Miranda House

University of Delhi

Final Progress Report ofDU Star innovation Project MH – 03

3R: Reduce, Reuse, Recycle

Utilization Certificate
DU Star Innovation Project
Project code: MH 03
Financial Grant under DU Star Innovation

Project Title : 3R - Reduce, Reuse, Recycle

Project investigators: Dr Pratibha Jolly, Dr Bani Roy, Dr Amrita T Sheikh, Dr Mallika Pathak, Dr Jyoti Arora

College : Miranda House

Grant sanctioned		Rs 40,88,000/-				
Grant released		Rs.20,64,000/-				
S. No.	**Budget Head**	**Amount utilized/Rs**				
		2015-16	**2016-17**	**2017-18**	**2018-19**	**Total**
1	Equipment	3,04,173.00	5,42,537.00	nil	nil	8,46,710.00
2	Manpower	nil	nil	64,330.00	4,63,381.00	5,27,711.00
3	Maintenance	46,450.00	1,94,730.00	2,82,679.00	89,432.00	6,13,291.00
4	Miscellaneous	nil	29,298.00	38,188.00	nil	67,486.00
Total amount utilized		3,50,623.00	7,66,565.00	3,85,197.00	5,52,813.00	20,55,198.00

Certified that from the amount released Rs 20,64,000/- an amount of Rs 20,55,198/- has been utilized for research. The unspent balance is Rs 8,802/-.

For Gupta Nandan & Associates
Chartered Accountants

Gupta Nandan & Associates ★ Chartered Accountants ★ New Delhi M. No. 086537

Pawan Kumar Gupta
(Proprietor)
Membership No. 086537
UDIN: 22086537AOAPLS8171
Date : 28/07/2022
Place : New Delhi

AJ Sheikh
(AMRITA T. SHEIKH)

Mallika
(MALLIKA PATHAK)

BJRoy
(BANI ROY)

(JYOTI ARORA)

Miranda House
University of Delhi

Final Report
Star Innovation Project MH 03

1. Title of the Project

3R: Reduce, Reuse, Recycle

Project investigators:

S. No	Name	
1.	Dr. Pratibha Jolly	Principal, Miranda House
2.	Dr. Bani Roy	Department of Chemistry
3.	Dr. Amrita Tripathi Sheikh	Department of Chemistry
4.	Dr Mallika Pathak	Department of Chemistry
5.	Dr. Jyoti Arora	Department of Zoology

2. Brief Introduction of the Project

The college has set up *Miranda Tech: The Green Technology Park* an initiative under which the following projects have been undertaken:

I. Solid Waste Management including a Paper Recycling Plant and a Composting Plant to study the various aspects of solid waste management.

- **The Miranda House Paper Recycling plant** was set up in 2004. In 2014, a bigger pulper was installed in Miranda House which enabled the recycling plant to produce paper (including printer quality A4 sheets) and paper products such as folders and bags for sale within the college and to visitors. Miranda House Paper products are very popular in the campus.
- **Composting unit** - Miranda House in collaboration with *Green Bandhu Environmental Solutions & Services* has set up a model decentralized organic waste-to-compost system. This initiative has been a huge success in minimizing the burden on the city's dumping grounds and landfills. The in-house composting system has been able to process over 2,00,000 kg or 200 tonnes of organic waste since its inception in a sustainable manner. The waste processed includes food-waste (cooked/uncooked), horticulture waste such as dry leaves, etc. The compost produced in this facility is being used for gardening and landscaping purposes within the college and is also available for sale in 2kg bags.

II. **Hydroponic plantation:** Grey water from the kitchen dishwasher is being circulated through a system of metal pipes and used to grow plants.

III. **Soil-less Plantation**: A lightweight medium in the form of pellets made up of clay, horticultural waste and wood shavings has been used to grow plants in pots. These plants are very low-maintenance, requiring only 200 mL of water per plant in 25 days.

IV. Solar Power Plant: The College has set up a 7 kWp Grid Connected Roof Top SPV Power Plant to meet the energy needs of both the **Miranda House Paper Recycling plant** and the **Composting plant** which, as mentioned above, had already been set-up at the *Miranda Tech: The Green Technology Park.* The excess energy produced by the solar power plant is given back to the power grid to enable net metering.

Our experience with handling and maintaining solar powered equipment in terms of the solar water geysers for the Miranda House Hostel and a number of solar lights which light up the pathways of the campus during the evening/night has been advantageous in the maintenance of the newly set up solar power plant.

3. Objectives :

1. Selection, orientation and training of student researchers for the theme-based projects.
2. Identification of materials for incorporation into paper to impart colour, fragrance and pest-resistance and to test the recycled paper made for its tensile strength.

4. Objectives met:

i. Orientation: The student researchers had undergone an orientation in 2016 and had worked out a schedule for working in the project in smaller groups compatible with timetable.

ii. Consolidation of existing standardized products: The process for making compost and paper products has been standardized and the products are being sold in-house and on order.

iii. Novel Product Development:

a. Innovative and aesthetically pleasing recycled paper and paper products using Neem, Turmeric, Indigo, Rose petal and Marigold have been made.
b. Bamboo and Coconut husk were used as additives instead of cloth to make stronger paper. Tests for tensile strength are being carried out.
c. Pulp balls as a substitute for naphthalene balls were made of neem, boric acid and a combination of the two and these were tested for pest resistance.

iv. Research and Innovation:

a. Soil less plantation project has been started using pellets made of clay, horticultural waste and wood shavings. The medium is lightweight and does not require watering on a regular basis.
b. The mulch from horticultural waste and compost from kitchen waste made in the college composting plant has been tested for nutrients and compared with different types of manure available in the market. It has been found that the compost produced at our composting plant is very effective as it has a high content of nitrogen and is also pest resistant. The excess compost has been bought back by our service provider *Green Bandhu*; they have further sold it to farmers who are using organic compost for their crops. The feedback we received was very encouraging.

5. Renewable Energy: 7 kWp Grid Connected Roof Top SPV Power. The plant has been set up to cater to the energy needs of the college, in particular, those of *Miranda Tech: The Green Technology Park.*

6. Methodology followed

The work was done collaboratively by teams comprising of students, teachers and technical staff. It was done in the following steps:

i. Selection, orientation and training of student researchers for the various theme based projects.

ii. Identification of materials for incorporation into paper to impart colour, fragrance, pest-resistance and tensile strength.

iii. Student Researchers have been divided into groups and have been assigned the following activities:

- Development of Novel Paper and Pulp Balls
- Compost Testing
- Grey Water Testing
- Paper Tensile strength
- Calculating savings in terms of manpower, energy and resource requirements for all ongoing projects.

7. During the last three years of the project, the following have been undertaken:

i. A greater variety of coloured and fragrant recycled paper using natural material such as flower petals and other plant material and their extracts have been made.

ii. Final saleable products such as fine writing paper and envelopes, gift wrapping paper, coasters, carry bags, folders etc. have been made from the recycled paper enhanced by the artwork done by the student researchers and technical staff.

iii. We have tried to establish a business model for the sale of the recycled paper and products made at Miranda House. The products have been sold at various events held in the College and also at *Melas* and environment fairs organized by CMS *Vatavaran* and the Department of Environment, Government of NCT. Currently, these products are for sale from the *MH Souvenir Shop* located near Gate no 1 of the college.

iv. Pest-resistant paper using pest-resistant material safe for human use has been made and tested.

v. Some student volunteers have been able to do small projects involving waste plastic, e.g., converting used plastic containers into beautiful flower pots and pot-holders.

vi. These experiments done on a small scale and upscaling of this endeavour is in the process. We hope to be able to continue doing recycling of waste plastic and make usable recycled plastic products. We are discouraging the use of single use plastic (SUP) and hope to achieve the goal of the campus being a plastic-free zone in the near future.

8. Student Researchers: During the period 2016-2019 ten students enthusiastically worked on the projects. Their names and courses are:

S. No	Name	Course
1.	Aashna Gupta	B.Sc. (H) Physics
2.	Arshia Bhatt	B.Sc. (H) Zoology
3.	Avni Gupta	B.Sc. (H) Zoology
4.	Bhavya Sirohi	B.Sc. (H) Zoology
5.	Jyoti Rani	B.Sc. (H) Physics
6.	Nishtha	B.Sc. (H) Chemistry
7.	Ojasvi Verma	B.Sc. (H) Chemistry
8.	Rimjhim	B.Sc. (H) Chemistry
9.	Sukriti Mishra	B.Sc. (H) Chemistry
10.	Vrinda Beria	B.Sc. (H) Chemistry

The above mentioned student researchers have contributed to the following:

- testing the compost prepared at the **Composting Plant** for its content of nitrogen,
- testing the water at the **Hydroponic Plantation** at the inlet stage (grey water from the Miranda House Hostel Mess) and after it has gone through various stages of filtration to make it a medium for the growth of plants.
- testing the tensile strength of the different types of recycled paper prepared at the **Paper Recycling Plant.**

Working on these projects, the enthusiastic students have developed a sense of enquiry, responsibility, research methodology and have pledged to spread the message of the importance of a clean environment and sustainable development.

9. Results achieved:

- The paper and pulp balls made with neem pulp as additive were used on kitchen shelves and found to keep away cockroaches and ants.
- The plants in the hydroponic system are growing well.
- The pots with soil-less medium have been showing good growth and look very fresh despite being watered once in 15 days, showing that it is a viable medium.
- The compost made in the Miranda House plant has been found to be equivalent in nutrient content to the commercially available manure.
- *Recognition:*
  1. Dr Shyamala Mani, Professor, National Institute of Urban Affairs (NIUA), New Delhi brought teams of senior officials from Urban Local Bodies (ULB's) of Class I cities who were attending workshops under *Swachh Bharat Mission* at NIUA for Exposure Visits to the Miranda House Recycling Unit as an example of Best Practice. The municipal officials from different parts of India were impressed by the work being done on recycling in Miranda House.

2. The College received the following certificate on World Environment Day, 5 June 2018:

3. In September 2019, Miranda House received an award *For delivering Excellence in the area of Environment and Society* given by Pandit Deendayal Upadhyaya Smriti Sansthan (PDUSS) under the guidance of Ministry of Environment Forest and Climate Change (MoEFCC) largely due to the work done under the 3R project.

Pt. Deendayal Upadhyay Smriti Sansthan

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Conclave on Circular Economy of Plastic Waste and Livelihood Opportunities & Excellence Awards for Academia and Community
25th September 2019

To
The Principal
Miranda House College
University of Delhi

Subject: Invitation to Excellence Awards as an Awardee on 25th September 2019, from 10 am to 2 pm, Venue: NDMC Convention Center, Sansad Marg, Connaught Place, New Delhi, 110001

Dear Madam,

It gives us immense pleasure to inform you that your Institution have been selected for the EXCELLENCE AWARD under the Category I: Academic Institutions "**For delivering Excellence in the area of Environment and Society**" by Pandit Deendayal Upadhayay Smiriti Sansthan (PDUSS) under the guidance of Ministry of Environment Forest and Climate Change (MoEFCC).

The award will be conferred to you on 25th September 2019 between 10 am to 2 pm by the Environment Minister Sri Prakash Javedkar and Sri Vinod Shukla (only nephew of Pt. Deendayal Upadhyay), National President, PDUSS.

The award ceremony will be part of the event on "Circular Economy of Plastic Waste and Livelihood Opportunities & Excellence Awards. Which PDUSS is organizing to mark the birth anniversary of Pt. Deendayal Upadhyay and to fulfill the vision of our Honourable Prime Minister Sri Narendra Modi to make India *Plastic Waste Free*.

A line of confirmation in this regard will be a great help to make the basic arrangements done. Look forward to have you in the event. You can confirm your presence by replying to this mail along with a high resolution picture of yours for the brochure latest by 21st September 2019. We will share the brochure with you as soon as it gets ready.

Thanking you, Warm Regards

Dr. Seema Sharma (+91 99710 06780)
HEAD RESEARCH,
Pandit Deendayal Upadhyay Smriti Sansthan
TEDx Speaker & Winner of World Ecology Environment and Development Award 2017

Sri Anand Mani (+91-9820158633)
National General Secretary
Pt. Deendayal Upadhyay Smriti Sansthan

Sri Vinod Shukla
National President
Pt. Deendayal Upadhyay Smriti Sansthan

- *Publications:*

1. Bhat A., Sirohi, B., Gupta, A., Mishra, S., Beria, V., Rimjhim, Verma, O., Nishtha, Rani, J., Gupta, A., Arora, J., Pathak, M., Roy, B., Sheikh, A. T. and Jolly, P. (2018) Handmade Paper Making by Eco-friendly Processes: Production of acid free, chlorine free and azo free paper in the International Conference on Advances in Biosciences and Biotechnology, ICABB-2018 at JIIT, Noida on 1 -3 February, 2018. Poster presentation

   Arora, J., Gupta, A., Bhatt, A., Sirohi B., Pathak, M., Roy, B., Sheikh, A.T. and Jolly, P. (2017) Generation of acid free, chlorine free and azo free hand-made paper by implementing 4r's of paper making: reduce, reuse, recycle and recreate ((Best Poster Presentation Award). In Abstracts INSCR International Conference entitled Role of Microbe- Plant-Animal Interactions in Human Health, University of Delhi, Delhi, pp 93.
2. Sirohi, B., Gupta, A., Bhatt, A., Gupta, A., Arora, J., Roy, B., Sheikh, A. T., Pathak, M. and Jolly, P. (2017) *From Trash to Treasure: 4R's at Miranda House.* Third National Symposium on *Environment: Challenges Generation Next* organized by Deshbandhu College on 31 March 2017. Poster Presentation
3. Bhatt, A., Gupta, A., Sirohi, B., Mishra, S., Beria, V., Rimjhim, Verma, O., Nishtha, Rani, J., Gupta, A., Arora, J., Pathak, M., Roy, B., Sheikh, A.T. and Jolly, P. *Solid Waste Management at Miranda House: A Zero Solid Waste Zone* (Best Poster Presentation Award). Third National Symposium on *Environment: Challenges Generation Next* organized by Deshbandhu College on 31 March 2017. Poster Presentation
4. Gupta A, Bhatt A,Sirohi B, Mishra S, Beria V, Rimjhim, Verma O, Nishtha, Rani J, Gupta A, Arora J, Pathak M, Roy B, Sheikh AT, Jolly P. (2017) Handmade Paper Making by Eco-friendly Processes: Generation of acid free, chlorine free and azo free paper (Best Poster Presentation Award). National Seminar -सक्षममहिला,सक्षमसमाज: एक वैज्ञानिकदृष्टिकोण - A Paradigm Shift Towards Empowerment of Women organized by Kalindi College on 3-4 February, 2017. Poster Presenation
5. Mishra S, Beria V, Rimjhim, Verma O, Nishtha, Rani J, Sirohi B, Gupta A, Bhatt A, Gupta A, Arora J, Roy B, Sheikh A T, Pathak M, Jolly, P. (2017). 3R at Miranda House. In: Abstracts National Conference on Environmental Sustainability and Waste Water Remediation: Current Status and future Prospects (ESWR-2017), Department of Chemistry, Sri Venkateswara College, pp 47.

10. Any other relevant information:

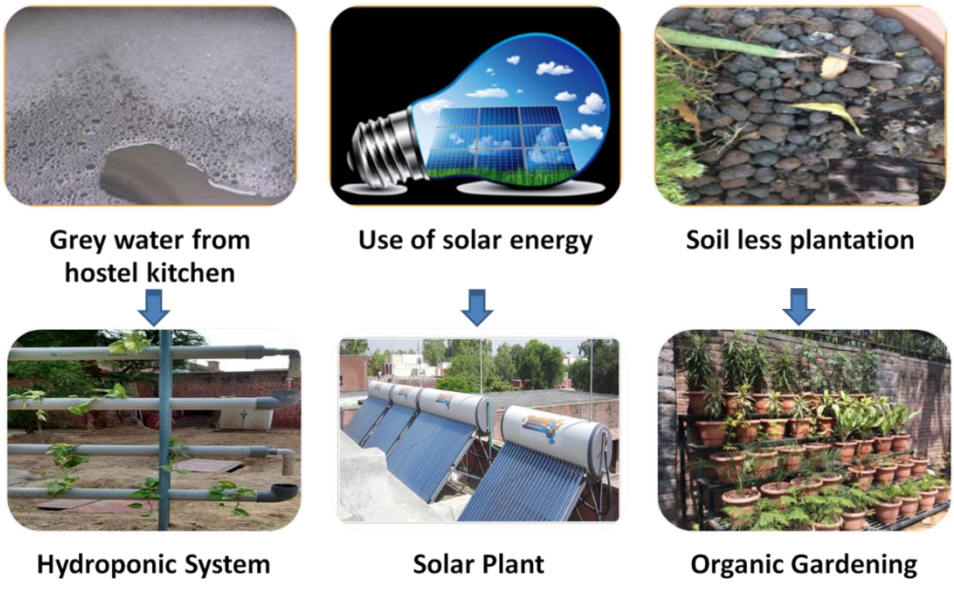
- We are working towards a common goal of creating a
  - *Zero Solid Waste Zone*
  - *Clean Campus, Green Campus*
  - participative model of sustainable green practice for students.
- Plans are underway for procuring equipment to monitor indoor air quality and to evaluate the impact of indoor air purifying plants on air quality.

11. Departments of the college that were involved in the project:

a. Department of Chemistry
b. Department of Physics
c. Department of Zoology

Miranda Tech Park

Miranda Tech Park



Paper Recycling Plant at Miranda House

Paper Shredder

Cotton Fillers

Hollander Beater

Pulp

I. Pulp Formation

Sheets of paper on Univat

II. Raw Paper Sheets

Screw Press

Solar Drying of Paper

Paper Calendering

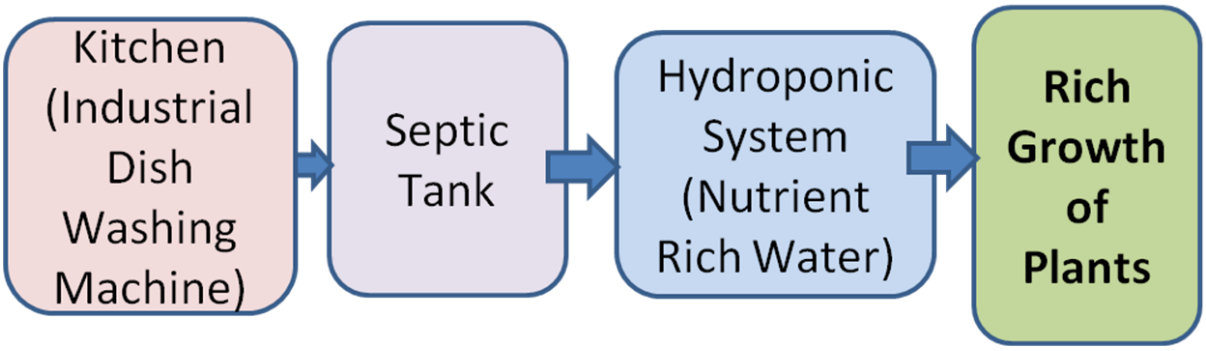
Paper Sheets

III. Processed Sheets

Composting Plant

Mulching Plant

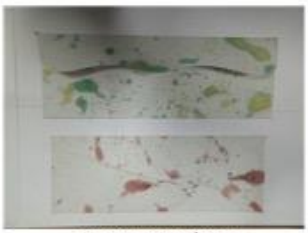
Grey Water Recycling-Hydroponics



Plastic Bottle Recycling

Results-Paper Recycling

Paper folders



Paper envelopes

Paper bag

Paper folder

Paper envelope

Results-Composting

Conclusions

Paper Recycling Plant

- Innovative and aesthetically pleasing paper and paper products
- Coloured and fragrant paper using natural materials such as flower petals
- Printer quality azo-free, chlorine-free & acid-free Paper

Composting and Mulching Plants

- Minimizes the burden on the city's dumping grounds and landfill
- The system can large amount of organic waste in a sustainable manner
- The compost produced is being used for gardening and landscaping purposes within the college
- Successful in generating revenue through sale of compost

Plastic Recycling Plant

- Bailed PET bottles easier to manage
- Plastic yarns can be knitted to make products like mats

Grey Water Recycling- Hydroponics

- Significantly reduced the nutrient load of the water for safe disposal
- Support rich growth of plants adding aesthetic value

Soil-less Organic Plantation

- Light, equipped with organic compost pellets
- Only one cup of water required after 15 days.

Energy Conservation - Use of Renewable Solar Energy

- 40 Solar Street Lights
- 7 Solar Water Heaters
- 7 kWp Grid Connected Roof Top Solar Photovoltaic (PV) Power Plant

CERTIFICATE OF ORIGINALITY

This is to certify that the research work carried out at Miranda House and the final project report submitted by the Project Investigators and the student researchers for the *DU Star Innovation Project 3R – Reduce, Reuse, Recycle* is original.

Any plagiarism/ academic dishonesty reported will be our responsibility.

Project Investigators

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(MALLIKA PATHAK)