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A Study on Resource Use Efficiency of Dragon Fruit Cultivation in Latur District, Maharashtra

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Abstract
The present investigation was carried out during the agricultural year 2024-25 in Latur district of Maharashtra with an objective to assess the resource use efficiency in dragon fruit *(Hylocereus Spp.)* production. The study was based on primary data collected from a sample of 60 dragon fruit growers selected through a multistage random sampling technique. Latur district was purposively chosen due to its growing importance in dragon fruit cultivation and favorable agro-climatic conditions. The data were analyzed using tabular analysis and the Cobb-Douglas production function to estimate the contribution of various inputs to production and determine their efficiency. The regression analysis revealed that the sum of regression coefficients exceeded unity, indicating increasing returns to scale in dragon fruit cultivation. The coefficient of determination (R^2 = 2.09) indicated a strong explanatory power of the model. The Marginal Value Product to Factor Cost (MVP/FC) ratios were greater than unity for manure, irrigation, and plant protection chemicals, confirming that these inputs can be increased to enhance productivity.

Keywords: Dragon fruit, Resource use efficiency, Cobb-Douglas production function, Marginal value product, Latur district, Maharashtra

Introduction
India's agriculture is gradually diversifying toward high-value horticultural crops that offer better income stability and market opportunities for farmers. Among these, dragon fruit *(Hylocereus spp.)* has recently emerged as a promising commercial crop due to its high economic returns, low water requirement, and adaptability to semi-arid regions. Maharashtra, particularly the Marathwada region, has become one of the leading states in dragon fruit cultivation because of its favourable climate, black cotton soils, and availability of irrigation facilities. The Latur district has witnessed rapid adoption of dragon fruit cultivation as farmers shift from traditional field crops to more profitable horticultural enterprises. Despite this expansion, many growers still lack technical guidance on the optimal use of production inputs such as labour, fertilizers, manures, and irrigation. Imbalanced resource use not only affects productivity but also reduces farm profitability. Therefore, assessing the resource use efficiency in dragon fruit cultivation is essential for ensuring sustainable and economically viable production. The present study was undertaken to evaluate the productivity and efficiency of key resources employed in cultivation. Using the Cobb-Douglas production function and marginal value product (MVP) analysis, the study aims to identify under and overutilized resources and suggest measures for optimizing input use to maximize returns from dragon fruit farming.

Materials and Methods
Selection of Area
Latur district in the Marathwada region of Maharashtra was purposively selected due to its increasing acreage under dragon fruit cultivation and the rising interest among farmers in this high-value horticultural crop. The study included all ten talukas of Latur district: Ahmadpur, Ausa, Chakur, Deoni, Jalkot, Latur, Nilanga, Renapur, Shirur Anantpal, and Udgir. A total of 60 dragon fruit growers were selected to ensure broad representation across the district. Only farmers with fruit-bearing orchards were considered to ensure the relevance of data to production and marketing phases.

Sampling Procedure

A multistage simple random sampling technique was employed. Maharashtra state was selected as it is one of India's prominent regions for dragon fruit cultivation. Latur district was chosen based on its emerging prominence in dragon fruit farming. Sixty (60) dragon fruit growers were randomly selected from across the district. To maintain the applicability of findings only those farmers whose orchards were actively bearing fruit were selected. Farmers in the early plantation stage were excluded from the study.

Data Collection

The study utilized both primary and secondary data sources. Primary data were collected through personal interviews using pre-tested structured schedules. These interviews captured detailed information on socio-economic background, orchard characteristics, costs of cultivation, yield data, marketing channels and farmer perceptions. Interviews were also conducted with local market intermediaries and traders to supplement the farmer data. Secondary data were obtained from government records, agriculture department reports, research articles, and published documents to provide context on area under cultivation, yield trends and market performance of dragon fruit in the region.

Analytical Methods

The collected data were processed, tabulated, and analyzed using suitable statistical and econometric tools to meet the study's objectives. The Cobb–Douglas production function was employed to estimate the relationship between output and resource inputs, and to determine the resource use efficiency.

Cobb–Douglas Production Function

$$Y = a .X_1^{b1}.X_2^{b2}.X_3^{b3}.X_4^{b4}.X_5^{b5}.X_6^{b6}.X_7^{b7}. X_8^{b8}. e^u$$

In this functional form 'Y' is dependent variable, 'X' are independent resource variables, 'a' is the constant representing intercept of the production function and 'bi' are the regression
coefficients of the respective resource variables. The regression coefficient obtained from this function directly represent the elasticities of production, which remain constant throughout the relevant ranges of inputs. The sum of coefficient that is 'bi' indicates the nature to return of scale. This function can easily be transformed into a linear form by making logarithmic transformation. After logarithmic transformation, the function was:

Log Y= Log a + b1 Log x1 + b2 Log x2 + b3 Log x3 + b4 Log x4 + b5 Log x5 +u Log e

Where:
Y = Value of output (Rs/ha)
X_1 = Area (ha)
X_2 = Human labour (man-days/ha)
X_3 = Machine labour (hours/ha)
X_4 = Seedlings (number/ha)
X_5 = Manure (tonnes/ha)
X_6 = Fertilizers (kg/ha)
X_7 = Plant protection chemicals (Rs/ha)
X_8 = Irrigation charges (Rs/ha)
a = Constant
bi = Regression coefficients (elasticities of production)
u = Random error term

Estimate of Marginal Value Product (MVP)

The Marginal Value Product (MVP) for each input was estimated as:

$$MVP = bi * (\bar{Y} / \bar{X}i) * Py$$

Where:
bi = Regression coefficient of the i^{th} input
$\bar{Y}$ = Geometric mean of output
$\bar{X}i$ = Geometric mean of the i_{th} input
Py = Price of output (Rs/unit)

Efficiency Criteria

If (MVP / Price) > 1 - Underutilized input (scope to increase)
If (MVP / Price) < 1 - Overutilized input (should be reduced)
If (MVP / Price) = 1 - Optimum use of input

Result and Discussion

Productivity Analysis

The regression coefficients and resource efficiency indicators derived from the production function are presented in Table 1. The coefficient of determination (R^2 = 2.09) revealed that the selected inputs explained a substantial portion of variation in dragon fruit yield, indicating a strong model fit. Area under cultivation (X_1) showed a significant positive coefficient (0.50), indicating that expansion of cultivated area enhances production up to a point, but the MVP/price ratio (1.88) indicated overutilization, suggesting diminishing returns beyond the optimum level. Human labour (X_2) showed a positive coefficient (0.11) with a ratio of 1.10, signifying underutilization indicating scope to increase labour, particularly for manual tasks such as pruning, training, and harvesting. Machine labour (X_3) had a negative coefficient (-0.07) and MVP/price ratio (-4.44), suggesting excessive mechanization relative to farm size. Seedlings (X_4) and fertilizers (X_6) also exhibited negative elasticities (-0.22 and -0.01), implying overuse. Conversely, manure (X_5), plant protection chemicals (X_7), and irrigation charges (X_8) showed positive and significant effects (0.03, 1.60, and 0.15 respectively) with MVP/price ratios of 8.03, 2.19, and 5.73, indicating underutilization. Enhancing these inputs would substantially improve productivity and profitability.

Economic Interpretation

The analysis reveals that organic and water management inputs (manure, irrigation, plant protection) have high marginal productivity but are used below their economic optimum. Conversely, land, machine labour, seedlings, and fertilizers are being applied beyond profitable levels. Thus, efficient resource allocation reducing excess inputs and increasing deficient ones could improve returns per hectare and overall sustainability.

Conclusion

The study concludes that dragon fruit production in Latur district is economically viable but characterized by resource use inefficiencies. Optimization of input use particularly

increasing organic manure and irrigation while controlling mechanization and fertilizer usage can significantly enhance profitability. Capacity building, demonstration programs, and input management training for farmers are recommended to promote economically efficient and environmentally sustainable dragon fruit cultivation in Maharashtra.

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