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The Impact of Agricultural Credit on Farms in the Rupandehi District of Nepal

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FOREWORD

The Ministry of Food and Agriculture of His Majesty's Government of Nepal is pleased to cooperate with the Agricultural Development Council in the Project "Training Nepalese in Agricultural Research and Development Planning". This Project has been made possible by substantial financial support from the U.S. Agency for International Development (USAID), while the Agricultural Projects Services Center (APROSC) provides management services in implementation.

One of the most important components of this Project is advanced training, at the Masters and Ph.D. levels of young professional staff of Ministry-related institutions. Up to now, more than forty A/D/C fellows have been selected for advanced training in Asia, Australia and the U.S.A. Most of them have written a thesis based on their research in a particular problem-area in Nepal's agricultural and rural development. In addition this Project sponsors problem-oriented research activities, which are carried out by the staff of Ministry related institutions with the cooperation of A/D/C staff.

The purpose of this Research Paper Series is to make the results of these research activities available to a larger audience, and to acquaint younger staff and students with advanced methods of research and statistical analysis. With more than 90% of our population being dependent on agriculture for their livelihood, it is hoped that the publication of this Series will stimulate discussion among policy-makers and thereby assist in the framing of policies which are suitable to the development of Nepal's agriculture.

The Ministry of Food and Agriculture appreciates the efforts of Dr. Shao-er Ong and Dr. Veit Burger, the A/D/C staff in Nepal, and of Dr. Ram Prakash Yadav, the Executive Director of APROSC, in making the publication of this Research Paper Series possible.

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THE IMPACT OF AGRICULTURAL CREDIT ON FARMS IN THE RUPANDEHI DISTRICT OF NEPAL

GOVIND KOIRALA*

ABSTRACT

The study was carried out in the Rupandehi district of Western Nepal in 1977 with a survey of 165 randomly selected farmers in 4 panchayats. About half of the sample were borrowers. The main objective was to see whether credit is a constraint in the production of cereal crops and if so, to estimate the net effect on production and income after relaxing the credit constraint. Production function analysis and a linear programming model were used to assess the impact of credit.

The study showed that there was a significant difference in output levels on farms using credit and those not using it. The linear programming model indicated a very high return per rupee of credit which was higher than the highest observed interest rate. The effect of increasing levels of credit was observed with parameterization of the level of credit which showed that profits could be increased with additions of credit, leaving other constrained resources at their existing level.

INTRODUCTION

The development of a nation is initiated with agricultural development. The productivity increase in agriculture increases capital and releases non-skilled labor for industrial production. Hence, the first and foremost need for paving the way for a country's development is a productivity increase in agriculture. The source of productivity increase may either be an improvement in biological technology, such as the use of improved varieties of crops, mechanical technology, such as the use of machines for large scale farming, or through the reshuffling of inputs if inefficiencies are noticed. The selection of appropriate technology or its composition depends upon the resource endowment of the country, for which Japan and America provide two contrasting examples. Both developed their agriculture, the former with intensive cultivation practices as land was scarce, and the latter with the use of machines as land was available but labor was scarce.

Most underdeveloped countries, Nepal being no exception, are characterized by a rapid growth in population densities, and a slow rate of capital accumulation at farm level. With ever-increasing population pressure and limited potential for expansion of

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* Govind Koirala is Loan Officer of the Agricultural Development Bank of Nepal. This paper is based on his M. A. thesis (Koirala, 1978) submitted to the School of Economics at the University of Philippines at Diliman, where he studied as an A/D/C fellow from 1976-1978. The author owes his gratitude to Dr. Robert Herdt of the Agricultural Economics Department of the International Rice Research Institute for his guidance. IRRI also provided partial financial support during the field survey.

cultivated land, growth in employment and productivity per unit of land calls for a greater use of modern varieties, chemical fertilizers, improved methods of cultivation and increased cropping intensities through proper manipulation of the timing of farm operations.

Nepalese agricultural statistics show an increase in productivity that has barely kept pace with the growth of population. Despite the purported benefits from improved methods of cultivation, the area under such methods is only 21 percent of the total cropped area as of 1975/76 (HMG 1977). The failure to adopt improved methods of farming may be attributed in part to lack of cash to meet considerable additional cost requirements. A slow rate of diffusion of technical knowledge and a low capacity to bear risk are perhaps other factors of some importance. While the diffusion of techniques can be enhanced through education and improvements in extension methods, capital requirements can be partially met from agricultural credit institutions.

OBJECTIVES

Productivity may be increased by increasing the quantity of inputs or by increasing the efficiency in the use of inputs. Both measures, however, may require additional cash. The cash required to buy necessary inputs can be obtained through farmers' own savings or through borrowing. Borrowing, in turn, can be from informal sources, or from formal sources like banks. Although credit from any source is the same as long as it is used in the production process, institutional sources are generally preferred as informal sources are usually found to charge higher credit cost thereby indirectly increasing input prices which results in lower levels of input use.

The specific objective of the study is to evaluate the impact of agricultural credit on cereal crop production. The study hopes to determine whether credit is a constraint in the production process and if so, what the net effect on agricultural production and returns to farmers will be from relaxing this constraint.

RESEARCH METHODOLOGY

Data Collection

The study was carried out from August to October 1977, with a survey of four randomly selected panchayats of Rupandehi district in the Western Terai area of Nepal viz., Anandban, Karahiya, Dayanagar and Asuraina. A special kind of random sampling called "Sectional Sampling Method" was used for selection of farms. In this procedure, village level locations were randomly selected out of a list of locations in each panchayat, and 4 to 5 purposively selected farmers were interviewed in each selected location. Since there was an option to choose among farmers in any one location, they were selected so that on an over all basis the sample would consist of nearly 50 percent borrowers (both from formal and informal sources). Altogether 165 farmers were included in the sample.

Information was collected by interviewing the selected farmers on their farms. Four persons were engaged for four weeks to complete questionnaires with information regarding the size, composition and social status of the farm family, farm-resources and land use, cost of production of cereal grains, as well as information on the farmer's credit situation and prices of inputs and outputs. Since only a handful of farmers maintained records of their farm operations, the data might have suffered from memory biasses of the farmers interviewed.

Analytical Techniques

For the purpose of estimating the productivity of important inputs and segregating the effects of size of holdings, irrigation and credit, a Cobb-Douglas type production function of the following general form was estimated:

$$Y_i = A_i \prod_{j=1}^{4} X_{ij}^{b_{ij}} e^{\sum_{k=1}^{3} c_{ik} D_k + u_i}$$

whose log linear form is:

$$\text{Log } Y_i = \text{Log } A_i + b_{ij} \text{ Log } X_{ij} + C_{ik} D_k + u_i$$

where : Y_i = yield of ith crop in kg/ha
(i = 1 to 4; improved paddy, local paddy, improved wheat and local wheat, respectively).

A_i = constant term

X_{ij} = amount of jth input used per hectare for growing i^{th} crop. (j = 1 to 4)

X_1 = nitrogen (N_2) in kg/ha

X_2 = human labor in standard days/ha

X_3 = bullock labor in pair-days/ha

X_4 = value of phosphorus, potash, other chemicals and seeds in Rs/ha

b_{ij} = partial elasticity of production of ith crop with respect to the jth input

D_k = dummies (k = 1, 2, 3)

D_1 = dummy for size of farm, 1 if the total area operated is greater than 4 bighas (2.67 ha), zero otherwise

D_2 = dummy for irrigation, 1 if a farm is fully or partially irrigated, zero otherwise

D_3 = dummy for credit, 1 if credit is used by a farmer, zero otherwise

c_{ik} = co-efficient of the kth dummy with respect to the ith crop; and

u_i = error term

The marginal physical products (MPP) of these inputs (X_{ij}) were computed by

using the following formula:

$$MPP\ X_{ij} = b_{ij} \frac{\overline{Y}}{\overline{X}_{ij}}$$

where $\overline{Y}$ and $\overline{X}_{ij}$ are the geometric means of output and inputs respectively. The marginal value products (MVP) were obtained by multiplying the marginal physical products with their respective output prices.

The above production function merely provides a rough basis for the comparison of farms using credit and those not using it. The exact magnitude of the productivity of additional credit can best be determined by using the linear programming model with credit as a parameter.

Linear Programming Model

Parametric programming has been used to determine the demands for key resources – particularly credit and the production of cereal crops. To detect the constraint in the production process and see the effect of relaxing the constraint, a linear programming model of the following form was built. The model covers 4 crops (improved rice, local rice, improved wheat and local wheat) and seven constraints (credit for rice, credit for wheat, own capital, total credit, total rice land, local rice land and wheat land).*

$$\text{Maximize } Z = P_j Y_j - \sum_{j=1}^{4} a_j X_j - iC$$

subject to

$$b_1X_1 + b_2X_2 \leq K \text{ (credit for rice)}$$

$$b_3X_3 + b_4X_4 \leq K \text{ (credit for wheat)}$$

$$a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 - C \leq K \text{ (own capital)}$$

$$X_1 + X_2 \leq L \text{ (land for rice)}$$

$$X_3 + X_4 \leq L \text{ (land for wheat)}$$

$$X_2 \geq L \text{ (land for local rice)}$$

$$C \leq K \text{ (credit limit)}$$

where : Z = net income to owned resources

a_j = cost of production per hectare of jth crop for inputs not explicitly considered in the model in Rupees

X_j = area under crop j in hectares

i_k = rate of interest associated with k^{th} source of capital k = 1 (institutional credit), 2 (informal credit)

* The terms paddy and rice are used interchangeably in this paper.

C = total credit in Rupees (treated as credit limit)

P_j = price per quintal of jth crop

Y_j = total output of jth crop in quintals

b_j = cash cost of production per hectare of jth crop in rupees

The first two constraints in the LP model viz., credit for rice and credit for wheat have been taken as 'greater than' constraints because they represent two mutually exclusive cropping seasons and the possibility of immediate shift of resources does not exist.

Own capital constraint has been placed to meet the deficit in cash cost of production after borrowing. The available credit has been used as the total credit limit and hence is placed as a constraint.

Land constraint has been fixed such that the area under local rice and improved rice do not exceed the total summer land available with the farmer. Similarly, the area under local wheat and improved wheat should also not exceed the winter land limit of the farmer.

A 'greater than' constraint in the case of land for local rice has been used because the farmers prefer local rice grown in their own farms for consumption. Local rice has a superior consumption value and the subsistence farmers grow this for their own consumption despite the fact that it fetches lower returns than improved rice.

Nearly all farmers reported that they could freely buy other material inputs like chemical fertilizers, chemicals, etc., and hence such material constraints are not placed in the model. Since Rupandehi is a border district with India and there exists nearly free entry and exit of labor from either side, there is no labor constraint except in the absence of capital, which is taken care of by the capital constraint.

RESULTS

General Characteristics of the Sample Farms

Before progressing into the direct output of this endeavour, it is worthwhile to discuss the general characteristics of the sample farms with special relevance to credit.

The general setting of the farm and the farm operator is presented in Table 1 and the credit situation by source of loan is presented in Table 2.

The operators of the sample farms covered under this study had an age range of 16 to 84. The education level of the operators averaged approximately 4 years of schooling with as high as 16 years of schooling in the extreme case.

No farm had an absence of working male members. An average of 3 male members (above 10 years of age) per farm was documented. Female members averaged slightly less than males. Two farms had no female members at all. Thirty two sam-

ple farms had no children below the age of 10. The maximum number of children found were eight, with an average of 2.7 children per farm family.

About 15 percent of the farms had no literate members at all in their family. The overall literacy rate was 38 percent. This low literacy rate partly explains the subsistence behaviour noticed in these sample farms.

Table 1: General Characteristics of 165 Sample Farmers in Rupandehi District, Nepal, 1977.

Characteristics	Number of null cases a/	Overall mean	Mean of yes cases	Range
Family				
Age of the operator	0	41	41	16-84
Years of schooling of the operator	54	3.87	5.76	0-16
Male members per farm	0	2.96	2.96	1-7
Female members per farm	2	2.44	2.47	0-29
No. of children	32	2.19	2.72	0-8
Literate members	26	2.90	3.44	0-31
Members engaged in farming	0	4.60	4.60	-
Credit				
Credit for rice farming (Rs)	131	280	1359	0-18000
Credit for wheat farming (Rs)	126	83	352	-
Unspecified credit (Rs) b/	127	1506	6540	-
Area				
Number of parcels	0	4.56	4.56	1-52
Size of the biggest parcel in ha	0	1.96	1.96	0.04-86.67
Irrigated area in ha	39	2.41	3.15	-
No. of bullocks	10	2.60	2.77	0-10

a/ No. of cases where the value of the relevant variable was zero

b/ Not specified as to purpose

Table 2 : Credit by Source and Purpose

Purpose/Source	Wheat		Rice		Unspecified	
	No.	Interest rate (%)	No.	Interest rate (%)	No.	Interest rate (%)
Institutions	36	14	17	17	26	11–14
Private money lenders	3	20–30	14	15–60	9	15–36
Friends and relatives	—	—	3	0–20	2	20
Total	39	—	34	—	37	—

Source : Field Survey, 165 Sample Farms of Rupandehi District, 1977.

A total of Rs. 46,220 was borrowed by 34 sample farm households exclusively for the purpose of rice farming. The average borrowing per farm for rice farming amounted to Rs. 1,359. Similarly 39 sample farms borrowed on an average Rs. 352 for growing wheat. Another 37 farmers borrowed money without specifying the purpose of taking the loans. Average borrowing under this head came to Rs. 1,506.

Of the borrowers for wheat farming, 36 borrowed from institutional sources paying an average interest rate of 14 percent per annum, whereas 3 borrowed from private money lenders with interest rates ranging from 20 to 39 percent per annum. Similarly, of the 34 borrowers for rice farming 17 borrowed from institutional sources, 14 borrowed from private money lenders and the rest borrowed from friends and relatives. The borrowers from private money lenders paid as high as 60 percent interest per annum. Although of least availability, borrowing from friends and relatives bore an interest rate as low as zero percent and was usually very nominal. Institutional borrowers topped the list in purpose unspecified credit (26), followed by private money lenders (9), and friends and relatives (2).

Five distinct categories were segregated in order to see the separate impact of credit in each category (See Table 3). The first category comprised of non-borrowers who utilized on an average Rs. 2,665 of their own capital for farming 2.97 hectares of rice and 1.44 hectares of wheat. Borrowers from money lenders are the second category and utilized on an average Rs. 1,301 as their own capital and borrowed Rs. 2,639 for farming 3.97 hectares of rice and 1.92 hectares of wheat. Among the institutional borrowers, three categories were identified based on their land holdings. Small farmers constituted those who had less than 2.67 hectares of net cultivated land. These small farmers used an average of Rs. 781 own capital and Rs. 1,610 borrowed capital to cultivate 1.95 hectares of rice and 0.97 hectares of wheat. The medium farmers owning between 2.68 to 6.67 hectares of land used on an average Rs. 3,011 own capital and Rs. 3,657 borrowed capital to cover 9.66 hectares of gross cultivated area. Large farmers owning more than 6.67 hectares of net cultivated area utilized nearly 1/3 credit and 2/3 their own capital (Rs.

67,982) in order to cover an average cropped area of 85.86 hectares. The credit equity ratio is found to be less than unity only in the case of non-borrowers and large farmers. Highest credit equity ratio is found among borrowers from money lenders.

Table 3 : Data For Programming Analysis.

	Credit Non-users	Borrowers from Money Lenders	Institutional Borrowers Land Holdings		
			Small	Medium	Large
Level of credit (Rs)	—	2,639	1,610	3,657	30,298
Own capital (Rs)	2,665	1,310	781	3,011	67,982
Available rice land (ha)	1.92	2.58	1.56	4.57	39.78
Available wheat land (ha)	1.44	1.92	0.97	3.46	38.40
Local rice land (ha)	1.05	1.39	0.39	1.63	7.68
Cost of production of improved rice in Rs/ha	1,124	1,028	1,186	1,333	2,202
Cost of production of local rice in Rs/ha	941	932	1,019	880	1,054
Cost of production of improved wheat in Rs/ha	1,181	1,256	1,349	1,572	2,343
Cost of production of local wheat in Rs/ha	999	752	1,295	—	—
Cash requirement for improved rice in Rs/ha	437	458	485	819	1,321
Cash requirement for local rice in Rs/ha	326	390	382	455	626
Cash requirement for improved wheat in Rs/ha	327	453	385	757	920
Cash requirement for local wheat in Rs/ha	196	307	231	—	—
Exclusive credit for rice (Rs)	—	—	153	281	18,000
Exclusive credit for wheat (Rs)	—	—	102	368	—

The number of fragments of cultivated area (i.e. separate parcels) ranged from 1 to 52 with an average of approximately 5 fragments per farm. The size of one fragment ranged from 0.04 hectares to 86.67 hectares. The average size of the biggest fragments of all farms came to 1.96 hectares. Fragmentation of holdings has become the principal factor explaining the lower technological level of farming and rare use of heavy machineries such as tractors, power-tillers and threshers. Instead, the use of bullocks is at peak with a sample farmer owning on an average 3 draft bullocks.

Production Function Analysis

The coefficients estimated in the regression analysis are given in Table 4. while the geometric means and marginal products of inputs are given in Table 5.

1. Improved Rice

Nitrogen, human labor and other inputs generated positive coefficients while the sign for bullock labor turned out to be negative. A one percent increase in the use of nitrogen increased output by 0.08, 0.037 and 0.22 percent respectively, whereas one percent increase in bullock labor decreased output by 0.078 percent. The sum of input elasticities is less than one and hence shows decreasing returns to scale, indicating that the doubling of all inputs (other than land) would not double the output.

At the margin, an additional day of human labor increased paddy output by 8.4 kg., while one additional kg of nitrogen added 15.1 kg of paddy, and one more rupee spent on other inputs added 2.1 kg of paddy. The marginal value products of nitrogen, human labor and other inputs have been found to be Rs. 18.57, 10.30 and 2.55 as against their prices of Rs. 5.67, 5.00 and 1.20 respectively. Bullock labor has a negative shadow price of Rs. 9.56. The negative coefficient in the case of bullock labor may be explained by the availabiiity of tractors for hire, which is a perfect substitute of bullock labor, and thus shows the abundance of the means of tilling operations.

2. Local Rice

The negative coefficient of nitrogen, though insignificant, indicates the low capacity of local varieties of rice to respond to fertilizers despite an average of only 3.7 kg of nitrogen use per hectare. Human labor explained the major variation in output of local rice. One percent increase in the use of human labor per hectare increased yield by 8.9 kg. The marginal value product of human labor is Rs. 10.94 as against the wage rate of Rs. 5.00 per day. Bullock labor has a negative and insignificant coefficient while the capital cost has the second highest coefficient of 0.23. An additional rupee invested in seeds, phosphorus, potash and chemicals would increase output by 2.3 kg.

3. Improved Wheat

The coefficient of all inputs are positive and significant at the 5 percent level of confidence. One percent increase in nitrogen, human labor, bullock labor and capital cost per hectare increased output on an average by 0.06, 0.36, 0.18 and 0.21 percent respectively. The positive and significant coefficient of bullock labor, in the case of wheat is justified on the ground that wheat responds more to the quality of land preparation than rice. The marginal value productivities of all inputs are higher than their respective prices showing a scarcity of inputs or the conservative use of inputs. The input elasticities add up to 0.96, again showing decreasing returns to scale.

4. Local Wheat

Since only 20 cases were available for the purpose of analysis, regression on

local wheat production suffers from low degrees of freedom. Although the coefficient of determination (R^2) is 0.63, the individual coefficients are mostly insignificant and little variation in output can be explained with assurance. Due to the low level of nitrogen use per hectare (3.88 kg), the coefficient of nitrogen is positive and significant. Marginal increase in the use of nitrogen per hectare increased local wheat yield by 18.2 kg. The coefficient of human labor is positive and significant at the 10 percent level. Bullock labor has a positive and insignificant coefficient while capital cost has a negative and insignificant coefficient.

It is seen that the wheat crop responds more to nitrogen use and land preparation than rice.

Table 4 : Summary of Regression Coefficients.

Independent variables \ Dependent variables	Improved Rice (n=112)	Local Rice (n=102)	Improved Wheat (n=135)	Local Wheat (n=20)
A Intercept	0.009 (0.02)	-1.025* (-1.47)	-0.965* (-1.58)	1.601* (1.19)
X_1 Nitrogen	0.080** (4.61)	-0.001 (-0.06)	0.063** (4.52)	0.065** (2.32)
X_2 Human labor	0.373** (3.25)	0.541** (3.59)	0.362** (3.80)	0.314** (1.56)
X_3 Bullock labor	-0.078* (-1.11)	-0.005 (-0.06)	0.184** (3.84)	0.024 (0.16)
X_4 Other inputs	0.223** (3.34)	0.234** (2.84)	0.219** (2.75)	-0.120 (-0.49)
D_1 Size of holding	0.021 (0.52)	-0.020 (-0.45)	-0.023 (-0.73)	-0.141* (-1.34)
D_2 Irrigation	0.140** (2.93)	0.148** (3.47)	0.086** (2.42)	0.013 (0.18)
D_3 Credit	0.094** (2.51)	0.068* (1.81)	0.062** (2.12)	0.043 (0.73)
R^2	0.54	0.41	0.61	0.63
F-value	17.72	9.06	28.38	2.99
Sum of elasticities	0.598	0.965	0.829	0.283
Dependent variable: Yield kg/ha	2113	1415	1520	1089

Note : a) includes the value of seeds, phosphours, potash and chemicals

* Significant at 10 percent level

** Significant at 5 percent level

Figures in parentheses represent t-values

Source : Survey Data, 165 Farms of Rupandehi District, 1977.

5. Dummies

The size of holding dummy gave mostly negative coefficients which promotes the general understanding that the yields tend to decrease as the farm size gets bigger. This is further supported by the finding of decreasing returns to scale, reported above.

The irrigation dummy has a positive and significant coefficient in most cases. Holding all other inputs constant, irrigated farms produced on an average more output per unit area than their counterpart unirrigated farms.

The dummy for credit, which is of major concern, yielded positive and significant coefficients in the case of improved rice and improved wheat, indicating that for these crops there seems to be a greater need for credit. The coefficients in the case of local rice and local wheat are also positive.

Table 5 : Geometric Means and Marginal Products of Inputs.

	Improved Rice	Local Rice	Improved Wheat	Local Wheat
Geometric Mean				
Yield (kg/ha)	2113	1415	1520	1089
Nitrogen (kg/ha)	11.2	3.7	12.5	3.9
Human labor (days/ha)	94.1	86.1	84.1	77.9
Bullock labor (days/ha)	21.2	19.4	22.6	22.6
Other inputs (Rs/ha)	227.3	144.3	311.8	198.2
Marginal Physical Products	— — — — kg — — — —			
Nitrogen	15.1	0.4	7.7	18.2
Human labor	8.4	8.9	6.5	4.4
Bullock labor	-7.8	-4.6	12.4	12.4
Other inputs	2.1	2.3	1.1	0.7
Marginal Value Products	— — — — Rs — — — —			
Nitrogen	18.57	-0.47	13.14	31.93
Human labor	10.30	10.94	11.45	7.68
Bullock labor	-9.56	-0.45	21.77	2.02
Other inputs	2.55	2.82	1.87	-1.15
Marginal Value Product / Price of Input	— — — ratio — — — —			
Nitrogen	3.28	-0.08	2.37	5.63
Human labor	2.06	2.19	2.29	1.54
Bullock labor	-1.26	0.04	1.81	0.17
Other inputs	4.25	4.70	3.12	-1.92

Source : Survey Data and Table 4, 165 Sample Farms of Rupandehi District, Nepal, 1977.

This implies that the credit-using farms are realizing more output per hectare than the credit non-users. The positive contribution of credit is also demonstrated by the finding that the inputs to be bought with capital have marginal value productivities higher than their respective prices and a state of conservative use of inputs is noticed. Addition of these inputs with credit is sure to add to the output.

6. **Account of Efficiency**

The ratios of marginal value products and prices of inputs should be equal for all inputs within and between the crops for optimum (equimarginality) conditions. However, as can be seen from Table 5, this is not so in the present case. Capital cost has the highest ratio in the case of paddy followed by human labor, nitrogen and bullock labor. In wheat, nitrogen has the highest ratio followed by human labor, bullock labor and capital cost. In improved wheat cultivation and the use of human labor, however, farmers are seen to allocate resources close to optimum. This analysis indicates that farmers could increase profits, at the same level of total cost of production, by reallocating inputs within and between crops, which, however, presupposes that inputs are available to the farmer in the desired quantities at the desired time.

Programming Analysis

Programming analysis was done to test the hypotheses that credit is an important constraint in the production process, and that added credit in all cases would add to net revenue per farm. The constraint position is shown by the ordinary linear programming model whereas the impact of added units of credit is shown by the credit parameterization process. The credit for rice and credit for wheat is a 'greater than' constraint because the cash cost of production per hectare of a crop multiplied by the area planted under that crop should not be less than the amount of credit borrowed exclusively for that crop. This is done to force the model to treat paddy and wheat as mutually exclusive season crops. The taste constraint in the model is introduced because of the non-commercial nature of farming in the area and the superiority of local rice for consumption purpose. Farmers prefer local rice produced in their own farms for their domestic consumption and hence some portion of land is set aside for local rice growing.

For this purpose, farms were synthesized into 5 nearly homogeneous categories with a view to reflect the situation near to reality. Credit non-users were treated in a separate group. Credit users were stratified on the basis of land holdings as follows : Farmers holding less than or equal to 2.67 hectares of land are called small farmers. Medium farmers have holdings from above 2.67 to less than or equal to 6.67 hectares of cultivated land. Big farms have more than 6.67 hectares of cultivated land. The groupwise data is given in Table 3.

Table 6 summarises the change in credit, change in output supply and the productivity of credit for each group of farms. One rupee additional credit is seen to generate Rs. 1.92, 2.00, 2.06, 1.82 and 1.78 in borrowers from money lenders, credit non-users, small farms, medium farms and big farms, respectively. Thus the lowest shadow price of capital is seen to be Rs. 0.78 which is more than the highest observed

Table 6 : Productivity of Credit

	Present credit situation	Credit Parameterization a/			Maximum credit b/
		+25%	+50%	+75%	
A. Credit non-users					
Level of credit (Rs)	0	250	500	750	1,003
Credit per hectare (Rs)	0	130	260	391	522
Derived production increase (kg/ha) c/	—	157	157	157	—
Productivity of credit (Rs/ha) d/	—	2.00	2.00	2.00	—
B. Borrowers from money lenders					
Level of credit (Rs)	2,639	3,298	3,958	—	3,631
Credit per hectare (Rs)	1,023	1,278	1,534	—	1,407
Derived production increase (kg/ha)	—	326	155	—	—
Productivity of credit (Rs/Rs)	1.92	1.92	1.46	—	—
C. Institutional borrowers					
(a) Small farmers					
Level of credit (Rs)	1,610	2,013	2,415	—	2,329
Credit per hectare (Rs)	1,032	1,290	1,548	—	1,493
Derived production increase (kg/ha)	—	319	251	—	—
Productivity of credit (Rs/Rs)	2.14	2.06	1.83	—	—
(b) Medium farmers					
Level of credit (Rs)	3,657	4,571	5,485	6,399	7,783
Credit per hectare	800	1,000	1,200	1,400	1,703
Derived production increase (kg/ha)	—	307	227	227	—
Productivity of credit (Rs/Rs)	1.87	1.82	1.82	1.82	—
(c) Big farmers					
Level of credit (Rs)	30,298	37,873	45,447	53,022	93,221
Credit per hectare (Rs)	762	952	1,142	1,333	2,343
Derived production increase (kg/ha)	—	205	205	205	—
Productivity of credit (Rs/Rs)	1.78	1.78	1.78	1.78	—

a/ Credit Parameterization refers to a hypothetical increase (25,50 and 75 percent) in the level of credit made available to a farmer and the resulting increase in production. This percentage increase, of course, does not apply to credit non-users, in their case, a constant increase of credit by Rs. 250 was employed.

b/ The maximum credit is reached when the land is exhaustively used in paddy and wheat production.

c/ Derived production increase refers to the computed increase in composite production of rice and wheat.

d/ Prductivity of credit indicates the increase in the net income which results from an additional rupee of credit.

interest rate. According to the theoretical expectation, the productivity of capital is seen to decline with the additions of credit. The maximum credit absorption capacity with the present technology of farming is listed in the last column of Table 6 while the first column represents the present actual credit use. No group seems to have reached the maximum potential with all groups borrowing less than 75 percent of their absorption potential.

In most cases, the wheat area is slack and the area improves with every relaxation of the credit constraint. This is because improved rice is more profitable than improved wheat. The conditions of profit maximization in the model allocate resources to the most profitable crop which is improved rice, and after the land under this crop becomes a constraint, it is shifted to the next most profitable crop, which is improved wheat. This is the reason why, in most cases, the area under rice crop and output of rice remains constant while the area and output of wheat increases with successive parameterization.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary and Conclusions

Production function analysis showed that credit had a positive coefficient in all cases, statistically significant in the case of improved rice and improved wheat. For these two crops there seems to be a greater need for credit. All inputs, with the exception of bullock labor in rice production, were found to have a marginal value product greater than the respective input prices, indicating that these inputs are used to levels below the optimum. Bullock labor appeared to be applied above the optimum level. Larger farms were found to have lower yields per hectare in all crops than small farms, indicating decreasing returns to scale.

Programming analysis showed a high positive marginal productivity of capital and all groups of farms were observed to use less credit than would be optimal. Total production and net profits increased with successive additions of credit. Winter land was the main slack input in the presence of capital shortage, meaning that credit was used for wheat production only after all rice land was brought under cultivation, because net income from cultivation of paddy was found to be higher than that of wheat.

Recommendations

Since credit was found to have a positive impact on production and net profit of farmers and since all groups of farms were using less credit than would be optimal, it would be sound policy to increase the supply and availability of credit to farmers in order to raise national cereal production levels and increase economic benefits to farmers.

Since farmers were found to be inefficient allocators of inputs both within and between crops (as indicated by the differences between the ratios of MVP/MFC) a

reshuffling of inputs towards the direction suggested by the equimarginality condition, would result in an increase in net income.

At the present level of use of purchased inputs, the availability of these inputs is no constraint. However, at largely increased levels of credit, the supply of other material inputs may become a constraint.

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