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Flower Waste Management : A Review

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ABSTRACT

According to Indian Government data, there are about 108,000 temples and mosques and flowers are offered by devotees in temples and mosques every day and are left dump in the landfill or sent to water bodies for disposal which later becomes waste. Nearly 80, 00,000 tons of waste flowers are dumped in the water bodies every year. India being a country of many festivals and lots occasions are celebrated round the year which eventually leads to the generation of solid waste. This causes a foul smell when they degrade as well as they pollute the water body causing serious problems. This proportion of waste is neglected and always tends to blame the industrial waste but never give a think to flower pollution which causes major environmental issues due to its highly biodegradable nature. Some cities in India are known for temples and pilgrimages and in such cases, the flower waste content is increasing over tenfold. Floral waste can be utilized in different ways and can thus it can help to save the environment from pollution caused due to improper disposal of flower waste. Floral waste is known to contained adequate nutrients and other lignocellulosic materials. It can be utilized for compost making, biofuel and biogas generation, extraction of dyes and essential oils, making of holi-color and also to produce valuable eco-friendly products like incense sticks, soaps, handmade paper, besides using them for some art and craft techniques.

In this paper, we have reviewed the ways by which flower waste can be utilized, managed to get valuable products and thus conserving the environment are explained.

Keywords Flower, Floral waste, Vermicomposting, Bio fuel, Natural dye.

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INTRODUCTION

One of the most severe issues in India's major cities is solid waste management (SWM) and this is due to population growth, inadequate technology, lack of maintenance. Religion is a path of life in India and an intrinsic element of the entire Indian culture. It

was estimated that around 800 million tons of flowers are offered across the temples, mosques, gurudwaras and other worshiping centers in India (Subhojit 2018). Because of religious beliefs, many people avoid throwing flowers and other items that are used for prayers in the garbage and instead put them in the plastic bags and throw them directly in the water bodies or in open land inappropriate way. Harmful pesticides and insecticides are used when flowers are grown and they remain as residue on the flower and as a result, when thrown into the water body it gets merged with water thereby polluting the water. Flowers also come as waste from various sources like hotels, marriages, gardens, temples, churches and various other cultural and religious ceremonies.

The degradation of floral waste is a very slow process as compared to kitchen waste degradation (Jadhav *et al.* 2013). Therefore to avoid the hazard there is a need for waste treatment. For any waste management process, Recycling, Reuse and Recover plays a very vital role. Several organizations are working towards recycling and reusing flower waste. But flower pollution continues to rise and that's simply because people are not treating the flower waste effectively. Hence to avoid ill effects caused by the disposal of these offerings, there is a need to make some valuables and various eco-friendly products.

Problems caused by the negligence of flower waste

In India flowers are used for various purposes for offering to deities in religious places for worship, making garlands, bouquets, as a decorative item and social gatherings and as a result of this approximately 300 MT of flower waste is produced per day and it is one of the major constituents of municipal solid waste (Singh *et al.* 2013) and since temple offerings are considered sacred in India, discard them in landfills is discouraged and most temples throw flower waste into local water bodies such as sea, rivers, ponds and lakes. About, 8 lakhs of flower waste are dumped in the Indian rivers each year (Anisha 2017) and these flowers rot in water bodies, killing fishes and creating damage in the ecosphere of the water body and cause water pollution. Organic matter present in the flowers decomposes which results in algal blooms and eutrophication in lakes and these led to further depletion of oxygen levels in the water bodies and cause marine life to die. Various drains and waterways connected to the water bodies also get clogged, decayed flowers may also cause pollution problems on land and which ultimately altered the ecosystem. Floral waste is said to account for 16 % of the total pollution of the river (Subhojit 2018).

Management

Vermicomposting

One of the bioremediation methods is vermicomposting. Vermicomposting is a bioconversion, oxidation process of organic materials and involves a joint action of earthworms and microorganisms which is widely being used for solid waste management. In this process, earthworms feed on the flower waste and convert it to vermicompost and vermiwash. Vermicomposting of temple flower waste is an excellent and eco-friendly method to get valuable products that will lead to a healthier and waste-free environment.

Gurav and Pathade (2011) utilized temple waste for treatment methods like Biomethanation and vermicomposting. The earthworm *Eudrilus eugeniae* was used for this study. The slurry from the biomethanation process was mixed with the admixtures of temple leaves and flower waste along with cattle dung and later mixed with biogas digester effluent and kept for partial decomposition for 30 days and then used for vermicomposting. They conclude that the temple waste when vermicomposted are highly rich in nutrient.

Jadhav *et al.* (2013) collected soil samples from the areas near and around the temples and bacteria were isolated from these samples. Collected flower waste was dried and mixed with agar medium andstreaking was performed with selected soil samples for isolation. It was observed that microbial constrium enhances the digestion of the waste and the bio-manure constrium was found to have good quality and posed no harm to the environment.

Sailaja *et al.* (2013) examined the nutrient status and microbiological enumeration of the vermicompost prepared from temple waste and concluded that

the growth rate of plants grown in vermicompost was more as compared to the respective control. Vermicomposting contains plant hormones like auxin and gibberellins and enzymes which are believed to stimulate plant growth and discouraged plant pathogens.

Tiwari (2014) conducted a study to utilize and manage floral waste obtained from ten popular temples of Jaipur city and to reduce the floral waste, vermicomposting technology was used. Marigold (floral waste) was collected, segregated and composted in earthen pots in different ratios. Various parameters like pH, temperature, moisture content, organic carbon, available phosphorus were evaluated for the vermicompost obtained. It was proved from the study that flowers can be used as a substrate for vermicomposting.

Aruna *et al*. (2016) Pre-composted flower waste at 30°C and used as a substrate for vermicomposting by earthworm species *Eisenia foetida* for 90 days. It was found to contain a sufficient concentration of microelements like zinc, manganese, iron and copper and the bacteria which was isolated from vermiwash showed various enzyme activities like protease, cellulase, phosphatase, amylase, gelatinase and lipase. The vermicompost obtained was effective for the growth of the *Tagetes erecta* and *Solanum melongena*.

Makhanial and Upadhyay (2015) Composting of floral waste by heap type composting method and evaluated the physico-chemical parameter like temperature, pH,electrical conductivity, moisture content and volatile solid samples. Maximum temperatures were found on the 4th day of heap composting and then decreased gradually. The pH decreased within 7-8 days and increased within 12 days. Minor fluctuations were observed in electrical conductivity. The moisture content increased within 7 days and then started to decrease. Covering the heap with a polythene sheet helps in fungal growth and increases in temperatureand proved that composting is an effective "zero–waste" method for treating organic waste like flowers.

Nisha Jain (2016) studied the different proportions of a mixture of cattle dung and floral wastes and performed vermicomposting process using Eisenia foetida earthworm species. Various proportions of floral waste and cattle dung were taken for the experimental work, Control (Garden soil), 50:50: (50% flower waste + 50% cow dung+ earthworm), 60:40: (60% flower waste + 40% cowdung + earthworms) and 70:30: (70% flower waste +30% cow dung + earthworms). The bioconversion ratio i.e., wastes into vermicompost was found to be high in 50:50 (maximum height 42 cm, 146 number of leaves, length of roots as 24 cm and a maximum diameter of the stem as 0.8 cm in four weeks) in tomato plants. Vermicomposting led to lowering of EC, C: N ratio, C: P ratio and increase in nitrogen, phosphorus, potassium, calcium, magnesium and sulfur.

Ravinder Kohli and Hussain (2016) experimented on vermicomposting process using *Eudrilus eugeniae* earthworm species. Portable HDPE vermi beds were used with 200 earthworms while the moisture content was maintained at 60%. At the end of the vermicomposting process (45 days), parameters like C/N ratio, pH and electrical conductivity (EC) were checked. It was found that there was a reduction of pH from alkaline to the neutral condition, EC increased on 15th day and reduced on 35th and 45th day of composting and C/N ratio decreases and shows enhanced mineralization efficiently.

Sharma and Yadav (2017) developed an approach to optimize the quantity of flower waste and determine the maturity during the vermicomposting of flower waste by using response surface methodology (RSM). *Eisenia foetida* was used for vermicomposting of flower waste with cowdung. The experimental finding shows that compost obtained from the vermicomposting of flower waste and cow dung contains sodium, potassium and phosphorus and these are beneficial for plant growth. The compost is suitable for organic manure which reduces the quantity of waste by converting it into valuable products.

Natural dye, pigment extraction and essential oils

Khan and Rehman (2009) Rosa species were used for extracting and analyzing the essential oil. Various parameters were assessed such as oil yield, color and other physical and chemical properties of Rosa damascene and Rosa centifolia. From their study, it

was concluded that the aroma constituents of essential oil have quantitative and qualitative differences in chemical composition.

Vankar *et al.* (2009) concluded that flower waste can be utilized in making dyes for the dyeing of clothes i.e.,cotton, wool and silk on an industrial scale. Marigold (*Tagetus erecta*) petals which mainly consist of carotenoids-lutein and flavonoid-patuletin are used, these colorants were identified, isolated and used for dyeing textiles. Innovative dyeing showed good results on textiles. Pretreatment with 1-2% of metal mordant and 5% of plant extract was found to be satisfactory and showed a very good result to dye cotton, wool and silk.

Perumal *et al.* (2012) collected flowers from five temples of Chennai, Tamil Nadu and around 2,350 kg of flowers were offered every day. The flowers offered were rose, marigold, chrysanthemum and jasmine. Out of all flowers collected rose petals were shade-dried to extract essential oils from them by using a steam distillation process. The chemical components of rose oil were analyzed by GC-MS technique. 54 compounds were found out of which phenyl ethyl alcohol was recorded as a major component (23.19%), then by octadecane (10.49%), hexadecane (7.76%), phenyl ethyl decylester (5.77%) and tetra methyl trisilocen decanol (3.45%).

Raja *et al.* (2012) petal part of the saffron flower was used to extract dye for application on the Pashmina shawl. The extracts are then applied on Pashmina wool at two different pH (4-5 and 7-8) with and without the use of mordant. The results showed that saffron flower waste extracts were able to dye the Pashmina shawl with very good washing and light fastness properties.

Naquvi *et al.* (2013) analyzed the volatile oil of *Rosa damascena* obtained by hydrodistillation of the petals using gas chromatography and gas chromatography/mass spectrometry method. It was observed that variation occurs in hexacosane, octacosane, octadecanoic, nonadecane, patchouli alcohol and t-cadinol and concluded that the variation of oils depends on their genetic variations, geography, time of collection, stages of plant growth and seasonal and environmental factors.

Jadhao and Rathod (2013) carried out an extraction process of patuletin dye from French marigold flower and concluded that it has antioxidant properties. It was found that the extracted patuletin dye showed good antioxidant properties in sulfuric acid medium, nitric acid medium and hydrochloric acid medium and reported that patuletin dye has no hazardous effect, easily degradable, pollution-free and used in antioxidant treatment.

Teli *et al.* (2013) isolated natural dyes from the flowers of hibiscus and marigold and dyed them on the cotton and cotton/silk blended fabric with the help of different natural mordents like alum and ferrous sulfate. And concluded that the dyes thus extracted show very good potential to dye cotton and cotton/silk blended fabric.

Ravishankar *et al.* (2014) reported that around 1450 tonnes of flowers (Rose, jasmine, marigolds, chrysanthemum, hyacinth, hibiscus and tuberose) are being offered to the deities in various temples all over the country. For the extraction of dyes, flowers were dried and ground and were dissolved in solvents such as ethanol, methanol and hexane. While for the extraction of essential oils, the soxhlet apparatus was used. A mixture of fresh flower and suitable solvent were heated and put in soxhlet apparatus and the distillate obtained gives the desired product. They concluded that the dye thus extracted gives satisfactory results and can be used on clothes.

Singh *et al.* (2017) studied the natural dye foundin various biodegradable temple waste and household wastes. The extracted natural colors were produced by ultrasonication and then dried in the spray drier. They were used for the dyeing of various fabrics such as cotton, silk and wool and the remaining residue, left after dye extraction, was rich in nutrients and reported that it can be further used as the resource material, itself.

Biogas and biofuel production

Prasad *et al.* (2011) experimented to determine

the biogas yield production by using temple flower waste. Tests were conducted in control by following parameters such as pH, temperature, Retention time, Moisture content, C/N. Biogas production was achieved in 10 days in a single-phase lab-scale reactor under ambient conditions. The pressure of biogas was 0.44kg/cm^2 in the reactor.

Kumar and Swapnavahini (2012) worked on biogas production and analyzed the nutrient reduction potential of the rose residue by anaerobic digestion in a batch reactor. 2.5 L batch reactor was used which was filled with rose residue and kept for digestion for 30 days retention period at room temperature. Various parameters like Total Solids (TS), Volatile Solids (VS), Chlorides, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Kjeldahl Nitrogen (TKN) were analyzed at 5 days interval. The process removed up to 73%, 45%, 82%, 42%, 58% of TS, VS, chloride, BOD, TKN respectively along with the production of biogas. While the gas production was reduced due to the pickling of the reactor.

Singh and Bajpai (2012) conducted an experiment on anaerobic digestion of flower waste for methane production. For this gas chromatographer was used to determine the quality of gas produced and it was conducted in cold atmospheric conditions in Lucknow. They concluded that the process eliminates the pollution effects caused by flower disposal and also removed pollutants like BOD and TS and produced biogas in the process.

Ranjitha *et al*. (2014) to generate biogas using vegetable waste and flowers waste using 1L capacity anaerobic digester and cow dung as inoculum in a Lab. It showed that flowers produced a higher yield of biogas i.e., 16.69 g/kg than vegetable waste i.e.9.089 g/kg and the digestion period of flowers was less. They concluded that flowers that are abundantly available in India are very good feedstock for biogas production and the generation of biogas from these flowers can turn waste into wealth in enhancing sustainability.

Depanraj *et al.* (2015) described the anaerobic digestion of vegetables (Banana, Cauliflower, potato and sweet potato) and flower wastes (Rose, sambangi, gulmohar, marigold, golden shower tree, silk tree mimosa) in a 1L capacity of anaerobic digester using pig manure as an inoculum. The results obtained showed that the marigold flower had given a higher yield of biogas than vegetable wastes and the digestion period was less. The average biogas production potential of withered flowers was observed as 14.36 g/kg in 5 days, where in the case of vegetable wastes it was 10.0234 g/kg in 6 days.

Kulkarni and Ghanegaonkar (2019) use novel alkaline pretreatment, solar heating of the digester, and co-digestion technique along with food waste and flower wastes. Biogas yield increased by 106% in novel alkaline pretreatment using sodium carbonate and sodium bicarbonate while Solar heating of the digester increases the biogas output by 122% and co-digestion of the floral waste with food waste developed the biogas output by 32.6% a. Raw biogas from floral waste released 57% methane at the same time.

Handcrafted products from flower waste

Flower wastes are used by many communities to make incense sticks. Many flowers like marigolds, roses, jasmine, hibiscus are used as raw materials. The flowers are segregated, dried and pulverized. The rotten flower petals can be used for making herbal homemade soap using suitable soap ingredients such as sodium hydroxide or lye in crystal form. Flower waste can be converted into various useful products such as pigments, colors, foodstuffs, sugar syrup, biofuels, compost, biogas, organic acids, bioethanol. In Shirdi, Maharashtra, approximately 2 MT of flower waste are treated every day to get 80 kg of agarbatti and used in the same premises of Shirdi Sansthan in Pooja to Shirdi Saibaba (CPHEEO 2018).

Floral waste from the temples is used for making handmade papers. Reduces the flower waste discarded from urban temples and also recycle it as eco-friendly paper and reuse it (Waghmode *et al.* 2018).

Handmade paper produced from floral waste has a lot of benefits as it is 100% wood-free with no chemicals added and does not leave any danger-

Sl. No.	Technologies available	Product	Technology provider
1	Technology for utilization of waste	Incense sticks from waste flowers	CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow Website : www.cimap.res.in
2	Dehydration of flowers and foliage technologies	Artistic greeting cards, wall plates, landscapes, three-dimensional interior decorative items	CSIR-National Botanical Research Institute, Lucknow Website : www.nbri.res.in
3	Eco-friendly dyeing and antibacterial finishing of soya been protein fabricusing waste flowers from temples	Natural dye	Department of Fibers and Textile Processing Technology, Institute of Chemical Technology, Matunga (E), Mumbai 400019, India
4	Production of vermicompost from temple waste	Vermicomposting of temple waste is an excellent and eco-friendly method of temple waste management	Department of Microbiology, K.W. College, Sangli, Maharashtra and Department of Biotechnology, Fergusson College, Maharashtra
5	Utilization of temple waste flower for dyeing of cotton, wool and silk on industrial scale		Indian Institute of Technology, Kanpur

Aakanksha 2018.

ous by-products during manufacture (Dumitrescu *et al.* 2004).

Technologies are available in India that can solve the problem of waste flower and help to augment existing enterprise or start a new one.

CONCLUSION

Temple waste flowers make significant environmental and human health impacts. This proportion of waste is neglected and we always tend to blame industrial waste but never give a think to flower pollution which causes major environmental issues. From this literature reviews, it can be concluded that the exploitation of floral waste from temples and flower markets can be converted into valuable products such as pigments, incense sticks, food products, compost, biofuels, biogas, bioethanol, handmade paper which have a variety of use. Awareness of floral waste will reduce the heap of floral waste load in the society and floral waste utilization would turn to be beneficial to the society as people would get to live in a cleaner and healthier environment. The "green temple concept" can prove to be helpful in government policy formulation for waste management and in promoting a sustainable development approach towards temples.

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