

RESOURCE USE AND PRODUCTIVITY IN DRYLAND AGRICULTURE IN NAGOUR DISTRICT (RAJASTHAN)

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ABSTRACT

Resource use and productivity in dryland agriculture in Nagaur district of arid Rajasthan was examined for 1977-78 to 1979-80 for three farm size groups by employing production function approach. All the components of input-mix, excepting human labour, need additive adjustment for enhancement of value productivity of crop output-mix on dryland farms.

INTRODUCTION

Efficient allocation of resources for rational crop production on dryland farms is of crucial importance for growth oriented and unskewed agricultural production. The development strategy for dryland agriculture in recent years had concentrated more on the problems associated with crop production (Rangaswamy, 1986). Despite the time tested viability of the existing crop production technology, the resource use imbalances continue to adversely affect the marketable surpluses of agricultural sector in western Rajasthan. Location of these imbalances thus assumes greater relevance in the light of sizeable technological (Jodha, 1986), spatial and demographic (Malhotra et al., 1983) changes over time.

Earlier studies on the productivity and allocation of resources (Rajkrishna, 1964; Saini, 1969; Singh and Pandey, 1971; Singh and Patel, 1973, Gaur, 1979, Sadhu and Mahajan, 1981, and Sircar and Heady, 1983) had little relevance to dryland agriculture in western Rajasthan. This study was, therefore, undertaken to estimate the resource productivity and allocative efficiency of major resources on different size groups of dryland farms in a typical arid district in western Rajasthan.

MATERIAL AND METHODS

The local and methodology of its selection has already been described (cf. Vyas 1989).

Model specification

To estimate the resource productivity and allocative efficiency of major resources, production function of the following alternative forms were used :

$$\text{Linear} \quad : \quad Y = a + b_1 X_1 + b_2 X_2 + \dots + b_n X_n + u \quad \text{(i)}$$

$$\text{Cobb-Douglas} \quad : \quad Y = a x_1^{b_1} x_2^{b_2} \dots x_n^{b_n} u \quad \text{(ii)}$$

$$\text{Semi-log} \quad : \quad Y = \text{Log } a + b_1 \log X_1 + b_2 \log X_2 + \dots + b_n \log x_n \log u \quad \text{(iii)}$$

$$\text{Exponential} \quad : \quad Y = \text{Log } a + b_1 x_1 + b_2 x_2 + \dots + b_n x_n + u \quad \text{(iv)}$$

where 'a' was intercept, x_1, x_2, \dots, x_n and b_1, b_2, \dots, b_n were the respective explanatory variables and regression coefficients, and 'u' was random error.

The variables included in the farm production functions were :

Y = Total crop output value on the farm (Rs)

X_1 = Total area cropped on the farm (ha)

X_2 = Human labour (hired and owned) used on the farm (Man days)

X_3 = Material inputs including expenses incurred in seed, manure, fertilizer and plant protection material used on the farm (Rs)

X_4 = Capital input (fixed cost) including the use depreciation on machinery and implements, draught animals and interest on fixed capital (Rs)

X_5 = Bullock labour including human labour days attached (days)

X_6 = Tractor power use (hours)

Table 1. Value of R^2 in different forms of farm production functions, 1977-80

Farm size and Years	Linear	Cobb-Douglas	Semi-log	Exponential
Small				
1977-78	56.29	56.08	49.78	55.30
1978-79	43.89	56.32	43.31	52.03
1979-80	67.27	71.05	51.63	61.70
1977-80	41.93	53.16	39.87	44.91
Medium				
1977-78	42.32	67.99	49.72	46.94
1978-79	85.58	80.76	78.24	82.77
1979-80	65.75	71.34	59.07	75.16
1977-80	47.43	56.39	41.82	64.18
Large				
1977-78	72.38	70.93	74.67	64.12
1978-79	70.66	70.72	68.52	67.32
1979-80	73.85	70.42	74.27	68.01
1977-80	60.86	64.31	65.86	54.25
All size				
1977-78	55.84	56.24	49.45	55.44
1978-79	84.63	81.57	71.30	73.23
1979-80	81.57	84.99	62.52	73.13
1977-80	59.83	61.67	51.60	51.90

The presence of multi-collinearity and its severity was simultaneously tested by following the criteria set by Heady and Dillon (1968) and Klein (1965).

RESULTS AND DISCUSSION

Returns to scale

The regression coefficient estimated by Cobb-Douglas production function also represent the production elasticities and their summation is direct indicator of increasing (if > 1), decreasing (if < 1) or constancy of returns (if $\sum b_i = 1$) to scale. Irrespective of the quality of survey years and farm size groups, the farm production function generated constant returns to scale in dryland agriculture (Table 2). Obviously under the existing technological possibilities, the output enhancement would be directly in proportion to the quantum of resource-mix. This finding is in consonance with earlier studies of Khusro (1964), Rajkrishna (1964), Saini (1969) and Singh (1975).

Resource productivity

Farm size was found to be a major determinant for variations in the resource productivity performance and production function registered a marked increase with increase in the farm size and productivity was invariably related with the size but for labour and material input, a reverse trend was discernible. Notwithstanding the minor inter-size group variations, the farm capital and bullock labour did not significantly contributed the variations in the value of total crop output. Tractor use on the other hand was productive on large farms. It could, thus, be concluded that in a good rainfall year (1977-78), small farms used tractor power, human labour and material input more judiciously. Medium farms, on the other hand, used only draft resources (bullock and tractor power) more judiciously in good rainfall year (1977-78). Finally, the large size farms used their land and human labour resources more judiciously during good rainfall year (1977-78). An overall aggregation of all farms revealed that the farms in Nagaur district, in general, used human labour (X_2), material input (X_3), and tractor power (X_6) rather judiciously.

In the average year (1978-79) barring tractor use (X_6) for small farms and human labour (X_2) for medium farms, resources did not contribute significantly to explain the variation in the value of farms crop product-mix on small and medium size farms. However on the large farm land (X_1), and human labour (X_2) contributed positively and significantly in explaining the variation in value of total crop output. Bullock labour (X_5) and tractor use (X_6) on large farms had negative but significant contribution. It can, thus, be inferred that large farms in arid district of Nagaur under the pressure of aridity tried to diversify their portfolio by putting land and labour resources to intensive use.

Table 2 : Farm production function estimates by farm size groups 1977-80.

Farm size & years	No. of observations	Constant	Land (X ₁)	Human labour (X ₂)	Material input (X ₃)	Capital input (X ₄)	Bullock labour (X ₅)	Tractor use (X ₆)	bs	R ^e
1977-78										
Small	46	3.0745	-0.1441 (0.4001)	0.8707* (0.3851)	-0.2855* (0.1409)	-0.2010 (0.2473)	0.0537 (0.0688)	0.2580** (0.0864)	1.1228	56.08
Medium	32	6.9437	0.6886 (0.6305)	-0.4960 (0.4260)	-0.2430 (0.1278)	0.4947 (0.3096)	0.2285* (0.0848)	0.4115** (0.1108)	1.0899	67.59
Large	35	3.6739	1.1490 (0.5533)	0.6850* (0.2701)	-0.2265 (0.1488)	-0.0839 (0.3522)	0.0028 (0.0649)	0.0826 (0.0712)	1.6090	70.93
All size	113	3.1082	-0.1215 (0.3772)	0.8561* (0.3726)	0.2861* (0.1392)	-0.1987 (0.2440)	0.0520 (0.0674)	0.2770 (0.1852)	1.1310	56.26
1978-79										
Small	31	5.0374	0.5142 (0.3404)	-0.2531 (0.2282)	-0.0980 (0.1260)	0.5660 (0.3372)	0.0585 (0.0840)	0.0711* (0.0268)	0.8587	56.32
Medium	25	3.4881	0.9555 (0.5010)	0.2440 (0.1012)	-0.0532 (0.0861)	0.3211 (0.3702)	0.0061 (0.0562)	-0.0352 (0.0731)	1.4383	80.76
Large	26	3.2527	0.8812* (0.4044)	0.4658* (0.1682)	-0.1108 (0.0911)	0.3107 (0.1918)	-0.0949* (0.0421)	-0.1817 (0.1265)	1.2703	70.72
All size	82	4.4883	0.5021* (0.2322)	0.0787* (0.0351)	-0.084 (0.0623)	0.3584* (0.1625)	0.0170 (0.0317)	0.0564 (0.0554)	0.9648	81.5
1979-80										
Small	31	3.0045	-0.0113 (0.2724)	0.6487** (0.1842)	-0.0813 (0.1034)	0.2351 (0.2842)	-0.0156 (0.0845)	0.2164* (0.0872)	0.9920	71.05
Medium	26	0.6378	0.0396 (0.0212)	0.8012* (0.3271*)	-0.0037 (0.1120)	0.5093 (0.4196)	-0.0964a (0.0704)	0.1162 (0.0975)	1.3362	71.24
Large	26	1.5035	0.1343 (0.1001)	1.0482** (0.1997)	-0.1936 (0.1554)	0.2520 (0.3559)	0.0229 (0.0579)	0.1979 (0.1087)	1.5920	70.47
All size	83	2.4077	0.5510* (0.1661)	0.7373** (0.1095)	-0.0800 (0.0614)	0.2855 (0.1733)	-0.0261 (0.0329)	0.1754** (0.0478)	1.1672	84.99

(Contd.)

(Table 2 contd)

1977-80										
Small	118	3.7878	0.0013 (0.1958)	0.4771** (0.1107)	0.1042 (0.0692)	0.0889 (0.1605)	0.1017** (0.0430)	0.2671** (0.0548)	1.0403	53.16
Medium	88	3.3633	0.6025* (0.3028)	0.4454 (0.1526)	0.0391 (0.0671)	0.1700 (0.1955)	0.0398 (0.0394)	0.1448** (0.0553)	1.3634	56.39
Large	87	2.0838	0.3628 (0.2186)	0.7043** (0.0990)	-0.1727 (0.0724)	0.3838 (0.1558)	-0.0286 (0.0292)	0.0717 (0.0427)	1.3213	64.31
All sized	278	3.0252	0.1395 (0.1949)	0.6331** (0.1743)	0.1085 (0.0721)	0.0532 (0.1554)	0.0450 (0.0350)	0.1612** (0.0392)	1.1405	61.67

Figures in parentheses indicate errors of regression coefficients

**Significant at 1 per cent level

*Significant at 5 per cent level

In the drought year (1979-80) despite a generally high R^2 , only human labour (X_2) exerted positive and significant contribution in total crop output. Tractor use on small farms and to some extent on large farms was another important variable which exerted influence on the explanation power of the estimated function. The variance owing to farm sizes, upon aggregation exerted positive and significant effect for land (X_1), human labour (X_2) and tractor use (X_6). It could thus be inferred that the components of new technology including seed, fertilizer and capital assets did not, on an average, contribute towards the explanation of the variation in the existing total crop output on sample dryland farms (Table 2).

On the aggregation of data for the three consecutive years, the positive and significant effect of labour and tractor use was clearly discernible irrespective of the farm size variations in the sample farms. The results revealed that with increase in the farm size, variable production inputs tended to exert negative influence on value of crop output. The contribution of fixed capital assets was significant and increased with increase in the farm size. Thus, it seems that farm size has more important role to play in the productivity relationship and efficiency of resource use when capital intensive techniques are employed. However, its statistical significance was restricted to large farms. It could thus be inferred that despite inter-temporal variations in the crop output performance, labour and tractor use had crucial contribution to make in explaining the variation in the crop output-mix. The technical component of the production process had negative influence on farm productivity. It seems that under all pervading aridity, the technology of crop production does not have an overwhelming potential to succeed. If the constraints on resource-mix posed by aridity are removed, one could expect sizeable positive shift in the production surface. When the production functions for all the years and farm sizes were aggregated, only the labour and tractor use explained the variation in product-mix.

Resource allocation efficiency

A comparison of marginal value productivity of a given resource estimated from production function with the acquisition cost or opportunity cost of the input would provide the degree of allocative efficiency and would give an idea of possibility of resource adjustment at farm level. In the present case the marginal value productivities were computed by using the regression coefficient estimated in 'Cobb-Douglas' production function. The ratio of marginal value product to factor costs for different size farms for the survey years revealed that land was used near optimal on large farms in drought (1979-80). Barring small and medium farms in drought year (1979-80), increase in the land use capacity of dryland may in general result into increased productivity. An exception, was, however, noticeable that land use on small farms in good year (1977-78) where possibly land use was predominantly extensive cultivation of marginal and submarginal lands in general. Results however, revealed that in the long run, increase in land use intensity and discouragement of putting marginal

and sub-marginal land under plough in all farm size groups may result in optimum use of this crucial input (Table 3).

Material inputs were found to be excessive in use for all the farms size groups in all the survey years except these on small farms. It thus seems that repeated sowings due to erraticity of rainfall and the attendant expenditure involved material input turned out to be negative in their impact on crop output. An evolution of a technology which could minimize the repetitive use of material input would inevitably lead to enhanced productivity of this input (Table 3).

Capital inputs were found to be very productive in all the survey years excepting the good rainfall year (1977-78). It seems that good year led to extra capital use on farms in an attempt to cover most of the farm areas leading to negative productivity. It suggests that good rainfall year does not lead to excessive use of capital. In all other situations, the results revealed that irrespective of farm size groups and annual fluctuation, farms continue to remain capital starved. Increase in doses of capital, in general, may lead to enhanced productivity on the sample farms (Table 3).

Table 3. Ratio of MVP to factor costs by size of farms (at Geometric Mean levels of their inputs)

Year farm size	Land (X ₁)	Human labour (X ₂)	Materialinput (X ₃)	Capital in put (X ₄)	Bullock labour (X ₅)	Tractor use (X ₆)
1977-78						
Small	-1.51	2.74**	8.23	-1.18	2.60	2.83
Medium	4.49	1.58	-4.41*	-2.28*	8.51*	4.01*
Large	11.77	2.66	-5.09	-0.51	0.80	1.32
All sized	-1.06	2.71	8.23	-1.51	2.43	2.77*
1978-79						
Small	6.20	-0.96*	-2.88	3.81	1.91	0.66**
Medium	9.87	0.94	-1.02	1.67	0.53	-0.32
Large	6.34	1.81	-1.95	1.75	-4.87*	-1.15*
All sized	5.08	0.30**	-1.93*	2.34**	1.39	0.46**
1979-80						
Small	0.08	2.33*	1.36	0.92	0.14	0.98
Medium	0.29**	3.48*	-0.06	2.05	9.80	0.61**
Large	1.05	4.67**	-2.72	1.16	0.98	1.27
All sized	0.38	3.09**	-1.21*	1.18	-2.05	0.93
1977-80						
Small	0.01	1.61	2.59	0.48	2.69	2.17*
Medium	4.60	1.62	-0.67	0.78	2.71	1.10
Large	3.34**	2.83**	2.13**	2.09	-4.09	0.66
All sized	1.02	1.48	1.88	0.24	1.38	1.99*

** Significant at 1 per cent level *Significant at 5 per cent level

Almost similar conclusions follow from bullock labour and tractor use intensities on farms. It can thus be concluded that from amongst components of input-mix currently in use on drylands, additive adjustment on land, labour, capital, bullock labour and tractor use are needed.

CONCLUSIONS

The results of farm-level production functions revealed that in short-run, input output relationship of almost all farm crop activities followed log-linear specification and generated constant returns to scale in dryland agriculture. Labour and tractor use were conspicuous by their positive and significant effect on all farm size groups. Material input tended to exert negative influence on value of crop output-mix with increase in the size of farms. The contribution of fixed capital assets was positive but significant for large farms only. Marginal value productivity analysis led to inescapable conclusion that all the components of input-mix excepting labour need additive adjustments for enhancement of value productivity of crop output-mix on dryland farms in Nagaur district of Rajasthan.

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