative credit to agriculture (Rs/ha)	125	84	256
Gross cropped area (GCA) (ha)	1,41,227	96,305	5,71,622
Net sown area (NSA) (ha)	1,12,075	74,981	4,69,783
Cropping intensity (%)	126.01	128.44	121.68
Net area irrigated (ha)	10,862	61,042	2,12,872
Area under cereals (% of GCA)	41.57	46.29	48.75
Area under pulses (% of GCA)	17.71	6.11	11.73
Area under oilseeds (% of GCA)	39.53	19.20	27.32
Area under commercial crops (% of GCA)	0.31	24.78	9.59
Area under horticultural crops (% of GCA)	0.80	2.58	2.06

Source: DSO Bagalkot (2007), *Bagalkot District at a Glance (2005-06)*, District Statistical Officer, Bagalkot.

$LOAN_i$ = Amount borrowed (Rs/farm),
b_0 = Intercept,
$b_1,\ldots,b_8$ = Slope coefficients,
u_i = Random disturbance term (i=1,….,n), and
n = Number of observations (=120)

Probit Function Estimates for Nutritional Security

The probit model is defined by Eq.(2):

$$Pr\ (Y = 1/X = x) = \Phi\ (x' b) \qquad \ldots(2)$$

where,

Pr = Probability
Y = Binary / Dichotomous dependent variable
X = Vector of explanatory variables
Φ = Standard cumulative normal probability distribution function, and
b = Probit coefficients estimated by maximum likelihood method

The log-likelihood function for probit is:

$$\ln L = \Sigma\ w_j\ \ln\ \Phi(x_j\ b) - \Sigma\ w_j\ \ln\ (1- \Phi(x_j\ b)) \qquad \ldots(3)$$

where, Wj is the optional weight.

The above probit model was employed to estimate the influence of major factors on the probability of an individual respondent as being nutritionally secure. The nutritional security, expressed as a binary variable assuming the value one if the individual respondent's calorie intake was higher than the Recommended Dietary Allowance (RDA) as per the norms of the Indian Council of Medical Research (ICMR), otherwise zero, was the dependent variable (NUTSEC). The explanatory variables used in the model were:

AREA = Area code (PA=1; LPA=0)
AIPCU = Agricultural income per CU per annum (Rs)
PURPRICE = Average price of all the commodities purchased for consumption (Rs/q)
CST = Caste (SC=1; ST=2; OBC=3; GEN=4)
LITNUM = Literates per household (No.)
DISTMKT = Distance to market (km), and
CUIF = Total consumption units per household (No.)

Table 2. Socio-economic characteristics of respondents

Characteristics	LPA	PA	Combined
Age of the respondent (years)	46.27	39.15	42.71
Family size (No.)	7.12	6.15	6.63
Literacy level of the family (No./farm)	4.12	3.45	3.78
Dependents in the family (No.)	5.23	4.28	4.76
Females in the family (No.)	3.23	2.95	3.09
Size of holding (ha)	4.03	3.10	3.56
Area irrigated (ha)	0.11	2.47	1.29
Area irrigated as % of landholding	2.73	79.68	36.24
Agricultural productivity (Rs/ha)	7967	68153	38060
Annual income of the family (Rs)	51,747	1,45,337	98,542
Amount borrowed per farm (Rs)	37,150	1,07,750	72,450
Households Below Poverty Line (No.)	26	3	29
Distance to the market (km)	4.75	8.89	6.82
Poverty (Households Below Poverty Line) (No.)	26	3	29
Income per capita per annum	7719	24360	16040
Number of ration card holders			
a) Green	15	11	26
b) Yellow	36	40	76
c) Ashwini	1	0	1

Note: LPA=Less progressive area; PA=Progressive area.

Results and Discussion

General Socio-economic Characteristics of Respondents

The socio-economic characteristics of respondents are given in Table 2. In general, the respondents in the study area were middle aged (43 years); they were younger (39 years) in the PA than LPA (46 years) (Table 2). An average household had 6 to 7 members. The households were larger in LPA (7.12) than PA (6.15), by a member or so. These households consisted of 3 or 4 literates on an average; the literacy level was less in PA (3.45) than LPA (4.12). The number of dependents in a household was less in PA (4.28) than LPA (5.23), the district average being 4.76. The number of females in the household was opined by the respondents to influence poverty owing to liabilities of marriage expenditure on females, lower productivity or wages of females, etc. The average number of females per household was about three; it was slightly higher for LPA (3.23) than PA (2.95). The average size of holding in the study district was 3.56 ha; it was larger in LPA than in PA almost by a hectare. The average net irrigated area was about 1.29 ha in the study area; it was more in PA (2.47 ha) than in LPA (0.11 ha).

Across all crops and enterprises, the average agricultural productivity in monetary terms was almost eight times higher in PA (Rs 68,153/ha) than in LPA (Rs 7,967/ha), with an overall productivity of Rs 38,060/ha in the district. Since agriculture was the main profession in the study area and contributed substantially to the total income of the farm households, higher the productivity, higher the income of the respondents. Thus, the average annual income of a household in PA was almost three-times higher than that in LPA.

The average amount of borrowing per farm in PA was relatively very high and almost three-times higher (Rs 1,07,750) than that in LPA. It could be due to commercial farming, relatively higher productivity levels, higher repayment capacity and higher risk-bearing ability of the households in the PA. The number of BPL people as a proportion to the total population in that area (poverty ratio) was much (nine-times) higher in LPA than in PA.

Productivity Levels of Different Crops and Livestock Enterprises

Foodgrains

In general, the productivity levels of cereals, pulses and oilseeds were much higher in the PA than LPA (Table 3). The average productivity levels of cereals were more than double in PA than in LPA. Interestingly, sunflower, safflower and groundnut were the oilseeds grown in LPA as against only sunflower in PA. The productivity of oilseeds was more than double in PA than in LPA. The higher productivity in the PA was, probably, due to higher proportion of irrigated land, higher proportion of land under high-yielding varieties and more fertile soils.

Commercial and Horticultural Crops

With respect to commercial crops, only sugarcane was cultivated by the respondents of PA while their counterparts in LPA could not venture into any commercial crop. Sugarcane, being an irrigated crop, was cultivated only in PA due to the availability of sufficient irrigation in the region. The productivity of sugarcane in PA was about 12 t/ha, which was almost nearer to the demonstration yield of the University of Agricultural Sciences, Dharwad. The average productivity of horticultural crops in PA (78.7 q/ha) was more than double than that in LPA (31.5 q/ha), the district average being 51.5 q/ha.

Table 3. Productivity levels of different crops and livestock enterprises

Crop/Livestock	LPA	PA	Combined
(A) Crops (q/ha)			
Jowar	7.34	9.27	8.10
Wheat	6.63	16.37	14.05
Maize	13.34	28.87	27.58
Bajra	5.01	6.39	5.27
Cereals total	6.85	15.00	10.62
Bengal gram	7.70	11.46	8.29
Green gram	4.97	9.50	5.51
Red gram	3.28	-	3.28
Pulses total	5.71	10.24	6.28
Sunflower	5.87	12.50	6.16
Safflower	3.90	-	3.90
Groundnut	8.57	-	8.57
Oilseeds total	6.11	12.50	6.34
Sugarcane	-	1244.28	1244.28
Commercial crops total	-	1244.28	1244.28
Onion	103.85	106.25	104.33
Tomato	12.50	30.09	26.18
Brinjal	10.00	10.00	10.00
Ladies finger	-	7.50	7.50
Coriander	-	2.50	2.50
Horticultural crops total	31.54	78.71	51.50
(B) Livestock			
Milk (litres/annum)	165.92	362.50	264.21

Note: LPA=Less progressive area; PA=Progressive area

The higher productivity of commercial and horticultural crops in PA than LPA could be mainly due to higher proportion of irrigated land (80 per cent versus 3 per cent), higher fertilizer use (194 kg/ha versus 33 kg/ha), higher credit flow to agriculture (Rs 4,042/ha versus Rs 1,175/ha) and more fertile soils in the PA as compared to the LPA.

Livestock

Livestock output in the region was mainly in terms of milk. The average productivity of milk per household per annum was more than double in PA (363 litres) than LPA (166 litres). It was mainly due to higher number of milch animals per household in PA (2.43) than in LPA (1.52).

Status of Poverty in Study Area

The status of poverty in the study area was studied in terms of below poverty line (BPL) households, per capita annual income and number of different types of ration card holders. The relevant information has been given in Table 2. It was found that the number of BPL households was significantly higher (almost nine times) in LPA than in PA. The poverty ratio was as high as 48 per cent in the LPA as against only 5 per cent in the PA.

The distribution of ration cards indicated that the respondents possessed three types of ration cards, viz., Green, Yellow and Ashwini. The total number of ration card holders was almost same in both PA (51) and LPA (52). The number of BPL households in PA was 3 but the number households possessing green ration cards in that area was 11. This could be probably due to under-reporting of income by some of the respondents and/or due to possession of 2-3 cards per household in the case of joint families.

Linkages between Farm Level Socio-economic Factors and Poverty

Bhattacharya (2002) has observed that rural poverty in India has multiple dimensions arising out of economic as well as social factors. The linkages between farm-level socio-economic factors and poverty in the study area could be roughly analysed by having a two-way table, with four poverty categories (viz. BPL, Poor, Middle income and Rich) on one side and twelve different socio-economic variables on the other side under PA, LPA and the entire district separately. These twelve socio-economic variables could be grouped into three categories: first, those have positive influence on poverty; second, those have negative influence thereon, and third, those have no influence.

The socio-economic variables which had perceptibly positive impact on poverty were four, namely, household size, number of dependents in a household, number of females in a household and literacy level (Table 4). In other words, as the value of these variables increased, individually or collectively, the poverty decreased. As the household size increased, the income per capita decreased, thus leading to increase in poverty. Similar was the effect of number of dependents in a household. Further, increase in the number of females in the household, reportedly reduced the per capita income. Interestingly, literacy level had positive association with poverty, that is, higher the literacy, higher was the poverty. This is a situation akin to "too many cooks spoil the broth". As the number of literates in a household increased, probably, the decision-making became difficult due to lack of unanimity.

The seven socio-economic variables, namely, size of holding, net area irrigated, gross cropped area, cropping intensity, annual income of the household, amount borrowed per farm and distance to market, had negative impact on poverty. In other words, as the value of any of these variables increased, the poverty decreased or the household moved from BPL-category towards rich-category. The variables, viz. size of holding, net irrigated area, gross cropped area and cropping intensity had a direct bearing on the farm income and hence, indirectly on poverty. Limited endowments of the poor, specifically, land and education and their failure to benefit adequately from them tend to perpetuate their poverty (Gaihar, 1998). Obviously, as the annual income of the household increased, poverty decreased. The distance of the household to the market had negative impact on poverty.

Linkages between Socio-economic Factors and Agricultural Productivity

The six socio-economic variables which perceptibly had positive impact on productivity were: net area irrigated, gross cropped area, cropping intensity, annual income of household, borrowed amount per farm and distance to market. These have been presented under four productivity categories (Very low, Low, Medium and High) in Table 5.

Two variables, viz. age and literacy level of respondents were found to have negative influence on productivity. No definite association was found between productivity and size of holding, household size, number of dependents in a household and number of females in a household.

Crop Productivities at Different Poverty Levels

Overall Crop Productivity in Monetary Terms

The overall crop productivity in monetary terms was highest in the case of rich-category of respondents (Rs 43,946), followed by medium (Rs 34,344), poor (Rs 9,232) and BPL (Rs 7,063) categories (Table 6). In other words, agricultural productivity and poverty were negatively related at farm level. Since farm income is a significant component of the household income, any increase in the agricultural productivity would increase the household income and thus reduce the poverty level. Datt and Ravallion (1998) have also found that higher farm productivity brought both absolute and relative gains to poor rural households.

Crop Productivity in Physical Terms

It was observed that as productivity of cereals increased from 6.93 q/ha to 16.10 q/ha, the households moved from BPL to rich categories of poverty. The relation between pulses' productivity and poverty was negative between BPL and middle categories and not beyond. Again in the case of oilseeds, as productivity of oilseeds increased, poverty decreased. The productivity of oilseeds varied from 5.49 q/ha in BPL category to 8.27 q/ha in rich category. As the sugarcane productivity increased from 1000 q/ha to 1272 q/ha, the household moved from poor category to rich category. The negative association between agricultural productivity and poverty was observed between BPL to middle categories and not beyond.

Table 4. Linkages between socio-economic factors and poverty

Variable→ Poverty category ↓	Size of holding (ha)	Area irrigated (ha)	Gross cropped area (ha)	Cropping intensity (%)	Annual income of family (Rs)	Amount borrowed per farm (Rs)	Family size (No.)	Age of farmer (years)	Literacy level (No./family)	Distance to market (km)	Dependents in family (No.)	Females in family (No.)
Less progressive area												
BPL	3.26	—	4.66	168.62	11404	32346	7.31	43.73	4.19	5.13	5.65	3.31
Poor	4.04	0.14	6.07	166.48	42694	28353	7.35	47.47	3.76	4.82	5.24	3.29
Middle income	4.48	0.13	7.87	186.89	86750	38750	6.83	45.00	4.17	4.33	5.08	3.33
Rich	6.92	0.48	8.25	129.56	208300	88200	6.00	58.40	4.80	3.50	3.40	2.40
Overall	4.03	0.11	6.00	168.41	51747	37150	7.12	46.27	4.12	4.75	5.23	3.23
Progressive area												
BPL	1.53	1.00	1.80	133.33	24533	36667	7.67	40.67	3.00	7.83	5.00	3.67
Poor	1.09	0.57	1.83	178.27	26171	50000	5.00	37.00	1.86	8.79	3.29	2.57
Middle income	3.12	2.54	7.90	255.61	104776	115600	6.56	38.88	3.72	8.56	4.64	2.96
Rich	3.82	3.10	9.42	258.58	233760	124600	5.88	39.84	3.68	9.38	4.12	2.96
Overall	3.10	2.47	7.52	241.71	145337	107750	6.15	39.15	3.45	8.89	4.28	2.95
Combined												
BPL	3.08	0.10	4.37	164.97	12762	32793	7.34	43.41	4.07	5.41	5.59	3.34
Poor	3.18	0.27	4.83	169.92	37875	34667	6.67	44.42	3.21	5.98	4.67	3.08
Middle income	3.56	1.76	7.89	233.32	98930	90676	6.65	40.86	3.86	7.19	4.78	3.08
Rich	4.34	2.67	9.22	237.07	229517	118533	5.90	42.93	3.87	8.40	4.00	2.87
Overall	3.56	1.29	6.76	205.06	98542	72450	6.63	42.71	3.78	6.82	4.76	3.09

Table 5. Linkages between socio-economic factors and agricultural productivity

Variable→ Poverty category ↓	Size of holding (ha)	Area irrigated (ha)	Gross cropped area (ha)	Cropping intensity (%)	Annual income of family (Rs)	Amount borrowed per farm (Rs)	Family size (No.)	Age of farmer (years)	Literacy level (No./family)	Distance to market (km)	Dependents in family (No.)	Females in family (No.)
Less progressive area												
Very low	4.04	0.06	5.55	159.11	37427	28081	7.19	47.05	4.22	4.06	5.22	2.97
Low	3.90	0.19	6.58	183.98	78095	54524	7.19	45.00	4.05	5.95	5.38	3.67
Medium	5.20	—	8.20	177.08	40000	22500	5.00	45.00	3.00	4.75	4.00	3.50
High	—	—	—	—	—	—	—	—	—	—	—	—
Overall	4.03	0.11	6.00	168.41	51747	37150	7.12	46.27	4.12	4.75	5.23	3.23
Progressive area												
Very low	1.10	0.73	1.73	157.14	29033	17500	5.33	44.33	1.83	9.83	3.67	2.83
Low	1.60	1.08	2.40	166.00	32520	67000	6.20	32.20	2.80	7.60	3.80	3.40
Medium	3.84	2.64	8.63	225.98	212250	125000	6.44	42.31	3.88	8.78	4.56	3.00
High	3.33	2.91	8.81	276.18	151133	121970	6.15	37.73	3.64	8.97	4.33	2.88
Overall	3.10	2.47	7.52	241.71	145337	107750	6.15	39.15	3.45	8.89	4.28	2.95
Combined												
Very low	3.63	0.16	5.02	158.84	36256	26605	6.93	46.67	3.88	4.87	5.00	2.95
Low	3.45	0.36	5.78	180.52	69331	56923	7.00	42.54	3.81	6.27	5.08	3.62
Medium	3.99	2.34	8.58	220.55	193111	113611	6.28	42.61	3.78	8.33	4.50	3.06
High	3.33	2.91	8.81	276.18	151133	121970	6.15	37.73	3.64	8.97	4.33	2.88
Overall	3.56	1.29	6.76	205.06	98542	72450	6.63	42.71	3.78	6.82	4.76	3.09

Table 6. Crop productivity at different poverty levels

(q/ha)

Crops	Less progressive area				Progressive area				Combined			
	B	P	M	R	B	P	M	R	B	P	M	R
Cereals	6.29	6.42	8.27	7.10	13.57	12.63	13.20	18.16	6.93	8.49	11.21	16.10
Pulses	4.60	6.33	7.14	3.47	—	—	10.68	9.79	4.60	6.33	7.97	6.00
Oilseeds	5.49	5.49	7.46	6.86	—	12.50	—	12.50	5.49	5.93	7.46	8.27
Commercial crops						1000.00	1225.03	1271.77	0.00	1000.00	1225.03	1271.77
Horticultural crops	125.00	68.75	88.75	57.08	5.00	—	23.75	34.18	65.00	68.75	77.92	39.57
Overall crop productivity (Rs/ha)	6979	8099	15981	10729	8414	13511	50729	52888	7063	9232	34344	43946

Note: B=Below poverty line; P=Poor; M=Middle income; R=Rich.

Thus, by and large, in all the crop group categories, increase in agricultural productivity has pushed up households from BPL category towards rich category up to a level, decided by the amount of increase in productivity.

Poverty Response Function at Farm Level

Unlike categorical classification tables, functional analysis would help identify precisely the determinants of poverty at farm level and estimate the association accurately. Hence, a multiple linear regression model was estimated using OLS technique with POV (Poverty measured as poverty line minus the per capita annual income) as the dependent variable regressed by eight explanatory variables, namely, PRODY (average value of agricultural productivity across all crops and enterprises), DEP (number of dependents in the household), CST (caste), FMGTYP (type of farming), HOLD (size of holding), IRRIG (area under irrigation), FEM (number of females in the household) and LOAN (amount borrowed). The estimated model (Table 7) explained nearly 86 per cent of the variation in POV.

The regression coefficients of all the variables included in the model were negative except DEP. However, only four out of eight variables included in the model were significant, namely, PRODY, DEP, FMGTYP and LOAN. Among these four significant variables, PRODY, FMGTYP and LOAN negatively influenced poverty while DEP exerted positive influence.

As the agricultural productivity increased, poverty decreased and vice versa. This was quite obvious since agriculture was the main profession of the respondents; farm income formed a major chunk of the total income of the household. Lanjouw and Shariff (2004) have also found that the direct contribution of the non-farm sector to poverty reduction was possibly quite muted as the poor lacked assets, while the growth of certain non-farm sub-sectors was strongly associated with higher agricultural wage rates. Christopher and Barrett (2005) have shown that geographical and physical characteristics being constant, communes that had higher rates of adoption of improved agricultural technologies and consequently higher crop yields enjoyed lower food prices, higher real wages for unskilled workers and better welfare indicators.

Type of farming also influenced the POV negatively. As the farming diversified, poverty reduced, while, on the other hand, the specialised farming faced more risks and led to more of poverty. Amount of short-term agricultural loan borrowed by the respondent also negatively influenced poverty. Higher the loan amount borrowed, higher the productivity owing to strong and positive association between productivity and risk levels. Contrastingly, number of dependents in the household affected poverty positively; higher the number of dependents, higher was the poverty. Thus, in order to reduce or do away with poverty, either the household should be optimally sized or the number of earning members in the household should increase, among other solutions.

Nutritional Security Status by Poverty Categories

The respondents were classified into different nutritional security groups based on the ratio of their calorie intake (kcal/day/CU) to the RDA for energy (kcal/day/CU) as recommended by the ICMR. If the

Table 7. Poverty response function at farm level

Particulars	Regression coefficients
Intercept	2554.08
Average value of agricultural productivity across all crops and enterprises (Rs/ha)	-0.19***
Number of dependents in the household (Number)	2070.31*
Caste [SC=1, ST=2, OBC=3, General=4]	-527.02
Type of farming [0=Specialised; 1=Diversified]	-11811.92**
Size of holding (ha)	-867.31
Area under irrigation (ha)	-1190.31
Number of females in the household (Number)	-207.67
Amount borrowed (Rs/farm)	-0.24*
	0.86

Note: ***, **, * Significant at 1 per cent, 5 per cent and 10 per cent levels, respectively.

Table 8. Nutritional security status by poverty categories

(Number)

Nutritional security status	Less progressive area					Progressive area					Combined				
	B	P	M	R	O	B	P	M	R	O	B	P	M	R	O
Secure (>1)	8 (30.8)	7 (41.2)	3 (25.0)	3 (60.0)	21 (35.0)	1 (33.3)	6 (85.7)	13 (52.0)	15 (60.0)	35 (58.3)	9 (31.0)	13 (54.2)	16 (43.2)	18 (60.0)	56 (46.7)
Moderately insecure (0.80-0.99)	5 (19.2)	6 (35.3)	7 (58.3)	1 (20.0)	19 (31.7)	1 (33.3)	1 (14.3)	8 (32.0)	8 (32.0)	18 (30.0)	6 (20.7)	7 (29.2)	15 (40.5)	9 (30.0)	37 (30.8)
Mildly insecure (0.5-0.79)	13 (50.0)	3 (17.6)	2 (16.7)	1 (20.0)	19 (31.7)	1 (33.3)	0 (0.0)	4 (16.0)	2 (8.0)	7 (11.7)	14 (48.3)	3 (12.4)	6 (16.3)	3 (10.0)	26 (21.7)
Severely insecure (<0.5)	0 (0.0)	1 (5.9)	0 (0.0)	0 (0.0)	1 (1.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.2)	0 (0.0)	0 (0.0)	1 (0.8)
Total	**26**	**17**	**12**	**5**	**60**	**3**	**7**	**25**	**25**	**60**	**29**	**24**	**37**	**30**	**120**

Note: B=Below poverty line; P=Poor; M=Middle income; R=Rich; O=Overall.
Figures within the parentheses indicate percentages to the column's total.

ratio was more than one, he/she was termed as "nutritionally secure", while if it was less than one, he/she was termed as "nutritionally insecure". Nutritionally insecure respondents were further classified on the basis of extent of nutritional insecurity; those falling in the range of 0.80 to 0.99 were termed as "moderately insecure", those in the range of 0.50 to 0.79 were called as "mildly insecure" and those with less than 0.50 were referred as "severely insecure". Overall, nearly 46.7 per cent of the respondents were found to be "nutritionally secure", while the remaining (53.3 per cent) were "nutritionally insecure" to a varied degree (Table 8). Amongst nutritionally insecure households, 30.8 per cent were "moderately insecure", followed by "mildly insecure" (21.7 per cent). It was quite interesting to note that there was hardly a case of severe nutritional insecurity in the study area. A similar situation existed in both LPA and PA. Contrastingly, Ijarotimi and Oyeneyin (2005) have observed in Nigeria that 17.9 per cent of the households were food secure, 26.6 per cent were moderately food insecure and 55.5 per cent were severely food insecure.

Across poverty categories, nutritional security, as expected, was observed maximum in the rich category. But it was observed in other poverty-categories also. Even in the BPL-category, nearly 31 per cent of the

Table 9. Probit function estimates for nutritional security

Particulars	Regression coefficients
Constant	-3.416
Area code (PA=1; LPA=0)	0.468
Agricultural income per CU per annum (Rs)	0.292***
Average price of all the commodities purchased for consumption (Rs/q)	0.001
Caste (SC=1; ST=2; OBC=3; GEN=4)	0.347
Literates per household (No.)	0.327*
Distance to market (km)	-0.004
Total consumption units per household (No.)	-0.839***
log likelihood	-114.691

Note: ***,* Significant at 1 per cent and 10 per cent levels, respectively.

respondents were nutritionally secure. A majority of respondents were found to be nutritionally secure in poor (54 per cent) as well as middle (43 per cent) categories. The moderate insecurity was observed maximum in middle (40 per cent), followed by rich (30 per cent), poor (29 per cent) and BPL (21 per cent) categories. Mild nutritional insecurity was maximum in BPL (48 per cent) category, followed by middle, poor and rich categories. By and large, a similar pattern was observed individually in less progressive and progressive areas under each poverty category.

Since nutritional security various across different poverty categories, policies with different strategies should be evolved for different poverty categories.

Probit Function Estimates for Nutritional Security

To estimate the change in probability that the respondent would be nutritionally secure, the probit model was run on the dichotomous dependent variable, NUTSEC, with the explanatory variables as used in the above regression model.

Three of the eight explanatory variables included in the probit model, namely, AIPCU, LITNUM and CUIF significantly influenced the probability that the respondent was nutritionally secure (Table 9); AIPCU and LITNUM influenced positively and CUIF, negatively. Other things being equal, a unit increase in the AIPCU would increase the probability of a respondent becoming nutritionally secure by 29.2 per cent, while a unit increase in LITNUM would increase the corresponding probability by 32.7 per cent. Contrastingly, a unit increase in CUIF would reduce the probability of a respondent becoming nutritionally secure by 83.9 per cent.

Conclusions and Policy Implications

The study has revealed that rural poverty is significantly and negatively influenced by the agricultural productivity at the micro level. Low agricultural productivity is the root cause of rural poverty. Further, poverty is the root cause of under-nutrition. Higher the poverty, lower the nutritional security and vice versa. Hence, in order to upgrade the nutritional status of the respondents in the region, effective poverty alleviation programmes should be launched and monitored by the government and/or NGOs.

In order to reduce poverty, training on income-generating activities should be organised. The R&D institutions/NGOs should educate the households about the benefits of diversified farming, and the government and financial institutions may support this cause through developing suitable infrastructure. Agricultural credit being an important aspect of productivity, appropriate steps should be taken to increase access of rural households to financial institutions. The farm credit may be liberalized and its effective utilization be monitored.

More than half of the respondents have been found nutritionally insecure in the study area. Further, a large chunk of the population in BPL category has been noted "mildly insecure" as against "moderately insecure" in other poverty categories. It calls for immediate policy formulation aiming at achieving nutritional security and should have different strategies for different poverty categories.

The agricultural productivity and literacy could enhance nutritional security, while the consumption units in the household could reduce. Diversification in the production of milk, fruits and vegetables should be the current research priority with additional research support (Jha *et al.,* 1995). The diversified food basket would provide food security and improve the quality of life by adding to the nutritional status (Kumar and Rosegrant, 1995). In this context, researchers may work on the "optimization models of consumption" – maximizing nutrient intake per rupee invested or minimizing the cost per nutrient intake.

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