

## A Study on Ecological, Cultural Significance of Walnut and Yearly Walnut Production in Kashmir Valley

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### Abstract

The horticulture sector in Jammu and Kashmir's economy is one of the most dominant sectors and the backbone of the economy with a yearly turnover of over Rs. 1200 Crores. The Jammu and Kashmir region announced as the "Agri. Export zone for Apples and Walnuts" is the major producer of apples and walnuts as around 80 per cent of apple and 90 per cent of walnut production in India belongs to the Jammu and Kashmir region. Walnut (Akhrot in Urdu and Doon/ Doun in Kashmiri) is the edible seed of the tree of the genus *Juglans* and is well known for its health and environmental significance. In this paper, we study the annual growth rate of Walnut production in Kashmir Valley using secondary data from 2004-2005 to 2023-24 with the help of statistical techniques. Finally, we discuss the ecological significance of walnuts and show the forecasts of the area under walnuts and their production.

**Keywords:** Walnut, Growth rate, Forecast, Economic Development, Production.

### INTRODUCTION

Worldwide, walnuts (*Juglans regia* L.) are one of the most nutritious nut crops grown in temperate climates. The history of walnut is lost in antiquity; however, it is believed to have originated in Iran and its surrounding areas from where it was brought to Europe by Alexander the Great and then from Europe it was brought to China (Jasrotia *et al.*, 2024). In India, agro-climatic conditions of the Himalayan

region are eminently suited for commercial exploitation of walnuts from the northwestern Himalayas to the northeastern Hill as was noticed (Pandey and Shukla, 2007). Walnut, one of Jammu and Kashmir's major cash crops, is an important part of its booming horticulture industry. In Jammu and Kashmir Walnut produced is purely organic as it is grown in naturally induced conditions without the use of heavy doses of fertilizers and chemical sprays. The major districts of walnut production in

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Kashmir valley are Anantnag, Kulgam, Kupwara, Shopian, Baramulla, Pulwama and from Jammu; the major districts are Doda, Reasi, Rajouri, Kishtwar, Kathua, Udhampur and Ramban (Malhotra and McNeil, 2009). In different parts of the world, Walnut is referred to by various names. The most commonly used name is akhrot in Hindi, doon in Kashmiri and Gardgani in Unani, the trivial name walnut derives from old wealth nuts, literally foreign nut, wealth meaning foreign. Every part of this plant is utilized in one way or another, the edible portion, the kernel is rich in proteins, fats, minerals and vitamins, especially vitamin B-6, walnut leaves can be used as an infusion which is beneficial for skin disorders and irritations in the eyes, also the rind of the nut when tonics for edible purposes is useful for chronic diarrhoea (Ahmad *et al.*, 2018). In the literature, we found several studies that mentioned the health and economic benefits of the Walnut fruit as a tree (e.g., McGranahan *et al.*, 2012, Venkatachalam and Sathe, 2006; Shah and Bakhshi, 2016). It was a common practice for people of Kashmir to plant a walnut tree near their homes in villages. This tradition was rooted in the cultural, economic, and environmental significance of walnut trees in the region. The main reasons why people in Kashmir value having a walnut tree around their homes are:

### Cultural Significance

1. Symbol of prosperity: Walnut trees were considered a symbol of prosperity and good fortune in Kashmiri culture.
2. Traditional practices: Planting a walnut tree was often a part of traditional practices and rituals, such as during weddings or when building a new home.

### Economic Benefits

1. Food source: Walnut trees provide a reliable source of nutritious food, including walnuts, which are consumed fresh or used in traditional recipes.
2. Income generation: Walnut trees are a source of income for many families, as they sell walnuts, walnut oil, and other walnut-based products.
3. Shade and timber: Walnut trees provide shade and timber, which are used for various purposes, including furniture-making and construction.

### Environmental Benefits

1. Soil conservation: The roots of walnut trees help conserve soil and prevent erosion, which is particularly important in Kashmir's mountainous terrain.
2. Climate regulation: Walnut trees provide shade, cooling the surrounding area and helping to regulate the local climate.
3. Biodiversity support: Walnut trees support local biodiversity by providing habitat and food for various wildlife species.

### Social Benefits

1. Community bonding: Walnut trees often serve as community gathering places, fostering social bonding and cohesion.
2. Intergenerational connection: Walnut trees are often planted by one generation and enjoyed by future generations, promoting a sense of connection and continuity.



Walnut tree around House in Kashmir Walnut tree in Summer and Winter Season of Kashmir



Walnuts are a rich source of essential nutrients and bioactive compounds including flavonoids, polyphenols, flavanols, carbohydrates, fatty acids, cardiac glycosides, steroids, minerals, tannins, proteins, dietary fiber, melatonin, plant sterols,  $\alpha$ -tocopherol, folate, tannins, vitamin A, vitamin C, and vitamin E family compounds (Chang *et al.*, 2016). The antibacterial properties of walnut phenolic extracts have been demonstrated in numerous studies, making them as potential alternatives to antibiotics and food preservatives. In the food industry, these natural compounds are highly valued for their nutritional benefits, health-promoting properties, and desirable mouthfeel. Walnuts are often considered a delicacy and are enjoyed as royal cuisine worldwide. The dried bark of walnut trees, with its hard, fibrous structure has been used as a natural tool for mechanical tooth cleaning. Juglone, a significant component in walnut bark, is recognized for its tooth-whitening, anti-plaque, antifungal, antibacterial, and anticariogenic properties, making it a subject of increasing interest in dental care research (Khattak *et al.*, 2022). Additionally, walnut green husk extract has been found to be an effective natural hair-dye with strong antimicrobial properties, offering an environmentally friendly and affordable alternative to synthetic dyes (Beiki *et al.* 2018).

From an ecological standpoint, walnut trees play an important role in improving soil structure and can serve as alternatives to more destructive land-use practices (Cantarello *et al.*, 2014). The green walnut, as a part of the walnut tree, has a lower carbon footprint and water usage compared to other plants, partly due to the utilization of various tree parts that would otherwise be considered waste. The intricate relationship between water and carbon influences the growth and resource use of walnut trees. Research into the ecological

applications of green walnut husk biomass is still in its early stages, with a growing focus on its energy potential and the extraction of valuable chemicals. The husks, typically discarded post-harvest, contain valuable components like glucans and pectins, and are being explored as a potential alternative fuel source due to their energy properties.

Furthermore, walnut shells, such as those from the husks, have shown promising energy qualities, making them suitable for use as alternative fuels. Studies have demonstrated increased heating values of walnut shells after thermal processes like pyrolysis (Yilmaz *et al.*, 2017). Differences in biomass generation have been observed across various walnut cultivars, particularly regarding the distribution of green husk and in-shell biomass, which may influence their ecological applications (Dong *et al.*, 2021).

The demand of Kashmiri walnut is increasing rapidly which needs to bring more land under it and require a regular attention to this industry so that it can better flourish in the times to come. Examining the growth rate of Walnut production is essential for planning and policy making in the horticultural sector. In view of economic, medical and social importance of Walnut, we chose this topic for study. The data collected from secondary sources, was analysed in this study and used for examining trend of walnut area in Kashmir region.

## **METHODOLOGY**

In this study, secondary data collected from published sources e.g., digest of statistics, internet etc. was used for analysis purpose. The growth models e.g., Linear, Logarithmic, Inverse, Quadratic, Cubic, Compound, Power, S, Exponential and logistic growth models were considered in this study to examine the trend. To

recognize the best model for a particular time series data the latest available diagnostic tools are  $R^2$ , Adjusted  $R^2$ , RSME, AIC, BIC, MAE and MAPPE.

In this study various statistical models were used to fit the Walnut area and production data (2004-05 to 2023-24) and on the basis of best fitted models forecasting was done. It is important to mention that for forecasting purpose we can also use ARIMA as well as moving average techniques.

The best fitted model was chosen on the basis of  $R^2$  i.e., coefficient of determination from a time trend regression adjusted by the number of degrees of freedom. The simple Coefficient of Variation (CV) often contains the trend component and thus overestimates the level of instability in time series data characterized by the long-term trend.

Mathematically,

$$\text{Instability Index (I.I)} = CV \sqrt{1 - R^2}$$

Where,

CV = Simple estimate of coefficient of variation in percent.

$$CV = \frac{\sigma}{\bar{x}} \times 100$$

Where

CV = Coefficient of Variation

$\sigma$  = Standard Deviation

$\bar{x}$  = Mean

And

$R^2$  = coefficient of determination from a time trend regression adjusted by the number of degrees of freedom.

The Compound Growth Rates in area and production were estimated using the following equation:

$$\text{Log } Y = \log a + t \log b$$

where

Y = area, production and yield.

t = time trend, denoting years

The compound growth rate in percent =  $\{\text{antilog of } (\log b) - 1\} \times 100$ .

## RESULT AND DISCUSSION

The data shown in Figure 1, represents a trend in the area and production of Walnut in Jammu and Kashmir from 2004-05 to 2023-24. The trend in the area under Walnut shows a decreasing trend, however, the production trend is increasing. The reason is an increase in Knowledge of agriculture and the availability of the latest technology. It is expected, in future more increase in production of Walnuts

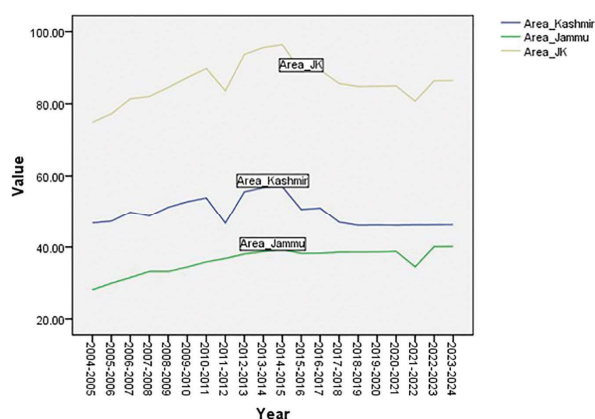


Fig. 1: Trend in area under Walnut in Kashmir, Jammu & Total JK

The data presented in Table 1, shows the annual growth rate (%) of the area under Walnut and Walnut production in the Kashmir region. The growth rates show fluctuations in walnut production as well as in area under walnut. Generally, due to the revolution in the horticulture sector, people are more economically conscious. They prefer those fruit plants which will give more benefits and occupy less space. We expect an increase in walnut production in future as we have now new walnut varieties that occupy less space than the traditional walnut trees.

Table 1: Annual Growth Rate (%) in Area and Production of Walnut in Kashmir Region

| Year      | Kashmir division (Area) | Growth Rate (%) | Kashmir division (Production) | Growth Rate (%) |
|-----------|-------------------------|-----------------|-------------------------------|-----------------|
| 2004-2005 | 46.786                  | -               | 80.578                        | -               |
| 2005-2006 | 47.291                  | 1.0678          | 86.578                        | 6.9301          |
| 2006-2007 | 49.837                  | 5.1086          | 92.147                        | 6.0436          |
| 2007-2008 | 48.786                  | -2.1543         | 121.712                       | 24.290          |

| Year      | Kashmir division<br>(Area) | Growth Rate (%) | Kashmir division<br>(Production) | Growth Rate (%) |
|-----------|----------------------------|-----------------|----------------------------------|-----------------|
| 2008-2009 | 51.299                     | 4.8987          | 126.7                            | 3.9368          |
| 2009-2010 | 52.837                     | 2.9108          | 130.501                          | 2.9126          |
| 2010-2011 | 53.895                     | 1.9630          | 133.247                          | 2.0608          |
| 2011-2012 | 46.755                     | -15.2710        | 158.693                          | 16.0347         |
| 2012-2013 | 55.561                     | 15.8492         | 159.545                          | 0.5340          |
| 2013-2014 | 56.785                     | 2.1554          | 163.949                          | 2.6862          |
| 2014-2015 | 57.048                     | 0.4610          | 129.671                          | -26.4345        |
| 2015-2016 | 50.655                     | -12.6206        | 174.941                          | 25.8772         |
| 2016-2017 | 51.021                     | 0.7173          | 174.053                          | -0.5101         |
| 2017-2018 | 47.004                     | -8.5460         | 190.451                          | 8.6100          |
| 2018-2019 | 46.124                     | -1.9079         | 195.066                          | 2.3658          |
| 2019-2020 | 46.175                     | 0.1104          | 180.973                          | -7.7873         |
| 2020-2021 | 46.134                     | -0.0888         | 177.07                           | -2.2042         |
| 2021-2022 | 46.197                     | 0.1363          | 182.659                          | 3.0597          |
| 2022-2023 | 46.231                     | 0.0735          | 213.575                          | 14.4754         |
| 2023-2024 | 46.253                     | 0.0475          | 214.903                          | 0.6179          |
| CAGR      | -0.06%                     |                 | 5.03%                            |                 |

*Digest of statistics 2022-2023; Directorate of Economics and statistics, J&K*

The data presented in Table 2, shows the results obtained by fitting various models to the total Area under Walnuts in Kashmir, India data (2004-05 to 2023-24). It has been observed that the best-fitted trend is with R<sup>2</sup>=0.572) and we can use it for forecasting purpose.

**Table 2:** Model Summary and Parameter Estimates. Area under Walnut in Kashmir (Using SPSS software)

| Model Summary and Parameter Estimates |               |       |     |     |      |                     |        |       |      |
|---------------------------------------|---------------|-------|-----|-----|------|---------------------|--------|-------|------|
| Dependent Variable: Area              |               |       |     |     |      |                     |        |       |      |
| Equation                              | Model Summary |       |     |     |      | Parameter Estimates |        |       |      |
|                                       | R Square      | F     | df1 | df2 | Sig. | Constant            | b1     | b2    | b3   |
| Linear                                | .103          | 2.071 | 1   | 18  | .167 | 51.808              | -.207  |       |      |
| Logarithmic                           | .006          | .106  | 1   | 18  | .748 | 50.395              | -.360  |       |      |
| Inverse                               | .018          | .336  | 1   | 18  | .570 | 50.049              | -2.308 |       |      |
| Quadratic                             | .492          | 8.230 | 2   | 17  | .003 | 45.784              | 1.436  | -.078 |      |
| Cubic                                 | .572          | 7.138 | 3   | 16  | .003 | 42.014              | 3.359  | -.302 | .007 |
| Compound                              | .112          | 2.270 | 1   | 18  | .149 | 51.754              | .996   |       |      |
| Power                                 | .008          | .139  | 1   | 18  | .714 | 50.353              | -.008  |       |      |
| S                                     | .017          | .311  | 1   | 18  | .584 | 3.910               | -.044  |       |      |
| Growth                                | .112          | 2.270 | 1   | 18  | .149 | 3.946               | -.004  |       |      |
| Exponential                           | .112          | 2.270 | 1   | 18  | .149 | 51.754              | -.004  |       |      |
| Logistic                              | .112          | 2.270 | 1   | 18  | .149 | .019                | 1.004  |       |      |

The independent variable is year.

The data presented in Table 3, shows the results obtained by fitting various models to the total Production of Walnuts in Kashmir region, India

data (2004-05 to 2023-24). It has been observed that the best fitted trend is with  $R^2=0.915$ ) and we can use it for forecasting purpose.

**Table 3:** Model Summary and Parameter Estimates. Production of Walnut in Kashmir Region (Using SPSS software)

| Model Summary and Parameter Estimates |               |         |     |     |      |                     |          |        |      |
|---------------------------------------|---------------|---------|-----|-----|------|---------------------|----------|--------|------|
| Dependent Variable: Production        |               |         |     |     |      |                     |          |        |      |
| Equation                              | Model Summary |         |     |     |      | Parameter Estimates |          |        |      |
|                                       | R Square      | F       | df1 | df2 | Sig. | Constant            | b1       | b2     | b3   |
| Linear                                | .882          | 134.761 | 1   | 18  | .000 | 87.595              | 6.358    |        |      |
| Logarithmic                           | .872          | 122.904 | 1   | 18  | .000 | 56.938              | 46.019   |        |      |
| Inverse                               | .584          | 25.314  | 1   | 18  | .000 | 178.992             | -136.984 |        |      |
| Quadratic                             | .904          | 80.284  | 2   | 17  | .000 | 72.517              | 10.470   | -.196  |      |
| Cubic                                 | .915          | 57.403  | 3   | 16  | .000 | 58.059              | 17.848   | -1.053 | .027 |
| Compound                              | .840          | 94.501  | 1   | 18  | .000 | 92.881              | 1.046    |        |      |
| Power                                 | .917          | 198.979 | 1   | 18  | .000 | 72.246              | .341     |        |      |
| S                                     | .685          | 39.133  | 1   | 18  | .000 | 5.195               | -1.072   |        |      |
| Growth                                | .840          | 94.501  | 1   | 18  | .000 | 4.531               | .045     |        |      |
| Exponential                           | .840          | 94.501  | 1   | 18  | .000 | 92.881              | .045     |        |      |
| Logistic                              | .840          | 94.501  | 1   | 18  | .000 | .011                | .956     |        |      |

The independent variable is year.

The data presented in Table 4, shows the forecasts area under Walnut and production of Walnut in J&K.

Forecasts are very important for policymakers, govt and private agencies linked with fruit industry.

**Table 4:** Forecasting of Area and Production of Walnut in Kashmir Region

| Year      | Area Forecast of Area under Walnut in Kashmir (Thousand hectares) | Forecast of Walnut Production in Kashmir (Thousand hectares) |
|-----------|-------------------------------------------------------------------|--------------------------------------------------------------|
| 2024-25   | 44.198                                                            | 218.540                                                      |
| 2025-2026 | 44.280                                                            | 228.558                                                      |
| 2026-2027 | 45.446                                                            | 240.035                                                      |
| 2027-2028 | 46.614                                                            | 253.130                                                      |
| 2028-2029 | 48.228                                                            | 268.009                                                      |
| 2029-2030 | 50.330                                                            | 284.830                                                      |

## CONCLUSION

In Kashmir Walnut tree around the home was a cherished tradition that provided numerous cultural, economic, environmental, and social benefits. Walnuts are a nutrient-rich food that provides numerous environmental and health benefits such as Walnut trees help in Carbon Sequestration, Soil Conservation, Support Biodiversity and water conservation. Walnuts are rich in omega-3 fatty acids, which help lower cholesterol and reduce the risk of heart disease. Further, Walnuts contain antioxidants

and phytochemicals that may help prevent certain types of cancer, such as breast and prostate cancer. Walnuts are a rich source of neuroprotective compounds, which may help prevent age-related cognitive decline and dementia. Walnuts are high in dietary fiber, which can help promote regular bowel movements and prevent constipation. Walnuts are low in carbohydrates and high in healthy fats, making them a nutritious snack for those trying to manage their weight. Walnuts contain anti-inflammatory compounds that may help reduce inflammation and improve overall health.

In the Jammu and Kashmir region, approximately 7 lakh families depend on agriculture directly or indirectly. In India J&K is the largest producer of Walnuts which acts for a large section of farmers as an important source of livelihood. In India, the demand for fruits especially Kashmiri Walnuts is tremendously increasing each year due to the health benefits of Walnuts. Given the increasing demand for fruits, the present study was carried out using area and production under Walnut time series data of the Jammu & Kashmir region, India to forecast Walnut production for the next 6 years. The results of our study showed that there is an increasing trend in Walnut production. The forecasted data based on statistical models showed that the Walnut production rate would increase. The annual growth rate in the area under Walnut as well as in production shows nonlinear trend in general. We know forecasting Walnut production is important as it would enable the government, various organizations linked with Horticulture and scientists working in different fields to plan and prepare their activities in an optimal way to meet the increasing Walnut demand. It is expected the government of India will implement agricultural policies and strategies to increase the production of Walnuts in J&K.

## SUGGESTIONS

In order to get more benefits from fruit industry, efforts should be made by the Government to encourage farmers by providing them economical, social and technical support.

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