**Measures of Resource Use Efficiency and Constraints of Mentha crop production in Ambedkar Nagar district of Uttar Pradesh**

**Abstract:**

This research was conducted in the Ambedkar Nagar District of Uttar Pradesh to assess the resource use efficiency and identify challenges in Mentha cultivation . A multistage stratified sampling method, incorporating purposive and random sampling technique, was employed to select the study area including the district, block, villages, and farmers. Specifically, the Akbarpur block was chosen , from which, five villages were selected. Using proportionate allocation, a total of 100 Mentha growers were surveyed. Primary data were collected through personal interviews, using a pre-structured and pre-tested survey schedule. To analyze the data, employed the Cobb-Douglas production function, which helped estimate the impact of various factors on production. The regression analysis indicated that farmers were in the second stage of production, characterized by decreasing returns to scale. Key factors such as human labor, manure and fertilizer, seed costs expenses, irrigation and machinery expenses accounted for *etc*, explained 77.00%, 79.00% and 83.00% for the variation in production for marginal, small, and medium farms, respectively. We identified several constraints faced by menthe growers, where major problems are high input cost of mentha cultivation with garret score 75.18, lack of quality seed with garret score 58.63, lack of credit availability with garret score 55.07 and lack of new technology with garret score 54.25. These insights underline the critical areas that need attention to improve Mentha cultivation efficiency and support the farmers for overcoming these obstacles.

**Keywords*:*** *Cobb-Douglas production function, resource use efficiency, MVP and Constraints etc.*

**INTRODUCTION:**

Mentha, known for its medicinal and aromatic qualities, belongs to a significant group of plants that supply essential raw materials for pharmaceuticals, perfumes, flavors and other everyday products. These plants and their derivatives not only provide a vital income source for small-scale farmers and entrepreneurs but also contribute to foreign exchange earnings through exports. India, with its diverse soil and climatic conditions, is considered the native home of medicinal and aromatic plants, supporting a wide variety of plant species. Globally, these plants are gaining popularity for their untapped economic potential, particularly in the field of herbal medicines.

India boasts a rich ethnobotanical tradition, utilizing a large variety of plant species in various agro-ecosystems through multiple indigenous medical and industrial systems. The country cultivates numerous aromatic and medicinal plants, including Aloe Vera, Ashwagandha, Tulsi, Pipali, Guggul, Khas, Lemongrass, Mentha (Mint), Shatavar, and Stevia. In the past decade, several new high-value crops have been introduced nationwide. Mint, specifically, is grown worldwide and is becoming increasingly popular in India (WHO, 2019).

Medicinal plants are crucial in producing effective therapeutic medicines. An estimated 80 percent of people in developing countries such as India, Bangladesh, Myanmar, Afghanistan, Nepal, and Uganda primarily rely on traditional medicine, which focuses on plant and animal species for their primary healthcare needs. The WHO predicts that a similar percentage of the global population will depend on plant-based medicines in the coming decades. The use of conventional medicines has decreased in developed countries, with approximately 40-50 percent in Germany, 42 percent in the United States, 48 percent in Australia, and 49 percent in France turning to plant-based or alternative treatments (WHO, 2022).

Mentha is an herbaceous perennial crop known for its peppermint aroma. Scientifically referred to as Mentha arvensis, it is commonly known as Japanese mint or pudina, originating from Japan. Mentha consists of about 30 species, primarily found in temperate and tropical/subtropical regions. Belonging to the genus Mentha (family Lamiaceae), these plants are renowned for bearing essential oils. Mentha is a single-stemmed, erect plant with elliptic bases and a few hairs towards the top, with some branches. It has creeping rhizomes and can reach heights of 40-120 centimeters. The leaves are serrate, lanceolate to elliptical, arranged in opposing pairs, 5-10 centimeters long and 1.5-3.0 centimeters wide, green to greyish-green on top and white underneath. The inflorescence is a thick, cylindrical terminal spike, sometimes purple and around 5 millimeters long. The corolla is two-lipped with four sub-equal lobes, and the fruit is a small, dry capsule containing one to four seeds.

Keeping this in view the proposed study entitled “***A study on: Resource Use Efficiency and Constraints of Mentha crop production in Ambedkar Nagar district of Uttar Pradesh***” assumes special significance. The main objectives of studied were.

1. To work out of the Resources use Efficiency of Mentha crop in different size of sample farms.
2. To identify the constraints faced by farmers in Production of Mentha crop and to suggest suitable measures to overcome them**.**

**Methodology:**

1. **Sampling Technique:** Multistage stratified purposive cam random sampling techniques were applied for selection of respondents to deal with the investigation.
2. **Selection of District:** In view of limited time and knowledge of the researcher with Ambedkar Nagar district was selected purposively.
3. **Selection of Block:** One at first, a list of all 9 blocks of Ambedkar Nagar district of Uttar Pradesh along with acreage of Mentha cultivation were prepared and arranged in descending order. The block namely “baskhari” having highest area in field Mentha was selected purposively for this study.
4. **Selection of Village:** A list of all the villages falling under Baskhari block was prepared, arranged in ascending order to the area covered under Mentha crop and five villages were selected randomly from this list.
5. **Selection of Respondents:** A separate list of all respondent growing Mentha of each selected village was prepared. All Mentha grower of selected village was stratified into three categories.

Marginal - (less than 1 ha.),

Small - (1-2 ha.) and

Medium - (2-4 ha. and above)

From this list, a sample of 100 respondents was drawn following the proportionate random sampling technique categories.

1. **Collection of Data:** The primary data was collected through survey method with the help of personal interview of pre-structured schedule while secondary data collected from Zila Vikas Bhawan, Zila Sankhyaki Patrika, Department of Agriculture at block and district headquarter, journal reports, books and internet etc. A list of all the villages falling under select block was prepared and arrange in ascending order according to area and five villages from Baskhari block was randomly selected forth study.
2. **Period of study:** The data was collected for the agriculture year 2022-23.

### Functional analysis:

To study the resource use efficiency in Mentha production, various forms of production function have been deals with, However, Cobb-douglas production function was found most fit to the data.

### The Mathematical form of cob-douglas production function is:

Y= a x1b1x2b2 x3b3 x4b4 x5b5……. xnbn eµ

Where,

Y = Dependent variable (output values Rs./ha.)

Xi = ith independent variable (input values Rs./ha.) X1 = Human labour (Rs./ha.)

X2 = Manure and fertilizer (Rs./ha.) X3 = Seed (Rs./ha.)

X4 = Irrigation (Rs./ha.)

X5 = Machinery charges (Rs./ha.) a = Constant

bi (i=1,2,3,4,5,..) = Production elasticity with respect to Xi (input variables)

e = Error term or disturbance term

µ = Random variables

The values of the constant (a) and coefficient (bi) in respect of independent variables in the function have been estimated by using the method of least squares.

### Cobb-Douglas Production functions in log form:

Log Y = log a + b1log x1 + b2log x2 + b3log x3 + b4log x4 + b5log x5 + e

This form was used for estimating the parameters of the function based on sample data.

### Significance test of the sample regression coefficients:

Having estimated the elasticity coefficients, it is desirable to ascertain the reliability of these estimated. The most commonly used ‘t’ test was applied to ascertain whether the sample production elasticity coefficient, bj is significantly different from zero or not at some specified probability level.

**Estimation of Marginal Value Product:**

The marginal value product of input was estimated by taking partial derivatives of returns with respect to the input concerned, at the geometric mean level of inputs.



Where,

bj = Production elasticity with respect to Xj

 = Geometric mean of y (output values in Rs./ha.)

= Geometric mean of Xj (input values in Rs./ha.)

j = 1, 2, 3, 4, 5

**Analysis of the constraints faced by farmers in menthe crop production in the study area**:

Constraints faced by farmers have been analyze through survey based on demographic profile of the farmers like age groups, ponds holding size, and educational level of the farmers. Garret ranking technique (Henry Garrett) has been used to analyze the constraint faced by the farmers, wholesalers, retailers involve in plant marketing. Constraints faced by farmers in plants value chain is the most important aspects of research for suggestion to government policy. The respondent has been asked to rank the constraints and these converted in to score (**Gautam *et al.,* 2022**).

**Percent position = 100\*(Rij-0.5)/ Nj**

Where,

Rij= Rank given for ith factor by jth individual

Nj= Number of factors ranked by jth individual

**Results and Discussion:**

**Resource use efficiency in Mentha:**

Table 1. presents resource use efficiency, production elasticity, return to scale, and other relevant attributes concerning Mentha crops across various farm sizes. A high R2 value of the fitted function signifies that a significant and maximal portion of the overall variation in the dependent variable was accounted for by the factors incorporated in the production process.

The combination of five variables, namely seed, tractor charges, manure & fertilizer, irrigation, and human labor, collectively accounted for 7291%, 69226 %, and 5711% of the variation in the dependent variable on marginal, small, and medium farms respectively.

For marginal farms, seed, tractor charges, manure & fertilizer, and human labor were statistically significant at the 1% and 5% probability levels. However, irrigation was found to be statistically non-significant.

For small farms, seed, tractor charges, and human labour were statistically significant at the 1% and 5% probability levels, while manure & fertilizer and irrigation were found to be non-significant.

For medium farms, tractor charges and human labour were statistically significant at the 1% and 5% probability levels, while seed, manure & fertilizer, and irrigation were found to be non-significant. X1, X2, X3, X4, and X5 represent seed, tractor charges, manure & fertilizer, irrigation, and human labor respectively. The return to scale on marginal, small, and medium farms was found to be 0.7291, 0.69226, and 0.5711 respectively, all of which are less than one. This leads to the conclusion that Mentha cultivation exhibits decreasing returns to scale across all sizes of farms.

### Table 1. Resource use efficiency in Mentha crop on different size of sample farms.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Size Group of sample farms** | **Production Elasticity** | | | | **Sum of Elasticity/ return to scale** | | | **R2** |
|  | **X1** | **X2** | **X3** | **X4** | | **X5** |  |  |
| **Marginal** | **0.3302\*\***  **(0.0286)** | **0.11270.)** | **0.0133**  **(0.0153)** | **0.1307\***  **(0.0286)** | | **0.1422\***  **(0.0355)** | **0.7291** | **0.77** |
|  |
| **Small** | **0.3243\*** | **918\*\*** | **0.0122** | **0.1405\*\*** | | **0.12346\*** | **0.69226** | **0.79** |
|  | **(0.0684)** | **0.0143)** | **(0.0162)** | **(0.0238)** | | **(0.0295)** |  |  |
| **Medium** | **0.3042\*\*** | **0137** | **0.0082\*** | **0.1466\*** | | **0.0984** | **0.5711** | **0.83** |
|  | **(0.0521)** | **.0741)** | **(0.0032)** | **(0.0678)** | | **(0.0977)** |  |  |

Figures in parenthesis denoted standard error probability level) (\*\*Significant at 1 per cent and \*significant at 5 per cent probability level)

X1, X2, X3, X4, & X5 stand for human labour, manure & fertilizers, seed, irrigation and machinery charges respectively.

### Table-2. Marginal Value Productivity (MVP) of included factors in production process of Mentha crop.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Size group of Farms** | **Marginal Value Productivity (MVP) of input/factors** | | | | |
|  | **X1** | **X2** | **X3** | **X4** | **X5** |
| **Marginal** | 5.583266 | 4.805204 | 0.250029 | 3.985043 | 14.02238 |
| **Small** | 5.423769 | 3.098331 | 0.218206 | 4.028795 | 7.441996 |
| **Medium** | 3.979674 | 4.481585 | 0.429825 | 2.378096 | 6.761299 |

**Marginal value productivity (MVP) of Mentha:**

Table 2. highlights the substantial marginal value products (MVP) of seed, tractor charges, manure & fertilizer, irrigation, and human labor, ranging from 0.22 to 14.02 m across various farm sizes. The positive MVP-to-factor costs ratio for both types of farms and all five variables indicates that increasing investment in these factors could potentially yield returns surpassing the costs incurred.

### Table – 3. Problem of Mentha production on different size sample farms:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Constraints** | **Garret Position** | **Garret Value** | **Garret**  **score** | **Final rank** |
| Lack of awareness of insecticide and pesticide  and high price of insecticide and pesticide | 5.00 | 82 | 42.68 | IX |
| High input cost for Mentha cultivation | 15.00 | 70 | 75.18 | I |
| Shortage of fertilizer and manures | 25.00 | 63 | 46.72 | VII |
| higher production expenditure | 35.00 | 58 | 52.72 | V |
| Non availability of labour when needed and higher labour charge | 45.00 | 52 | 48.53 | VI |
| Lack of availability of sufficient quality seed | 55.00 | 48 | 58.63 | II |
| Lack of availability of credit | 65.00 | 42 | 55.07 | III |
| Lack of awareness about new technology and Practices | 75.00 | 37 | 54.25 | IV |
| Infrastructural facilities. | 85.00 | 30 | 45.21 | VIII |
| Lack of distillation units. | 95.00 | 18 | 24.55 | X |

**Summary and Conclusion:**

The Cobb-Douglas production function was implemented to ascertain the efficacy of resource utilization in the Mentha crop. The dependent variable was the per hectare gross income, while the independent factors in Mentha production are the costs of five key inputs: human labour, machinery charges, seed cost, manure and fertilizers, machinery charge, and irrigation. The "t" test was conducted to assess the significance of the various input factors, while the "F" test was used to evaluate overall regression model. The coefficient of multiple determination (R2) was calculated to determine the extent to which variations in output could be explained by the included input factors .

The analysis revealed a significant relationship between the dependent variable and most of the input factors at the 5% and 1% probability levels.

The analysis of Mentha production constraints reveals that the most critical issue is the high input of cost for cultivation, which ranks first with the highest Garret score of 75.18. This is followed by the lack of availability of sufficient quality seed and credit, highlighting significant concerns regarding input quality and financial support. The awareness and adoption of new technologies and practices also poses a major challenge. Other notable constraints include higher production expenditure and labor-related issues, such as labor shortages during peak demand periods and high wage rates. Additionally, shortages in fertilizers and manures, along with infrastructural deficiencies, are significant but less critical than the top ranker issues. Lesser concerns include the lack of awareness about insecticide and pesticide use and their high costs, as well as the availability of distillation units, which ranks the lowest. Addressing these constraints, particularly the top-ranking ones, can substantially improve Mentha production efficiency and profitability.

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