"IMPACT OF CREDIT ON CROPPING PATTERN AND CROPPING INTENSITY ON FARMS IN UNIRRIGATED AND IRRIGATED VILLAGES IN BIJAPUR DISTRICT OF KARNATAKA-AN APPLICATION OF LINEAR PROGRAMMING TECHNIQUE"

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ABSTRACT

Cropping pattern and cropping intensity, *inter alia,* are the important factors that influence the farm profits. Studies in the past attempted to evaluate the impact of new farm technology on these two variables. However, the adoption of new technology is itself affected by the availability of credit. Hence, an assessment of impact of credit on cropping pattern and cropping intensity assumes great significance.

The present study probes into the impact of credit on the farms in unirrigated and irrigated villages. For this purpose, a sample of 120 farmers representing small and large categories were selected. The data pertained to 1987-88. Linear programming technique was used for analyis of the data.

The findings revealed that the optimization of resource use with existing and improved technologies led to cultivation of a few but more profitable crops in the new cropping patterns. The cropping intensity in different plans showed an increasing trend from the existing cropping pattern through the optimum plan with existing technology to the optimum plan with improved technology. These changes were possible because of supply of liberal credit through relaxation of capital constraint. This calls for improvements in farmer's accessibility to the liberal credit and input supplies.

Introduction

The advent of green revolution in India in 1960's has thrown open new technological possibilites for a breakthrough in agriculture. Simultaneously these possibilities also indicated that the adoption of new technology demands higher capital deployments. The increased demand for capital

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arises because of the new structure of resource use under the new technology like use of High Yielding Variety seeds, irrigation, fertilizers and plant protection chemicals. The adoption of new package could be considered as a function of farmer's resources. Any constraint on this count could be visualized as a serious impediment in the process of agricultural growth. The adequacy of individual farmer's financial resources has to be augmented from outside. Any negligence of this aspect of farming would result in sub-optimal utilization of inputs and consequently less optimum level of production.

Studies in the past have shown that improved technology does not have equal impact on irrigated and unirrigated farms due to variations in resource use efficiencies. Though credit facilitates use of off-farm resources, their optimum supply at the macro-level is yet to be scientifically established. Micro-level studies in this context would contribute to such evidences for macro-level decisions. Among the different financial institutions serving the rural credit sector, the Regional Rural Banks, inspite of all their limitations have come to play a very crucial role in the rural ecomomy. In fact in many regions the growth of the Regional Rural Banks has been exemplary because of their services.

Considering the role of credit from the demand side, as Vijayakumar (1976) observed, "under improved technology, the adoption without adequate capital may lead to reduction in net returns because of lack of proper combination of inputs"[1], there is a need for caution. Any pushing through of latest technology would prove counter-productive, without a balanced, well conceived credit policy. Therefore, the entire gamut of interrelationships among the level of technology, credit requirements (demand) for agricultural production and supply of institutional finance has to be considered in depth. Further, cropping pattern and cropping intensity are the important factors that influence the farm profits. Studies in the past attempted to evaluate the impact of new farm technology on these variables. However, the adoption of new technology is itself affected by the credit availability. Hence, an assessment of impact of credit on cropping pattern and cropping intensity assumes great significance.

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1. Vijayakumar, 1976, Credit requirements and its impact on irrigated and unirrigated farms in Bangalore South Taluka. M. Sc. (Agri.) Thesis (Unpublished), UAS, Bangalore

The present study addresses itself to the task of probing into the impact of credit and technology on the farms in unirrigated and irrigated villages.

For a meaningful analysis the study was undertaken with the following specific objectives.

1. To assess the effect of credit on cropping pattern and cropping intensity on farms in unirrigated and irrigated villages.

2. To compare the effect of borrowings from the Regional Rural Banks on the cropping pattern and cropping intensity on farms belonging to the unirrigated and irrigated villages.

Methodology

For a meaningful analysis of the impact of credit and comparison of the same on farms in unirrigated and irrigated villages, four villages were selected. The four villages in Indi taluk of Bijapur district in Karnatka state, fall under the jurisdiction of Dhulakhed branch of Bijapur Grameena Bank. Of the four villages, two were considered as unirrigated and the remaining two as irrigated. This classification was based on the proportion of irrigated land to the net cultivated area in each village. Furthere, it is usually argued that technology is scale neutral. However, small farmers have a general complaint that they are unable to adopt the improved technology because of their small scale of operations. Hence to probe into this issue, farmers were grouped into small and large to study the differential impact of credit and technology on these two categories of farms. A sample of 15 small and 15 large farmers was randomly selected from each village. Hence, the total sample size for the study was 120 farmers.

The relevant data were collected through personal interviews of farmer-respondents with the help of structured questionnaires. The data pertained to the agricultural year 1987-88. For analysis of the impact of credit linear programming technique was used to suggest optimum farm plans with the existing and improved technologies.

The model used in the study may be mathematically represented as follows:

$$\text{Maximise } Z = \sum_{j=1}^{n} C_j X_j \qquad (j = 1, 2 \ldots\ldots n)$$

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subject to,

$$a_1x_1 + a_2 x_2 + \ldots\ldots a_{1n} x_n \leq b_1$$

$$a_{m1} + a_{m2} + \ldots\ldots a_{mn} x_n \leq b_m$$

subject to $x_1, x_2, x_3, \ldots\ldots x_n \geq 0$

where,

Z = is the objective function to be maximized indicating the net returns over variable costs in crop enterprises.

x_j = level of the jth activity on the farm

c_j = net returns from one hectare of jth activity.

b_i = i^{th} resource available for taking up j^{th} activity.

a_{ij} = amount of ith resource required per unit of jth activity.

Activities in the Model

The activites used in the programming models were broadly grouped into real activities (crop-production), labour hiring and borrowing activities

Real activities

On the irrigated land in all the four programming models the crops were taken in kharif, rabi and summer whereas cropping activities were possible only in kharif and rabi on dry land.

Labour hiring activities

The programming model was programmed to hire labour in case of shortage with the available labour on an average farm. The Cj value assigned to this activity was (-) 10.00, since each unit of labour hired was to be paid a wage of Rs. 10.00 per day.

Borrowing and repayment activities

Similarly, the programming model was programmed to borrow capital in case of a shortage with the available capital on an average farm. The Cj value assigned to this activity in the objective function was (-) 1.06, since an amount of Rs. 1.06 was to be repaid for every rupee borrowed.

Input-output coefficients (aij's)

Input-output coefficients in the initial matrix were the resource requirements per hectare of activities included in the model. The coefficients were estimated for land, labour and capital.

Resource levels and constraints (bj's)

Resource restrictions were imposed on land, labour and capital since these items were most constraining factors in the study area.

Land

Three types of restrictions were imposed for land. They were, (a) the total land used by optimum plan should be less than the total available, (b) maximum land constraint for area under sugarcane in view of the problems faced by the farmers in the sale of cane, and (c) minimum land constraints on local jowar which satisfied the consumption needs of the farmers and minimum land constraint for fodder maize to meet the fodder needs of the livestock.

Labour

Only family labour was a constraint in the models since any excess demand for labour over that available in the family could be hired in.

Cash supply

Different levels of cash availabilities in the case of small and large farms in the unirrigated and irrigated villages were worked out and used in the models.

In order to simulate conditions to measure the credit requirement. its impact on cropping pattern and intensities, two models were designed for each group in the following manne. Model A-1: Referred to the optimum plan with existing technology for small farms in the unirrigated villages.

Model A-2: Referred to the optimum plan with improved technology for small farms in the unirrigated villages.

Model B-1: Referred to the optimum plan with existing technology for large farms in the unirrigated villages.

Model B-2: Referred to the optimum plan with improved technology for large farms in the unirrigated villages.

Model C-1: Referred to the optimum plan with existing technology for small farms in the irrigated villages.

Model C-2 : Referred to the optimum plan with improved technology for small farms in the irrigated villages.

Model D-1: Referred to the optimum plan with existing technology for large farms in the irrigated villages.

Results and discussion
I. Optimum cropping patterns
1. Unirrigated villages
a. Small farms

It was clear from the results of optimization of resource use in Model A-1 (Table 1) that all the available land in kharif was allocated for MFSH-. 8 variety of sunflower. This was because of the relatively high profitability of the crop. Sugarcane crop grown in the current plan was totally eliminated in the optimum plan with existing technology because of high capital demanded by this crop in each season, which could not be met even while borrowing was allowed. No land was, however left fallow in kharif. In rabi, only MFSH-8 variety of sunflower was allocated all irrigated land.

Thus, it was clear that cropping pattern in Model A-1 included a few but more remunerative crops. The increases in the net returns per farm from Rs. 5, 365.10 in the current plan to Rs. 8, 121.60 in the optimum plan were possible only with these changes in the cropping pattern. The cropping pattern remained the same for kharif even with the improved technology Model A-2 because of its efficiency in resource use.

On unirrigated land in Model A-2, during rabi, the entire land was allocated to local jowar. However, irrigated land was left fallow during rabi but fully allocated to sunflower during summer because of its potential for higher returns.

The cropping pattern in Model A-2 would fetch net returns of Rs. 17, 201. 90 which were Rs. 11, 837 and Rs. 9,080 more than those from the current cropping pattern and the cropping pattern suggested in Model A-1.

Table 1. Optimum crop plans

Sl. no.	Season	Model A-1		Model A-2	
		Crop activity	area (ha)	crop activity	Area (ha)
1.	Kharif	Unirrigated Sun-flower (MFSH-8)	0.97	Unirrigated Sun-flower (MFSH-8)	0.97
		Irrigated Sun-flower (MFSH-8)	0.85	Irrigated Sun-flower (MFSH-8)	0.85
2.	Rabi	Irrigated Sun-flower (MFSH-8)	0.85	Unirrigated local jowar	0.97
		Unirrigated fallow	0.97	Irrigated fallow	0.85
3.	Summer	Irrigated groundnut (local)	0.85	Irrigated sunflower	0.85

Net Returns = Rs. 8, 121.60   Net Returns Rs. 17, 201.40

b) Large farms

The cropping pattern suggested in model B-1 (Table 2) was in conformity with the maximum land specified for sugarcane. The net returns in this model increased to Rs. 12, 169.40 compared to those obtained in current cropping practices obtained by farmers (Rs. 1, 251. 30). This was because of reduction in areas under greengram, bajra and wheat and increases in the areas under sugarcane, sunflower and groundnut.

In Model B-2, with the exclusion of sugarcane, entire irrigated land was indicated for Morden variety of sunflower and entire dryland for MFSH-8 variety in kharif. In rabi, 1.31 ha of irrigated and 0.58 ha of dryland were put under local jowar which satisfied the consumption needs of the farmers. Local bengalgram on 1.30 ha of dryland when given new package of practices enhanced farm incomes. On irrigated summer land fodder maize (0.59 ha) was introduced to meet the fodder needs of the livestock.

The net returns in the plan increased by Rs. 5, 371 and Rs. 6, 620.20 over the optimum plan with existing technology and the current cropping pattern respectively.

Table 2. Optimum crop plans

Sl. no.	Season	Model B-1		Model B-2	
		Crop activity	area (ha)	crop activity	Area (ha)
1.	Kharif	Irrigated Sugarcane (CO-419)	0.40	Irrigated Sun-flower (Morden)	1.31
		Irrigated local Groundnut	0.91	Unirrigated Sun-flower (MFSH-8)	1.88
		Urirrigated sunflower (Morden)	1.88		
2.	Rabi	Irrigated Sugarcane (CO-419)	0.40	Irrigated local jowar	1.31
		Irrigated sun-flower (Morden)	0.91	Unirrigated local Jowar	0.58
		Unirrigated local jowar	0.58	Unirrigated local Bengalgram	1.30
		Unirrigated fallow	1.30		
3.	Summer	Irrigated Sugarcane	0.40	Irrigated fodder maize	0.59
		Irrigated fallow	0.91	Irrigated fallow	0.72

Net Returns = Rs. 12, 169.40   Net Returns Rs. 17, 540.30

2. Irrigated villages
a. Small farms.

As is clear from Table 3, Model C-1 indicated sugarcane (variety CO-419) and sunflower (Variety-Morden) on irrigated land in kharif. Sugarcane allocation was according to the model specifications of 0.40 ha, the remaining land was allocated for sunflower because of the relatively better performance of this crop. In rabi, in addition to sugarcane two crops viz., local groundnut (0.25 ha) on irrigated land and local jowar (0.62 ha) on dryland were suggested. In summer only sugarcane was continued. This plan could realize net returns of Rs. 8, 344. 70 inspite of a large amount of unutilized land.

Compared to model C-1, model C-2 was more efficient. Sunflower (MFSH-8) and HYV groundnut occupied kharif land. In rabi, entire irrigated and drylands were put under local jowar and bengalgram, respectively because these crops were found more profitable with the new

package of practices. The summer land was suggested for fodder maize to meet the fodder requirements. This cropping pattern enchanced the net returns of farms by 273.67 per cent and 147.78 per cent over those in the existing cropping pattern and the optimum plan with existing technology.

Table 3. Optimum crop plans

Sl. no.	Season	Model C-1		Model C-2	
		Crop activity	area (ha)	crop activity	Area (ha)
1.	Kharif	Irrigated Sugarcane (CO-419)	0.40	Irrigated Sun-flower (MFSH-8)	1.80
		Irrigated sunflower (Morden)	0.68	Unirrigated HYV groundnut	0.88
		Unirrigated local groundnut	0.09		
		Unirrigated fallow	0.79		
2.	Rabi	Irrigated Sugarcane (CO-419)	0.40	Irrigated local jowar	1.08
		Irrigated local groundnut	0.25	Unirrigated local Bengalgram	0.88
		Unirrigated local jowar	0.62		
		Irrigated fallow	0.43		
		Unirrigated fallow	0.26		
3.	Summer	Irrigated Sugar cane (CO-419)	0.40	Irrigated fodder maize	1.08
		Irrigated fallow	0.68		
		Net Returns = Rs. 8, 344.70		Net Returns Rs. 20, 677.00	

b. Large farms

The optimization Model D-1 (Table 4) suggested local groundnut and sunflower (MFSH-8) on irrigated and drylands, respectively. However, in rabi, Morden variety of sunflower replaced MFSH-8 variety. These crops had relatively better performance. Local jowar occupied rabi dryland which satisfied the consumption requirements of farm families. Morden variety of sunflower occupied the summer irrigated land.

This cropping pattern utilized the land efficiently and increased the net returns (Rs. 26, 086) by 42. 24 per cent over the current plan.

The optimum plan with the improved technology and liberal credit supply (Model D-2) included irrigated sunflower (Morden) and dry local bajra during kharif. In rabi, irrigated land was recommended for local jowar and hybrid tomato (Vaishali). The summer land was put under modern variety of sunflower.

This cropping pattern realized highest net returns (Rs. 37,924) among all the crop plan. Such enhancements in net returns in optimum plan with improved technology demonstrated the possible effects of liberal credit supply on the net returns of large farms in the irrigated villages.

Table 4. Optimum crop plans

Sl. no.	Season	Model D-1		Model D-2	
		Crop activity	area (ha)	crop activity	Area (ha)
1.	Kharif	Irrigated local Groundnut	1.41	Irrigated Sun-flower (Morden)	1.41
		Unrirrigated sunflower (Modern)	1.82	Unirrigated local bajra	1.81
2.	Rabi	Irrigated Sun-flower (Modern)	1.41	Irrigated local jowar	1.29
		Unirrigated local jowar	0.66	Irrigated HYV Tomato	0.12
		Unirrigated sunflower (Modern)	1.16	Unirrigated local Jowar	0.66
				Unirrigated local bengalgram	1.16
3.	Summer	Irrigated Sun-flower (Modern)	1.41	Irrigated sunflower (Modern)	1.41
		Net Returns = Rs. 26, 085.60		Net Returns Rs. 37, 923.70	

II. Cropping intensities in different crop plans:

The cropping intensities in different farm situations are given in Table 5.

Table 5. Cropping intensities on farms under different farm situations (per cent)|

Sl. No.	Size group	Type of land	Existing Cropping pattern	Optimum plan with existing technology	Optimum plan with improved technology
			Unirrigated region		
1.	Small	Irrigated	154.35	300.00	200.00
		Dry	97.11	100.00	200.00
2.	Large	Irrigated	136.64	130.53	245.04
		Dry	145.00	130.85	200.00
			Irrigated Region		
3.	Small	Irrigated	124.90	205.56	300.00
		Dry	111.82	80.68	200.00
4.	Large	Irrigated	190.00	300.00	300.00
		Dry	130.88	200.00	200.00

1. Unirrigated villages
a. Small farms

The cropping intenstity on irrigated land of small farms in these villages changes from 154.75 per cent in the existing crop plan to 300 per cent in the optimum plan with the existing technology. The cropping intensity also saw an increase of about 45 per cent by optimization with improved technology. There was a difference of 100 per cent decrease in cropping intensity between the optimum plans with existing and improved technologies, because in the latter rabi land was not fully utilized. This might be due to the shortage of other resources. On dry land, the cropping intensity increased from 97.11 per cent in the current plan to 100 per cent in the optimum plan with the existing technology and finally to 200 per cent in the optimum plan with the improved technology. This increasing trend in cropping intensity was brought about by the efficient land utilization due to optimization of resource use.

b. Large farms

The cropping intensity on irrigated land of large farms in the unirrigated villages changed from 136.64 per cent through 130.53 per cent to 245.04 per cent in the three respective farm situations referred above. The dryland witnessed changes from 145 per cent to 130.85 per cent and finally to 200 per cent. This indicated an increasing trend in cropping intensities except for the reductions in cropping intensities in optimum plan with existing technology both in irrigated and drylands. These reductions were due to non-utilization of 69.50 per cent of irrigated and 69.15 per cent of dryland in rabi and summer seasons, respectively. The comparison of trends in cropping intensities and net returns in each crop plan on both small and large farms showed that the cropping intensity had a definite bearing on farm incomes

2. Irrigated villages
a. Small farms

The cropping intensity on irrigated land increased from 124.90 per cent through 204.56 per cent to 300 per cent in the current plan, optimum plans with existing technology and improved technology, respectively. The optimization process allocated large amounts of land for a few but profitable crops. Simultaneously the extent of unused land was also reduced. Drylands

witnessed changes from 111.82 per cent through 80.68 per cent to finally 200 per cent in that order. The reduction in cropping intensity on optimum plan with existing technology was because of dryland left fallow in kharif (0.79 ha) and rabi (0.26 ha).

b. Large farms

The cropping intensity on irrigated land of large farms increased from 190 per cent in current plan to 300 per cent each in optimum plans with existing and improved technologies. The increases noticed on drylands were from 130.88 per cent in the current plan to 200 per cent each in optimum plans with the existing and improved technologies, respectively. This growth was possible because of liberal credit supply which facilitated modification in crop plans.

Thus, the cropping intensity in different plans on small and large farms in both the unirrigated and irrigated villages, showed a general increasing trend from the existing plan through the optimum plan with existing technology to the optimum plan with the improved technology. Further, a camparison of trends in cropping intensity and capital borrowings in different crop plans revealed the role of credit in enhancing the cropping intensity.

Conclusions

1. The findings of the study with respect to the impact of credit on cropping patterns on small and large farms in both the unirrigated and irrigated villages revealed that the optimization of resource use with the existing and improved technologies led to cultivation of a few but more remunerative crop enterprises in the new cropping patterns. However, the optimization of resource use itself was possible mainly because of relaxation of capital restraint.

2. The cropping intensities in different plans on small and large farms in both the unirrigated and irrigated villages showed an increasing trend from the existing cropping pattern through the optimum plan with the existing technology to optimum plan with improved technology. Further, a comparison of trend in cropping intensities and capital borrowings revealed the role of credit in increasing cropping intensities in different farm situations.

Reference

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