# Resources Use Efficiency of Cut Roses Farming in Karnataka, India

**Abstract:**

The flowers represent the most sensitive, delicate and loving feelings that ours words cannot portray. In India, roses are an essential and popular flower. It is an ornamental herb planted for its visually appealing and long-lasting blossoms. India has ample sunshine, plenty of land and the availability of skilled labour, all of which contribute to our ability to cultivate flowers in various locations. The cut flower growing farmers were selected from the Bengaluru rural districts of Karnataka by employing the simple random sampling techniques. The Cobb-Douglas production function was employed to determine the resource use efficiency of rose farming in Karnataka. The results reveals that land, Farm Yard Manure (FYM), fertilizer and labour contributed positively to the flower production, while farmers followed closer spacing and used more Plant Protection Chemicals (PPC). FYM and human labour were the most significantly influencing variables in protected rose cultivation. However, PPC was negative but non-significant. The ratio of Marginal Value of Product to Marginal Factor Cost (MVP to MFC) showed that FYM, fertilizers and human labour were under-utilized in open-field cultivation, suggesting potential for higher use. In protected conditions, there is a scope to increase FYM, fertilizers and human labour to optimize returns from cut rose production. However, land use, planting materials and plant protection chemicals should be reduced to optimize returns in protected conditions. Reorganizing expenditure among resources based on MVP to MFC ratios is necessary to optimize rose production. This includes reducing the use of PPC and following wider spacing in open-field cultivation. India's rose farming industry can benefit from increased efficiency and resource utilization.

**Key words:** Rose, Resources, Labour, MVP and MFC.



## 1. Introduction

India is an agricultural country with diverse soil and climatic conditions favourable for growing various crops. Climatic conditions are favourable not only for growing food crops but also for increasing flower crops. These crops are essential in improving farmers' livelihood and nutritional security (Aryal, J.P. *et.al.*2020). Over the years, horticulture has become a crucial part of agriculture. The horticulture sector includes fruits, vegetables, ornamental plants, flowers, spices, plantations, medicinal plants and aromatic plants (Singh *et al.*, 2024). This is the fastest-growing agricultural sector today because it provides many options for farmers to diversify their crops and offers excellent opportunities to support many innovative agricultural industries and job opportunities (Heffron K. *et al., 2021*).

As time passes, horticulture has become one of the potential agrarian businesses to accelerate the growth of our economy (Sargent, M.J., 1973). Among the various horticultural professions, floriculture is essential because of its enormous expandability. Nowadays, flowering plants are no longer just for window gardens but also play a vital role in decorating homes and offices (Gabellini S. *et al.*, 2022). Flowers improve the quality of life and influence human emotions more than words or other gifts. (Huss, E. *et.al., 2017*).

Near major cities, the areas have become major flower-growing centres. These small farmers near major cities focus on growing large quantities of flowers to meet local demand (Kirigia E. *et al., 2016*). On the other hand, growing cut flowers has become an important industry, mainly meeting the needs of foreign markets and businesses, hotels and restaurants (Fernandes, L. *et al.* 2020). There is a transformation noticeable in our floriculture sector, mainly due to the entry of cut flower companies to meet the growing demand for floriculture products in developed countries (Martsynovska et *al., 2011*).

The government of India has identified floriculture as a niche industry with excellent export potential and is providing various incentives for setting up floriculture units, including through export-oriented units (EOU). Most flowers are grown in open fields; they are the most widely cultivated. This is also among the most chosen cut flowers in the international market (Faust, J.E. *et al.*, 2021)

Rose, "Queen of Flowers", symbolises elegance, purity, love, friendship and sympathy. The species belongs to the genus Rosa and family Rosaceae. It is a perennial woody plant with hundreds of species and thousands of cultivars, most originating from Asia. The flowers vary in size, shape and attractive colour and are widely grown for beauty and fragrance. They have acquired cultural significance and become integral to almost every religious or spiritual ceremony in India (Satpathy et al., 2015).

The versatility of roses is truly remarkable. They are widely used in commercial perfumery and pharmaceuticals, and are also popular as commercial cut flowers. Some species are used as hedges, ornamentals, and slope stabilisers. The fragrant flowers are not just popular for worship and making garlands, but also for preparing a wide range of products such as rose oil, rose water, gel hand, rose essential oil, and rose otto (Duke, J., 2012). Rose oil, one of the oldest and most valuable perfume ingredients, gives perfumes their characteristic scent. Rosehips, or rosehip berries, are sometimes made into jams, jellies, marmalades, and soups or tea because they are high in vitamin C. The flowers are also used to prepare rose water, herbal tea, rose syrup, cream, and kulfi. (Singh, D. B., 2016).

Roses are divided into three main types: roses, old garden roses and modern roses. A *protected condition* can be defined as a growing condition in which plants are grown in an inflated structure covered with transparent or opaque material in which the growing environment is wholly controlled or partial. It protects plants from adverse climatic conditions such as wind, cold, rain, excessive radiation, extreme temperatures, insects, and diseases by constructing greenhouses (Reddy, P.P., 2016).

The global impact of roses is staggering. The floriculture trade, which includes roses, is worth a staggering USD 17 billion, growing at a rapid 10 to 15 per cent annually. This figure is projected to reach USD 25 billion by 2025, underscoring the immense commercial value of roses (Chawla *et al.*, 2016). The major flower-producing countries in this global market are the Netherlands (52 %), Colombia (15 %), Ecuador, Kenya, Belgium, and Ethiopia. The scale of flower exports has also seen a phenomenal increase, from USD 8 billion in 2006 to USD 14 billion in 2021. India, for instance, exported 22,086 tonnes of flowers to the world, valued at 549 crore rupees during 2021-22, further highlighting the global demand for roses (Bhagat, *et.al*., 2019).

In India, the floriculture industry is experiencing rapid growth, encompassing fresh flower trade, production and sale of nursery and potted plants, seed and bulb production, micro-propagation, and essential oil extraction (Tripathi A. *et.al*.). India's total area devoted to floriculture is the second largest in the world, after China. The total flower-growing area in 2021-2022 was 309.70 thousand hectares; bulk flower production was estimated at 1,653 tons, and cut flower production was 593 tons (Anonymous, 2021). Fresh and dried cut flowers dominate India's floriculture exports. Roses, gerberas, gladiolus, carnations, chrysanthemums, orchids, tulips, anthuriums and lilies are essential in the international cut flower trade. Commercial floriculture in India is now considered a fast-growing industry, especially under protected conditions (Sheela, V.L., 2004).

The United States of America, Germany, the United Kingdom, the Netherlands, and the United Arab Emirates are the main export destinations for India's floriculture products. Despite the area under rose cultivation in India remaining relatively stable between 2011-12 and 2021-22, there has been a significant increase in the production of bulk and cut roses (Gopinath, D., 2008). In the years 2021-2022, the rose growing area in India was approximately 30,003 hectares. The total output of loose flowers was about 1,35,190 tons, and cut flowers were about 1,96,760 tons. Uttar Pradesh leads in the rose production area, with about 11,090 hectares. The highest bulk flower production is in Gujarat, with 41,700 tons, and the highest cut rose production is in West Bengal (65,320 tons), followed by Karnataka (56,120 tons) in an area of about 28,600 hectares (Anonymous, 2022).

Karnataka ranks second in flower production after Tamil Nadu, accounting for 19 per cent of India's flower-growing market share. Karnataka's area under flower cultivation is about 32.92 thousand hectares; Rose acreage and production in Karnataka have remained almost the same recently. The area under rose cultivation in Karnataka in 2016-17 was 2.80 lakh hectares; Bulk flower production was 0.60 thousand tons, and cut flower production was twelve thousand tons (Indiastat, 2023). The significant districts contributing to rose production in Karnataka are Rural Bangalore, Urban Bengaluru, Kolar, Chikkaballapura and Haveri. These areas have very good conditions suitable for growing cut flowers because these locations do not need a cooling or heating system (Singh, A.K., 2006).

Floriculture is not just booming in India, but it also holds immense potential for sustainable growth. Despite the challenges it faces, the ornamental horticulture industry can be a significant boon and one of the most attractive and viable options for any country looking to expand its export-oriented agricultural base. Roses, in particular, are highly valued in foreign markets, further highlighting the industry's potential (Indiastat, 2023). Therefore, this study aims to provide a comprehensive and scientific estimate of the comparative economic aspects of growing roses in the field and under protected conditions using farm-level data. This valuable information will empower all stakeholders and policymakers, helping our country secure a strong position in the global floral platform.

**Specific objective of the study:**

1. To estimate the resource use efficiency under open and protected method of cultivation.

**Hypotheses**.

The efficiency of resources used in the cultivation of roses under protected cultivation is higher than in open-field cultivation.

## 3. Methodology:

### 3.1 The sampling technique and procedure adopted

The study was undertaken mainly to compare every aspect of rose cultivation under protected and open-field conditions. Accordingly, Bengaluru rural and Chikkaballapura districts of Karnataka were selected. In the next stage, two taluks were chosen from each study district. *viz.*, Devanahalli and Hosakote from Bengaluru rural district and Chikkaballapura and Shidlagatta taluks from Chikkaballapura district based on relatively higher acreage under rose cultivation than other taluks in the respective districts. Finally, twenty farmers were selected randomly from each of the selected taluk (10 growing roses under protected conditions and ten growing roses in open-field conditions). Thus, 40 farmers growing roses under protected conditions and 40 growing roses under open field conditions were selected for primary data collection on establishing and cultivating rose gardens.

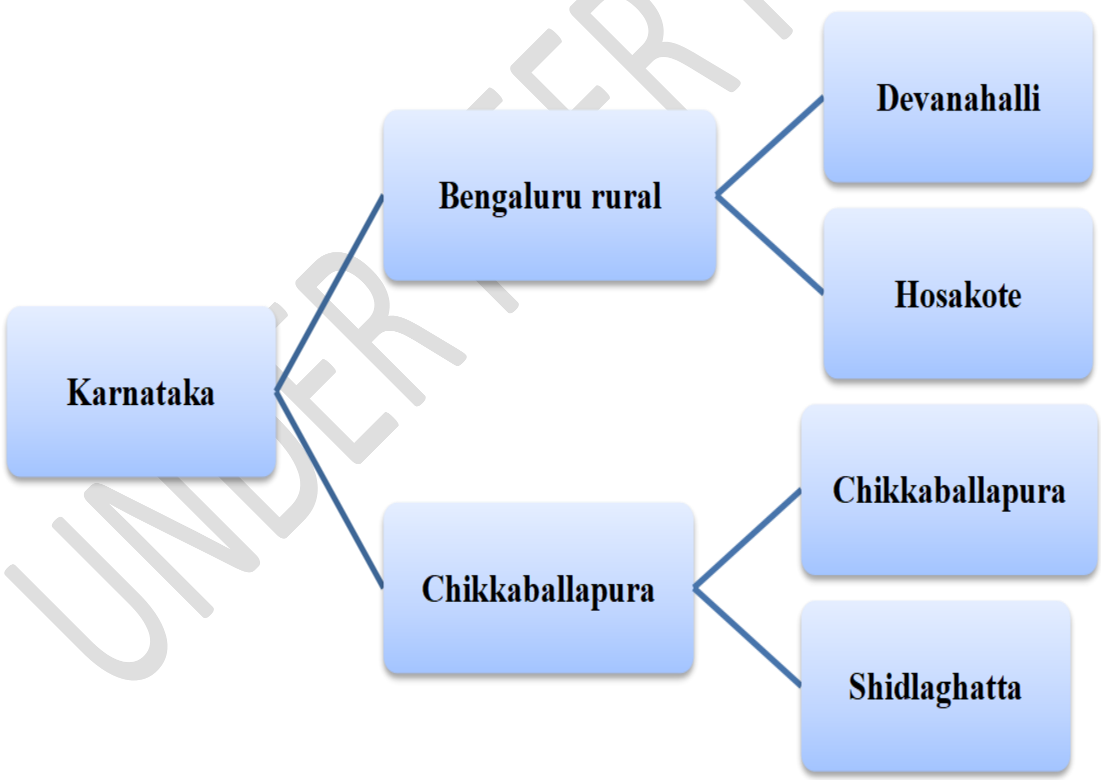


***Fig. 1. Sampling design***

Note: 10 samples are collected from both the conditions, i.e. Open and Protected Cultivation

## 3.2 Nature and sources of data

**Primary data on roses cultivated under protected and open-field conditions**

The needed primary data on the cost of establishing the rose garden and the cost involved in cultivation were collected by pre-tested schedules during 2023-24 and later used in Cobb-Douglas's production function to know the resource use efficiency of rose farming in the study area.

## 3.3 Analytical tools and techniques used

### 3.3.1 Resource use efficiency

The efficiency of resources used in Rose cultivation in both cultivation methods was estimated using the Cobb-Douglas type of production function. Being a homogenous function, it provided a scale factor, which enables the direct measurement of the returns to scale. The estimated regression coefficients represent the production elasticity.

The form of the Cobb-Douglas production function used in the present study was as follows.

$$\mathbf{Y = a\, X_1^{b1}\, X_2^{b2}\, X_3^{b3}\, X_4^{b4}\, X_5^{b5}\, X_6^{b6} e^{u}}$$

This production function was converted into log-linear form and the coefficients were estimated by using the Ordinary Least Square Technique (OLS) as given below,

$$\mathbf{\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + u \log e}$$

Where,

Y = Flower production (Kg [loose flowers] or Bunches [cut-flowers])

a = Intercept

$X_1$ = Land area (acres)

$X_2$= Planting materials used (numbers)

$X_3$ = Quantity of FYM applied (tonnes)

$X_4$ = Quantity of Fertilizers applied (Kgs)

$X_5$ = Quantity of plant protection chemicals applied (Litres)

$X_6$ = labour used (Man days)

bi’s = Output elasticity of respective factor inputs, i = 1, 2, 3, 4, 5, 6

The regression coefficients (bi’s) were tested using a test at the chosen significance level.

### 3.3.2 Allocative efficiency:

Given the technology, allocative efficiency exists when resources are allocated within the farm according to market prices. It implies the proper level of input use in production. Its marginal value products are computed to decide whether a particular input is used rationally or irrationally. If the marginal value product of an input covers its acquisition cost, it is said to be used efficiently.

The Marginal Value Product (MVP) was calculated at the geometric mean levels of variables using the formula,

MVP = Py × Marginal Physical Product (MPP)

Where Py = Price of per unit Output

$$= Regression\ coefficient\ of\ X_i \left(\frac{Geometric\ mean\ of\ Y_i}{Geometric\ mean\ of\ X_i}\right)$$

The value of the MVP is obtained by multiplying the MPP by the price of the unit output and comparing it with its Marginal Factor Cost (MFC). A ratio of the value of MVP to MFC greater than unity implied that the resources were advantageously employed and that there was scope to use more of them than the existing use. A ratio of less than one indicates an overuse of resources and the need to reduce their usage. (Wijaya, A. *et.al.)*

The criterion for determining the optimality of resource use was

MVP/MFC > 1 underutilization of resources

MVP/MFC = 1 optimal use of resources

MVP/MFC < 1 excess use of resources

**4. Results And Discussion**

**4.1 Resource use efficiency in rose cultivation under both methods of cultivation**

To examine important factors determining and their relationship in rose production, the Cobb-Douglas production function was fitted to the sample of pooled data of all three category farms under open and protected cultivation. Since the sample size and data were insufficient to fit production function for different size groups of farms to know the factors governing rose yield.

The estimates of rose production function for both situations are presented in Table 1. The coefficient of multiple determination (R2) values was found to be 0.84 and 0.89 for open-field and protected conditions, respectively. This implied that the variables included in the production function explained about 84 per cent and 89 per cent variation in the rose production under open-field and protected conditions, respectively. The models fitted to the data were found to be a good fit, as revealed by the significant ‘F’ value. The summation of regression coefficients obtained indicated that slightly increasing returns to scale were found on the farms cultivating rose under open fields, *i.e.*, for each incremental use of all inputs simultaneously; farmers would get more than one unit of output. While almost constant returns to scale were observed under protected cultivation.

The regression coefficients for land, planting materials, FYM, fertilizer, PPC and labour were 0.0958, -0.4701, 0.6695, 0.3685, -0.0085 and 0.5682 on farms cultivating rose under open-field conditions. Meanwhile, the respective for roses cultivated under protected conditions were 0.0077, 0.0005, 0.3275, 0.0834, -0.0407 and 0.6547. In both methods of cultivation, FYM and human labour inputs were the most significantly contributing inputs, and the coefficient of these inputs was statistically significant. The production coefficient for PPC was found to be negative but non-significant. In addition to PPC, the planting materials were also found to be negative but failed to exert any significant influence on rose yield as the coefficient was non-significant in open-field cultivation. A one-per cent increase in planting materials and PPC from the existing level would decrease gross returns by 0.470 per cent and 0.008 per cent, respectively.



**Table 1. Estimates of Cobb-Douglas production function for rose cultivation under open-field and protected conditions** ***(Per farm)***

| Sl. No. | Particulars | Parameter | Units | Open-field Cultivation | t-value | Protected cultivation | t-value |
|---|---|---|---|---|---|---|---|
| 1. | Number of observations | N | No. | 40 | | 40 | |
| 2. | Intercept | Ln A | | 4.4590 | 1.0202 | 3.9709 | 0.4314 |
| 3. | Land | $X_1$ | Acres | 0.0958 | 0.2410 | 0.0077 | 0.0089 |
| 4. | Planting materials | $X_2$ | No. | -0.4701$^{NS}$ | -1.6032 | 0.0005 | 0.0007 |
| 5. | FYM | $X_3$ | Tonnes | 0.6695* | 2.1201 | 0.3275* | 2.0928 |
| 6. | Expenditure on fertilizers | $X_4$ | Rupees | 0.3685 | 1.2685 | 0.0834 | 0.2075 |
| 7. | Expenditure on PPC | $X_5$ | Rupees | -0.0085$^{NS}$ | -0.0639 | -0.0407$^{NS}$ | -0.3054 |
| 8. | Human labour | $X_6$ | Person-days | 0.5682* | 2.5534 | 0.6547** | 2.7967 |
| 9. | Coefficient of multiple determination | $R^2$ | | 0.84 | | 0.89 | |
| 10. | Adjusted $R^2$ | $\bar{R}_2$ | | 0.81 | | 0.87 | |
| 11. | F value | F | | 30.27** | | 47.30** | |
| 12. | Returns to scale | $\sum b_i$ | | 1.22 | | 1.03 | |

Note: ** and * indicate significant at one and five per cent probability levels, respectively, and NS – non-significant

In the same way, if land, planting materials, FYM, fertilizers and labour under protected cultivation increase by one per cent, gross returns will increase by 0.0077, 0.0005, 0.3275, 0.0834, and 0.6547 per cent, respectively. On the other hand, with increased use of PPC by one per cent, yield decreases by 0.04 per cent.

**4.2 Allocative efficiency of resources:**

The efficiency of different resources used in rose production was judged with the help of the MVP/MFC ratio, and the allocative efficiency results are presented in Table 2. It is evident from the table that the ratio of MVP to MFC was found to be more than unity for FYM, fertilisers and human labour, indicating that all these resources were under-utilised and there is scope for optimising returns from the rose by increasing the use of these resources. For instance, increasing the amount of fertilisers used or hiring more labour could be strategies to consider. The ratio of MVP to MFC was negative in the case of planting materials and plant protection chemicals, indicating these inputs were over-utilised in the farmer's field and that these inputs need to be reduced to optimise returns from rose cultivation. In other words, farmers followed closer spacing of seedlings than the recommended rate. Hence, planting materials should be reduced to get higher returns. This could be achieved by spacing the seedlings at the recommended rate or using less plant protection chemicals.



**Table 2. Resource use efficiency in Rose cultivation under open-field conditions**

| Particulars | Regression coefficients | Geometric mean | MPP | MVP | MFC | MVP/MFC |
|---|---|---|---|---|---|---|
| Yield | | 31951.21 | | | | |
| Land | 0.0958 | 0.98 | 3114.74 | 112161.82 | 26916.67 | 4.17 |
| Planting materials | -0.4701 | 2040.31 | -7.36 | -265.09 | 14.00 | -18.93 |
| FYM | 0.6695 | 13.28 | 1611.12 | 58016.59 | 3581.55 | 16.20 |
| Fertilizers | 0.3685 | 145345.86 | 0.08 | 2.92 | 1.00 | 2.92 |
| PPC | -0.0085 | 144480.02 | -0.002 | -0.07 | 1.00 | -0.07 |
| Human labour | 0.5682 | 461.85 | 39.31 | 1415.63 | 322.33 | 4.39 |

Note : MPP : Marginal Physical Product : MVP : Marginal Variable Product

MFC : Marginal Fixed Cost : FYM : Farm Yard Manure :

PPC : Plant Protection Chemical

The allocative efficiency of various inputs used in rose cultivation under protected conditions is presented in Table 3. It can be noted from the table that the ratio of MVP to MFC was found to be more than unity for FYM (10.65), fertilisers (1.77) and human labour (4.46). It was found to be 0.74 for land, 0.01 for planting materials and -0.97 for plant protection chemicals. This implies that there is scope to increase FYM, fertilisers and human labour to optimise returns from rose production. However, the use of land, planting materials and plant protection chemicals should be reduced to optimise returns in the case of protected conditions, as revealed by the ratio, which is less than unity.

**Table 3. Resource use efficiency in Rose cultivation under protected condition**

| **Particulars** | **Regression coefficients** | **Geometric mean** | **MPP** | **MVP** | **MFC** | **MVP /MFC** |
|---|---|---|---|---|---|---|
| Yield | | 26028.03 | | | | |
| Land | 0.0160 | 0.71 | 283.627 | 26888.55 | 36206.67 | 0.74 |
| Planting materials | 0.0070 | 21431.76 | 0.001 | 0.06 | 7.54 | 0.01 |
| FYM | 0.5967 | 21.15 | 402.980 | 38203.46 | 3587.50 | 10.65 |
| Fertilisers | 0.1495 | 116567.42 | 0.019 | 1.77 | 1.00 | 1.77 |
| PPC | -0.2522 | 103891.90 | -0.010 | -0.97 | 1.00 | -0.97 |
| Human labour | 0.5756 | 1292.59 | 13.183 | 1249.80 | 280.00 | 4.46 |

MPP : Marginal Physical Product : MVP : Marginal Variable Product

MFC : Marginal Fixed Cost : FYM : Farm Yard Manure :

PPC : Plant Protection Chemical

**5. Conclusion:**

A comparison of both cultivation systems revealed that the production function analysis was carried out to study the influence of various factors on gross returns on rose farming. FYM and human labour were the most significant contributing inputs for both cultivation methods. Plant Protection Chemical (PPC) and the planting materials were also negative but failed to significantly influence rose yield as in open-field cultivation. So, farmers in the study area can increase the quantity of inputs that are influenced positively to increase the yield. This can be achieved by introducing modern technology in rose farming, establishing rose processing units to handle excess production during peak harvest season due to limited demand for cut flowers, minimizing wide price fluctuations and helping farmers realize better returns with due attention to quality flower production. Finally, due to the indiscriminate use of PPCs, pests developed resistance mechanisms to existing chemicals. Therefore, attention needs to be paid to creating new chemicals to manage pest and disease incidence and educate farmers about the judicious use of these chemicals, which also help to protect the environment and reduce the cost of cultivation by strengthening existing extension services.

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