

Turning Flower Waste into Wealth: A Sustainable Future for Floriculture

Shriya Gupta¹ and Harish Kumar²

¹ PhD. Scholar, Division of Floriculture and Landscaping

² PhD. Scholar, Division of Post Harvest Management

Faculty of Horticulture and Forestry

Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatha, Jammu

INTRODUCTION

Floriculture is an important branch of horticulture that contributes to farmers' income, employment generation, rural entrepreneurship and economic development. In India, flowers are widely used for religious ceremonies, festivals, weddings and decorative purposes, leading to the generation of substantial quantities of floral waste. This waste mainly consists of wilted flowers, discarded garlands, petals, leaves, stems and unsold flowers. Improper disposal of floral waste through open dumping or discharge into water bodies can cause environmental pollution, unpleasant odours and deterioration of water quality. However, floral waste contains valuable organic matter, pigments, essential oils and other bioactive compounds that can be utilized to develop useful products. Various methods, including composting, vermicomposting and the extraction of natural dyes, can help convert floral residues into valuable resources. Other potential products include incense sticks, handmade paper, biofertilizers and decorative items. The utilization of floral waste can reduce environmental pollution, promote resource recovery and generate additional income opportunities for farmers and small-scale entrepreneurs. In Jammu and Kashmir, the effective management and value addition of floral waste can play an important role in promoting sustainable floriculture, supporting rural livelihoods and encouraging environmentally friendly waste management practices.

Keywords: Generative Artificial Intelligence, Sustainable Consumption Behaviour, Trust in Generative AI, Environmental Awareness, Young Consumers..

2. Magnitude and Sources of Floral Waste

Floral waste is produced at different stages of the floriculture supply chain, from flower cultivation and harvesting to transportation, marketing and final use. The amount and type of waste generated depend on several factors, including flower species, cultivation methods, seasonal variations, marketing practices, postharvest handling and the purpose for which the flowers are used.

2.1 Production and harvesting stage

Floral waste is generated during cultivation when flowers are damaged by pests, diseases or improper handling, or fail to meet market quality standards. Premature wilting and excess production during peak flowering seasons also contribute to waste. Additionally, leaves, stems and pruning residues removed during routine crop management increase the overall amount of floral waste.

2.2 Postharvest handling and grading

During harvesting, sorting, packaging and transportation, flowers may get damaged, lose freshness or become unsuitable for sale in premium markets. Flowers with a short vase life or minor defects are often discarded, even though they still contain useful natural compounds that can be recovered and utilized.

2.3 Wholesale and retail markets

Flower shops and retail markets produce large amounts of floral waste due to the short shelf life of flowers and changes in customer demand. Unsold flowers are often discarded with regular household and municipal waste at the end of the day. However, these flowers can still be used to prepare compost, extract useful compounds, produce natural dyes and develop other value-added products.

2.4 Religious and cultural activities

Religious activities are a major source of floral waste in India. Flowers such as marigold, rose, jasmine, chrysanthemum and lotus are commonly used for worship, garlands and temple decoration. After religious ceremonies, these flowers are often thrown into open areas, drains or water bodies. Festivals and pilgrimage sites can generate large amounts of floral waste within a short period, making its proper collection and management essential.

2.5 Weddings, hotels and public events

Flowers are widely used for decoration at weddings, exhibitions, conferences, hotels, restaurants and cultural events. After these events, floral arrangements, garlands and decorative structures are removed and discarded, generating large amounts of floral waste within a short time.

2.6 Household and post-consumer waste

At the consumer level, wilted bouquets, floral arrangements and religious offerings contribute to post-consumer floral waste. Although individual quantities may be small, their cumulative volume becomes significant in urban and semi-urban areas.

Thus, floral waste can be conceptualized as a continuous stream:

Production → Harvesting → Grading → Packaging → Transportation → Wholesale → Retail → Religious/Event Use → Household Consumption → Disposal

3. Global and Indian Context

Floral waste is a growing environmental concern worldwide due to the short shelf life of flowers, poor postharvest handling and fluctuations in market demand. In India, the widespread use of flowers for religious ceremonies, festivals and commercial purposes generates large quantities of waste. Major pilgrimage centres, such as Varanasi and Haridwar, produce considerable amounts of discarded flowers, some of which are improperly disposed of in rivers and other water bodies, contributing to water pollution and oxygen depletion. The problem is further increased by the mixing of flowers with plastic bags, synthetic threads and other non-biodegradable materials. However, floral waste contains several valuable components, including natural pigments, essential oils, cellulose, phenolic compounds and flavonoids. With suitable processing techniques, these materials can be converted into useful products, helping to reduce environmental pollution, recover valuable resources and promote sustainable floral waste management.

4. Floral Waste in Jammu and Kashmir

Jammu and Kashmir offers considerable potential for floral-waste utilization because of its floriculture activities, religious tourism, rich horticultural diversity and cultural traditions associated with flowers. Flowers are widely used in temples, shrines, festivals, weddings and other ceremonies, contributing to the generation of floral waste from both commercial and religious activities. Major religious sites, including Mata Vaishno Devi, Raghunath Ji Temple and several local temples and shrines, generate discarded flowers and garlands, particularly during festivals and peak pilgrimage periods. Without proper collection and segregation, these floral residues may become mixed with municipal waste or be disposed of in unsuitable locations.

A study conducted at Mahan Shiv Parvati Temple, Jammu, reported that floral-waste generation ranged from approximately 18–20 kg day⁻¹ during normal days to 40–45 kg day⁻¹ during peak days. Marigold accounted for the largest share of the waste (75%), followed by rose (14%), China rose (7%) and other flowers (4%). The study also demonstrated that aerobic composting could convert temple floral waste into nutrient-rich organic material. These findings highlight the potential for developing decentralized floral-waste management systems in Jammu and other religious centers. Similarly, initiatives at the Mata Vaishno Devi shrine have explored the conversion of discarded floral offerings into incense sticks and other value-added products, demonstrating opportunities for both environmental protection and livelihood generation.

Beyond religious sites, commercial flower cultivation, wedding decorations, hotels, tourism activities, urban flower markets and household practices also contribute to floral-waste generation in Jammu and Kashmir. Establishing local collection, segregation and processing facilities could help transform these residues into useful products, reduce environmental pollution and promote a sustainable waste-to-wealth approach in the regional floriculture sector.

5. Environmental Implications of Improper Floral-Waste Disposal

5.1 Water pollution

Direct disposal of floral residues into rivers, streams, drains and lakes introduces large quantities of biodegradable organic matter into aquatic systems. Microbial decomposition consumes dissolved oxygen and can negatively influence aquatic organisms. Nutrient release may also contribute to eutrophication under favourable environmental conditions.

5.2 Soil and groundwater concerns

Uncontrolled dumping can result in the accumulation of partially decomposed biomass and leachate. Depending on the composition of the waste and associated contaminants, leachate may affect surrounding soil and potentially groundwater quality.

5.3 Greenhouse-gas emissions

When organic waste is deposited under anaerobic or poorly aerated conditions, decomposition can generate methane and other gases. Therefore, uncontrolled disposal contributes to greenhouse-gas emissions and represents an inefficient use of carbon-containing biomass.

5.4 Odour and public-health problems

Accumulated floral waste rapidly undergoes microbial decomposition, producing unpleasant odours and creating favourable conditions for insects and microorganisms. Such conditions can reduce sanitation and negatively affect the surroundings of temples, markets and public places.

5.5 Loss of valuable biomass

Perhaps the most important concern from a circular-economy perspective is the loss of potentially valuable organic matter and bioactive compounds. Disposal eliminates the possibility of recovering nutrients, pigments, essential oils, antioxidants and other valuable constituents.

6. Floral-Waste Valorization: From Waste Management to Resource Recovery

Floral-waste valorization involves converting discarded floral biomass into products with economic, agricultural, environmental or industrial value. The most appropriate pathway depends on the flower species, degree of contamination, moisture content, availability of processing infrastructure and intended end product.

A hierarchical approach can be adopted:

Collection → Segregation → Cleaning → Size Reduction → Drying/Pre-treatment → Primary Processing → Extraction/Conversion → Product Development → Packaging → Marketing

The major valorization pathways are described below:

7. Organic Fertilizers, Compost and Vermicompost

Composting represents one of the simplest and most environmentally appropriate methods for managing large quantities of floral waste. Flower residues contain biodegradable organic matter and plant nutrients, making them suitable substrates for aerobic decomposition.

7.1 Aerobic composting

Aerobic composting involves the microbial decomposition of organic material under controlled oxygen availability. Floral waste can be mixed with complementary materials such as cow dung, agricultural residues or kitchen waste to achieve a suitable carbon-to-nitrogen ratio and moisture level.

Typical operations include:

- Collection and segregation of floral waste.
- Removal of plastic, threads, metal wires and other contaminants.
- Shredding or chopping to increase surface area.
- Mixing with appropriate bulking or nitrogen-rich materials.
- Composting in pits, tanks, windrows or suitable containers.
- Regular monitoring of moisture, temperature and aeration.
- Periodic turning to maintain aerobic conditions.
- Maturation and stabilization of the compost.
- Screening and packaging of the finished product.

The resulting compost can be used as an organic soil amendment in horticultural and floricultural production.

7.2 Vermicomposting

Vermicomposting uses earthworms and associated microorganisms to transform organic residues into a stabilized, fine-textured material rich in organic matter and plant nutrients. Properly pre-composted floral residues can be particularly suitable for vermicomposting because excessive heat and readily fermentable compounds are reduced before earthworm introduction.

7.3 Biofertilizer and microbial formulations

Further research may explore the use of floral residues as substrates for beneficial microbial consortia. Such approaches could facilitate the development of microbial-enriched organic fertilizers and soil amendments, although product quality, pathogen safety and regulatory compliance must be established before commercialization.

8. Recovery of Bioactive Compounds

Floral waste is increasingly being investigated as a source of high-value phytochemicals. Flowers and petals contain numerous secondary metabolites that can potentially be recovered through appropriate extraction technologies.

Important compounds include:

- Phenolic compounds
- Flavonoids
- Anthocyanins
- Carotenoids
- Essential oils
- Terpenoids
- Natural pigments
- Antioxidant compounds
- Cellulose and other structural polysaccharides

The use of environmentally friendly extraction technologies, including ultrasound-assisted extraction, microwave-assisted extraction, enzyme-assisted extraction and green solvent systems, can improve the recovery of selected compounds while reducing solvent consumption and processing time.

This provides an opportunity to develop floral-waste biorefineries, in which high-value compounds are recovered first, followed by utilization of the remaining biomass for compost, bioenergy or material applications.

9. Essential Oils and Aromatic Products

Aromatic floral residues can serve as potential sources of volatile compounds. Rose, jasmine, lavender and other aromatic flowers contain volatile constituents that have applications in perfumery, cosmetics, aromatherapy and personal-care products.

Traditional extraction methods such as steam distillation and hydrodistillation can be complemented by advanced techniques such as ultrasound-assisted extraction and microwave-assisted extraction. The selection of technology should consider extraction yield, energy requirement, quality of the volatile fraction, processing time and economic feasibility.

For Jammu and Kashmir, lavender is particularly relevant because of the expansion of lavender cultivation under aromatic-crop development programmes. Residual lavender biomass after essential-oil extraction could be further investigated for the production of incense, candles, soaps, room fresheners, compost and other products, thereby increasing the overall utilization efficiency of the crop.

10. Natural Dyes and Pigments

Flower petals represent an important source of natural pigments. Marigold, rose, China rose and other coloured flowers contain carotenoids, anthocyanins and related compounds that can potentially be used as natural colourants.

Natural pigments may find applications in:

- Textile dyeing
- Handmade paper
- Cosmetics
- Natural paints
- Herbal colors
- Craft products



Figure 1: Preparation of Natural Dyes from Flowers Waste

Source: NDTV Swachh India. (2018, December 10). 33-Year-Old Makes Khadi Colours From Floral Waste In Bihar. [ndtv.com](https://www.ndtv.com).

The use of floral waste for pigment extraction is particularly attractive because the raw material has already lost its ornamental value but may retain significant pigment content.

11. Incense Sticks, Dhoop and Religious Products

Incense manufacturing represents one of the most practical routes for floral-waste valorization in religiously important regions. Dried petals can be powdered and combined with suitable natural binders and aromatic ingredients to manufacture incense sticks, cones and dhoop. This pathway has several advantages. It requires comparatively modest capital investment, can be undertaken at small or medium scale and can provide employment opportunities for women SHGs and rural youth.



Figure 2: Conversion of Floral Waste into Agarbatti/Dhoop Products

Source: Reuters. (2021, March 19). Recycling flowers: One man's mission to clean up the sacred Ganga river. Moneycontrol. moneycontrol.com.

For Jammu and Kashmir, locally generated floral waste could be transformed into products carrying regional identity, thereby linking environmental management with cultural entrepreneurship.

12. Biodegradable Materials and Floral-Based Biomaterials

The cellulose-rich fraction of floral biomass has attracted attention for the development of biodegradable materials. Depending on processing and formulation, floral residues may be converted into handmade paper, composite sheets, packaging materials, fibre-based products and other biodegradable materials. Recent innovations have also demonstrated the possibility of converting flower-derived cellulose into leather-like biomaterials. Such products represent an emerging field of research in which agricultural and floral residues are converted into alternatives to conventional petroleum-derived materials. Further research is required to optimize fibre extraction, mechanical properties, moisture resistance, biodegradability, scalability and economic feasibility.

13. Soaps, Candles and Personal-Care Products

Dried petals and floral extracts can be incorporated into a range of artisanal consumer products, including soaps, candles, bath salts and decorative personal-care products. Floral pigments, fragrances and botanical extracts can provide aesthetic and sensory value. However, products intended for direct skin contact or human consumption require appropriate safety evaluation, quality control, allergen assessment and regulatory compliance. Therefore, commercialization should be based on scientifically validated formulations rather than simply incorporating untreated floral waste into consumer products.

14. Herbal Teas and Nutraceutical Applications

Selected edible and medicinal flowers may have potential for use in herbal beverages, functional foods and nutraceutical products. Marigold, chamomile and other botanically suitable flowers contain bioactive compounds that have attracted research interest. However, this pathway requires considerably greater quality control than composting or incense production. Floral material intended for food applications must be correctly identified, free from pesticides and contaminants, hygienically processed and evaluated for safety. Therefore, only suitable flower species and appropriately managed production systems should be considered for food applications.

15. Handicrafts and Decorative Products

Not all floral waste needs to undergo chemical or biological processing. Flowers that retain suitable colour and structural characteristics can be dried and transformed into:

- Potpourri
- Dry-flower arrangements
- Greeting cards
- Decorative frames
- Floral jewellery
- Wreaths
- Handmade paper
- Festival decorations
- Gift products
- Educational and artistic materials

Such activities are particularly suitable for women SHGs, cottage industries and rural artisans because they can be initiated with relatively low capital investment.

16. Bioenergy and Biorefinery Applications

Floral waste can also serve as a substrate for bioenergy production. Depending on its composition and moisture content, possible pathways include anaerobic digestion, fermentation, pyrolysis and other thermochemical or biological conversion technologies.

Anaerobic digestion can convert biodegradable organic matter into biogas and digestate. The biogas may be used for thermal energy or electricity generation, while the digestate can potentially be utilized as a nutrient-rich soil amendment after appropriate treatment.

The biorefinery concept is particularly promising because it seeks to maximize the value obtained from a single biomass stream. For example:

Floral waste → high-value phytochemical extraction → pigment/fragrance recovery → fibre recovery → compost/bioenergy from residual biomass

Such cascading utilization can improve resource efficiency and reduce the amount of material requiring final disposal.

17. Socio-Economic Opportunities

Floral-waste valorization can contribute significantly to rural entrepreneurship and livelihood diversification. Small-scale processing units can be established near temples, flower markets, commercial floriculture clusters and urban centers.

Potential beneficiaries include:

- Floriculture farmers
- Flower vendors
- Temple management committees
- Women SHGs
- Farmer-producer organizations
- Rural youth
- Self-employed artisans
- Small and medium enterprises
- Start-ups
- Cooperatives

Women SHGs can particularly benefit from low-cost activities such as incense production, dry-flower crafts, handmade paper, candles and decorative products. More technologically advanced activities such as extraction of essential oils and phytochemicals can be developed through collaborations among universities, research institutions and private enterprises.

18. Role of Institutions and Policy Support

Successful floral-waste valorization requires coordination among multiple stakeholders. Local governments and municipal authorities can establish dedicated collection systems at major flower markets and religious sites. Temple administrations can introduce segregated collection bins specifically for floral offerings.

Agricultural universities and research institutions can contribute through:

- Characterization of floral waste
- Development of optimized processing technologies
- Product formulation
- Nutritional and phytochemical analysis
- Safety assessment
- Shelf-life studies
- Pilot-scale validation
- Life-cycle assessment
- Techno-economic analysis
- Entrepreneurial training

Government programmes supporting waste management, rural entrepreneurship, self-help groups, start-ups, skill development and circular bioeconomy initiatives can further facilitate commercialization.

Conclusion

Floral waste is a valuable resource that is often discarded, causing environmental problems and the loss of useful natural materials. Through proper collection and processing, it can be converted into compost, natural dyes, incense sticks, essential oils and other value-added products. In Jammu and Kashmir, the region's floriculture potential and religious tourism offer promising opportunities for floral-waste utilization. Adopting sustainable waste management practices can help reduce pollution, generate employment and support rural livelihoods. Therefore, transforming floral waste into useful products can promote a circular economy and make floriculture more sustainable, giving practical meaning to the concept of "Turning Flower Waste into Wealth."

References

- Dutta, S., & Kumar, M. S. (2021). Potential of value-added chemicals extracted from floral waste: A review. *Journal of Cleaner Production*, 294: 126280.
- Gupta, S., Tewari, S. K., & Pathak, S. (2023). Temple floral waste for various bio-products in India. In *Recent Trends in Solid Waste Management* (pp. 293–307).
- Kumari, S., Kothari, R., Kumar, V., Kumar, P., & Tyagi, V. V. (2021). Kinetic assessment of aerobic composting of flower waste generated from temple in Jammu, India: A lab-scale experimental study. *Environmental Sustainability*, 4(2), 393–400.
- Masure, P. S., & Patil, B. M. (2014). Extraction of waste flowers. *International Journal of Engineering Research and Technology*, 3, 43–44.

