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A NORMATIVE ANALYSIS OF THE IMPACT OF CAPITAL AVAILABILITY ON FARM INCOME AND DEMAND FOR SHORT-TERM CREDIT ON FARMS IN DELHI

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Lack of adequate capital has been acknowledged as one of the most serious inhibiting factors in modernization of traditional agriculture and as the key element behind the vicious circle of poverty. From this flows the stress on agricultural credit in our development programmes. The impact that the agricultural credit policies make is directly related to the extent to which these are biased on research relating to credit requirements on farms. In fact, ignorance of this crucial factor has been stated to be one of the major reasons behind the rather tardy progress of the agricultural credit programmes. This study concerns itself with the assessment of short-term credit requirements on farms in the Union Territory of Delhi or, in other words, seeks to provide a measure of the extent of capital starvation on farms. It assumes that credit needs vary substantially between farms and that the production (income) potential rather than any other criterion would serve as an appropriate basis for this assessment.

Another important consideration in agricultural credit policies is the question of cost of credit. It is generally believed that agricultural credit must be cheap so that even the poorest farmers could afford it. This welfare principle and the popularity held concept of low rate of returns to capital in traditional agriculture have been overriding and farm credit provided by Government or co-operative agencies is, therefore, cheapest as compared to other institutions. This preferential policy is criticized by those who hold that farm finance can never be commercialized on this principle. They argue that cost of credit could more rationally be linked with the additional return it generates and also that under new technology, the rate of returns is fairly high. There is thus considerable interest in the analysis of demand for short-term credit.

In brief, the objectives of the study are : (1) to estimate the short-term production credit requirements and its impact on farm income, and (2) to evaluate the impact of interest rate on credit requirement.

METHODOLOGY

The study pertains to three out of the 12 soil series comprising the Union Territory of Delhi. Three villages from each of the selected series, namely, Dichaon Kalan, Nangal Thakran and Gharaoli were purposively selected in consultation with agriculture and extension specialists with a view

to obtain a sample representing typical cropping pattern situations. The villages selected also cover a range with respect to irrigation and adoption of new technology. Dichaon Kalan ranked first on both these counts while Gharaoli had lowest irrigated area and also poorest level of adoption of innovations. Nangal Thakran ranked in between.

A sample representing ten per cent of the total population from small (up to 7.49 acres), medum (7.50 to 14.99 acres) and large (above 15 acres) farms was selected randomly with probability proportional to the distribution of farm in each village. Thus the sample consisted of 43 farms; 13, 14 and 16 farms from the sample villages Dichaon Kalan, Nangal Thakran and Gharaoli, respectively. The required data for the agricultural year 1967-68 were obtained by personal interviews.

Preliminary analysis revealed that 'net returns per acre'[1] provided a better criterion for classification as compared to the conventional 'acre-size' criterion. Thus the sample farms in each village were arranged in ascending order of net return per acre and were divided into two groups, that is, low income and high income farms.[2] Thus in all, there were six income groups (three low income and three high income groups) in the three sample villages. Corresponding to each income group, a synthetic farm situation was developed for detailed analysis.

Linear programming technique was used to assess the capital requirements of these synthetic or average farms and also to study the capital-technology relationship. The model sought to maximize net returns accruing from various crop activities subject to a number of resource and other constraints like those of soil type, irrigation, periods of labour stress for both human and bullock labour, working capital and minimum cereal and fodder production. A crop rotation was considered as an 'activity' and was further divided into various 'processes' on the basis of differences in the soil type on which it is grown, irrigation levels, fertilization levels and variety of the crop. For each income group farm, a separate technological matrix was developed. In order to assess the credit requirements, a capital borrowing activity was added in the model to provide additional working capital. A number of labour hiring activities (one activity for each restrictive period) were also incorporated in the model to permit labour hiring, if required. To study the impact of improved technology and the role played by credit in this context, the activities built around high-yielding crop varieties grown by the farmers in the other income group of the same village were added in its technological matrices and vice versa. This situation is termed, in this study, 'acceptable technology' since it represents a level of technology already in vogue in the village.

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1. Net returns=gross returns—variable costs (cost of seed, manures and fertilizers, cash expenses on irrigation and plant protection measures, bullock work feed cost, and depreciation and repairs.

2. These have been designated as LIF and HIF in subsequent discussion.

Thus, the following programming situations were examined:

Situation I : Optimal plans were derived with the existing resources and current technology.

Situation II : Provision of additional credit was made under the Situation I.

Situation III : Optimal plans were worked out under the existing resource and 'acceptable technology' conditions.

Situation IV : Additional credit was permitted in the plans under the Situation III.

The impact of varying interest rates on optimal credit requirements was studied by the use of price variable programming with reference to the current as well as acceptable technological situations. This gives the normative demand for credit. The functional relationship between interest rate, (price of credit) and the quantum of borrowings obtained by the use of this technique is discontinuous and when plotted, appears in the form of a step function. The concept of price elasticity is not useful in connection with these curves. By the application of minimum integral approach,[3] these step functions have been transformed into an approximate continuous form which is more meaningful.

RESULTS

1. INCOME POTENTIAL AND CREDIT NEEDS OF FARMERS

Optimal plans were developed under the current and 'acceptable technology' situations with both existing and unbounded capital availabilities to provide an insight into the credit requirements of the farmers for executing the most profitable farm plans and the ensuing change in farm income. In the subsequent discussion, income increases and credit needs of the farms have been discussed in detail.

Income Potential

Table I indicates that the provision of additional credit invariably helped in augmenting farm incomes as compared to the Situation I. Of the three villages, under the current technological situation, the highest income increases accrues from Gharaoli followed by Dichaon Kalan and Nangal Thakran, the increases being 30.16 and 24.02, 19.69 and 10.92 and 15.01 and 2.49 per cent of the existing incomes on the HIF and LIF respectively. Income increases on account of additional capital were always lower on the LIF as compared to the HIF. These results revealed that capital rationing is indeed evident on the farms. This is more stringent in the unprogressive village of Gharaoli. Secondly, scarcity of credit causes comparatively

3. Oscar R. Burt, "Curve Fitting to Step Functions" *Journal of Farm Economics*, Vol. 46, No. 3, August, 1964, pp. 662-672.

TABLE I—INCOME POSSIBILITIES ON SYNTHETIC FARMS UNDER VARIOUS CAPITAL AND TECHNOLOGICAL SITUATIONS

(amount in rupees)

Village	Farm size	Existing income	Increases over existing incomes in				Increase over optimal income (Situation I) due to			Increase in income in Situation IV over Situation II
			Situation I	Situation II	Situation III	Situation IV	Current technology with additional capital (II—I)	Acceptable technology without additional capital (III—I)	Acceptable technology with additional capital (IV—I)	
Dichaon Kalan	HIF	7,182·42	386·13 (5·37)	1,801·09 (25·06)	386·13 (5·37)	1,801·09 (25·06)	1,414·96 (19·69)	Nil	1,414·96 (19·69)	Nil
	LIF	8,254·02	1,374·91 (16·66)	2,275·84 (27·58)	1,777·60 (21·54)	6,504·71 (78·81)	900·93 (10·92)	402·69 (4·88)	5,129·80 (62·15)	4,228·87 (15·23)
Nangal Thakran	HIF	7,059·51	1,574·55 (22·30)	2,634·11 (37·31)	1,574·55 (22·30)	2,634·11 (37·31)	1,059·56 (15·01)	Nil	1,059·56 (15·01)	Nil
	LIF	5,511·60	1,594·93 (28·94)	1,732·08 (31·43)	1,894·76 (34·38)	2,182·35 (39·60)	137·15 (2·49)	299·84 (5·44)	587·42 (10·66)	450·27 (8·17)
Gharaoli	HIF	4,837·54	1,644·72 (34·00)	3,103·47 (64·16)	1,644·72 (34·00)	3,103·47 (64·16)	1,458·75 (30·16)	Nil	1,458·75 (30·16)	Nil
	LIF	5,902·61	2,065·77 (35·00)	3,483·28 (59·02)	2,265·42 (38·40)	4,612·14 (78·65)	1,417·51 (24·02)	199·65 (3·38)	2,576·37 (43·65)	458·86 (19·63)

Figures in parentheses indicate the percentages of existing income.

greater potential loss to the progressive farmers (HIF) who could have obtained, as compared to the respective LIF, larger returns under adequate capital availability situation.

Provision of additional capital under the 'acceptable technology' (Situation IV) produced substantial increases in farm incomes on LIF, as compared to the incomes obtained under the current technology situation (Situation II) in all the sample villages (Table I). No change occurred on the HIF implying that the high-yielding crop activities grown on the LIF were technically inferior to the activities grown on the respective HIF.

The above finding highlights the fact that capital plays a more vital role under the improved technological situation. Here, it is important to point out that with the existing capital (Situation III), adoption of 'acceptable technology' could fetch only 4.88, 5.44 and 3.38 per cent income increases on the LIF in Dichaon Kalan, Nangal Thakran and Gharaoli respectively which is a very meagre amount. The inadequacy of capital, therefore, may be regarded as a most crucial factor for the poor acceptance of high yielding crops variety on the LIF (unprogressive farms), implying that the adoption of advanced technology to a large degree is positively correlated to the amount of credit available to the farmers. Secondly, additional credit produces better results in terms of net returns when used with the advanced technology.

Credit Needs of Farmers

The optimal plans developed under Situations II and IV give an idea of the additional working capital requirements of the farmers under both the current and 'acceptable' technology situations at the prevailing interest rate. Table II summarizes the extent of borrowing in the various optimal farm plans.

TABLE II—EXISTING CAPITAL AND EXTENT OF BORROWING AT CURRENT RATE OF INTEREST

(amount in rupees)

Village	Farm size	Existing capital	Amount of borrowed capital	
			Situation II	Situation IV
Dichaon Kalan	HIF	1,907·68	982·76 (51·52)	982·76 (51·52)
	LIF	2,005·78	648·58 (32·34)	3,257·17 (162·39)
Nangal Thakran	HIF	1,518·19	676·82 (44·58)	676·82 (44·58)
	LIF	1,152·23	109·46 (9·50)	212·29 (18·42)
Gharaoli	HIF	1,448·97	1,490·03 (102·83)	1,490·03 (102·83)
	LIF	1,932·50	1,536·08 (79·49)	2,498·06 (129·27)

Figures in parentheses indicate the percentages of existing capital.

The analysis brings out that under the current technology, capital rationing was evident on all farms, though in varying degrees, and the requirement of capital ranged between 9.5 and 102.83 per cent of the existing capital on the farms. The provision of funds to the extent indicated in Table II would enable farmers to move to much higher income levels (Table I), the impact being felt more on the HIF. An examination of the amounts of credit borrowed in various optimal farm plans further shows that the borrowings were invariably higher on the HIF confirming that scarcity of capital is more acutely felt by the HIF (progressive) as compared to the LIF (relatively unprogressive). Of the three sample villages, the existing amount of credit proved most inadequate in Gharaoli on both the farms. This brings out the important conclusion that paucity of capital does not permit the fullest exploitation of even the meagre irrigation resources (which is a pre-requisite for Mexican wheat) in this village. Thus, a liberal credit policy would enable farmers to gain substantially in terms of net returns which will ultimately add to the risk bearing ability and loan repayment capacity of the farmers. This finding, although applies to all the farms, is more important for the areas with only a small fraction of land under irrigation.

The analysis thus reveals that firstly, inadequacy of capital is a great bottleneck in the full exploitation of the potential productivity of available resources. Secondly, capital scarcity is more acutely felt by the progressive (HIF) farmers, implying that under the current technology the provision of required amount of credit would enable the HIF to reap greater relative increased income as compared to the respective LIF, and thirdly, it is more acute on farms in the relatively unprogressive village (Gharaoli) and the supply of adequate amount of fund would enable the farmers of this village (Gharaoli) also to make the fullest use of the existing resources and obtain substantial income increases.

Under the 'acceptable technology' (Situation IV), the relative amount of borrowing was highest on the LIF in Dichaon Kalan and lowest in Nangal Thakran. There was no change in Situation IV as compared to Situation II on the HIF. In fact, the additional capital requirement under this situation was determined by the comparative technical superiority of the high-yielding variety activities of the HIF over the respective LIF and the availability of suitable land for growing them. In Dichaon Kalan, the proportion of such land was highest, followed by Gharaoli and Nangal Thakran. Consequently, the credit requirement too was in the same order. This finding, therefore, suggests that credit has to play a key role in the successful implementation of the High-Yielding Variety Programme. Also, since the total borrowing differed significantly among farms, the credit lending institutions should take into account the variability in effective production credit demand while sanctioning loan to the farmers. Thus a credit policy based on the farm planning approach is indicated. It would not only enable farmers to adopt and expand improved technology on a larger area in order to achieve higher net returns but will by itself create the means for repayment of loans.

The findings further suggest that in a static framework (current technology) credit requirements are comparatively higher on the HIF but in the dynamic context (when all the farms are allowed to the level of technical efficiency already achieved in the respective villages under the 'acceptable technology') the credit requirements of the LIF are generally much higher (except in Nangal Thakran) due to the adoption of technically superior high-yielding crop activities on the LIF (Situation IV).

The study also emphasizes the fact that even in largely unirrigated areas (Gharaoli), the availability of capital offers significant opportunities and the credit policy need not, therefore, be biased in favour of assured irrigation areas. In fact, as a positive measure to combat growing disparities in farm incomes, a liberal credit policy may have a crucial role to play. Information on optimal farm returns obtained under Situation II presented earlier (Table I) indicates the possibilities of income increases of the tune of 10.92 and 19.69 per cent on the LIF and HIF in Dichaon Kalan and of 24.02 and 30.16 per cent on the corresponding farms in Gharaoli, due to additional credit only. This implies that the supply of the required amount of credit would tend to minimize the income differential between these two villages. On the other hand, the corresponding potential income increases in Situation IV are 57.27 and 19.69 per cent on the LIF and HIF in Dichaon Kalan and 40.25 and 30.16 per cent in Gharaoli respectively (Table I) showing that the income disparity existing between the LIF and HIF will be reduced. Thus the provision of required amount of capital to the farmers would be very helpful in reducing income disparities among villages as well as farmers. This argument is, however, subject to one important qualification. The model employed in this study subsumes perfect certainty. In reality this may not hold and by and large, largely unirrigated village (Gharaoli) will be subject to larger vagaries of weather and this would substantially affect credit need. This aspect, therefore, needs a more detailed examination.

The results of price variable programming obtained in this study are presented in Table III, and Figure 1. Linear and double logarithmic functions have been used to approximate the step function. The former gave relatively better fit and it has been used in this analysis to work out the price elasticity estimates for additional funds at the current rate of interest. An examination of the table indicates that the demand for credit does not, generally, change with fairly large changes in interest rates. The point elasticity of demand at the current rate of interest worked out from the linear function fitted to the step curves varied between —0.0062 to —0.0285, implying that the demand for credit is highly inelastic.

The foregoing discussion thus suggests that the use of variable interest rate may not be an effective instrument to change the demand for short-term credit and hence a credit policy based on differential interest rate may not achieve the desired objective. While the earlier results exhibit the prevalence of capital scarcity on farms, this analysis reveals that the interest rate does

Figure 1—Stepped and Approximated Demand Curve

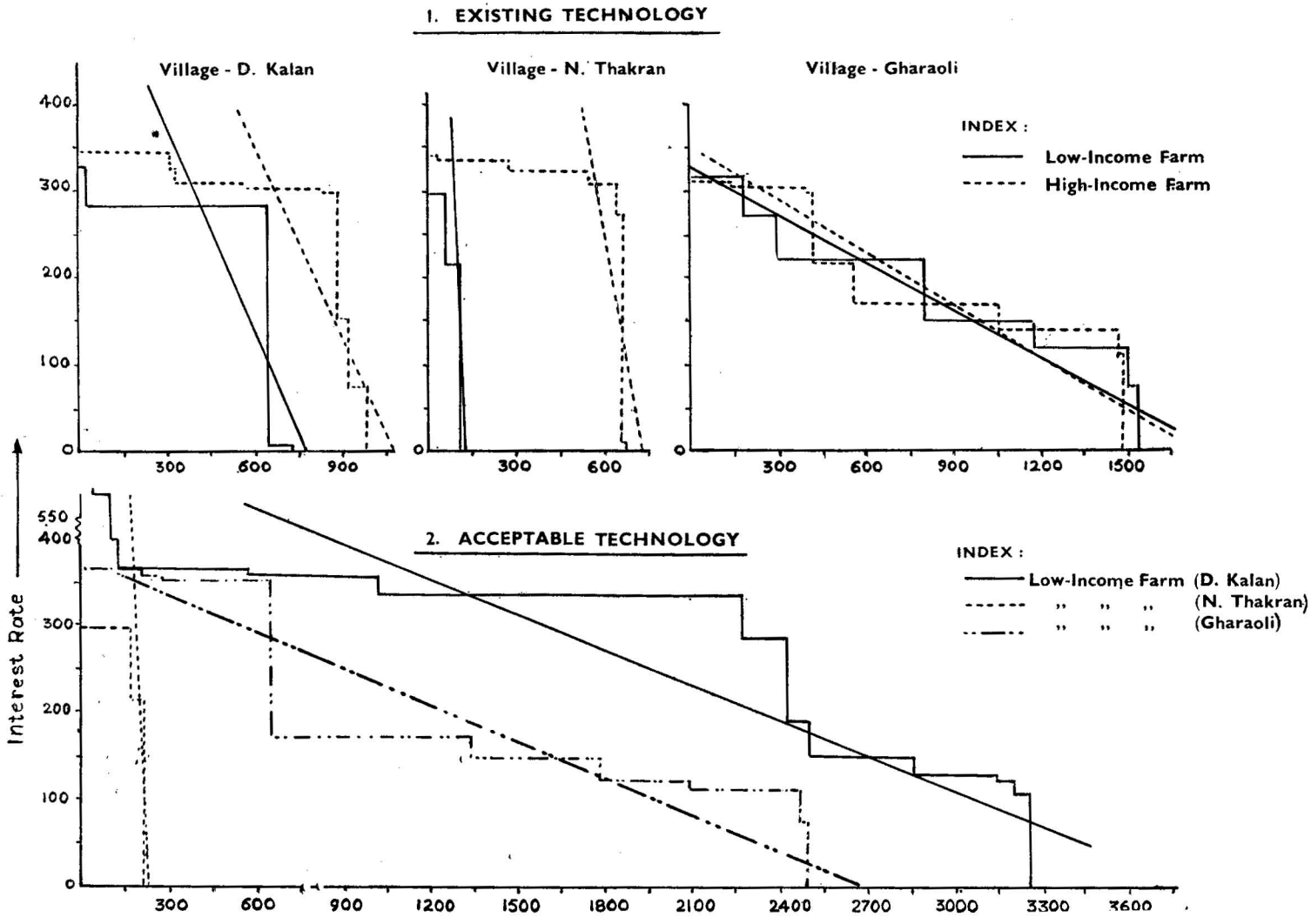

TABLE III—DEMAND FUNCTION AND PRICE ELASTICITIES FOR CAPITAL IN VARIOUS FARMS

Village	Farm size	Function	R^2	Elasticity at current rate
(*a*) *Current Technology*				
Dichaon Kalan ..	LIF	C = 783·5145—1·3180 I	0·3515	—0·0154
	HIF	C = 1083·4582—1·3923 I	0·5020	—0·0117
Nangal Thakran ..	LIF	C = 124·8487—0·1922 I	0·5893	—0·0141
	HIF	C = 731·1441—0·5393 I	0·2360	—0·0067
Gharaoli ..	LIF	C = 1834·4424—5·6541 I	0·9181	—0·0285
	HIF	C = 1777·0977—5·1081 I	0·8497	—0·0266
(*b*) *Acceptable Technology*				
Dichaon Kalan ..	LIF	C = 3805·1374—7·3602 I	0·8847	—0·0177
Nangal Thakran ..	LIF	C = 224·6029—0·1538 I	0·5892	—0·0062
Gharaoli ..	LIF	C = 2703·2270—7·3367 I	0·8393	—0·0250

I=Interest rate; R^2=Coefficient of multiple determination; C=demand of capital.

not inhibit the acquisition and use of outside funds and it is profitable to borrow even at higher than the current interest rates without detriment to the amount of borrowing. This contradiction is only superficial. Cost of credit is not the only factor influencing the use of borrowed funds, psychological and other factors, *i.e.*, the availability of credit at proper time and in the form required, are also important. Again, the failure to incorporate risk and uncertainty factors in the analysis might itself be responsible for the emergence of capital rationing problem. Why farmers do not borrow even though it apparently is profitable to do so, is a question which cannot be answered unless a more detailed analysis is undertaken.

NET PRESENT VALUE OF LOAN-FINANCED INVESTMENT FOR IRRIGATION DEVELOPMENT AND REPAYMENT CAPACITY OF FARMERS—A CASE STUDY IN PUNJAB*

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'Credit is a hangman's rope,' this old proverb has been replaced by a new one, 'credit serves as an elevator.' The dynamic outlook, of late, being

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