

Technology for Utilization of Floral Waste and Corresponding Products- A Review

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Abstract— Flowers are used as an offering to God at religious places and for decoration at houses and public places. Being an offering, the discarded flowers do not find their way to the conventional disposal system. Instead these are discarded in rivers or around the trees creating environmental problems. The techniques for their proper disposal should be identified. These techniques are Vermicomposting, Anaerobic digestion, dyeing, Paper manufacturing. This not only provides for proper disposal but also produce utility products like incense sticks, manure, natural dye, handmade paper and bio gas. Therefore, these technologies provide for eco- friendly way of floral waste disposal along with economic benefit.

Index Terms— Floral waste, Waste management, Vermicompost, Biogas, Incense sticks, Natural dye, Handmade paper

1 INTRODUCTION

Waste accumulation is the major concern threatening the world. The causes of massive waste accumulation could be attributed to population growth demanding rapid urbanization and limited availability of land. Waste gets generated from almost each and every activity and eventually degrades the quality of human health and accelerates the deterioration of the environment in an alarming proportion. The municipalities are responsible for management of solid wastes in the locality. But due to lack of financial resources, organization and complex structures they have been failing in handling of solid wastes [1]. The viable solution to the problem of solid waste disposal would be better knowledge of its composition. The solid waste has been categorized world over for better handling. Similarly, In India it has been categorized as Biodegradable waste (kitchen waste and paper), Recyclable materials (paper, glass items, metals and certain plastic), Inert waste matter (construction and demolition waste), Composite waste (waste clothing, waste plastic), Domestic hazardous waste (waste medicine, batteries, shoe polish etc.) [2]. India a culturally vibrant and religious nation practices religion strictly and celebrate festivals daily. In this practice huge quantity of flower is discarded as the waste at temples, mosques, churches, dargahs, gurudwaras, hotels, banquets and houses. Being an offering to God, flowers do not find its way to the conventional waste disposal system. As a result it is discarded into rivers and streams, thereby polluting already polluted water bodies. Varanasi is called the city of temples which discards 3.5- 4 tonnes of flower waste daily [3]. The KR flower market in Bengaluru alone generates 15- 20 tonnes of floral waste daily [4].

2 UTILIZATION TECHNOLOGY AND PRODUCT

Degradation of floral waste is a very slow process as compared to kitchen waste degradation [5]. Therefore there is a need of proper and eco-friendly process for floral waste treatment. The floral waste generated can be used for making natural Holi colors, rose water essence, natural dyes, incense sticks, handmade paper and for various ornamental purposes. The technologies for floral waste utilization and the corresponding products from it are discussed as under.

2.1 Vermicomposting- Manure

Vermicomposting is a biotechnological process of composting, in which certain species of earthworms are used to better waste conversion and produce an enriched end product. It is a mesophilic process, utilizing microorganisms and earthworms that are active at 10-32°C (not ambient temperature but temperature within the pile of moist organic material). This process is faster than composting. The resulting manure is rich in microbial activity, plant growth regulators and has pest repellence attributes. Thus these worms are capable of transforming garbage into gold. Compost and vermicompost are the end products of aerobic composting process, the latter with using earthworms. Kohli and Hussain [6] produced 2.75 kg of vermicompost by mixing 5 kg each of flower waste and cow dung. Alternating layers of farm waste, floral waste and cow dung were placed and around 200 hundred earthworms were spread in partially digested material with 60 percent moisture content. Vermiwash obtained was diluted with water and sprayed on plants as anti- fungal agent. The obtained vermicompost had higher C/N ratio. Tiwari and Juneja [7] mixed flower waste and cow dung in different proportions and reported that 50:50, 60:40 and 70:30 gives nutrient rich vermicompost. Similarly, Sharma et al. [8] produced vermicompost by mixing floral waste, cow dung and saw dust. Singh et al. [9] reported that vermin compost made from floral waste has better C/N and C/P values as compared to vermicompost made from kitchen waste and farm yard waste. Vermicomposting of temple waste obtained from Ganesh temple, Sangli, Maharashtra was done by Gaurav and Pathade

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[10]. They mixed the effluent from biogas digester with temple waste and cattle dung. This was then allowed to decompose for a period of 30 days at 30°C. The vermicompost obtained was used as a fertilizer with five flowering plants. It was reported that good growth parameters were obtained in terms of height, flowering time as well as the number of flowers produced as compared to the control set up, which were not treated with vermicompost. Hence, vermicomposting of flower waste is an excellent and eco-friendly method of flower waste management. Jadhav et al. [5] have reportedly developed a microbial consortium for the effective degradation of flower waste generated from temples. It was observed that microbial consortium enhanced the digestion of the waste and the bio-manure consortium was found to have good quality without posing any harm to the environment. Sailaja et al. [11] reported that growth rate of plants grown in vermicompost made from temple waste was more as compared to the respective control. In their study, they checked nutrient status and microbiological activity of vermicompost prepared. They reported that Vermicomposting from flowers contains enzymes that stimulate plant growth and discouraged plant pathogens resulting in good plant yield.

Hence awareness should be created among the temple authorities, pilgrims and waste handling persons to adopt vermicomposting in large scale to have clean environment and financial independence.

2.2 Paper Industry- Handmade paper

Paper is a fundamental part of most aspects of society; worldwide a total of approximately 300 million tonnes of paper is produced every day and 90% of this paper is produced from mature pulp wood [12]. Paper industry is timber based which is responsible for the diminishing forest cover. The production paper has adverse effects on the environment like deforestation, water pollution from the paper mill discharges and toxicity caused by inks and dyes. Hence there is a need for alternatives that could replace the conventional methods and reduce the adverse effects on environment. In this respect handmade paper is an alternative to conventional paper which has not only become an important source of livelihood as a small scale industry but also an eco-friendly form of paper production. The handmade paper made from flower waste has the advantage of being 100% wood free, it is free from all chemicals and leaves no harmful by products during the manufacturing which makes it the eco-friendly form of paper around [13]. Apart from being made of 100% recycled waste, the paper itself is recyclable. Hence, the concept of reduce; reuse and recycle can be very well implemented in handmade paper making.

2.3 Herbal Products- Incense Sticks

Burning incense sticks and greeting god with flowers adversely affect the environment. Incense sticks are burnt at temples and households during the religious festivals. Incense smoke (fumes) contains particulate matter (PM), gas products and many organic compounds. Methods have been developed to make herbal incense sticks using flower wastes. Under a Project named Mission Sakshama initiated by CSIR- CIMAP,

Lucknow aimed at utilizing waste flowers, the floral waste is converted to Incense sticks [14]. On an average 1,500 agarbattis (incense) can be made from one kg raw material (filling material as flower powder and binding material) through this technology. Flowers like genda are used to make incense sticks. The method has been discussed below-

- Temple wastes are collected in separate dustbins.
- The flowers are then segregated and set out to dry.
- The dried flowers are powdered and mixed with binding powder and saw dust.
- The charcoal is mixed in the mixture to make it combustible.
- Prepare distilled water and add to incense mixture slowly. Knead the incense dough slowly.
- This mixture is rolled over bamboo sticks to produce final product.
- Binding materials used may be 'Gum Arabic' or 'Makko' (an incense powder material derived from tree bark).

2.4 Anaerobic Digestion- Biogas

With increasing demand for energy and cost effective environmental protection, anaerobic digestion biotechnology has become focus of worldwide attention. Anaerobic degradation or digestion can be defined as a biological conversion process without external electron acceptor such as oxygen as in aerobic process or nitrate/sulphate as in anoxic processes. In the anaerobic process organic carbon is converted by subsequent oxidations and reductions to its most oxidized state (CO₂), and to its most reduced state (CH₄). A wide range of microorganisms catalyze the process in the absence of oxygen. The major advantages of anaerobic digestion are low sludge production, low cost, high energy efficiency and process simplicity, compared with other waste treatment methods. Moreover it offers a positive environmental impact since it combines waste stabilization with net fuel production and allows the use of the effluent as fertilizer. Biogas is a mixture of gases composed of methane (CH₄) 40 – 70 vol.%, carbon dioxide (CO₂) 30 – 60 vol.%, other gases 1 – 5 vol.% including, hydrogen (H₂) 0 – 1 vol.% and hydrogen sulphide (H₂S) 0 – 3 vol.%. It originates from bacteria in the process of bio-degradation of organic material under anaerobic (without air) conditions. The natural generation of biogas is an important part of the biogeochemical carbon cycle. In the absence of oxygen, anaerobic bacteria decompose organic matter as follows:

Organic matter + anaerobic bacteria \longrightarrow CH₄ + CO₂ + H₂S + NH₃ + other end products + energy

The use of floral waste in biogas production is advantageous as flowers gives higher yield of bio gas that too at a faster rate [13]. Kumar and Swapanvahini [15] have produced biogas from flower waste containing rose petals with reduced amount of Total Solids, Volatile Solids, Chlorides and BOD.

2.5 Textile Industry- Natural Dye

Enormous amount of flower waste is produced in temples of India which can be utilized in making dyes for dyeing of cotton, wool and silk on industrial scale. Singh et al. [16] has used flower waste for the natural dye production and the

biomass obtained in the process has been converted to bio char thereby implying double benefit from floral waste utilization. Vankar et al. [17] have used Marigold from temple flower waste for producing natural dye. As per the study *Tagetes erecta* (marigold) consists of colorants called carotenoids-lutein and flavonoid-patuletin, which have been identified, isolated and used for dyeing textiles. Pretreatment with 1-2% of metal mordant and 5% of plant extract was also done. The dye enhancement was found to be 52%, 46% and 51% higher in cotton, silk and wool respectively as compared to conventional dye without using metal mordant. Jadhao and Rathod [18] has reported use of wasted French Marigold flowers (*Tagetes patula*) for making patuletin dye which has better anti-oxidant properties. Raja et al. [19] extracted dye from waste saffron petals which showed good dyeing properties like light fastness when used on Pashmina fabric.

3 FLORAL WASTE UTILIZATION IN INDIA – EXAMPLES IN PRACTICE

Few examples of Management and utilization of flower waste are as discussed below.

3.1 Kashi Vishwanath Temple

The foot fall of devotees is very high at the Kashi Vishwanath temple all-round the year, especially in the month of Shrawan. It has its own system for the disposal of the hundreds of kilograms of waste resulting from offerings by devotees which is converted into manure [3].

3.2 Ajmer Sharif Dargah

Another case where floral waste management has yielded good results is that of Ajmer Sharif Dargah of Khwaja Moinuddin Chishti where about 15 to 18 Quintals of flowers, offered each day were dumped in a well. Now, the flowers are not only recycled, but also generate employment for local women. With technical assistance from Central Institute of Medicinal and Aromatic Plant (CIMAP), Lucknow, the Dargah Committee has established a rose water distillation plant at the outskirts of Ajmer [20].

3.3 Pushpanjali Prawah

Youth Fraternity Foundation (YFF), an organization based out of Delhi, has undertaken a project Pushpanjali Prawah meaning the flow of flowers. A container termed as Pushpanjali Prawah Patra has been kept at the public places for the immediate disposal of the flowers, which were subsequently disposed by their volunteers at an appropriate place. This tremendously helped in the reduction of pollution in Yamuna River [21].

3.4 Temples in Walkeshwar, Mumbai

Few temples in Mumbai have adopted religious practices ensuring sustainable living. The flowers offered every day are converted into compost. This practice not only eliminates their disposal but also provides manure for soil. These efforts have been initiated by an organization called Vishwa, which is committed to environmental conservation and sustainability. The organization encouraged temples in the identified zones

to convert the Nirmalya (floral offerings) into manure by composting it. There are at least 20 temples in the Banganga area of Walkeshwar, majority of them immersed flowers in the Banganga pond on a regular basis. Often, these came with plastic bags, oil and kumkum, which contains acid, that adversely affect the aquatic life in the pond. One of the temples at Walkeshwar (Parasuram Temple) consented to do composting in their premises. During normal days, the quantity of flowers offered ranged from 2-3 kilograms a day. During Shrawan, it reached up to 7-8 kilograms. By composting, the offerings got dignity and in the bargain, the environment got enriched as well [22].

3.5 Temples in Pammal, Tamilnadu

Mangalam Balasubramanian, founder of Exnora Green Pammal (EGP), has been involved in Temple waste management in Pammal town in Tamil Nadu. As a part of the project, the organic waste generated at temples is now disposed in a responsible and eco-friendly way. The two temples in Pammal, namely Arulmigu Aarkeshwarar and Vinayak temple reuse the waste they create. They have set up bio-gas plant that utilizes leftovers, fruits and other organic offerings to produce biogas, which is used to make prasad at temple itself. The sludge coming out of biogas plant is used as manure for temple's garden [23].

3.6 Chandrika Devi Temple, Lucknow

The flowers offered at famous Chandrika Devi Temple, Mankameshwar Temple and Devan Sharif in Lucknow are utilizing flowers in different ways with the help of Central Institute of Medicinal and Aromatic Plants, a CSIR laboratory in Lucknow. The women folk from the villages around the area collect the flowers from these places and convert them into incense sticks and sell them at puja stalls in these places. It generates source of income for them. The roses collected from the Devan Sharif mazar are converted to rose water by distillation technology provided by scientists at CIMAP. Such an initiatives by CIMAP and Local Women have considerably reduced the pollution of Gomti river [24].

3.7 Help us green – NGO

An organization named Help Us Green in Kanpur collect the flower waste from different places of worship in Kanpur. They convert these disposed flowers into bio-fertilizers and lifestyle products. The flowers are mixed with organic cow dung and treated with natural components like coffee residue, corn cobs and earth worms are added after few days. The end product is a dark, odourless and nutrient rich material that work as a great soil conditioner. This product has been named Mitti and helps to improve soil texture for better growth of plants. While 80% of the flowers are used to make vermicompost, the rest are crushed and made into incense stick and yajna/havan items. For manufacturing these items the organization has employed 85 women from different self-help groups in villages around Kanpur, thus providing them with a source of income. Since people do not throw away packets that have pictures of Gods and Goddesses on them the havan/yajna items are packed in seed paper embedded with tulsii seeds. The discarded packets will grow into beautiful plants when

they come in contact with soil. The flowers from ten temples and three mosques in Kanpur are being utilized. The products are exported to Germany and Switzerland and are available online at Amazon, Flipkart and E-commerce [25].

4 CONCLUSION

The review of various methods of utilizing temple waste for one or the other useful product like vermicompost, biogas, dyes, incense sticks, handmade paper suggest that the temple waste can not only be disposed safely in an environmental friendly manner but can also be utilized for making different products. This study proposes an alternative approach to waste management since the waste is neither land filled nor burnt but could be used as a resource for manufacturing useful products. It would further help temples in generating additional revenues. Floral waste utilization would eventually be beneficial to the society as people would get to live in a cleaner and a healthier environment.

Hence awareness should be created among the temple authorities, pilgrims and waste handling persons to adopt vermicomposting in large scale to have clean environment and financial independence. The floral waste generated can also be used for making natural holi colours, rose water, essence, natural dyes, incense sticks, mottling of paper, handmade paper making and various ornamental purposes. This will help in reducing the burden on overburdened waste disposal problem in India. The "green temple concept" can prove to be helpful in Government policy formulation for waste management and in promoting sustainable development approach towards temples.

REFERENCES

- [1] S.J. Burnley, "A review of municipal solid waste composition in the United Kingdom", *Waste Management*, vol. 27, pp. 1274-1285, 2007.
- [2] R. Joshi and S. Ahmed, "Status and challenges of municipal solid waste management in India: A review", *Cogent Environmental Science*, 2016, doi: <http://dx.doi.org/10.1080/23311843.2016.1139434>
- [3] N. Mishra, "Temple Waste, A Concern" *Times of India*, <http://www.timesofindia.indiatimes.com>. 2013, August 17.
- [4] R. Gowalla, "The Not So romantic Story of Bengaluru's Floral Waste", *The Times of India*, <https://timesofindia.indiatimes.com/city/bengaluru>. 2019, February 21.
- [5] A.R. Jadhav, M.P. Chitanand and H.G. Shete, "Flower Waste Degradation Using Microbial Consortium", *Journal of Agriculture and Veterinary Science*, vol. 3, no. 5, pp. 1-4, 2013.
- [6] R. Kohli and M. Hussain, "Management of Flower Waste by Vermicomposting." *International Conference on Global Trends in Engineering, Technology and Management*, pp. 34-37, 2016.
- [7] P. Tiwari and S.K. Juneja, "Management of Floral Waste Generated From Temples of Jaipur City through Vermicomposting." *International Journal of Environment*, vol. 5, no. 1, 2016.
- [8] D. Sharma, K.D. Yadav and S. Kumar, "Biotransformation of Flower Waste Composting: Optimization of Waste Combinations Using Response Surface Methodology." *Bioresource Technology*, vol. 270, pp. 198-207, 2018.
- [9] A. Singh, A. Jain, B.K. Sarma, P.C. Abhilash and H.B. Singh, "Solid Waste Management of Temple Floral Offerings by Vermicomposting Using *Eisenia Fetida*." *Waste Management*, vol. 33, pp. 1113-1118, 2013.
- [10] M.V. Gaurav and G.R. Pathade, "Production of Vermicompost from Temple Waste (Nirmalya): A Case Study", *Universal Journal of Environment and Research Technology*, vol. 1, no.2, pp. 182-192, 2011.
- [11] D. Sailaja, P. Srilakshmi, Shehanaaz, H. Priyanka, D.L. Bharathi and A. Begum, "Preparation of Vermicompost from Temple Waste Flowers." *International Journal of Science Innovation and Discoveries*, vol. 3, no. 3, pp. 367-375, 2013.
- [12] H. Muralaeddharan and K. Perumal, "Eco friendly Handmade Paper Making", *Shri AMM Murugappa Chettiar Research Centre, Chennai, India*, 2010.
- [13] M.S. Waghmode, A.B. Gunjal, N.N. Nawani and N.N. Patil "Management of Floral Waste by Conversion to Value-Added Products and Their Other Applications", *Waste and Biomass Valorization*, 2016, doi: 10.1007/s12649-016-9763-2
- [14] IANS, "Recycling Flowers Empowers Rural Women." *The Free Press Journal*, <https://www.freepressjournal.in/webspecial/recycling-flowers-empowers-rural-women>. 2013, January 25.
- [15] M.S. Kumar and K. Swapanvahini, "Nutrient Reduction and Biogas Production of Rose Residue by Anaerobic Digestion in a Batch Reactor." *International Journal of Advanced Research in Science and Technology*, vol. 1, no.2, pp. 125-129, 2012.
- [16] P. Singh, R. Singh, A. Borthakur, S. Madhav, V.K. Singh, D. Tiwary, V.C. Srivastava and P.K. Mishra, "Exploring Temple Floral Refuse for Biochar Production as a Closed Loop perspective for Environmental Management." *Waste Management*, vol. 77, pp. 78-86, 2018.
- [17] P.S. Vankar, R. Shanker and S. Wijaypala, "Utilization of Temple Waste Flower- *Tagetes Erecta* for Dyeing of Cotton, Wool and Silk on Industrial Scale", *Journal of Textile and Apparel, Technology and Management*, vol. 6, no. 1, 2009.
- [18] N.U. Jadhao and S.P. Rathod, "The Extraction Process and Antioxidant Properties of Patuletin Dye from Wasted Temple French Marigold Flower", *Asian Journal of Plant Science and Research*, vol. 3, no. 2, pp. 127-132, 2013.
- [19] A. S. M. Raja, P. K. Pareek, D. B. Shakyawar, S.A. Wani, F.A. Nehvi, and A. H. Sofi, "Extraction of Natural Dye from Saffron Flower Waste and its Application on Pashmina Fabric." *Advances in Applied Science Research*, vol. 3, no. 1, pp. 156-161, 2012.
- [20] S. Khyati, "With CIMAP Help, Flowers at Ajmer Dargah to Bring Jobs", *The Indian Express*, <https://indianexpress.com/article/cities/lucknow>. 2010, May 10.
- [21] "Volunteers Urge People Not to Pollute Yamuna with Puja Items." *The Hindustan Times*, <https://www.hindustantimes.com/delhi>. 2012, April 2.
- [22] S. Chatterjee, "Worship With a Green Turnover", *The Times of India*, <https://timesofindia.indiatimes.com/home/environment>. 2010, July 16.
- [23] S. Kurian, "The Face of Waste Management." *The Hindu*, <https://www.thehindu.com/news/cities/chennai>. 2017, February 17
- [24] S. Pandey, "Women Turn Waste Into Wealth", *The Deccan Herald*, <https://www.deccanherald.com/special-features/a-close-connect-893239.html>. 2018, November 19.
- [25] "Kanpur Startup Working to Cleaning Ganga." <https://helpusgreen.com/media>. 2020, February 28.