**Economic analysis of Mango Cultivation in Lucknow District of Uttar Pradesh, India**

**Abstract:**

Mango is a tropical fruit which is nutritionally rich in beta carotene, vitamin A, C and D. So it is also known as “King of the Fruits”. Mango cultivation is a significant agricultural activity in India, contributing to both regional economy and food security. This study was based on the agricultural year 2021-2022 and the primary data was collected using personal interviews with the mango farmers in the Lucknow district of Uttar Pradesh. The study, explored the cropping pattern employed by farmers and crop intensity of mango cultivators which was highest in case of small farmers (153.46 percent) in the study area, alongside a detailed cost estimation using cost function and benefit-cost ratio (BCR) to evaluate the economic viability of mango farming under different scenarios, which revealed that the efficient resource utilization and optimized farming practices lead to higher profitability as the average BCR is more than 2 solidifying that mango cultivation is a highly profitable venture. In addition, this study identified key constraints faced by mango cultivators using the Garret ranking technique such as Shattering of flower and dropping of premature fruits and outbreak of insect, pest and disease which serve as valuable guide for policymakers, agricultural advisors, and farmers aiming to improve cultivation practices and economic outcomes.

**Keyword:** *Mango cultivation, cropping pattern, cropping intensity, benefit-cost ratio, Garrett ranking technique*

**Introduction:**

 *Mangifera indica* is commonly known as Mango. It is also called “King of Fruits” because of its nutrients value, taste, fragrance, religious connection and most importantly the health promoting qualities. This fruit has been cultivated for over 4000 years and originated from Indo-Burma region in northeastern India. Mango is one of the most important tropical and sub-tropical crops grown in various countries across the world more significantly in south and southeast Asian countries like India, China, Pakistan, Bangladesh, Thailand, Malaysia, Indonesia, African countries like Niger, Senegal, Ivory coast, Brazil, tropical Australia, Mexico and USA (Nirmal Kumar et al, 2019).

Mango is the “National fruit of India”, and India is the largest producers of mangos, contributing to 50 percent of total mango production around the world with 1500 varieties cultivated, all having unique taste and flavour. India Ranks Ist in mango consumption in the world with total 20.6 million MT (Year- 2020) or 45 percent of the global production area under mango production in India is 2, 60,000 Hectares (National Horticulture Board. 2019-20) which is 40 percent of all fruits cultivated 95 percent of India’s mango fruit exports are the Middle East countries like UAE, Dubai, Oman only 5 percent are to USA, UK, Europe, Japan, Hong Kong.

Mango is an indehiscent type of fruit, known as “Drupe”, which can be grown under both tropical and subtropical climates, that’s why it is also called “Mother of all Tropical Fruits”. Mango grows best in well-drained soil with loamy texture, having a pH of 5.5-7.5, mango requires copious water supply during 3 to 4 years after plantation and twice a week during fruiting season. The ideal temperature for mangoes during the day is 24°C- 30°C and at night 18°C -24°C with high humidity. Mango is a rich source of variety of vitamins and minerals such as Beta carotene, Vitamin C, choline, Vitamin A and K, folate and magnesium. It is also high in fiber which is good for digestive tract. The greatest months for Mango growth in India are April through July. May through July is the busiest month for mango Processing (Mishra and Singh 2023).

It is a rare fruit used from the early, immature, unripe stage to the fully developed and ripe condition. The mango crop is so highly exposed to adverse weather during fruiting that around 75% of the fruits break off between the blooming stage and maturing. The losses can be considerably minimized by utilizing the green fruits that are dropped to manufacture pickles, chutneys, candies, preserves, juice, dry powder (Anchor), beverages, jam, and other commodities (Barge *et al.,*2023).

Uttar Pradesh has the largest area under mango cultivation with an annual production of around 2. 5 million metric tons, Uttar Pradesh accounts for approximately 25% of the country’s total mango output which is critical for both food security and economic growth. This study focuses on exploring the cropping pattern, cropping intensity and analysis of benefit cost ratio to understand the potential of mango orchards with constrain analysis to minimize losses and develop policies for more wholesome approach.

 **Methodology:**

The research was conducted in the agricultural year 2021-2022 in which the primary data was obtained by personal interview under survey method. Multistage stratified random sampling was used in Uttar Pradesh for the ultimate sample unit selection. Uttar Pradesh has 18 divisions from which Lucknow division was selected. From the selected division, Lucknow district was purposively chosen to avoid the investigator and operational inconvenience. It’s comprising of 8 blocks in which “Malihabad” and “Kakori” have the highest are under mango cultivation that’s why they are selected for high efficiency. From these 2 blocks, 5 villages each were randomly selected and a total of 100 samples were taken (Rahman, et al, 2019).

**Tabular Statistics**: For the interpretation of data average and percentage are used to determine the area under cultivation and cropping pattern (A. Udaya Shankar et al, 2019).

x̅ $=\frac{ΣΧ}{Ν}$

Where, X= Value of variable, N= Number of observations

**Cropping Intensity**: Cropping intensity index refers to the changes in the cropping intensity of crop compared to a given base year. Cropping intensity is the number of times a crop is planted per year in each Agricultural area. It is the ratio of the effective crop area harvested to the physical area. (bhosale et al, 2016)

$$C.I. = \frac{\left(Gross Cropped Area\right)}{Net Sown Area } x 100$$

**Cost Analysis:** For cost analysis of mango production cost A1, A2, B1, B2, CI, C2 and C3 is calculated using the following formula (kumar et al, 2016)

* Cost A 1 = This gives the total cash expenses incurred by the grower. It’s consisting of Cost of hired labour, Cost of bullock labour and tractor charges, Cost of planting materials, Cost of manures, fertilizers and plant protection chemicals, Irrigation charges, Interest on working capital, Land revenue, Depreciation on fixed capital, Miscellaneous expenses.
* Cost A 2 = Cost A 1 + rent paid for leased land
* Cost B 1 = Cost A 2 + interest on fixed capital + rental value of owned capital assets (Excluding Land)
* Cost B 2 = Cost B 1 + Rental Value of owned land (Net land Revenue)
* Cost C 1 = Cost B 1 + imputed value of family labour
* Cost C 2 = Cost B 2 + imputed value of family labour
* Cost C 3 = Cost C 2 + 10 per cent of the managerial cost

For the calculation of farm profit gross income, net income, farm business income, family labour income and benefit cost ratio are calculated using the following formula (Ramani et al, 2019)

* Gross Income = Yield in quintal × Price per quintal
* Net Income = Gross Income – Cost C
* Farm Business Income = Gross Income - Cost A 2 or
* Net Income + imputed value of family labour
* Family labour income = Gross Income-Cost C
* $B:C Ratio =\frac{Cost C}{Gross Income}$

**Constraint Analysis:** Constraints faced by farmers have been analyzed through survey based on demographic profile of the farmers like age groups and educational level of the farmers. Garret ranking technique (Henry Garrett) has been used to analyze the constraint faced by the farmers, wholesalers, retailers involved in plant marketing. Constraints faced by farmers in farms, value chain are 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. (Singh et al, 2021).

$$Percent Position = 100 x \frac{\left(Rij-0.5\right)}{Nj}$$

Where,

R ij = Rank given for i th factor by j th individual

N j = Number of factors ranked by j th individual

**Result and Discussion:**

**Land holding:** Theaverage land holding of small, medium and semi-medium farmers from the sample units were 0.95, 1.76 and 6.10 hectares respectively and the overall average land holding was obtained as 1.73 hectares. 31.285 of cultivated land was owned by 57 small size farmers, 33.53% by 33 medium farmers and 35.19% by 10 semi-medium farmers from the sample unit of 100 (Table 1).

**Table 1:** Average size of land holding in the sample unit

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S no.** | **Size group of farms** | **No. of Farmers** | **Net cultivated land (ha)** | **Average size of holding** |
| 1.2.3. | SmallMediumSemi-medium | 573310 | 54.23 (31.28)58.13 (33.53)61.02 (35.19) | 0.951.766.10 |
| **Grand Total** | 100 | 173.38 | 1.73 |

**Cropping Pattern:** Cropping pattern of the sample unit consisted of Paddy, Black Gram and pearl millet in Kharif season while Wheat, Gram and Pea in Rabi season are clearly depicted in table 2. The average area covered under paddy was 28.95, black gram 6.11, pearl millet 5.40 during Kharif season and average area under rabi was wheat 24.86, gram 4.27, pea 5.54. Mango and guava occupied 15.49% and 9.36% of gross cropped area which was distributed as 1.46 ha for small farms. 17.72% for mango and 13.96% for medium farms and 10.24% and 6.98% respectively for mango and guava for semi-medium farmers.

**Table 2:** Cropping Pattern of sample units

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S. no.** | **crop** | **small** | **medium** | **Semi-medium** | **Overall average** |
| A. | Kharif1. Paddy
2. Black gram
3. Pearl millet
 | 0.620.450.090.08 | 0.970.650.170.15 | 2.491.890.320.28 | 0.920.660.140.12 |
| B. | Rabi1. Wheat
2. Gram
3. Pea
 | 0.480.390.040.05 | 0.860.580.120.16 | 2.331.530.350.45 | 0.790.570.100.13 |
| C. | Perennial crop1. Mango
2. Guava
 | 0.360.210.15 | 0.710.450.26 | 1.260.850.42 | 0.570.350.21 |
| **Gross Cropped Area (A+B+C)** | 1.46 | 2.54 | 6.09 | 2.28 |

**Cropping Intensity:** Cropping intensity was inversely related to the size of farm as the small farmers has the highest cropping intensity of 153.46%, for medium it was 144.19% and for semi-medium it was 99.8% while the average cropping intensity was 131.50% (Table 3).

**Table 3:** Cropping Intensity of sample units

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.no** | **Size groups of farms** | **No of farmers** | **Net cultivated land (ha)** | **Gross cropped area (ha)** | **Cropping intensity (%)** |
| 1.2.3. | SmallMediumSemi-medium | 573310 | 0.951.766.10 | 1.462.546.09 | 153.46144.1999.80 |
| **Overall**  | 100 | 1.73 | 2.28 | 131.50 |

**Cost of Cultivation:** From table 4 clearly depicted that the costs of cultivation were highest on semi medium farms (Rs. 143048.56) and medium farms (Rs. 114100.69), followed by small farms (Rs. 102788.10). The overall average costs of cultivation were observed Rs. 110547.30 on sample farms. The major component of the cost was rental value of land (27.14%), irrigation (15.80%), human labour (12.36 %), plant protection (8.61%), interest on fixed capital (6.24%) followed by manure and fertilizer (5.09%), planting material (5.03%), machinery charge (4.08%) and interest on working capital (3.72%) respectively of the total costs of cultivation. Per hectare cost of cultivation was found to have positive trend with farm size. The cost of production increases with the increase in the size of farm due to higher yields in return to the cost of cultivation on the medium farm. It is concluded that the higher value of output on medium farms was associated with the higher expenditure incurred on modern farm inputs. The cost of cultivation was estimated to be very less which is since the mangoes in sampled farm groups did not follow recommended cultivation practices for growing the crop.

**Table 4:** Cost of Cultivation in sample units

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **Particulars**  | **Size group of farms** | **Overall average** |
| **Small** | **Medium** | **Semi-medium** |
| 1.2.3.4.5.6.7.8. | Planting materialMachinery chargeManure & fertilizerPlant protectionIrrigationFencing/hedgingFamily labourHired labour | 5145.234036.555223.118563.5415165.231960.868123.215663.75 | 5950.514895.325964.759196.3218878.092536.754594.789012.56 | 6694.775985.756859.2215987.1825978.183959.783145.1110012.35 | 5565.934514.865631.469514.7217471.782350.805059.138605.61 |
| Total working capital | 53881.41 | 61029.08  | 78622.85 |  |
| 10.11.12.13. | Interest on working capitalLand revenueRental value of landInterest on fixed capital | 3771.70775.35300005015.27 | 4272.04775.35300007651.43 | 5503.60775.353000015142.35 | 4110.00775.35300006897.91 |
| **Sub total**  | **93443.73** | **103727.90** | **130044.15** | **100497.55** |
| **Managerial cost @10% of sub total** | **9344.37** | **10372.79** | **13004.41** | **10049.75** |
| **Grand total** | **102788.10** | **114100.69** | **143048.56** | **110546.30** |

**Benefit-Cost Ratio Analysis:** On an average cost A1/A2, costB1, costB2, cost C1, cost C2 and cost C3 came to Rs. 58540.51, Rs. 65438.42, Rs. 95438.42, Rs. 70497.55, Rs.100497.55, Rs.110547.30, respectively. On average, gross income was recorded Rs.278172.00 and net income came to Rs.167624.70. On semi medium farms, gross income was highest, which was recorded Rs.289350.00 followed by medium and small farms Rs.280350.00 and Rs. 274950.00. The net income was highest on small farms Rs.172161.90 followed by medium farms Rs.166249.31 and semi medium farms Rs.146301.44 On an average family labour income and farm business income were obtained to be Rs.195633.58 and Rs.219631.49 respectively. Family labour income was highest on medium farms (Rs.211216.88) followed by semi medium farms (Rs.192450.96) and small farms (Rs.187170.02). farm business income was highest on small farms (Rs.222185.29), followed by medium farms Rs.218868.31 and semi medium farms Rs.207593.31 On an average, cost of production per quintal and yield per hectare were estimated to Rs.178.58 per quintal and 618.16 quintal, respectively (Table 5).

**Table 5:** Cost Analysis of sample units

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **particulars** | **Size group of farms** | **Overall average** |
| **small** | **medium** | **Semi-medium** |
| 1.2.3.4.5.6. | Cost A1/A2Cost B1Cost B2Cost C1Cost C2Cost C3 | 52764.7157779.9887779.9863443.7393443.73102788.10 | 61481.6969133.1299133.1273727.90103727.90114100.69 | 81756.6996899.04126899.04100044.15130044.15143048.56 | 58540.5165438.4295438.4270497.55100497.55110547.30 |
| 7. | Yield | 611.00 | 623.00 | 643.00 | 618.16 |
| 8.9.10.11. | Gross incomeNet incomeFamily incomeFarm business income | 274950.00172161.90187170.02222185.29 | 280350.00166249.31211216.88218868.31 | 289350.00146301.44192450.96207593.31 | 278172.00167624.70195633.58219631.49 |
| 12. | Cost of Production (Rs/Qtl) | 168.23 | 183.15 | 222.47 | 178.58 |

The benefit-cost ratio for small, medium and semi-medium farmers is 2.67, 2.47 and 2.0 respectively. The overall benefit cost ratio of the study is turned around to be 2.54 indicating a positive business as benefit cost ratio greater than 1 show that the farm is expected to deliver a positive net present value to a farmer and its investors. If a project’s BCR is less than 1.0, the project’s costs outweigh the benefits, and it should not be considered showcasing that mango cultivation is beneficial in long run to sustain one livelihood and earn profit for a better standard of living (Table 6).

**Table 6:** Input-Output ratio of the sample units

|  |  |  |  |
| --- | --- | --- | --- |
| **Sr. No.** | **particulars** | **Input-output ratio** | **Overall average** |
| **small** | **medium** | **Semi-medium** |
| 1.2.3.5.6.7. | Cost A1/A2Cost B1Cost B2Cost C1Cost C2Cost C3 | 1:5.211:4.761:4.331:4.331:2.941:2.67 | 1:4.561:4.061:3.801:3.801:2.701:2.46 | 1:3.541:2.991:2.891:2.891:2.231:2.02 | 1:4.831:4.351:4.011:4.011:2.791:2.54 |
| **B:C Ratio** | **1:2.67** | **1:2.46** | **1:2.02** | **1:2.54** |

**Constraint Analysis:** The major production constraint faced by most of the Mango growers was shattering of flowers and dropping of premature fruit with a score of 52.80 (I). The second most important constraint faced by the mango growers was the outbreak of insects, pests and diseases with an overall Garrett score of 52.06 (II). The other most important constraints reported by the mango growers Alternate (Biennial) and Irregular bearing overall Garrett score 51.90 (III), wait a long period for returns overall Garrett mean score 51.25 with (IV) and Lack of knowledge to tackle the natural calamity overall Garrett score 51.06 (V). In addition to the above problems, the minor problems faced by also Lack of availability of loan and insurance facility (VII), Availability of Input (VIII), Lack of avail authentic inputs and high price (IX), and Scarcity of labour supply and high wage rate (X) in the study area.

**Table7:** Constrain Analysis using Garret Technique

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **Mango production constraints** | **Total** | **Average Score** | **Final Rank** |
| 1.2.3.4.5.6.7.8.9. | Availability of inputScarcity of labour supply & high wage rateAlternate and irregular bearingLack of availability of input and high priceOutbreak of insect, pest and diseaseShattering of flower and dropping of premature fruitTricky management practicesLack of knowledge to tackle the natural calamityLack of availability of loan & insurance facilityWait a long period for return | 5773545462285625624763365948612758726150 | 48.1145.4551.9046.8852.0652.8049.5751.0648.9351.25 | 81039216574 |

**Conclusion:**

The study on mango cultivation in Uttar Pradesh highlights both the economic potential and the challenges faced by farmers. Through the analysis of crop intensity, it was highest for small farmers with an average of 153.46%. It is evident that mango farming can be highly profitable, especially with proper resource management and optimized input use. The benefit-cost ratio (BCR) is more than 2 for small, medium and semi-medium farmers, demonstrates the long-term viability of mango orchards, although profitability is influenced by market dynamics and infrastructure availability. The use of Garret ranking to identify key constraints reveals that shattering of flowers and dropping of premature fruits, outbreak of insect and disease, alternate and irregular bearing are critical issues hindering productivity.

Addressing these challenges through improved irrigation systems, different techniques to support too premature fruit, provide adequate nutrients, access to affordable pest control measures, and better marketing infrastructure can significantly enhance the performance of mango farming. Mango cultivation in Lucknow district of Uttar Pradesh holds substantial promise, targeted interventions are necessary to overcome the existing constraints. Policymakers, agricultural advisors, and farmers must collaborate to ensure the sustainability and profitability of mango farming, providing proper marketing channels, ultimately contributing to the state’s agricultural development.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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