

Revitalizing Saffron (*Crocus sativus* L.) Cultivation in Kashmir: A Scientific Approach to Sustainable Production and Quality Enhancement

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Abstract

Saffron (*Crocus sativus* L.), a sterile triploid of the Iridaceae family, is cultivated for its high-value mauve stigmas used as spice and in various industries. Propagated through corms, saffron's quality depends on key apocarotenoids like crocin, picrocrocin, and safranal, which develop during flowering and drying. The Kashmir Valley, especially the Karewa plateau regions, provides ideal agro-climatic conditions for its growth. However, climate change, poor soil health, corm rot, and reliance on traditional practices have led to declining yields. This study presents a scientific framework for saffron cultivation in Kashmir, covering site selection, corm grading, nutrient and water management, pest/disease control, and modern post-harvest processing techniques. It highlights the role of initiatives like the National Saffron Mission and institutions such as IICSTC in promoting sustainable practices and value addition. Emphasis is placed on controlled drying, integrated pest management, and scientific harvesting, all essential for quality and economic viability. With proper integration of tradition and innovation, Kashmir's saffron industry holds significant potential for revival and global leadership.

Key words: *Crocus sativus* L., Stigmas, Agro-climatic suitability, Scientific cultivation practices, Post-harvest management, Revitalizing saffron cultivation

Saffron (*Crocus sativus* L.), a perennial bulbous herb belonging to the Iridaceae family is a sterile triploid ($2n = 3x = 24$), is highly valued for the spice derived exclusively from its amethyst stigmas, which are meticulously collected and dried [1]. This unique plant propagates through globular corms, typically 3-5 cm in diameter, as it is sterile and does not reproduce via seeds [2]. The distinctive qualities of saffron - its vibrant color, bitter taste, and characteristic aroma - are attributed to the accumulation of specific compounds within its stigmas, a process that intensifies as they mature; notably, crocetin and its glucoside derivatives (crocin) are responsible for the rich color, while picrocrocin contributes to the bitterness and serves as a crucial precursor for safranal, the primary compound responsible for the spice's unique aroma, which largely develops during the post-harvest drying process [3-4]. The precise balance and development of these compounds, alongside a dynamic shift in the volatile composition throughout the stigma's developmental stages, underscore the intricate biochemical pathways that define saffron's unparalleled quality and value [5].

Saffron, a high-value spice, is traditionally cultivated in open fields with a perennial growth cycle, its yield heavily dependent on corm size and density, soil properties, and crucial climatic conditions like temperature, which directly influence the plant's vegetative reproduction [6]. However, the industry, particularly in Kashmir, India—the world's largest producer

with an average yield of 4-5 kg per hectare—is facing severe limitations due to recent abiotic changes, notably increased temperatures and erratic precipitation patterns resulting from climate change [7]. These environmental stressors, combined with specific soil challenges in Kashmir's main cultivation region of Pampore and a scarcity of healthy saffron plants, present formidable obstacles to large-scale production. Given that Kashmir saffron is almost exclusively grown in traditional open-field settings, there is an urgent and critical need to develop and implement alternative propagation methods to enhance saffron production rates and ensure the sustainability of this economically vital crop [8].

However, declining productivity due to traditional practices and environmental challenges necessitates the adoption of scientific cultivation methods. This study provides a comprehensive guide to the scientific cultivation of saffron under Kashmir's unique agro-climatic conditions, covering site selection, soil management, corm selection and planting, nutrient and water management, pest and disease control, harvesting, and post-harvest processing, alongside insights into its economic viability and the role of governmental initiatives [9-10]. Saffron (*Crocus sativus*) is a perennial herb renowned for its rich aroma and flavor, making it a prized culinary ingredient. Beyond its role as a spice, saffron holds immense value in various industries, including food processing, pharmaceuticals, cosmetics, perfumery, and textile dyeing. It is

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considered a high-value crop and plays a significant role in the agricultural economy of Jammu and Kashmir (India), where its cultivation is deeply rooted in tradition and heritage [11-12].

The objective of this study is to provide a comprehensive guide to the scientific cultivation of saffron (*Crocus sativus* L.) under the unique agro-climatic conditions of Kashmir. This guide aims to address the declining productivity caused by traditional practices and environmental challenges, covering aspects such as site selection, soil management, corm selection and planting, nutrient and water management, pest and disease control, harvesting, and post-harvest processing, as well as insights into economic viability and governmental initiatives.

Agro-climatic suitability and scientific cultivation of saffron in Kashmir

The Union Territory of Jammu and Kashmir, particularly the Kashmir Valley, is uniquely suited for saffron cultivation due to its geographical and agro-climatic conditions. Located between 32° 17' and 36° 58' north latitude and 75° 26' and 80° 30' east longitude, the region lies in the north-western Himalayan range, forming the northernmost part of India. The average elevation of the Kashmir Valley is approximately 1,850 meters above sea level, while the surrounding mountains, often capped with snow year-round rise to altitudes between 3,000 and 4,000 meters [13]. These natural features contribute to the distinct quality and reputation of Kashmiri saffron on both national and international platforms. Saffron, derived from the stigmas of *Crocus sativus* L., holds immense cultural, economic, and medicinal significance. Kashmir, particularly the Karewa lands of Pampore, Pulwama, Budgam, and Srinagar, has historically been synonymous with high-quality Kashmiri saffron. Despite its rich heritage, saffron cultivation in the region has faced challenges such as climate change (erratic rainfall, temperature fluctuations, droughts), corm rot, pest infestations, and reliance on traditional, often less efficient, farming techniques [14]. To revive and sustain this crucial cash crop, a shift towards scientific and modernized cultivation practices is imperative. Saffron thrives in specific environmental conditions that are largely met by the Kashmir Valley. Understanding these requirements is crucial for successful cultivation. Saffron requires a distinct climate pattern with hot, dry summers (for corm dormancy) and cool, mild winters with snowfall (beneficial for flowering and corm development). Optimum temperature for flowering and corm development is in the range of 23-27°C, while corms require around 17°C for flower emergence. Saffron is largely a rainfed crop in Kashmir. Adequate rainfall (100-150 mm) during the pre-flowering period (late September to October) is essential for flower initiation and development [15]. However, excessive or unseasonal rainfall, especially during flowering, can be detrimental, leading to flower damage and corm rot [16]. Drought conditions during critical growth stages also negatively impact yield. Saffron flourishes best at altitudes ranging from 1600 m to 2140 m above sea level, aligning with the elevated Karewa topography of Kashmir. Plenty of sunlight is crucial for good flower and corm production. Saffron prefers well-draining, loose, friable, and fertile soils. Sandy loam to loamy soils are ideal. Heavy clayey soils are unsuitable due to poor drainage, which can lead to corm rot. A slightly alkaline to neutral pH range of 6.8 to 7.8 is considered optimum. Soils with good organic carbon content are beneficial. The Karewa soils of Kashmir are typically low to medium in organic carbon, available nitrogen, and phosphorus, but medium to high in available potassium [17]. Excellent drainage is paramount. Raised beds and proper drainage channels are essential, particularly in areas prone to waterlogging, to prevent corm

decay. Thorough land preparation is fundamental for establishing a healthy saffron field. The land should be ploughed 2-3 times during the spring season (March-April) to achieve a fine tilth. This helps loosen the soil, improve aeration, and control weeds. The field should be free of debris, stones, and clods. Repeated ploughing also helps bring subsoil to the surface, potentially improving fertility. For proper cultural practices and drainage, raised beds are highly recommended. Beds of 1.2-1.5 m width and 15-20 cm height, with 30 cm wide drainage channels between them, are ideal [18]. In sandy to sandy-loam soils or dry temperate regions with low rainfall intensity, raised beds might not be strictly necessary, but good drainage remains vital. Saffron benefits significantly from balanced nutrient application. As a basal dressing, well-decomposed farmyard manure (FYM) at a rate of 30-40 tonnes per hectare should be incorporated into the soil during land preparation (March-April). This improves soil structure, water retention, and fertility. A balanced NPK dose is crucial. Recommendations often suggest 45:60:60 kg NPK per hectare for higher yield of flowers and corms. However, excessive nitrogen can delay flowering. Application methods vary, but typically, NPK can be applied at the time of corm planting [19]. Soil testing is recommended to tailor nutrient application. While less commonly emphasized, ensuring adequate micronutrients can also contribute to optimal growth. The quality of corms and proper planting techniques directly impact saffron yield and longevity. Select healthy, firm, plump, and disease-free corms. Graded corms weighing 8 grams and above, or with an average diameter of 2.5 cm (average weight 10g), are preferred for new plantations, as larger corms generally produce more flowers and daughter corms. Obtain corms from reputable suppliers or certified nurseries to minimize disease risk and ensure genetic purity [20]. The most appropriate time for planting saffron corms in Kashmir is the second fortnight of August. This timing allows for adequate corm establishment before the flowering season. Late or early sowing is generally not recommended. Spacing influences both flower and corm production. A spacing of 20 cm x 10 cm is considered ideal for producing large-sized corms and good yields. This translates to approximately 50 corms per square meter or 500,000 corms per hectare. Corms are typically sown at a depth of 10-12 cm (4-6 inches). The surface should be covered loosely with soil to ensure proper aeration. Compact packing can restrict air circulation and corm development. This is a common and less labour-intensive method, especially for larger areas. Corms are placed in furrows created by ploughing. Pits of 12-15 cm depth are dug manually with an inter-plant distance of 10 cm, and corms are placed in them [21]. While saffron is often rainfed, judicious irrigation has become increasingly important due to erratic rainfall patterns in Kashmir. Irrigation at intervals of 15 days from late September to October is most critical for proper corm growth initiation and accelerating early bloom. The soil should remain moist but not waterlogged. Saffron corms are highly susceptible to rot in waterlogged conditions. Sprinkler irrigation is highly recommended for efficient water use and even distribution, especially in areas with unreliable rainfall. The National Saffron Mission in Kashmir has focused on creating irrigation facilities, including tube wells and sprinkler systems. Normally, irrigation is not required immediately after sowing the corms. Weeds compete with saffron plants for nutrients, water, and sunlight, significantly impacting yield. Manual weeding is highly labour-intensive but effective. Two rounds of weeding are typically recommended: around mid-July, coinciding with the preparation of the field, providing aeration to the soil; and in mid-August, crucial for good saffron yield. Adoption of wheel hoes and power weeders can

significantly reduce labour costs and improve efficiency. Combining manual methods with preventive measures (e.g.,

proper land preparation, use of clean corms) is the most effective approach [22].



a) Different saffron corm sizes



b) Sprouting saffron corms



c) Bloomed saffron flowers in the field



d) Plucking of saffron flowers



e) Stigmas after separation from flowers (Final produce)



f) Vegetative phase of saffron

Plate 1 Saffron (*Crocus sativus* L.) - Developmental stages and final product

Saffron cultivation in Kashmir is susceptible to various pests and diseases that can cause significant yield losses. Integrated Pest and Disease Management (IPDM) is essential. Rodents (Voles, Mice, Porcupines, Rabbits) can cause severe damage by feeding on corms and leaves, especially during winter. Control methods include trapping, baiting (with caution), and physical barriers. Fumigant toxins can be used for moles. Saffron Bulb Mites (*Rhizoglyphus robini*) attack corms, leading to tunnels and cavities, resulting in shorter, thinner, and yellow leaves. Control involves using healthy corms, proper weed control, and pre-planting treatment of corms with fungicides/miticides. Avoid irrigating during summer

dormancy. Thrips cause white and yellow spots on leaves. Chemical control is usually not necessary due to the high population observed late in the season; IPM methods are recommended. Corm Rot (Disease Complex) is the most destructive disease, caused by various fungi including *Fusarium oxysporum*, *Fusarium solani*, *Rhizoctonia crocorum* (violet root rot), *Sclerotium rolfsii* and *Macrophomina phaseolina*. Waterlogging significantly exacerbates corm rot. Symptoms include discoloured and decayed corms, stunted growth, yellowing, and drying of leaves. Control measures include cultural practices such as ensuring excellent drainage, avoiding waterlogging, crop rotation, and soil solarization.

Corms can be treated with fungicides (e.g., Carbendazim, Mancozeb) before planting. Biological control using biocontrol agents like *Trichoderma spp.*, *Pseudomonas fluorescens*, and *Bacillus spp.* is also an option. Research and development of disease-resistant varieties is ongoing. Other diseases include Leaf Blight, Root Rot, and Turnip Mosaic Virus (TuMV). Integrated Pest and Disease Management (IPDM) Strategies involve the use of certified, disease-free corms, regular removal of weeds and plant debris (field sanitation), crop rotation to break disease cycles, optimal planting density and depth to prevent overcrowding and promote good air circulation, and proper drainage, which is the single most important factor in preventing corm rot [23]. Balanced nutrition also makes plants more resistant to pests and diseases. Judicious use of pesticides/fungicides, only when necessary and following recommended guidelines, minimizes environmental impact, and promoting beneficial microorganisms contributes to biological control.

Scientific harvesting and drying practices for high-quality saffron production

The delicate nature of saffron requires precise harvesting and careful post-harvest handling to preserve its quality and value [24]. Saffron flowers typically emerge from mid-October to early November. Harvesting usually begins when flowers first appear and is done in three pickings at intervals of 4 days. Flowers should be hand-picked gently in the early morning after

the dew has dried but before the flowers fully open. This ensures peak quality of the stigmas. Collect flowers in baskets with proper aeration (e.g., craft paper bags, plastic baskets, willow baskets) to prevent damage. Avoid prolonged exposure of picked flowers to direct sunlight [25]. Stigma separation should be done within 10-12 hours of flower picking to achieve maximum pistil recovery and preserve quality. Delaying separation can significantly reduce recovery. Carefully open each flower and gently pluck the three red stigmas (along with a small portion of the style) using fingers or tweezers. Drying is the most critical step in post-harvest processing, determining saffron's final quality, colour, aroma and flavour. Traditionally, in Kashmir, stigmas are spread on large shady surfaces and air-dried for 27-53 hours [26]. However, this method can adversely affect quality (e.g., crocin degradation) and is slower. Modern, controlled drying methods are highly recommended, such as hot air dryers at a controlled temperature of 40-50°C for 4-7 hours, solar saffron dryers/solar tunnel dryers utilizing solar energy to achieve optimal drying temperatures (40-50°C), and vacuum drying, an advanced method that can significantly reduce drying time and improve quality. Benefits of scientific drying include faster drying time, better retention of colour (crocin), bitterness (picrocrocin), and aroma (safranal), leading to superior quality saffron [27]. The Indian Institute of Kashmir Saffron and Technology Centre (IHKSTC) located at Dussu Pampore plays a crucial role in promoting these advanced drying techniques.

Table 1 Average weight of the parts of the flower that comprised one kilogram of fresh flowers

	Stigma (g)	Style (g)	Stamen (g)	Sepal and petal (g)
Fresh weight	47.39	28.93	59.35	864.33
Dry weight	9.48	3.26	14.78	98.36

The average weight of the parts of the flower that comprised one kilogram of fresh flowers is as follows: Stigma (g) Fresh weight 47.39, Dry weight 9.48; Style (g) Fresh weight 28.93, Dry weight 3.26; Stamen (g) Fresh weight 59.35, Dry weight 14.78; Sepal and Petal (g) Fresh weight 864.33, Dry weight 98.36.

Dried saffron is graded based on quality parameters such as colour strength (crocin content), flavour (safranal), and bitterness (picrocrocin). India has specific standards for saffron quality. Saffron should be stored in airtight, dark containers to protect it from light, air, and moisture, which can degrade its quality [28]. Saffron cultivation is highly remunerative due to its high value and low volume. Studies indicate a high benefit-cost ratio, making it an economically viable crop. The value of saffron has seen significant increases, with prices rising from Rs 80,000 per kg to Rs. 2,20,000 per kg in recent years (2021-22).

The post-harvest processing of *Crocus sativus* (saffron) is a meticulous and labour-intensive series of steps that crucially impact the final quality, flavor, and market value of the spice. Immediately after harvesting, the *mondatura* process is initiated, where the flowers are manually opened to separate the stigmas from tepals and stamens, often done with clean gloves to ensure hygiene. Despite some mechanical aids, the process remains dominantly manual, and it is extremely time-consuming—requiring approximately 370–470 labor hours to obtain just 1 kg of dry stigmas, with the remaining floral material becoming waste. The drying phase, following separation, is the most critical step in transforming fresh stigmas into high-quality saffron, as it induces the development of key sensory attributes—color, taste, and aroma—by regulating the degradation and transformation of major metabolites such as crocins, picrocrocin, and safranal [29]. It is

imperative to maintain drying conditions within optimal ranges (35–45 °C, relative humidity below 50%) to avoid the loss of water-soluble compounds and preserve the integrity of apocarotenoids. The conventional methods of drying differ regionally—sun-drying in India and Morocco, charcoal sieves in Italy, or food dehydrators in Australia—each affecting the microstructure, metabolite concentration, and bacterial contamination differently. Higher drying temperatures (90–110 °C) have been linked to improved dye strength due to enhanced crocin release, although they may compromise texture. Conversely, traditional sun-drying methods yield saffron with superior structural compactness and flavor, albeit requiring longer time and climate dependency. Non-conventional drying techniques such as freeze-drying, vacuum ovens, infrared, and microwave radiation have shown promising results in retaining crocin content and maintaining cellular integrity, though they are energy-intensive and cost-prohibitive. Freeze-drying especially preserves original stigma morphology and color, but vacuum drying can induce protuberances due to rapid moisture evaporation [30]. The process is deemed complete when stigmas retain slight elasticity and moisture content is below 12%, as stipulated by ISO 3632 standards. Once dried, saffron must be stored in airtight, light-protected containers to prevent oxidative and hydrolytic degradation of its bioactive compounds. Decomposition rates during storage are significantly influenced by environmental factors like humidity, temperature, and light, making both drying and storage pivotal in safeguarding the chemical and sensory integrity of this highly valued spice. Inappropriate handling at any stage can compromise the potency and authenticity of saffron, reducing its economic and culinary value [31].

Table 2 Comparative trends in area, production and productivity of saffron

Year	Rejuvenated under NSM (ha)	Rejuvenated cumulative total (area in ha)	Average yield of rejuvenated area (Kg/ha)	Area sown by the growers under traditional method (ha)	Average yield under traditional method (Kgs/ha)
2010-11	-	-	-	3715	2.70
2011-12	331	331	4.5	3384	2.75
2012-13	943	1274	4.5	2441	2.75
2013-14	528	1802	4.8	1913	2.80
2014-15	157	1959	1.5 (Floods)	1756	1.5 (Floods)
2015-16	176	2135	5.50	1580	2.80
2016-17	79.81	2214.81	5.49	1497	2.85
2017-18	172.90	2387.71	1.64	1323.75	0.0973
2018-19	74.29	2462	1.75	1253	1.08
2019-20	116.75	2578.75	4.7	1136.25	2.54

Source: India International Kashmir Saffron Trading Centre (IIKSTC)

The data presented in (Table 2) Comparative trends in area, production and productivity of saffron vividly illustrates the ongoing transformation within Kashmir's saffron industry, driven primarily by the strategic interventions of the National Saffron Mission (NSM) and the escalating pressures of climate change. The table distinctly categorizes cultivation into "Rejuvenated under NSM" and "traditional method," providing a clear contrast in their respective trajectories. Critically, the NSM's initiation in 2011-12 marked a concerted effort to reverse the declining fortunes of this 'red gold.' In the rejuvenated areas, a consistent and commendable increase in average yield is evident, often achieving more than double the productivity of traditional fields (e.g., 4.5-5.5 Kg/ha compared to 2.70-2.85 Kg/ha in early years). This uplift in productivity directly reflects the success of scientific cultivation practices championed by the Mission, including improved corm quality, optimized nutrient and water management (crucial in a predominantly rain-fed environment), and modern post-harvest techniques. The establishment of institutions like the India International Kashmir Saffron Trading Centre (IIKSTC) further supports this by providing essential infrastructure for scientific processing, quality control, and better market access [32]. However, the data also reveals the vulnerability of even rejuvenated areas to extreme weather events, as seen during the 2014-15 floods and the challenging years of 2017-18 and 2018-19, where yields significantly dropped, although they generally recovered better than traditional areas. Conversely, the traditional method of saffron cultivation paints a stark picture of decline. The area under traditional cultivation has consistently shrunk, from 3715 hectares in 2010-11 to just 1136.25 hectares by 2019-20, indicating a widespread abandonment of these practices by farmers. This reduction is largely attributable to stagnant or low yields, which are highly susceptible to unpredictable weather patterns and diseases like corm rot, leading to severe economic losses. The abysmal yield of 0.0973 Kg/ha in traditional areas in 2017-18 dramatically underscores their extreme vulnerability to climate change, which manifests as erratic rainfall, prolonged dry spells, and unseasonal temperatures [33]. While the NSM has undeniably enhanced productivity in its targeted regions and provides a blueprint for sustainable saffron cultivation, the continued decline in traditionally cultivated areas highlights the immense challenge of widespread adoption and the urgent need for a more comprehensive strategy to reach and uplift all saffron farmers. The overall trend suggests that while pockets of modernized saffron farming are thriving, the broader industry still grapples with the imperative of adapting to a changing climate and transitioning from age-old, less resilient practices to scientifically backed, sustainable methods to ensure the long-term prosperity and global standing of Kashmiri saffron [34].

Revitalizing saffron cultivation in Kashmir

The labour-intensive nature of saffron cultivation, particularly during harvesting and processing, provides significant employment opportunities for local communities, especially women. Challenges to economic viability include historically low yields, the susceptibility of high-value saffron to adulteration which can undermine market prices and consumer trust, and erratic weather patterns due to climate change posing a continuous threat to yields [35]. Recognizing the importance of saffron, the Indian government has launched significant initiatives to revive and promote its cultivation in Kashmir. The National Saffron Mission (NSM), launched in 2010-11 with a substantial outlay (Rs. 400.11 crore), aims to rejuvenate existing saffron fields (targeting 3,715 hectares), improve productivity (from 2.50 kg/hectare to a target of 7.5 kg/hectare in rejuvenated areas), provide irrigation facilities (tube wells, sprinklers), promote scientific cultivation techniques, establish infrastructure for post-harvest handling, enhance product quality, and facilitate better market access. The Indian Institute of Kashmir Saffron and Technology Centre (IIKSTC) / Saffron Park, established under the NSM, provides facilities for scientific post-harvest processing, including stigma separation, drying, grading, packaging, and marketing, helping farmers achieve better prices and combat adulteration. Kashmiri saffron has received a Geographical Indication (GI) tag, protected its unique identity and ensured authenticity, which helps farmers fetch premium prices and combat counterfeiting. Continued research by institutions like SKUAST-Kashmir focuses on developing disease-resistant corms, improved cultivation practices, and mechanization. The scientific cultivation of saffron in Kashmir holds immense promise for reviving its dwindling production and ensuring sustainable livelihoods for thousands of farmers. By integrating modern techniques in land preparation, corm selection, nutrient and water management, pest and disease control, and particularly in post-harvest processing, Kashmir can reclaim its position as a global leader in saffron production [36]. The success of initiatives like the National Saffron Mission, coupled with continuous research and active farmer participation, will be crucial in overcoming existing challenges and ushering in a new era of "Red Gold" prosperity in the valley. A holistic approach that combines traditional wisdom with scientific advancements is the key to saffron's vibrant future in Kashmir.

CONCLUSION

Saffron cultivation in Kashmir, a rich tradition steeped in heritage, stands at a critical juncture. This study underscores that while Kashmir's unique agro-climatic conditions are inherently suited for producing highly valued *Crocus sativus* L.,

the industry faces significant challenges from declining productivity due to over-reliance on traditional methods and the escalating impact of climate change. Erratic precipitation, rising temperatures, and the prevalence of corm diseases, exacerbated by a scarcity of healthy planting material, collectively threaten the sustainability of this economically vital crop. However, the path forward is clear: scientific cultivation methods are not merely an option but an imperative. This comprehensive guide has detailed a holistic approach, from meticulous site selection and soil management to advanced corm selection and planting techniques, optimized nutrient and water management strategies (including critical irrigation in a rain-fed context), and robust Integrated Pest and Disease Management (IPDM) protocols. Critically, the study emphasizes the need to modernize harvesting and post-harvest processing, transitioning from labor-intensive traditional practices to scientific drying methods that preserve saffron's unique

biochemical profile – its vibrant crocins, bitter picrocrocin, and aromatic safranal. The establishment of the Indian Institute of Kashmir Saffron and Technology Centre (IIKSTC) and the Geographical Indication (GI) tag for Kashmiri saffron are pivotal steps in this modernization, offering vital infrastructure and authenticity guarantees. Ultimately, the revitalization of Kashmir's "Red Gold" requires a synergy between traditional wisdom and scientific innovation. The National Saffron Mission (NSM), with its significant investment in rejuvenation, irrigation, and post-harvest infrastructure, exemplifies the commitment to this revival. By embracing these scientific advancements, fostering continuous research, and ensuring active farmer participation, Kashmir can overcome current obstacles, enhance saffron yields and quality, and secure sustainable livelihoods for thousands, solidifying its position as a global leader in saffron production and ushering in a new era of prosperity for the valley.

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