

## Macadamia Nut: A sustainable Future for N-W Himalayan Subtropics

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**ARTICLE ID: 08**

The North-West Himalayan Subtropics encompass the lower-altitude regions, spanning parts of Jammu & Kashmir, Himachal Pradesh, and Uttarakhand in India, as well as the adjoining foothills of Nepal and Pakistan. This region is characterized by a subtropical climate, diverse agroecological conditions, and a mix of mountainous and valley landscapes. With an elevation range of 300 to 1,500 meters above sea level, the terrain is predominantly undulating and highly prone to soil erosion due to its fragile ecology and erratic climatic conditions. The natural vegetation in the region primarily consists of subtropical forests, dominated by species such as pine, bamboo, and sal. Major staple crops of the region are: wheat, maize, rice, and pulses. Additionally, cash crops such as turmeric, colocasia, and select vegetables are cultivated in specific pockets. Among fruit crops, mango, litchi, guava, and citrus fruits hold economic significance, though their cultivation remains limited in scale.

Agriculture in the North-Western Himalayan region is increasingly facing sustainability challenges due to its fragile ecosystem, sloppy terrain, erratic climate, and growing population pressure. Despite receiving over 1,200 mm of annual rainfall, the region



paradoxically experiences drought-like conditions for much of the year due to skewed rainfall distribution.

The combination of infrastructure development, deforestation, and shifting land-use patterns has triggered landslides, flash floods, and soil degradation, further threatening the viability of farming in the region. Additionally, habitat destruction and declining forest cover



have intensified human-wildlife conflict, with animals encroaching on farmlands and causing significant crop losses. Socioeconomic factors, such as fragmented landholdings and outmigration of youth, have further exacerbated the crisis by leading to severe agricultural labour shortages in the region.

Addressing these sustainability issues is critical for improving the livelihoods of local communities. A shift toward resilient, high-value crops could offer a sustainable alternative to traditional farming practices, helping to restore ecological balance while ensuring economic viability. Among potential diversification options, Macadamia nut stands out as a promising crop that aligns with the region's agro-climatic conditions and offers substantial commercial benefits. Given its adaptability to subtropical conditions, this nut crop has the potential for introduction in the North-West Himalayan Subtropics as a high-value, climate-resilient crop. The region's altitude, temperature, and soil conditions could support macadamia orchards, offering economic and ecological benefits.

Macadamia nut (*Macadamia* spp.) is native to Australia, specifically the rainforests of Queensland and New South Wales. It was first discovered by European botanists in the mid-19th century and was named after John Macadam, a Scottish-Australian chemist and politician. These nuts are now grown in various tropical and subtropical regions worldwide, with commercial production concentrated in the following countries: Australia, Hawaii, South Africa, Kenya, China, Brazil and Guatemala. The macadamia nut market is experiencing robust growth, driven by health-conscious consumers and expanding culinary uses. In 2022, the global macadamia nut market was valued at approximately USD 1.58 billion. By 2030, it is expected to reach approximately USD 3.57 billion at a annual CAGR of 9.3%. With these favourable market projections, Macadamia nut presents promising opportunities for producers and investors alike.

*"Macadamia nut is not just an alternative crop—it is the key to transforming the fragile farmlands of the North-West Himalayan Subtropics into thriving, resilient agricultural landscapes."*

#### **Potential regions in N-W Himalayas:**

- **Lower-altitude regions of Himachal Pradesh:** The Shiwaliks (Outer Himalayas) which includes the lower hills of Kangra, Hamirpur, Una, Bilaspur and the lower parts of Mandi, Solan and Sirmaur districts with an altitude of 350-1200 meters above sea level and annual rainfall 1,000 mm to 1,500 mm annually

• **Mid to lower-altitude regions of Uttarakhand:** The Bhabar and Terai regions of Uttarakhand, the Bhabar region that runs parallel to the Shiwalik Hills, is located in the southern part of the Lower Himalayas and the Indo-Gangetic plain. The Terai is the lowland region in parts of southern Nepal and northern India, experiences a tropical climate type with dry winters and hot summers with a mean annual temperature of 20-28°C.

• **Low altitude subtropical region of Jammu:** Jammu region comprises two major agro-climatic zones viz. Low altitude subtropical zone and mid to high intermediate zones. The low-altitude subtropical zone is characterized by hot spells of summer, relatively dry but pronounced winter and preponderance of alluvial soils. This zone comprises of whole Jammu district and the lower parts of the Kathua, Udhampur, Poonch and Rajouri districts.

#### Potential species and varieties for Cultivation:

Macadamias, primarily grown commercially, consist of two primary species: smooth-shelled *M. integrifolia* and rough-shelled *M. tetraphylla*, having different climatic preferences and nut characteristics. The former species is typically cultivated in subtropical regions, whereas the latter one flourishes in slightly cooler climates.

*M. integrifolia*, is expected to perform better in the plains and warmer regions of the North Western Himalayas similar to the lower hills of Kangra, Hamirpur, Una and Bilaspur. Whereas *M. tetraphylla*, is a practical choice for areas with milder temperatures, enabling farmers to diversify their crop production grounded on indigenous climatic conditions. Beaumont a hybrid of *M. integrifolia* and *M. tetraphylla* is another promising type, which is popular among growers worldwide due to its adaptability to various temperatures. This versatility makes it an ideal volition for growers in places with fluctuating weather.



#### Key Initiatives for Promoting Macadamia Cultivation in the NW Himalayan Subtropics



Recognizing the immense potential of macadamia nut cultivation in the North-West Himalayan Subtropics, Dr. Y. S. Parmar University, College of Horticulture and Forestry, Neri, Hamirpur, has taken significant steps to promote and develop this high-value crop. As a leading institution dedicated to subtropical horticultural research, it has integrated macadamia into its priority research agenda to establish it as a viable and sustainable crop for the region.

One of the key challenges in macadamia propagation is the short viability and hard coat of its seeds, which makes germination difficult. The university has successfully standardized protocols to improve seed germination efficiency, ensuring better seedling establishment. Further research is underway to enhance the production of graftable seedlings in a shorter time and refine grafting techniques to improve success rates.

To ensure the long-term availability of superior planting material, the institution is actively procuring elite macadamia varieties for further propagation and adaptation trials. Additionally, efforts have been initiated to establish seed orchards and budwood orchards, which will serve as vital sources for future large-scale plantation efforts in the region.

Through these pioneering initiatives, the university is laying a strong foundation for the commercialization and sustainable adoption of macadamia cultivation, potentially transforming the agricultural landscape of the NW Himalayan Subtropics.

### **Conclusion**

Macadamia cultivation offers a sustainable and profitable alternative for the North-West Himalayan Subtropics, addressing agricultural instability and economic constraints. Its adaptability to subtropical conditions, along with increasing global demand, makes it a viable option for diversification and income generation. Research initiatives at Dr. Y. S. Parmar





University of Horticulture and Forestry are laying the foundation for successful cultivation through improved propagation techniques and orchard establishment in the subtropical sub-Himalayan region. Further investment in nursery development and farmer training is essential for scaling up production. By adopting macadamia cultivation, the region can enhance ecological sustainability, improve rural livelihoods, and secure its agricultural future.

*"Embracing macadamia cultivation is not merely a choice; it is a necessity for securing a sustainable, prosperous future for the farmers of the North-West Himalayan Subtropics."*