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Functional Integration of Rural Communities with Propulsive Urban Growth Centre in their Vicinity through Nature Base Solutions

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1 ABSTRACT

Haridwar, being a religious town with 18 most visited famous temples, about 34 quintals of flowers are supplied daily for religious offerings. Given the constant demand for temple flowers in the sacred city of Haridwar, there is an opportunity to cultivate them within the nearby villages and supply them to temples and flower sellers. Once used in temples, these flowers can be reused for extraction of essence and essential oil, making incense stick, natural colors and compost and production of bioenergy. This approach not only proves economically viable but also aligns with environmental sustainability, creating livelihoods in a harmonious manner.

The present paper identifies these growth drivers by combining functional demand of Urban area (Haridwar City) and functional supply of Rural areas (Gaindikhata Rural Cluster). A unique Self-sustaining Circular Economy Ecosystems (SCEE) is created through the functional linkages of Haridwar's urban areas and Gaindikhata's rural areas. The paper discusses the Rural-Urban Circular functional linkages approach which not only generates employment but also streamlines complex processes for a more efficient system. The paper analyses the potential of floriculture in combination with other potential value-added functions such as medicinal, aromatic products as well as bio- energy. The existing paper promotes the functional integration between rural communities and nearby urban growth centers through nature-based solutions to foster sustainable development, improve quality of life, and address environmental challenges.

After understanding the sustainable practices for both rural and urban populations, the present paper promotes creating of skilled workforce that can contribute to eco-friendly initiatives, identifies the development of small-scale enterprises in rural areas, such as recycling units, agro-processing units and ayurvedic medicinal units creating economic opportunities for both Rural-Urban local communities. By implementing these nature-based solutions, the paper created a more holistic and sustainable integration between rural communities and nearby urban growth centers, ensuring the well-being of both environments and their residents.

Keywords: functional linkages, circular economy, sustainable development, linking rural-urban economy, rural-urban functional integration

2 INTRODUCTION

India with many religions, floral offerings are common in all the religious ceremonies and festivities. Therefore, India, being a spiriual country has vast potential in floriculture sector. In this sector Marigold flower possesses vital role in various auspicious ceremonies and temples. In these occasions flowers are discarded after single use and considered to be sacrosanct so that they canont be disposed with other waste for decomposition. Moreover, there is no proper handling strategies for this waste. This huge amount of flower waste of religious places contain high organic content resulting in a very slow decomposition process (Jadhav et al, 2013) and, therefore, creates air, water and land pollution. With increasing numbers of visitors in the religious places the requirement of the flowers and consequently the generation of enormous number of waste has increased (Samadhiya et al., 2017). To date disposal of temple flowers in most of the holy cities of India is a major challenge (Padmavathiamma et al., 2008; Murthy, and Naidu.2012; Wani et al., 2013).

Haridwar, one of the most visited pilgrim towns with 18 most visited famous temples, requires about 34 quintals of flowers for its daily religious offerings (Author, Primary Survey 2022). Marigold is the common

flower for this purpose. Due to lack of proper disposal nearly 90% of the flower offerings are found as flower debris lied in the city as unattended waste and dumped into the river Ganges as well. With constant demand of flowers for the temples in the sacred city of Haridwar, there is a requirement to cultivate them within the nearby villages for the supply to temples and flower sellers and there is an urgent need to manage this huge amount of floral waste sustainably.

3 ACTION RESEARCH AREA: GAINDIKHATA CLUSTER

Gaindikhata Cluster, located in Bahadrabad Block of Uttarakhand is 25 kms away from Haridwar towards Nazimabad on NH 74 (Figure 1). This cluster contains 7 Gram Panchayats comprising of 25 villages, with geographical area of 19268.70 Hect. The total population of the cluster is 58109 persons (during 2022) with 10565 number of households. The cluster represents typical characteristics of physical and geographical setting, like plain, undulating terrain, hills and mountain topography; micro-climatic variation, good forest cover under the shadow of big urban centre, i.e. Haridwar City.

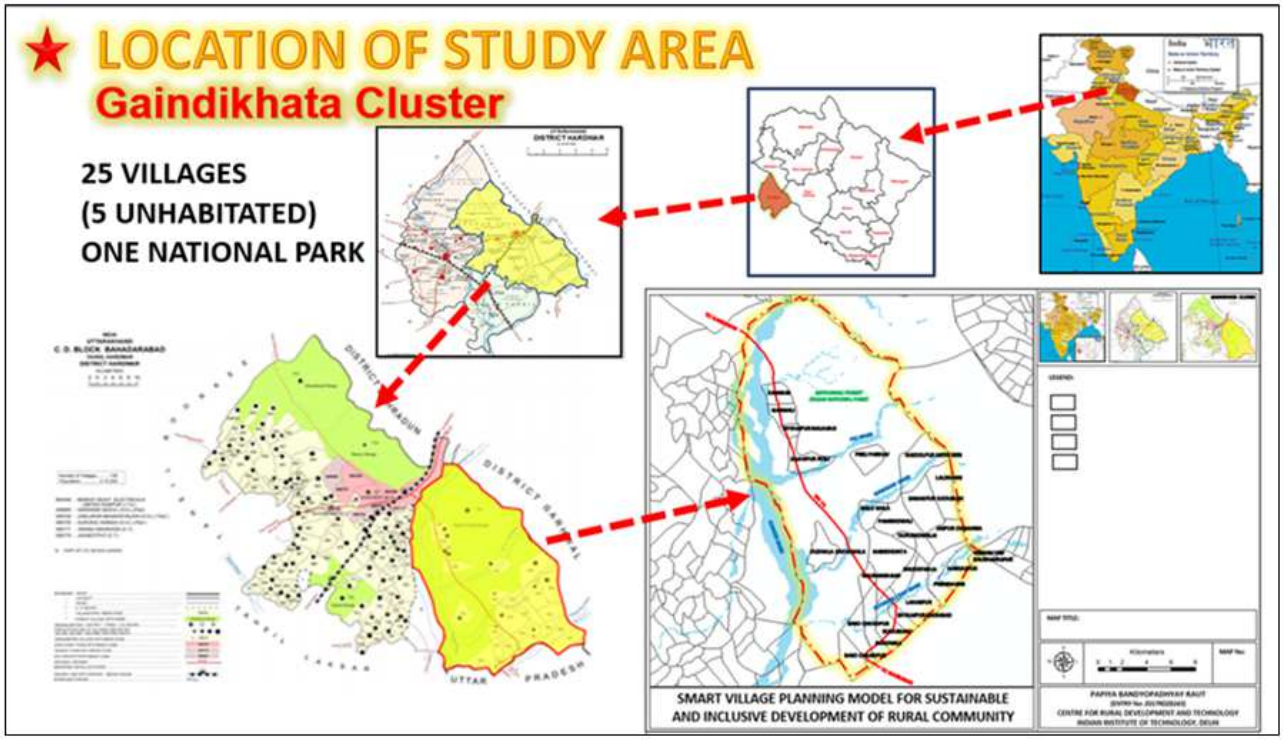


Fig 1: Location of Action Research Area: Gadikahata Cluster

Gaindikhata Cluster dominated by on farm (i.e. agriculture) as main activity and so the mainstay of the economy but at subsistence level. The present paper is an action research to increase the quality of life by enhancing the economic opportunities and diversification of economy by introducing the concept of Self-sustaining Circular Economy Ecosystems (SCEE) (Figure 5) by creating the functional linkages between Haridwar, as an urban area, and, Gaindikhata cluster as rural areas. Though the present action research explored many SCEEs related to medicinal plan cultivation, horticulture, sericulture, animal husbandry, small scale handicraft industries, village base tourism and eco-tourism, agro-forestry, food base industries etc, for this present paper SCEE of floriculture has been discussed. Hence, the present paper analyses the potential of floriculture in combination with other potential value-added functions such as medicinal and aromatic products as well as bio- energy. The existing paper promotes the functional integration between Gaindikhata Cluster's rural communities and nearby Haridwar urban growth center through nature-based solutions to foster sustainable development, improve quality of life, and address environmental challenges.

At present Floriculture, mainly Marigold cultivation is found in only four villages, i.e. Kangri (0.58 Hect.), Gajiwali (3.51 Hect.), Sajanpur Peeli (2.87 Hect.) and Shyampur Nauabad (1.33 Hect.) villages covering net 8.29 Hect. which is 0.31 percent of total agriculture area in the cluster. With increasing demand of Marigold in Haridwar this area is experiencing a continuous trend of expansion under Marigold cultivation. As per the analysis for identification of potential areas (91.24 Hect.), it is proposed to increase the Marigold cultivation area during the year 2024 as 306.20 Hect. which is 11.54 percent of total existing agricultural area with

estimated production of 138.42 quintal per day per Hect. The existing production of Marigold in the cluster is 3.65 quintal per day per Hect (Table 1)

Sr. No.	Village Name	Existing Marigold Flower cultivation Area (2024)	Potential Areas (2024)	Proposed Area (2024)	Annual Production (in quintal)	Production per day (in quintal)
1	Gajiwali	3.51		3.51	579.15	1.59
2	Hardaspur		12.82	12.82	2114.48	5.79
3	Kangari	0.58	1.13	208.39	34384.35	94.20
4	Lahadpur		30.21	30.21	4983.91	13.65
5	Padmowali		47.08	47.08	7768.98	21.28
6	Sajanpur Peeli	2.87		2.87	473.55	1.30
7	Shyampur Nauabad	1.33		1.33	219.45	0.60
	Total	**8.29**	**91.24**	**306.21**	**50523.86**	**138.42**

Table 1: Village wise Per Day Proposed Production of Marigold Flowers during 2024 (area in Hectare). Sources: Primary Survey by Authors, 2022.

4 CONCEPT OF CIRCULAR ECONOMY THROUGH FUNCTIONAL INTEGRATION BETWEEN RURAL HINTERLAND AND URBAN AREAS.

The huge amount of flower waste causing air, water and soil pollution is a challenge for the Municipality. It is required to have a proper and ecofriendly process for disposal and management of flower waste. The flowers which are being dumped, several value-added products can be prepared from these. It can be used for making value added products like incense stick and herbal colors, natural dyes, medicine, decorative items, handmade paper, food production, pigments, biofuels, compost, bioethanol (Bhattacharya et al., 2012; Ranjitha et al., 2014; Waghmode et al., 2016). As it contains enough nutrient and lignocellulosic material, it can be used for bioenergy and biofuel production to achieve sustainable energy demands. Basically, Environment friendly methods can be adopted to manage and treat this floral waste in a cost -effective way to develop useful products on sustainable manner (Bundela, et al., 2010; Jain et al., 2016). All these nature base solutions will enhance the job opportunity in the rural hinterland of the cluster through the functional integration with Haridwar urban center.

Government of India has launched Horticultur Mission for North East and Himalayan (HMNEH) States. This programme provides funds for promotion of floriculture though demonstration of technology and technological deployment, production of quality planting material, organic farming, efficient water management and plant health. Formation of Self-help group (SHG) at village level, managing funds from HMNEH, capacity building of the SHGs of Gaindikhata Cluster will integrate the functionality between the rural communities and Haridwar urban centre leading to promote nature base solution to address circular economy and environmental challenges of flower waste disposal.

Fig 2: PRA with local community

5 METHODOLOGY ADOPTED

In order to have first-hand information Participatory Rural Appraisal (PRA) technique has been conducted with different resource groups of Kangri, Sajanpur Peeli, Gajiwali, Peelipadav, Jaspur Chamaria, Samaspur Katabarh and Tapadowali villages (Figure 2 &3). Existing Resource Mapping, Seasonality Chart of the marigold production, Land-use mapping, problem tree analysis and problem matrix analysis were taken up with classified group of respondents of these villages. Simultaneously, actual field measurement to appreciate the ground conditions and to bridge the information gap has also been taken up. In this course of action both the qualitative and the quantitative data have been collected to supplement each other and to have the complete picture of the action research area.

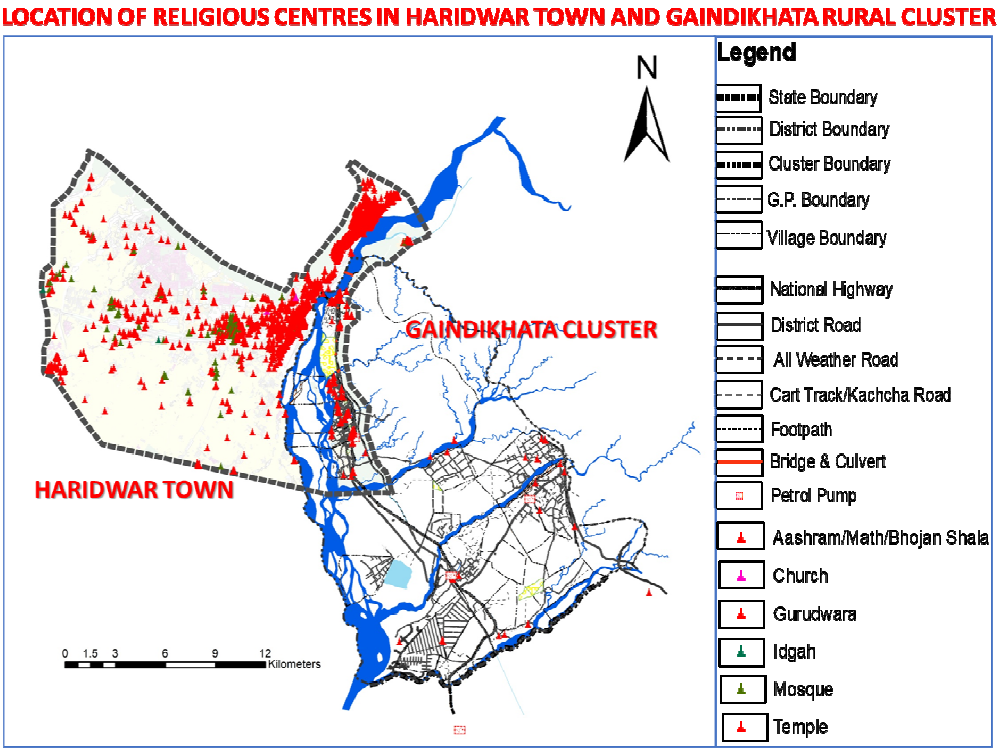
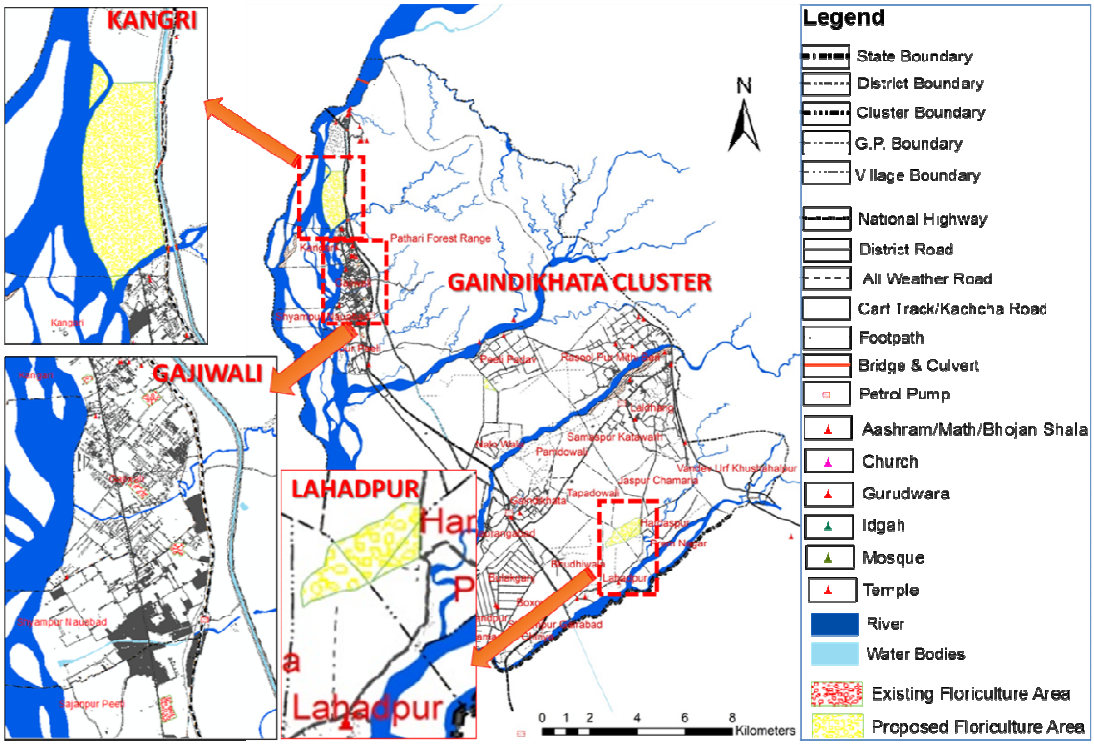


Fig 3: Location of Religious Centres in Haridwar town and Gaindikhata Rural Cluster



6 POST HARVEST VALUE ADDED PRODUCTS OF MARIGOLD

6.1 Incense Stick Production from Marigold Waste (Value-added Products)

In most of the Indian households lighting Incense sticks, Agarbatti and Dhoop symbolizing the religious practice of worship. The CSIR – CIMAC (Council of Scientific and Industrial Research – Central Institute Medicinal and Aromatic Plans) Lucknow has taken up a project ”Sakshma” which utilizes an innovative technology using flowers waste and leaves for incense sticks production. This innovative technology significantly addressed the associated problems of toxicity of smoke generated from typical charcoal -based incense sticks by using a massive amount of dried floral waste. In this technology the marigold waste is dried and mixed with binding agents (gums and makko powder) along with a small amount of charcoal to make it combustible. It has been able to reduce the poisonous smoke and harmful gases and help in combustion. It is found that 1500 Incense sticks could be made from 1 kg or raw material (Sakshama). Thus, Marigold can be utilized to prepare economical commercial product, providing job opportunity with low to no side effects. Bhoksa Basti of Jaspur Chamaria is selected for this incense dhup, agarbati making. Bhoksa community women of Jaspur Chamaria have already formed several Self-Help Groups (SHG). One hand roll incense stick making unit to collect 300 kg of flower waste from Haridwar to produce 4,50,000 incense sticks with 150 manpower, which can be marketed to Haridwar. Hence, three units are proposed in Gaindikhata Cluster, one unit each in Samaspur Katabarh, Jaspur Chamaria and Tapadowali villages. Out of total marigold flower waste which is 3094 Kg, 900 Kg of waste can be used in these three incense stick units providing employment to 450 households. Department of Horticulture and Horticulture Mission for North East and Himalayan States (HMNEH) will provide funds for training and capacity building, skill updation,. SHG formation and required fund arrangements.

6.2 Marigold Essential Oil and Herbal Medicines (Medicinal and Cosmetics Products)

In the flavor and fragrance industries the demand for marigold is rising. The extraction of flavonoids from marigolds can be used as anti-inflammatory, antioxidant properties. The marigold petal contains high level of lutein content. These petals are significant therapeutic products for herbal medicines. Marigold oil produces strong aromatic oil which is called Tagetes oil, generally used in cosmetics and perfume industry. This oil as an antiseptic can also be used to relieve sunburn, warts, itching, acne, sores dry skins. Therefore, it develops as a resource and exhibits great potential for contributing circular bio -economy. One extraction unit of Essential Oil is proposed at Kangri village with the total production of 81.54 Kg per day from 10,442 kgs of fresh marigold flowers per day which further can be marketed at Haridwar. Farmer can earn profit of Rs 80,000/- after spending of Rs 10,000/- per hectare each year (Figure 4).

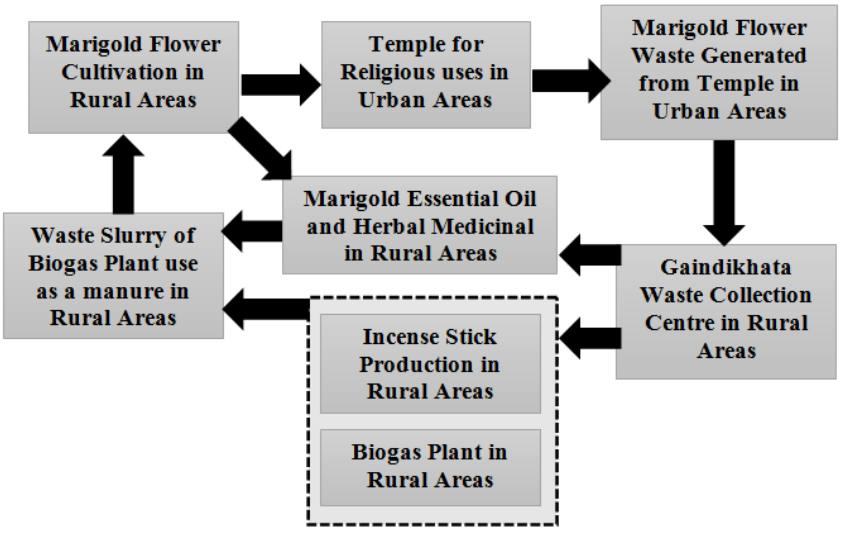
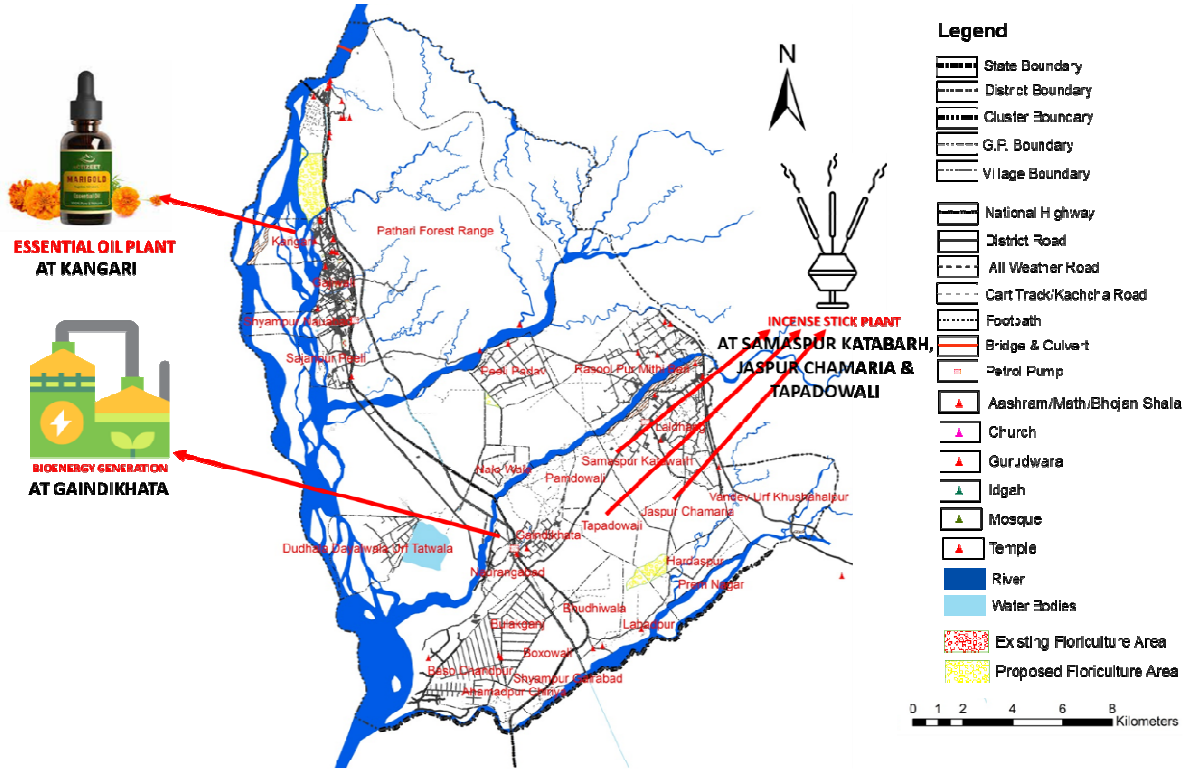


Fig 5: Example of Self-Sustaining Circular Economy Ecosystems (SCEE)

Oil extraction scheme can be formulated as individual entrepreneurship or a group of individual or company or as SHG to handle this agro –based enterprise. Department of Horticulture and Jila Yojna will provide the necessary funds and training for setting up the extraction unit under Growth Centre Scheme.

6.3 Bioenergy Generation through Marigold Flower Waste

Flower waste by using anaerobic digestion technology can be used as raw material to produce biogas (Lakshmi and Vijayalakshmi, 2017). A potent greenhouse gas is Methane (Singh and Bajpai, 2011). The huge amount of temple flower waste can be used for biogas production. It will reduce emission of methane in the atmosphere and soil pollution from decomposition of flower waste (Rashed and Torii, 2015). Moreover, the energy requirement for cooking purpose will also be met. The biogas produced from flower waste can be used as a source of heat for cooking purposes or can be used in electricity production (Kulkarni and Chane Gaonkar 2019). The amount of biogas to be produced from one kg of marigold flower waste is 120.46 liters per day. (Shrastha, Chaulagain and Shrastha, 2017). Hence, with the waste of 2194 kg it is estimated that 264289 liters of Biogas can be produced per day which can support about 117 households in Gandikhata village. This eco-friendly approach will reduce the carbon footprint. The waste generated from Biogas plant will be used as manure in cultivation areas. The Unnat Bharat Abhiyan (UVA) under Indian Institute of Technology, Delhi will take up the initiative for proving tangible infrastructure and knowledge dissemination for fostering awareness (Figure 6).



7 CONCLUSION

The action research-based paper tries to attempt to develop Self-sustaining Circular Economy Ecosystems (SCEE) by creating the functional linkages between Haridwar as an urban centre and Gaindikhata cluster as rural hinterland through enhancing the economic opportunities and diversification of economy through nature-based solution. After understanding the sustainable functional practices for both rural and urban communities, the present paper promotes circular economy that can contribute to eco-friendly initiatives, identifies the development of small-scale enterprises in rural areas, such as recycling labour incentive incense sticks units, essential oil extraction units, further use of essential oil for ayurvedic medicinal units and bioenergy generation units creating circular economic opportunities for both Rural-Urban local communities. By implementing these nature-based solutions, the paper created a more holistic and sustainable integration between rural communities and nearby urban growth centers, ensuring the well-being of both environments and their residents.

8 REFERENCES

Bhattacharya A., Saini V., Gupta A.: Novel application of mahua (Madhuca sp.) flowers for augmented protease production from aeromonas sp. Sl Nat. Prod, Commun. 7, pp. 1359-1362, 2012.

Bundela P.S., Gautam S.P., Pandey A.K., Awasthi M.K. and Sarsaiya S.: Municipal solid waste management in Indian cities: A review, International Journal of Environmental Sciences 1,4, pp. 591-606, 2010.

Jadhav A.R., Chianand M.P. and Shete H.G. (2013). Flower waste degradtion using microbial consortium, IOSR Journal of Agriculture and Veterinary Science, 3(5) pp. 1-63

Jain, N (2016). Waste Management of temple floral offerings by vermicomposting and its effect on soil and plant growth. Internatoional Journal of Environmental & Agriculture Research 2 (7): 1-6

Kulkarni, M.B.: Ghanegaomgkar, P.M. (2014) Biogas generation from floral waste using different technioques. Glob. J. Environ. Sci. Manag 7, 22-30

Lakshmi, C. And Vijaualakshmi, S (2017). Studies on biogas producton using withered flowers as substrate. Research Journal of Pharmacy and Technology. 10 (12): 1-4. https://doi.org/10.5958/0974-360X. 2017.00773.9

Murthy, P.S and Naidu, M. M. (2012) Sustaibanle management of Coffee industry by-products and value addtions –A review, Resource Conversation anf Recyclimg , 66:45 -58.

Padmavathiamma, P.K., Li. L.Y. and Kumari, U. R. (2008): An Experimental study of vermin biowaste composting for agricultural soil improvement, Bioresource Technol, 99 1672 -1681

Ranjitha J., Vijayalakshmi S., Vijayakumar P., Ralph N.: Production of biogas from flowers and vegetable wastes using anaerobic digestion Int. J. Res. Eng. Technol., 3(8), pp. 279-283, 2014.

Rashed, M and Torii, S (2015). Removal of Hydrogen sulfide from biogas using zero –valent iron,. Journal of clean energy Technology 3 (6): 1-5.http://doi.org/10.7763/jocet.2015 v3.236

Samadhiya H., Gupta R.B. and Agrawal O.P (2017).: Disposal and management of temple waste: Current status and possiblitiy of vermicomposting, International Journal of Advance Research and Development, 2(4), pp. 1-8.

Singh P., Borthakur A., Singh R., Awasthi S., Pal D.B., Srivastava P., Tiwary D., and Mishra, P.K.: Utilization of temple flora waste for extraction of valuable products: A close loop approach towards environmental sustainability and waste management, Pollution, 3(1), winter 2017.

Singh, P., and Bajopai, U (2011) Anaerobic digestion of flower waste for methane production: An alternative Energy source. Environmental Progress and Sustainable Energy, 1-5, http://doi.org/10.10002/EP.10589

Wakgmode, M. , Gujral A. B., Nawani, N. and Patil (2016). Management of floral waste conversation to value added products and their other applications. Waste Biomass Valor.

Wani, K., A, Mamta, K and Rao, R.J (2013); Bio conversation of garden waste, kitchen waste and cow dung into value added products using earthworm Eisenia fetid, Saudi Journal of Biological; Science, 20: 149 -154.