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Factors Affecting Cropping Intensity and Use of Fertilisers and High-Yielding Variety Seeds in Barak Valley

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INTRODUCTION

The Barak Valley constitutes the southern most part of the state of Assam. Flanked by the hills of the North Cachar Hill district of Assam in the north and the state of Mizoram in the south, the valley is named after its principal river the Barak, which flows in from Manipur in the east and branches out to Bangladesh in the west. As per 2001 Census, a population of 28.89 lakhs inhabits the geographical area of 6,922 square kilometres of the valley. The population density of 432 persons per square kilometre is high compared to the corresponding state level and all-India figures of 340 and 324 respectively. Its economy is predominantly agricultural with about 71 per cent of the workforce being engaged in agriculture and other primary activities. Though the region is not devoid of manufacturing units, its relative geographical isolation handicaps it for a programme of large-scale industrialisation. The prospects of economic development of the region therefore hinge critically on the growth of agriculture and allied activities. Agriculture in Barak Valley, as it stands today, is predominated by small farms growing mainly rice.[1] The analysis of macro level data collected from government agencies reveals that agricultural performance of the region, in terms of growth of output and attainment of yield of its principal crop rice, has been somewhat better than that of the state of Assam as a whole. But in comparison to the all-India standards, the region as well as the state continues to lag far behind (Roy and Bezbaruah, 2000). Clearly the farmers in Barak Valley, as in most parts of the North-Eastern region of India, have so far not succeeded in exploiting significantly the potentials of the high-yielding variety (HYV) seed-fertiliser technology. In this context it was felt that a probe into the farm level conditions would be instructive for identifying the constraints restricting the farmers from fuller utilisation of their production possibilities. Accordingly, a detailed field survey with farm as the unit of observation was carried out in the autumn of 1998. The paper is based on the analysis of the findings of that study.

The prime objective of the study was to identify the factors affecting the adoption and use by farmers in Barak Valley of those practices that tend to increase productivity per unit of net area cultivated. Attention is focused on the three key practices of use of HYV seeds, application of fertilisers and multiple cropping. The three practices, all enabling more intensive use of land, are of interest in the context

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of Barak Valley where population density is high and the average size of operational holding is relatively small. Land being relatively scarce, the growth in agricultural production there has to come primarily from augmentation of productivity per unit of area through more intensive use of land. The central hypothesis of the study is that the poor state of agricultural infrastructure, especially of irrigation and extension service, is primarily responsible for the observed performance level of agriculture in the region. The issue whether the institutional and environmental conditions in which the farmers in the valley operate also stand in the way of fuller exploitation of the HYV seed-fertiliser technology in the region has also been investigated.

DATA BASE AND METHODOLOGY

Sampling Framework

One Agricultural Extension Officer (AEO) circle from each of the six agricultural sub-divisions of the region was selected as the broad location for the field study. The selection at this stage was done in consultation with the officials of the State Agriculture Department and the selection was based primarily on two considerations. Firstly, the selected circle should be fairly representative of the whole sub-division in terms of the level of agricultural development. Secondly, the minimum infrastructure for adoption of the HYV seed-fertiliser technology should be available at least in some villages of the selected circle. From each of these AEO circles the sample of farm households was selected according to a two-stage random sampling design. In the first stage, from each circle three villages were selected at random. In the second stage 10 per cent of farm households in each selected village were then selected at random. Two hundred and eighty-two farm households thus selected from the six AEO circles constituted the sample for the study. For recording the relevant information for each household, a structured questionnaire was used.

Factors and Variables Included in the Analysis

The farmer's use of the three practices, on which the present study is focused, has been measured in the following way. Use of HYV seeds has been measured by the proportion of area under HYV paddy in the total paddy acreage of the farmer. The proportion is denoted by the variable AH. Application of fertilisers has been measured by the quantity of NPK applied per hectare, which is denoted by the variable FC. The cropping intensity of the farm, denoted by CI, has been taken as the measure of extent of multiple cropping. The levels of use of the three practices by the sample farmers in the six circles are shown in Table 1.

For explaining the variations among farmers in the use of these three inputs and practices, the following explanatory factors have been used.

1. *Availability of irrigation:* Importance of this factor for use of HYV seeds, application of fertilisers at a higher dose and also for adoption of multiple cropping is well known (Atteri and Joshi, 1982; Bezbaruah, 1994; Sawant *et al.*, 1997).

Traditionally irrigation has been the key factor in the use of the HYV seed-fertiliser package by the farmers. Apart from providing favourable conditions for exploiting the HYV seed-fertiliser technology, assured irrigation also facilitates multiple cropping by enabling the farmers to raise crops even in the dry season. Availability of irrigation facility to an individual farm has been measured by the variable IR defined as the proportion of net irrigated area in the operational holding of the farm.

TABLE 1. EXTENT OF USE OF HYV, APPLICATION OF FERTILISER AND CROPPING INTENSITY IN SAMPLE FARMS IN THE SIX CIRCLES

Circles	Percentage of farmers using HYVs	Percentage of paddy area under HYVs	Fertiliser consumption (N+P+K kg/ha)	Cropping intensity (per cent)
(1)	(2)	(3)	(4)	(5)
1. Fakira Bazar	100.0	56.13	35.81	144.88
2. R. K. Nagar	95.3	39.55	20.61	119.70
3. Narshingpur	100.0	44.65	42.85	130.00
4. Salchapra	90.9	25.52	38.73	125.41
5. Banskandi	86.0	38.31	39.73	140.59
6. Panchgram	95.7	36.01	57.88	128.93
Overall	95.0	41.15	39.85	132.39

2. *Access to extension service:* The crucial role of extension service in diffusing new innovations among the farmers, particularly in relatively backward conditions, has also been emphasised in several studies (Chauhan, 1980; Singh, 1980; Srinivas and Mukunda, 1980; Vadapalli, 1997). In the questionnaire used in the field study six questions related to the farmer's interactions with the extension agency were included.[2] The farmers' responses to these queries were codified into scores. The total score on these questions could vary from 0 to 7 depending on the level of the farmer's interactions with the extension agencies. A farmer's score on these questions has been used as the measure of his access to extension service. The variable measuring access to extension service has been denoted by EX.

3. *Farm size:* Since the advent of the HYV seed-fertiliser technology, it has been of interest to agricultural economists to see whether the small farmer is at a disadvantage compared to the large farmer with respect to the adoption and effective utilisation of the technology. The evidence in this regard has been found to be varied with respect to time and space (Schulter and Mellor, 1972; Castilbo, 1975; Bhalla, 1979; Sarap and Vashist, 1994). In the present study the operational holding of the farmer, denoted by the variable OH, has been taken as the measure of farm size.

4. *Tenancy:* The evidence regarding whether tenant farmers are in relative disadvantage in adopting improved farm practices has also been found to be varied (Mukherjee, 1970; Muthiah, 1971; Parthasarathy and Prasad, 1978; Sawant, 1997). The tenancy factor is sought to be captured by the variable TL defined as the proportion of land leased-in in the operational holding of the farmer. It may be

mentioned that tenancy in Barak Valley has been found to be in the form of crop sharing usually without sharing of costs.

5. *The Extent of low land:* In the Barak Valley region, as in the entire state of Assam, low lying plots prone to frequent flooding and prolonged waterlogging are fairly common. In the absence of suitable improved varieties for such deep-water conditions, farmers having such low lying land in their operational holdings are likely to be constrained in the extensive use of improved farm practices (Anden-Lacsna and Barker, 1978; Bezbaruah, 1994). Therefore the variable LL, defined as the proportion of low land in the operational holding, has also been included as one of the possible explanatory factors for analysing the extent of use of improved practices by the sample farmers.

Besides these five common factors, the proportion of area under HYV in the gross cropped area of the farmer, denoted by the variable PH, has also been used as an explanatory factor in the analysis of adoption of multiple cropping. For, adoption of short duration HYVs may be expected to facilitate increase in cropping intensity by releasing land early enough for an additional round of cropping. Similarly, in the analysis of application of fertilisers, the proportion of area under fertiliser intensive crops (HYV paddy and vegetables) in the gross cropped area has been included. This variable is denoted by PF.

Some studies on the adoption of HYV seed-fertiliser technology (e.g., Sarap and Vashist, 1994) have found availability of credit to be yet another factor influencing the farmers' decision in this regard. This factor however could not be taken care of in the present study as few farmers in the sample were found to have used institutional credit.[3]

Besides the factors mentioned above, five dummies C_2, C_3, C_4, C_5 and C_6, have been used to capture the effect of variations in locations across the six circles. The dummy C_i ($i = 2, 3 \ldots 6$) takes the value 1 for the circle number i and 0 for the other circles. The coefficient of C_i in the regression analyses reported below captures the differentials effects due to variations in local conditions between circle i and circle 1.

The Models

The basic tool of analysis used is multiple regressions. For explaining the application of fertiliser and extent of multiple cropping linear regression models have been used. However, the linear functional form was not found quite suitable for explaining the variation in the use of HYVs. The relevant dependent variable AH being contained in the range 0 to 1, a more appropriate functional form would be one in which the estimated value of the dependent variable will be contained within the range 0 and 1. Accordingly, the following logistic functional form was chosen:

$$AH = \frac{1}{1+e^{-Z}} + U \qquad \text{.... (1)}$$

where $Z = a_1 + a_2C_2 + a_3C_3 + a_4C_4 + a_5C_5 + a_6C_6 + a_7IR + a_8EX + a_9OH + a_{10}TL + a_{11}LL$ ....(2)

and U is random disturbance with zero mean.

The a_js (j = 1, 2,....,11) are the unknown parameters to be estimated.

Though Z is a linear combination of variables that have both upper and lower bounds, no bounds can be assigned to the variable Z itself, as values assumed by Z will depend on the values of the unknown parameters a_js also. The formulation of equation (1) however ensures that as AH increases with increase in Z, the impact of Z on AH is contained between 0 and 1.

The linear regression models for explaining the application of fertilisers and extent of multiple cropping are given by equations (3) and (4) below:

$$FC = b_1 + b_2C_2 + b_3C_3 + b_4C_4 + b_5C_5 + b_6C_6 + b_7IR + b_8EX + b_9OH + b_{10}TL + b_{11}LL + b_{12}PF + U \quad \text{.... (3)}$$

$$CI = d_1 + d_2C_2 + d_3C_3 + d_4C_4 + d_5C_5 + d_6C_6 + d_7IR + d_8EX + d_9OH + d_{10}TL + d_{11}LL + d_{12}PH + U \quad \text{.... (4)}$$

where b_js and d_js are the parameters to be estimated and U is random disturbance as in equation (1).

RESULTS AND DISCUSSION

Use of HYVs by Sample Farmers

Equation (1), explaining variation in the use of HYVs by the sample farmers, has been estimated by non-linear least squares method. The linear regression of AH on variables constituting Z was first estimated. The estimated linear regression coefficients were then used as the initial trial estimates of the parameters a_js for starting the iteration process of the non-linear least squares estimation. The results that converged after five iterations are presented in Table 2.

TABLE 2. RESULTS OF NON-LINEAR LEAST SQUARE ESTIMATION OF EQUATION (1) FOR EXPLAINING VARIATIONS IN THE USE OF HYVS ACROSS SAMPLE FARMS

Variables (1)	Estimated coefficients/values (2)	Standard errors (3)	t-values (d.f. = 271) (4)
Constant	1.06800	0.20317	5.2564***
C_2	-0.75598	0.19440	-3.8887***
C_3	-0.53084	0.18212	-2.9148***
C_4	-1.19500	0.21370	-5.5919***
C_5	-0.64876	0.20563	-3.1550***
C_6	-0.62723	0.21862	-2.8691***
IR	0.32521	0.40528	0.80243
EX	0.03512	0.03098	1.1335
OH	-0.13783	0.06189	-2.2269**
TL	-0.28932	0.14577	-1.9848**
LL	-0.88919	0.21162	-4.2018***
R^2	0.26131		
F (10, 271)	9.5865***		

** and *** Significant at 0.05 and 0.01 level respectively.

Though the R^2 value of 0.26131 is not particularly high, it cannot be dismissed as too low in the context of a fairly extensive cross-section study as the present one. Moreover, nine out of the eleven parameters of the function turned out to be statistically significant showing the relevance of the corresponding factors in explaining the variation in the extent of use of HYVs by the farmers. The F-statistic for overall regression is also statistically highly significant. Thus, on the whole, the results obtained from the analysis are fairly robust and credible.

Besides the coefficients of the circle dummies C_is and the intercept of Z, the coefficients of the variables OH, TL and LL have come out statistically significant and are negative. The negative sign of the coefficient of LL is expected as higher proportion of low land leaves a smaller part of operational holding suitable for the use of HYVs. The negative sign of the coefficient of the variable OH indicates that the smaller farmers actually put larger proportions of paddy acreage under HYVs. In other words, smaller farm size is not a handicap as far as the use of HYV is concerned. However, the coefficient of TL being negative implies that the tenant farmers tend to use HYVs less extensively. The coefficients of the variables IR and EX, representing respectively the effects of availability of irrigation and access to extension service, are expectedly positive. But neither of these coefficients is significant. The non-significance of these two coefficients can be reconciled in terms of the observation in Table 1 that the adoption of HYV among the sample farmers is almost universal. Thus the extent of their paddy acreage put under HYV is no longer restricted by access to extension service. Indeed the farmers have extended the use of HYV well beyond the available irrigated area, which is extremely limited in Barak Valley.

Application of Fertilisers

The results of ordinary least squares estimation of equation (3) for explaining variation in the application of fertilisers by the sample farmers are presented in Table 3.

The R^2 value of 0.25296, though not very high, is substantial for reasons mentioned in the context of similar R^2 value reported in Table 2. Estimates of seven of the twelve parameters of the equation are statistically significant and the F-statistic for the overall regression is also again significant at 0.01 level.

The coefficients of the variables IR, PF and EX are all positive and significant indicating that availability of irrigation, access to extension service and higher proportion of fertiliser intensive crops in the gross cropped area of the farmers induce greater use of fertilisers by them. On the other hand, the tenancy factor has a strong negative impact on the use of fertiliser. The coefficient of the variable OH indicating farm size has also turned out negative but not significant statistically. This implies that there are no real variations in the extent of application of fertilisers with respect to variations in farm size. The impact of the proportion of low land (LL) in operational holding on fertiliser use is also insignificant.

TABLE 3. RESULTS OF MULTIPLE REGRESSION ANALYSIS OF CONSUMPTION OF FERTILISER IN SAMPLE FARMS

Variables (1)	Estimated coefficients/values (2)	Standard errors (3)	t-values (d.f. = 270) (4)
Constant	27.75843	9.60450	2.890***
C_2	-18.70817	6.75258	-2.771***
C_3	9.69494	6.33316	1.531
C_4	-1.82444	7.04266	-0.259
C_5	-3.98064	7.10509	-0.560
C_6	14.27853	7.53480	1.895*
IR	28.47990	13.79943	2.064**
EX	3.83794	1.04593	3.669***
OH	-0.36407	1.92993	-0.189
TL	-15.01916	4.83939	-3.104***
LL	0.01860	7.39790	0.003
PF	19.85436	9.14840	2.170**
R^2	0.25296		
F(11, 270)	8.31167***		

*, ** and *** Significant at 0.10, 0.05 and 0.01 level respectively.

Extent of Multiple Cropping

The results of factors explaining the variation in the extent of cropping intensity across farms are presented in Table 4. The R^2 value in this case is higher than that in the case of equations (1) and (3). Once again the F-statistic for the overall regression is highly significant and nine of the twelve parameters are also individually significant.

TABLE 4. RESULTS OF MULTIPLE REGRESSION ANALYSIS OF CROPPING INTENSITY IN SAMPLE FARMS

Variables (1)	Estimated coefficients/values (2)	Standard errors (3)	t-values (d.f. = 270) (4)
Constant	180.50935	8.30047	21.747***
C_2	-22.11294	6.26270	-3.531***
C_3	-14.65237	5.89284	-2.486***
C_4	-2.89202	6.61502	-0.437
C_5	7.59872	6.69579	1.135
C_6	3.69362	7.09174	0.521
IR	-22.39223	13.06334	-1.714*
EX	-1.69081	0.98834	-1.711*
OH	-7.09071	1.80736	-3.923***
TL	-13.07648	4.56836	-2.862***
LL	-39.20926	6.97068	-5.625***
PH	16.37892	8.89775	1.841*
R^2	0.30243		
F(11, 270)	10.64163***		

* and *** Significant at 0.10 and 0.01 level respectively.

The coefficient of OH, the variable representing farm size, is negative and highly significant implying that cropping intensity tends to be higher on smaller farms. The coefficient of the tenancy variable TL is also negative and highly significant indicating that the tenant farmers are less inclined towards multiple cropping. The proportion of low land in operational holding (LL) also has a negative and highly significant coefficient implying that higher proportion of low land in operational holding is a handicap for increasing cropping intensity. This may be due to the absence of suitable short duration varieties for such conditions. PH, the proportion of area under HYV in the gross cropped area, has a positive coefficient as expected and the coefficient is significant at 0.10 level. The coefficients of availability of irrigation (IR) and access to extension service (EX) are also significant at 0.10 level. But contrary to expectation, these coefficients bear negative signs. The apparent negative impact of irrigation and extension service on cropping intensity cannot be ascribed to multicollinearity as the correlation matrix of the explanatory variables of the equation does not show strong collinearity among them.[4] Instead, the observed results need to be rationalised in terms of the ground realities in the Barak Valley.

With relatively small land holdings, the farmers in Barak Valley cultivate primarily for home consumption. The fact that their use of HYV is not restricted by the availability of irrigation or access to extension service shows their keenness to adopt practices that raise the productivity of their limited land resource. As the results presented in Table 3 show, the farmers also tend to apply the key complementary input of fertilisers at higher dose when irrigation and extension support are available. But in the absence of irrigation and extension support, the farmers are unable to apply fertilisers adequately to utilise the full yield potential of crops. Hence under such conditions the farmers may be compelled to increase the intensity of cropping to meet their essential requirements. Thus the negative coefficients of IR and EX can be viewed as indications of the farmers' compulsion for more intensive cropping in the absence of irrigation and extension support rather than as negative impact of the two factors on cropping intensity.

CONCLUSIONS

Both farm size and tenancy, the two agrarian structure related factors included in the study, have been found to have significant bearing on the use of practices that raise farm productivity per unit of net area sown. Farm size is a significant determinant of proportion of rice acreage planted with HYV and the intensity of cropping. But it is the smaller farmer rather than the larger one who puts a larger proportion of rice acreage under HYV and also tends to cultivate the net sown area more intensively. The result suggests no significant variations in the application of fertilisers per hectare with farm size. It can therefore be concluded that relatively small size of holdings of farmers in the valley does not constitute a constraint on the use of HYV, fertilisers and multiple cropping. However, tenancy has been found to be a hindrance to using HYV extensively, increasing cropping intensity as well as in applying fertiliser at a higher dose. Obviously the existing practice of sharecropping without sharing of costs adversely affects the tenant farmer's incentive to put in extra effort and resource needed for the use of the productivity raising practices. Fortunately though, a larger part of the land area used for cultivation in Barak Valley is not affected by this factor. As per estimates based on the sample data, only 9.6 per cent of the farmers are pure tenants, 38.3 per cent are tenant-cum-owner operators and a majority of 52.1 per cent are pure owner operators. On the whole, the area under tenancy comprises 29.77 per cent of the total area of all the operational holdings. Thus, in spite of its negative impact, the tenancy factor does not constitute a binding constraint on the use of the practices in the region. Nonetheless, implementation of suitable tenancy reforms can contribute to diffusion of the HYV seed-fertiliser technology in the region.

The influence of availability of irrigation and access to extension service on the effective use of the practices by the farmers is a little more intricate. The use of HYV by the farmers is apparently not significantly related to either availability of irrigation facility or access to extension service. Adoption of HYV being almost universal among the farmers, its use is no longer confined to situations where extension support and irrigation facilities are available. But the application of fertilisers per hectare by the farmers has been found to be significantly conditional upon availability of irrigation and access to extension service. Hence, though the farmers cultivate HYV even without assured irrigation or support of extension service, in the absence of these two facilities they are unable to support the use of HYV seeds by adequate application of fertilisers. Given the complementarities between HYV and fertilisers, the farmers without irrigation facilities and access to extension service could not effectively exploit the yield potentials of their HYV crop. It is worth noting in this context that the farmers in Barak Valley are still largely rainfall dependent, as the irrigation infrastructure there has remained virtually undeveloped. As per statistics of the State Irrigation Department, in 1996-97 the irrigation potential available in Barak Valley measured up to only 2.83 per cent of its gross cropped area. In the sample for the present study, the net irrigated area constituted 7.62 per cent of all the operational holdings taken together. The outreach of the extension service has also remained fairly limited. Almost 70 per cent of the sample farmers were found to have virtually no contact with extension agencies.[5] These facts along with the conclusion inferred above go to support the hypothesis that the poor state of irrigation and extension service constrains the farmers in the region from attaining higher levels of agricultural productivity.

The other factor identified by the study as a hindrance to achieving higher agricultural productivity in the region is one of technical-environmental nature. A substantial part of the cultivated area of the region is prone to frequent flooding and prolonged waterlogging during the long rainy season in this part of the country. Obviously, the short stature high-yielding paddy varieties are not suitable for such deep-water conditions. Neither any improved local variety nor alternative superior crop has been found so far for such conditions. In the absence of a better alternative, the taller traditional rice varieties, some of them with poor yield and long duration, are grown in such areas in the *kharif* season. In areas where water remains even in the middle of the dry winter season, *boro* paddy is traditionally cultivated. In the Brahmaputra Valley, the area under *boro* paddy has been expanding rapidly over the last decade, concomitantly with the expansion of tubewell irrigation, and a high proportion of *boro* paddy area there is under HYV. But in the Barak Valley, the area under *boro* paddy has not expanded in a similar manner and the cultivation of HYV in the *boro* season is virtually absent (Bezbaruah, 1997, p. 438). Ironically, it is the non-availability of assured water in the later stage of the *boro* season, which prevents the use of HYVs in that season. This point reiterates the urgent need for developing the irrigation infrastructure in the valley to facilitate fuller exploitation of HYV seed-fertiliser technology by the farmers.

The meagre irrigation facility that now exists in the Barak Valley comes almost entirely from government owned projects. The Brahmaputra Valley, by contrast, has seen impressive expansion of irrigation capacity in the private sector in the last few years. This irrigation capacity is mostly based on shallow tubewells which are suitable for exploiting the abundant groundwater reserve. The geological conditions of the Barak Valley however are not conducive for development of groundwater based irrigation facilities (Das, 1984). Therefore, plans for developing the irrigation infrastructure in the region will have to be based on its surface water resource, especially its river system. The farmers cannot be expected to privately take up the lumpy initial investment that would be required for diverting river flow for irrigation. Hence the programme for developing irrigation infrastructure in Barak Valley has to be spearheaded by a substantial dose of public investment. The complementary private investments for utilising the created irrigation potential can then be taken up by the farmers with credit support from financial institutions.

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NOTES

1. As per Agricultural Census of 1990-91, there were 2,09,875 agricultural holdings in the Barak Valley, 53.09 per cent of which was in the size-class of below one hectare. The average size of operational holding according to the same source works out to be 1.62 hectares, which contains some amount of upward bias due to the large holdings of the tea estates. In 1996-97, rice crops constituted 92 per cent of the gross cropped area (excluding the area under plantation and tree crops) of the region.
2. The following questions were asked to find out a farmer's level of interaction with extension agency.

Q1. Do you know your Village Level Extension Worker (VLEW)?
Answer: (i) YES (1) (ii) NO (0)
If YES,
Q2 Did you receive any advice from him on farming matters in the last 12 months?
Answer: (i) YES (1) (ii) NO (0)
If YES,
Q3 Did you follow his advice?
Answer (i) Did not follow (0). (ii) Followed but found useless (1). (iii) Followed and found useful (2).
Q4 Have you consulted him in the current crop season?
Answer: (i) YES (1) (ii) NO (0)
Q5 Do you know the Agricultural Extension Officer (AEO) of your area?
Answer: (i) YES (1) (ii) NO (0)
Q6 Has he visited your village in the last three months?
Answer: (i) YES (1) (ii) NO (0)

(The numbers within parentheses are scores assigned to the responses of the farmer.)

3. The sample farmers by and large met their operational expenditures of farming from their internal source. There were no instances of short-term borrowing either from financial institutions or from moneylenders. In the few instances of such borrowings the lender was either a friend or a relative and the loan was interest free. There were however a few instances of farmers taking medium-term loans from financial institutions for purchase of power tillers and tractors.

4. The simple correlation coefficients among explanatory variables do not suggest the presence of strong multicollinearity. The largest of these coefficients is of the magnitude of only 0.36. Since small values of simple correlation coefficients can sometimes be deceptive in cases involving more than two explanatory variables, the determinant of the correlation matrix was also checked. But the determinant is not close enough to zero to suggest the presence of seriously strong collinearity among the explanatory variables.

5. On the questions on extension service, 69.77 per cent of the sample farmers returned a score of either 0 or 1 indicating virtually no contact with extension agencies.

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