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Productivity Variation and Water Use in Farms of Madurantakam Tankfed Area of Chengalpattu District, Tamil Nadu

Indian agriculture is set in an unique situation of increasing population, on the one hand, and depleting resources, on the other. The farmers face the onerous task of doubling the existing food production by the turn of this century. The actual farm income realisation and resource situation of these farmers are dismal and neglected.

The productivity variation in terms of farm income is a very important factor to be examined with a view to bridging the lag in attaining at least the mean productivity of the area. On the resource side, constraints occur in continuous and increased supply of farm resources. The possibility lies in improving the efficiency of use of the existing resources at the farm level. In this context, Singh (1978), Bagi (1981), Thamodaran *et al.* (1982), Thakur and Kumar (1984), Patel and Patel (1984, p. 538), Palanisami and Easter (1984) and others have studied the resource use efficiency. The problem of productivity fluctuation among farms is pronounced in areas under uncertain water supply situations (Abel, 1975). Even under these situations the influence of supplemental irrigation is significant (Palanisami and Thornton, 1981, p. 10). Tank irrigated area has been dwindling in terms of area irrigated over the years at the all-India level. Risk and uncertainty in the availability of water in tankfed regions have contributed to more productivity variation. Hence, this study was conducted in a tankfed area with the objective of studying the variations of productivity in terms of income among tankfed farms and the influence of resource use on this variation.

METHODOLOGY

Sampling

The study was conducted in Chengalpattu district of Tamil Nadu State during 1987-88. Madurantakam tank was purposively selected (based on command area and low yield levels of crops). The tank had five sluices and six surplus weirs.

The registered command area of this tank was 1,141.02 hectares and is maintained by the Public Works Department. The command area received supplemental irrigation with open wells and bore wells. The cropping pattern in the command area showed that 72.32 per cent of the area was under paddy, followed by groundnut to the extent of 20.08 per cent. The other crops included sugarcane, *ragi*, pulses and vegetables grown to a limited extent. The average rainfall of the region was 1,086.92 mm, the highest receipt being in the North-east monsoon season. A random selection of 80 farms from the tank ayacut was chosen such that they had sole tank irrigation. This was done based on probability distribution of area under each sluice. To capture the effect of supplemental irrigation, 40 farms possessing wells to supplement the tank irrigation were selected. Thus a total of 120 farms was chosen for the purpose of study. The inter-farm variation in productivity[1] was studied size category-wise for the sample. The farm productivity function was used to analyse the magnitude of influence of various factors. The productivity of a farm was taken as the dependent variable, while the independent variables included those which had a bearing on influencing the productivity. The functional relationship was established based on previous works and was confirmed by the scatter diagrams. The data fitted best in the Cobb-Douglas form of production function which is specified as follows:

$$Y = ax_1^{B_1} \cdot x_2^{B_2} \cdot x_3^{B_3} \cdot x_4^{B_4} \cdot x_5^{B_5} \cdot x_6^{B_6} \cdot x_7^{B_7}$$

where Y = total value of crop output of the farm in rupees per net hectare,
x_1 = cropping intensity in percentage,
x_2 = managerial skill index[2],
x_3 = labour used in man hours per net hectare,
x_4 = amount of capital in rupees per net hectare,
x_5 = average quantity of water in cm per net hectare,
x_6 = dummy for supplemental irrigation:
= 1 (presence of supplemental irrigation),
= 0 (otherwise).
x_7 = dummy for tenancy status:
= 1 (owner operated),
= 0 (otherwise).

The Cobb-Douglas form was transformed to a linear form by logarithmic transformation. For estimation of the function, Ordinary Least Squares Method was adopted with classical normal assumptions. Estimated values of the regression coefficients were tested for statistical significance using 't' test and that of the regression equation by 'F' test. The correlation matrix of the independent variables was studied to identify occurrence of multicollinearity. No two variables had a correlation above 0.50, indicating the absence of multicollinearity.

RESULTS AND DISCUSSION

Productivity Variation due to Farm Size

Productivity in terms of income per farm was studied for each farm size category and presented in Table I.

TABLE I. INTER-FARM VARIATION IN INCOME DUE TO FARM SIZE

(Rs./farm)

Farm size-group	Situation I			Situation II			Total income of all farms (irrespective of the situations)
	Total	Mean	Number of farms	Total	Mean	Number of farms	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Marginal (0.40 ha)	1,77,616 (17.82)	10,448	17	-	-	-	1,77,616 (10.48)
Small (0.41 - 1.00 ha)	5,12,642 (51.45)	12,503	41	1,10,859 (15.87)	11,086	10	6,23,501 (36.79)
Medium (1.01 - 2.00 ha)	2,45,930 (24.68)	14,466	17	3,88,008 (55.56)	18,477	21	6,33,938 (37.40)
Large (2.00 ha)	60,277 (6.05)	20,092	3	1,99,547 (28.57)	22,172	9	2,59,824 (15.33)
All farms	99,96,465 (100.00)	12,775	78	6,98,415 (100.00)	17,460	40	16,94,879 (100.00)
Coefficient of variation		28.85			32.75		29.76

Situation I = Sole tank irrigation.
Situation II = Tank supplemented by wells.

Situation I (sole tank irrigated): Under this situation the marginal farmers earned a mean farm income of Rs. 10,448, which rose gradually to Rs. 12,503 to Rs. 14,466 and to Rs. 20,092 for the small, medium and large farmers respectively as shown in Table I. This clearly shows the positive influence of farm area on mean farm income. This may be due to the fact that small and marginal farmers grew more of traditional crops and have lesser farm area. Further, the contribution of the small farmers to the total farm income among sample farms was the highest, showing the preponderance of their number in sole tankfed area. The contribution of the large farms was only 6.05 per cent, and their number was the least among the size-groups. The coefficient of variations of farm productivity by size-group of farms was 28.85 in situation I.

Situation II (tanks supplemented by wells): Marginal farmers in the sample possessed no wells. The highest contribution of 55.56 per cent of the total income of the sample farmers was from the medium farmers, followed by the large farmers (28.57 per cent). This may be due to the prevalence of supplemental irrigation in the larger sized farms. The coefficient of variation among farms due to farm size was 32.73 under this situation.

The overall situation showed that around 75 per cent of the total income was contributed by small and marginal farms. The marginal farms were found to have lower productivity but they were more in number, while the large farms had higher income productivity but they were few in number. Thus there existed vast scope for increasing the level of income of the marginal farms through supplemental irrigation, since the coefficient of variation by farm size was 29.76.

Supplemental effect: By comparing the two situations, it could be seen that in a majority of the cases there was enhancement of productivity by Rs. 4,685 due to supplemental irrigation over that of the sole tank irrigated farms.

Influence of Resource Factors

The R^2 value was significant at one per cent level (F-test) confirming the goodness of fit of the model. The R^2 value was 0.59, which showed the 59 per cent of the variation in the dependent variable could be explained by the specified independent variables in the model. The results of the multiple linear regression equation are given in Table II.

The intercept value was 1.43 which was significant at ten per cent level.

TABLE II. RESULTS OF MULTIPLE REGRESSION (LOG-LOG TYPE)

Variable	Parameter	Estimates	Standard error	Computed 't' value	Level of significance
1	2	3	4	5	6
Intercept	B_0	1.43	0.82	1.74	*
X_1 Cropping intensity	B_1	0.49	0.11	4.45	***
X_2 Managerial skill	B_2	0.02	0.07	0.39	NS
X_3 Labour	B_3	0.31	0.06	5.17	***
X_4 Capital	B_4	0.30	0.08	3.75	***
X_5 Water	B_5	0.15	0.04	3.75	***
X_6 Dummy for supplemented irrigation	B_6	0.06	0.03	2.00	**
X_7 Dummy for tenancy status	B_7	-0.01	0.03	-0.36	NS

$R^2 = 0.59$. $\bar{R}^2 = 0.56$. F = 20.10***.

* Significant at 10 per cent level; ** Significant at 5 per cent level; *** Significant at 1 per cent level.
NS = Non-significant.

This indicates that the error of approximation or the error of omitted variables is not very serious so as to reject the fitness of the specified functional form.

A higher productivity was observed on farms with a relatively higher cropping intensity. To study its extent of influence, cropping intensity was introduced as a variable. The cropping intensity of the farms was significant in influencing the productivity of the sample farms at one per cent level; the estimated coefficient being 0.49. A similar result was obtained by Abel (1975) for Taiwan. The computed 't' value of the managerial skill index estimate was not significant in influencing the productivity.

The estimated coefficient of the labour parameter was 0.31, the 't' value being 5.17, which was significant at one per cent level. Capital had a parameter estimate of 0.30, with a 't' value of 3.75, which was highly significant at one per cent level.

Due to the infeasibility of accurate measurements at the farm level, a close approximation of the quantity of water used by a farm in a year was used. Here the average depth of irrigation is multiplied by the frequency of irrigation to get the quantity of water used. The parameter estimate was 0.15, with a computed 't' value of 3.75, which was highly significant at one per cent level. A dummy variable was included for capturing the possible effect of supplemental irrigation and its parameter estimate was 0.06 with a computed 't' value of 2.00, which was significant at five per cent level, indicating the scope for increasing the productivity by way of supplemental irrigation. The dummy for tenancy status was found to be non-significant.

CONCLUSION

The results of the study showed a clear picture of the inter-farm variations in farm productivity. There was a positive influence of farm area on the productivity, which may be due to the presence of supplemental irrigation on farms of larger area. There was productivity variation due to farm size even under homogeneous irrigation situations. There existed potential for increasing the productivity of marginal farms through community wells. The cropping intensity was found to be the most determining factor in the farm income. This was followed by labour and capital. Supplemental irrigation had a vital influence on farm productivity.

It could be concluded from the study that employment opportunities can be created in the area due to low levels of labour use. Credit facilities need to be provided to the farmers in the form of short-term credit since capital has a scope to improve the productivity. The influence of supplemental irrigation on the productivity of farms is so high that efforts should be made for provision of long-term credit facilities, especially for installation of community wells to help the marginal and small farmers. Nevertheless, care should be taken in well installations to avoid indiscriminate tapping of groundwater.

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NOTES

1. The term productivity used throughout this paper refers to gross income per farm.

2. Managerial skill index (S) $S = \frac{M_i}{M} \times 100$

where $M_i = \frac{1M_1 + 2M_2 + 3M_3}{6}$

where M_1 = number of years of schooling; M_2 = years of experience in faming; M_3 = farm training undergone, if any.

Weightages: $M_1 = 0$ - illiterate; 1 - upto school/school drop out; 3 - college/college drop out; $M_2 = 0$ - no experience; 1 - 1 to 10 years; 3 - more than 10 years; $M_3 = 0$ - no farm training; 1 - once trained; 3 - trained more than once.

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