Optimizing Returns in Mulberry Cultivation: A Resource use Efficiency Study in Chikkaballapur District of Karnataka, India

ABSTRACT

The present study was conducted to analyze resource use efficiency in mulberry cultivation using data from cultivators of Chikkaballapur district of Karnataka collected during 2021-22 from mulberry growing farmers. Twenty mulberry growers were selected using random sampling procedure from each of the two chosen taluks leading in mulberry cultivation in Chikkaballapur district. The resource use efficiency analysis was carried out using production function analysis by comparing the marginal value productivity from each of the resource with marginal input cost from each of the resources (profitability ratio). Results indicated scope to increase the use of fertilizer, FYM, and irrigation as additional expenditure on these resources would result in additional return. The summation of the production coefficients indicated increasing returns to scale and scope to increase the use of resources and optimize returns from mulberry cultivation from the current level.

Keywords: Mulberry, Resource use efficiency, Profitability ratio

1. INTRODUCTION

Sericulture, the art and science of silk production, has been an integral part of India's cultural and economic heritage for centuries. Silk is known throughout the world as the "Queen of Textiles" because of its unparalleled grandeur, natural sheen, and inherent affinity for dyes, light weight, and high durability. It is a natural fiber derived from silkworm cocoons through a process known as sericulture.

Silk forms a small part in the global textile market, the major silk-producing countries in the world include China, India, Uzbekistan, Brazil, Japan, the Republic of Korea, Thailand, Vietnam, Korea, Iran, etc. Few other countries, such as Kenya, Botswana, Nigeria, Zambia, Zimbabwe, Bangladesh, Colombia, Egypt, Japan, Nepal, Bulgaria, Turkey, Uganda, Malaysia, Romania, Bolivia are also engaged in the production of cocoons and raw silk in negligible quantities. Among the leading contributors to the global silk industry, India stands out as a prominent player with a rich history of sericulture. Silk produced in India is renowned for its quality and variety making it a significant player in the international silk market. Mulberry cultivation forms the integral part of Sericulture. The total area under mulberry plantation in

India was increasing over a years and it stood at 2.55 million ha during 2022-23 with annual mulberry silk production of 20,118 metric tonnes (Anonymous, 2023).

Sericulture is a tradition in Karnataka and culturally the state accords great value to silk. Karnataka, one of India's leading states in sericulture, produces nearly 31.4 per cent of the country's total raw silk. The total area under mulberry plantation in Karnataka (2022-23) accounted for 1.12 lakh hectares, Ramanagara accounted for the highest area of 20,805 hectare (18.66 %) closely followed by Chikkaballapura 20,545 hectare (18.43 %) and Kolar 19,908 hectare (17.85 %) respectively. Sericulture plays a predominant role in shaping the economic destiny of rural communities. India ranks as the world's second-largest silk producer, with domestic demand surpassing current supply levels, indicating ample scope to increase production. In this background, given the importance of the mulberry cultivation in sericulture, present study is an attempt to estimate the resource use efficiency in the cultivation of mulberry.

2. METHODOLOGY

2.1 Data Collection

The study was undertaken in Sidlaghatta and Chintamani taluks of Chikkaballapur district in Karnataka during 2021-22. The study area was chosen purposively, by considering the area under mulberry cultivation. Sidlaghatta taluk has largest area under mulberry cultivation of about 6,758 ha followed by Chintamani taluk which has about 4,752 ha of area under mulberry cultivation. Primary information on inputs, labour utilization, output and prices were collected from a randomly selected 40 respondents using pre-tested and well-structured schedule through personal interview method.

2.2 Analytical Tools

2.2.1 Resource use efficiency in mulberry cultivation

Resource use efficiency in mulberry cultivation was studied by fitting the Cobb-Douglas type of production function to the farm level data as specified below.

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} e^{u} \quad \ldots\ldots. (1)$$

Where,

Y = Mulberry Yield (tons/acre)

X_1 = Area under mulberry cultivation (acre)

X_2 = Human labour (man days)

X_3 = Farm yard manure (Tractor load)

X_4 = Fertilizer (kg)

X_5 = Irrigation dummy (1 for irrigated, 0 for non-irrigated)

A = Intercept

b_1 to b_5 indicates production elasticity coefficients of respective inputs.

The estimated production co-efficient (bi) were tested for their significance using 't' test

t= bi/Standard error of bi ……. (2)

The above equation was converted into the logarithmic form and parameters were estimated using OLS technique.

$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X4 + b_5 \ln X_5 + u$ ……. (3)

Specification of Variables

Dependent Variables

a. Yield obtained from mulberry cultivation per acre was taken as a dependent variable

Independent Variables

a. Area under mulberry cultivation (acres) - X_1
b. Human labour used (Man days/acre) - X_2
c. Quantity of FYM (Tractor load/acre) -X_3
d. Quantity of chemical fertilizer applied in mulberry cultivation (kgs/acre) -X_4
e. Irrigation (Dummy) - X_5

The optimality in resource use was assessed using the Marginal Value Product (MVP) and the Marginal Factor Cost (MFC). The Marginal value product (MVP) of each input was obtained as the product of its Marginal Product (MP) and the price of output (Py) . The MP was calculated using the production function estimates (bi) and the ratio of Geometric Mean (GM) level of output and input . The Marginal Factor Cost (MFC) was the cost incurred on per unit of the input.

Then the Economic Efficiency was arrived at using the following relationship.

EE = r = MVP/MFC

Where,

EE = Economic efficiency

MVP = Marginal value product of variable inputs

MFC = Marginal factor cost (price per unit of inputs)

Based on economic theory, a firm maximizes profits or reaches economically optimum level of output when the ratio of the marginal value product to its opportunity cost is unity. Thus, if,

- r is <1; resource was overused and indicates the need to reduce its use.
- r is >1; indicates the resource is underutilized and hence increasing its use from the existing level would increase profit.
- r is = 1; shows the optimum utilization of resource and the point of profit maximization.

3. RESULTS AND DISCUSSION

3.1 Resource-use efficiency in mulberry cultivation

To study the economic optima in use of various resources in mulberry leaf cultivation, the Cobb-Douglass type of production function as specified earlier was fitted to the data collected from sample farmers. The results presented in table-1 reveals that area under mulberry cultivation, human labour, FYM, fertilizer, and irrigation were found to be the significant contributors to leaf output. Among the production coefficients for various inputs, the coefficient for fertilizer input was found to be highly significant at one per cent probability level, while the coefficients for human labour and farm yard manure were significant at five per cent probability level. In other words, the production coefficients indicated that one per cent increase in mulberry area on sample farms labour, FYM, fertilizer and irrigation would result in increase in mulberry leaf output by 0.13 per cent, 0.19 per cent, 0.16 per cent, 0.58 per cent and 0.05 per cent, respectively from current level of production. The production variables included in the model found to account for about 90 per cent of the variation in mulberry yield as revealed by the co-efficient of multiple determination (R^2) value. The sum of the regression coefficients (1.11) illustrates increasing returns to scale i.e., incremental use of all inputs simultaneously, would result in more than one unit increase in mulberry leaf yield.

Economic Efficiency

To assess the economic optimality in resource use, the profitability ratio of various resources used in mulberry cultivation was estimated using the MVP/MFC ratio presented in previous section and results are presented in table-2. It could be observed from the results that the ratio of MVP to MFC was found to be less than unity for two inputs *viz.,* human labour and area under mulberry cultivation, indicating that these inputs were over-utilized on the farmers' field and that the use of these inputs needs to be reduced to optimize returns from mulberry cultivation. In other words, the cost of these two resources *viz.* land rent and wage rates were found to be higher than their marginal value products and this leading to ratio being less than

unity. These findings revealed that the prevailing high land rent and high wage rates cautioning the farmers to use them very judiciously. On the other hand, the MVP to MFC ratio for fertilizer, irrigation, and FYM was found to be greater than unity, this indicated that there exists opportunity to optimize returns from mulberry cultivation by increasing the use of these resources from the current use level. Thus, farmers can reap more benefits from mulberry cultivation by reallocating the expenditure among the resources used in the model based on results of profitability ratios.

Table1: Estimates of the Cobb-Douglass production function

[Dependent variable (Y): Mulberry Yield (tons/acre)]

Sl. No.	Variables	Parameters	Elasticity coefficients
1.	Intercept	a	-1.0823
2.	Area in acre (X_1)	b_1	0.1301* (0.0743)
3.	Labour in man days (X_2)	b_2	0.1925** (0.0894)
4.	FYM in tractor load (X_3)	b_3	0.1641** (0.0539)
5.	Fertilizer in kgs (X_4)	b_4	0.5756*** (0.0679)
6.	Irrigation dummy (X_5)	b_5	0.0465* (0.0264)
7.	Co-efficient of multiple Determination (R^2)		0.9121
8.	Returns to scale		1.11

Note: 1. ***, ** and * and indicates significant at one per cent, five per cent and ten per cent probability level, respectively

2. Figures in parentheses represents standard error

Table2: Economic efficiency of resource use in mulberry cultivation (Per farm)

Independent Variables	Geometric mean level of inputs	Elasticity Coefficient	MVP (Rs.)	MFC (Rs.)	MVP/MFC
Area in acre	1.94	0.1301	3440.39	4485.00	0.77
Labour in man days	29.63	0.1925	333.01	550.00	0.61
FYM in tractor load	2.86	0.1641	2936.69	1662.00	1.77
Fertilizer in kgs	92.23	0.5756	319.78	30.00	10.66
Irrigation dummy	0.85	0.0465	2805.82	853.67	3.29

4. CONCLUSION

The resource use efficiency in mulberry cultivation using cobb-Douglass production function estimates showed that inputs such as area under mulberry cultivation, human labour, FYM, fertilizer, and irrigation are positive and significant. Analysis of the ratio of Marginal Value Product to Marginal Factor Cost shows that human labour and the area under mulberry cultivation were found to be over-utilized. Thus, there is need to reallocate the expenditure among various resources or more specifically increase the use of underutilized resources like fertilizer, irrigation, and FYM and reduce use of human labour and area under mulberry for better management to optimize mulberry leaf production and realize better return.

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