Puducherry Pollution Control Committee
Government of Puducherry

Department of Science, Technology & Environment
Government of Puducherry

Pondicherry University

Association for Promoting Sustainability in Campuses and Communities

# Training and Capacity Building for the Compliance of 'Green Protocol' @ Puducherry - India

## **Activity Report** (Pictorial)


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**&**

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GLOBAL SOIL PARTNERSHIP

**January - 2020**


**The 'Green Team' for Regenerative Agriculture**

'Regenerative Agriculture' is defined as an integrated soil conservation approach primarily focusing on the topsoil regeneration by re-establishing the ecology of soil biodiversity, thereby increasing the readily available plant nutrients and water holding capacity, and strengthening the water cycle, ecosystem services, complex food chain, and bio-sequestration, ultimately forming the base for resilience to climate change.

## Acknowledgments:


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- **Prof. K. V. Devi Prasad,** Ecology and Environmental Sciences, Pondicherry University
- **Prof. R. Nalini,** HoD, Social Work, Pondicherry University
- **Prof. Shahin Sultana,** Dean, Students Welfare, Pondicherry University
- **Prof. Hanna Rachel Vasanthi,** Director, PUSH, Pondicherry University
- **Prof. S. Gajalakshmi**, HoD, Pollution Control, Pondicherry University
- **Shri. P. Ramachandran** (Principal); Mr. J. Sundararajan (Vice Principal i/c), Mrs. Shanthi (Science Teacher); Mrs. Visalatchi (Tamil Teacher) of Jawahar Navodaya Vidyalaya, for providing constant encouragement and resources for this on-campus training and capacity building program
- More importantly to **all the students, staff, volunteers and APSCC Green Team Members - Er. M. Nakkeeran, Mr. S. Bhaskaran, Mr. M. Neelakandan, Mr. P. Kavin Kumar & Mr. V. Ajithkumar** and **Mr. Natesan (Apiculturist)**


## Training Period:

- June – August 2019

## On-campus Training and Capacity Building Provided at:

- Jawahar Navodaya Vidyalaya, Puducherry

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## 1. Executive Summary

The Union Ministry of Environment, Forest and Climate Change – India had notified six categories of Waste Management (SWM) Rules in 2016 (Solid – Plastic - Ewaste - Biomedical - Hazardous - Construction). Simultaneously, the National Water Framework Act – 2016 was also notified by the Ministry of Water Resources. In view of this, the *'State Level Awareness Program on Sustainable Waste Management'* in association with Pondicherry University; Department of Science, Technology, and Environment; Puducherry Pollution Control Committee and the Association for Promoting Sustainability in Campuses and Communities as the lead organization was conducted in all the four regions of the Union Territory (Puducherry, Karaikal, Yanam & Mahe).

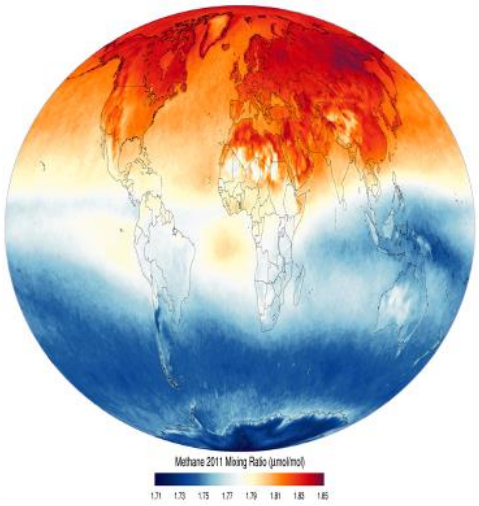
As an outcome of the 30-day event, the '*COMPREHENSIVE GREEN PROTOCOL for the Educational Institutions, Industries, Residences & Other Organizations of the Union Territory of Puducherry*' was developed and released on 14th April 2018, by the Hon'ble Chief Minister, Shri. V. Narayanasamy and Hon'ble Vice-Chancellor, Prof. Gurmeet Singh (Pondicherry University) in the presence of Hon'ble Minister for Environment, Shri. M. Kandasamy, Mrs. Smitha, Director (DST&E); Dr. M. Nandhivarman (Program Lead & Organizer), Dr. Ramesh (Environmental Engineer), Dr. Golda A. Edwin, Executive Director (APSCC), Dr. Shahin Sultana, Dean, Students Welfare (Pondicherry University) and other Dignitaries (https://www.thehindu.com/news/cities/puducherry/green-protocol-for-ut-released/article23598802.ece). Since then, various initiatives and activities *'in compliance with green protocol'* were implemented across Puducherry. More recently, an intensive hands-on training and capacity building, with special preference to water-food-energy-biodiversity nexus, resource recovery, conservation and entrepreneurship (startups & green business ideas) – encompassing *'regenerative agriculture'*, was provided to the postgraduate students *Ms. Juliette Vachon & Ms. Alice Scotti, Université Panthéon-Sorbonne, Paris, France* along with the *students & researchers of Pondicherry University & Jawahar Navodaya Vidyalaya (Central School).* This pictorial document is a summary of the various tasks and activities performed in the training and capacity building program. The purpose of this training and capacity building was to provide a roadmap with background and a broad conceptual framework to plan and implement 'green campus' strategies for sustainability and/or to kick start similar strategies in Universities/Colleges/Schools across the globe, for the compliance of 'Green Protocol'.

## 2. Background

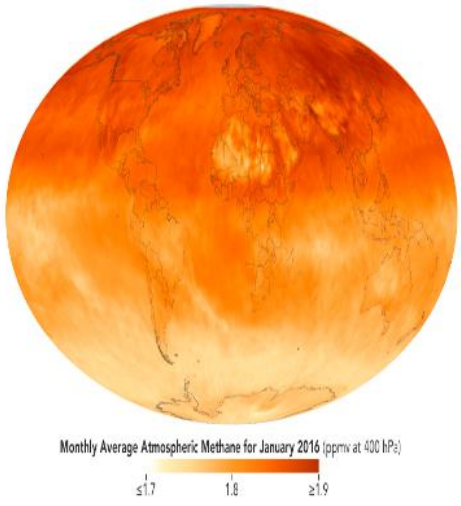
Sustainable development is one of the biggest challenges of the twenty-first century. Even though the origins of the terms 'sustainable development' or 'sustainability' goes back many decades, it was substantially enhanced since the Brundtland Commission Report (1987): '*development which meets the needs of the present without compromising the ability of future generations to meet their own needs*'. The Union of Concerned Scientists also reported that *'fundamental transformational changes mitigating the*

*environmental challenges (precisely, resource exploitation and waste generation) are urgent if we are to avoid the collision our present course will bring about*' (Kendall, 1992).

In this consumerist world, managing solid wastes is one of the key challenges for sustainable development. Among various kinds of solid wastes, organic wastes constitute a maximum of around 60-70%. When these organic wastes are diverted to landfills, Methane ($CH_4$) is produced through decomposition along with other adverse gases and environmental issues (Nandhivarman et. al., 2014). The comparative impact of $CH_4$ on climate change is over 20 times greater than $CO_2$ over a 100-year period and it is the second potent greenhouse gas having approximately 21 times more global warming potential than that of $CO_2$. Landfill gas from the dumpsite is approximately 40 to 60% methane, mostly $CO_2$ with varying amounts of nitrogen, oxygen, water vapor, hydrogen sulfide, and other contaminants collectively known as 'non-methane organic compounds' (NMOCs). The NMOCs usually make up less than 1% of landfill gas. In 1991, the US EPA identified ninety-four NMOC's including toxic chemicals like benzene, toluene, chloroform, vinyl chloride, and carbon tetrachloride. At least forty-one of the NMOC's are halogenated compounds (chemicals containing halogens: typically, chlorine, fluorine, or bromine) (www.usepa.gov). Apart from this, NASA had also systematically studied the concentration of atmospheric methane and the results were published in this decade, during 2011 & 2016, indicating a steep rise over 5 years (orange color denotes methane concentration).




**Global distribution of methane 2011 by NASA/AIRS**
**(**http://daac.gsfc.nasa.gov/giovanni/**)**




**Global-View of Methane - NASA Earth Observatory map by Joshua Stevens, using AIRS, 2016**
**(**https://earthobservatory.nasa.gov/images/87681/a-global-view-of-methane**)**

The optimistic solution to this ever-increasing issue is 'sustainable entrepreneurship development through lab-to-land environmental education'. Uhl et al. (2004) claimed that *'even though the educational system contains enormous brainpower, but a dearth of vision, courage, and moral responsibility, are more concerned about training students to fit into a status quo world that is unraveling, offering our young people a sense of hope and purpose'*. Whereas, Leal (2011) also highlighted that, *'the sustainability efforts should involve everyone, be lifelong, be holistic about connections, be practical and action-oriented'*. In this context, universities, higher education and schools have greater responsibility *'to use it in creative and exciting ways through the lab-to-land environmental education – i.e. through* ***regenerative agriculture****'* as indicated by Golda & Nandhivarman (2017).

With an ethical obligation, the educational institutions across the world have highlighted that, 'providing lab-to-land environmental education would act as the catalysts for attitude change' (Orr, 2004; Edwards, 2010; Rasmussen, 2011; Savelyeva and McKenna, 2011; Osmond et al., 2013). On one hand, *'efforts towards implementation should be focused to empower people with the knowledge, understanding, and capacity to influence society in a way which progresses environmental objectives along with other legitimate social and economic objectives'* (DEH, 1999; Pandey, 2005; Sharma, 2007; Sundar, 2007; Ghosh, 2009; Leal, 2011, Nandhivarman, 2017). On the other hand, *'behavioral change could be induced through motivation as otherwise the stakeholders will not be well informed and confident about what to engage with and act* (Parkin, 2010; Godemann et al., 2014; Horhota et al., 2014; Nandhivarman, 2017). Such 'lab-to-land' initiatives would pave way for the reorientation of the thinking and practice of formal education, including curriculum, teaching-learning approaches and assessment, which goes beyond the formal curriculum to a holistic, i.e. *'whole campus approach' where the student's experiences are not confined to the classroom but are part of the learning process in the school, college, university and the community, linked to real-life situations, precisely implementing 'lab to land' concepts* (Sharma and Pandya, 2015; NCERT, 2015; Nandhivarman, 2017). The United Nations' ever-ambitious set of goals for the period 2016-2030, known as the Sustainable Development Goals (SDGs) also stresses that *'the next generation of students could be effectively trained to implement the SDGs in a holistic manner'* (Michigan University, 2015).

More importantly, we believe that sustainable development is not only limited to ecological/environmental considerations but also the economic, social and cultural dimensions as well. Against this backdrop, the definition for 'Green Campus' and 'Green Campus Initiative' was evolved. *'Green Campus is one that conserves natural resources and promotes environmental, economic and social sustainability based on environmental education for sustainable development through awareness, motivation, action research and experimental learning*' (Nandhivarman & Golda Edwin 2017). Whereas, *'Green Campus Initiative is a program that plans, formulates, designs and implements a package of sustainable solutions by the campus community to reduce the environmental impact, enhance the campus sustainability and to protect the health and well-being of the surrounding community & ecosystem, implemented thorough selfless cooperation and coordination'* (www.apsccindia.org).

## 3. Consortia of Organizations

### (A) About APSCC (http://www.apsccglobal.org/)

The formation of the Association for Promoting Sustainability in Campuses and Communities (APSCC) is to serve as an impetus, not-for-profit, and voluntary organization for sustainable development in conservation strategies, programs and projects pertaining to water, healthy food, energy, waste (solid & liquid), and biodiversity among the educational institutions and local communities based on the Principle *'the right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations'*. We do this by providing resources, initiating and promoting sustainable innovations at the grassroots level, fostering 'attitude change', in collaboration with a network of eminent sustainability professionals across the globe.

APSCC envisions a world where campuses and communities are environmentally, ecologically and economically sustainable by successfully addressing all the challenges at a more decentralized level, ensuring that due recognition is given to the role of education and action research in the promotion of Sustainable Development Goals (SDGs). Some of the examples include the Green Campus Initiatives at the following locations since 2011:

- Pondicherry University (Central University)
- Jawahar Navodaya Vidyalaya (Central School)
- Savarayalu Nayagar Government Girls High School (State Govt. School)

setting an example of environmental responsibility by establishing institutional ecology, policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations, through *'lab to land – environmental education'*. More recently, APSCC has pioneered the implementation of the Notified Solid Waste Management Rules (2016), National Water Framework Act (2016), Green Protocol (2018) at several institutions, complementing and furthering the Sustainable Development Goals. The same has been provided at the grass-root level through *'lab to land environmental education'* and *'training & capacity building programs'* under the umbrella ***'Green Campus Initiatives for Climate Change Adaptation'***.

APSCC had partnered/ collaborated with various International, National & Regional Organizations and Departments to promote sustainability among the Indian Universities, Colleges, School, Industries & Communities. Naming few:

- Association of University Leaders for a Sustainable Future (ULSF, USA)
- Sulitest.org (Kedge Business School, France)
- 2020 UN – Decade on Biodiversity (Canada)
- FAO – Global Soil Partnership (Italy)
- United Nations Framework Convention on Climate Change (Germany)
- Pondicherry University, Puducherry (India)
- Indian Institute of Technology, Madras (India)
- Department of Science, Technology and Environment, Puducherry (India)
- Directorate of School Education, Puducherry (India)
- Directorate of Forest & Wildlife, Puducherry (India)
- Department of Agriculture and Farmers Welfare, Puducherry (India)
- Puducherry Pollution Control Committee, Puducherry (India)
- Renewable Energy Agency, Puducherry (India)
- Gazing Glory (India)
- National Solid Waste Association of India (India) and Others

## (B) About Pondicherry University (http://www.pondiuni.edu.in/)

Pondicherry University (PU) holds a special place in the Indian University System. It was created to meet out the demands of the local community, and ever since its inception in 1985, it has shown a tremendous commitment to innovation and serving the needs of the nation. The University's vision is to serve as an enabler of societal transformation through state-of-art higher education and research that match global benchmarks by providing access, resources and opportunities, to become an institution of global eminence and to adapt to ever-changing needs of the society and industries. Its mission is to deploy globally competent resources in terms of people, infrastructure and partners through the development of trained human resources, who

will serve as agents of value-based Societal Transformation in various spheres of life enriched with technology-assisted education, research, training and cultural integration. PU has entered into MoUs with a good number of reputed International Institutions in India and abroad for collaboration and faculty development.

## (C) About the Department of Science, Technology, and Environment

(http://dste.puducherry.gov.in)

The Department of Science, Technology and Environment (DST&E), Puducherry has been functioning since 1993 post-merger of the erstwhile Science & Technology and Environment Cells in the Union Territory of Puducherry's Administration. Objectives of DST&E are to create scientific awareness among the general public and students. Also, to extend support in carrying out research projects/studies and to conserve and protect the environment of this Territory. Functions include, popularization of science and scientific technologies, promotion of technology transfer from lab to land, facilitation of scientific research by way of grants for better-applied research, bringing awareness among the public regarding environmental issues by celebrating days of environmental importance, and also, to advise the State Government to any matter concerning with the prevention and control of pollution. The DST&E consists of the following Divisions:

- Puducherry Pollution Control Committee (PPCC)
- Puducherry Council for Science and Technology (PCS&T)
- Puducherry Coastal Zone Management Authority (PCZMA)
- State Environment Impact Assessment Authority (SEIAA)
- Puducherry Climate Change Cell (PCCC) – Green Protocol

## (D) About the Puducherry Pollution Control Committee

(http://pollutioncontrolboard.com/state/pondicherry-pollution-control-board-ppcc.html)

Puducherry Pollution Control Committee (PPCC) has been functioning since 1992 in Union Territory of Puducherry (UTP). It is a statutory body in the Department of Science, Technology & Environment (DST&E). Since, UTP consists of various ecosystems like marine, freshwater, wetlands, mountain, crop, mangroves & duns, PPCC realized its role in protecting those fragile ecosystems by enforcing the provisions of Rules and Acts. Establishment of industrial estates, medical and other institutions, coupled with urban sprawl and rapid urbanization have led to the generation of a considerable quantity of biomedical, hazardous, plastic, solid and e-wastes along with multiple water-related issues. PPCC in collaboration with private entrepreneurs and other stakeholders trying to find a sustainable solution to overcome this burden. PPCC encourages industry to shift the conventional technology to Clean Development Mechanism in order to minimize greenhouse gases and mitigate climate change. PPCC is not only adopting command and control policy but also provide consultancy, advocacy and disseminating of best practicing technology. It identifies and recognizes the industries and individuals who are adopting and promoting green technologies by awarding 'Green Award' and 'Environment Award' respectively. Activities of the Puducherry Pollution Control Committee (PPCC) are guided by the Ministry of Environment, Forests & Climate Change and Central Pollution Control Board and further, shaped by the Southern State Region Conferences of Pollution Control Boards/Committees.

## 4. Water

### *Grading of Sand Grains & Substrates for Water Treatment*



### *Constructed Wetland - Water Treatment System - Microcosm*



### *Constructed Wetland - Water Treatment System - Macrocosm*





### *Role of Macrophytes - Arundo donax & Typha latifolia in Constructed Wetland*


## 5. Food

### *Plant Nursery Development*







### *Establishing an Organic Vegetable Garden*



### *Application of Vermicompost for Garlic*



### *Seed Ball Production (Sand + Red Soil + Field Soil + Compost + Vermicompost + Seeds)*



## 6. Energy

### *Anaerobic Bio-digester – Maintenance*





### *Anaerobic Bio-digester – Operation*






## 7. Biodiversity

### *Tree Plantation (Indigenous)*


### *Role of Xeriscape in Habitat Restoration (Flora & Fauna)*

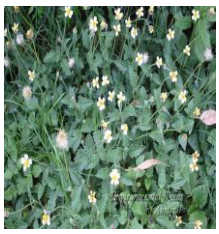
## *Importance of Medicinal and Aromatic Plants (MAPs) of South India*

**Balloon Vine**

**Veldt Grape**

**Indian Borage**

**Basil - Black**



**Tridax**

**Mint**

**Solanum**

**Aloe vera**

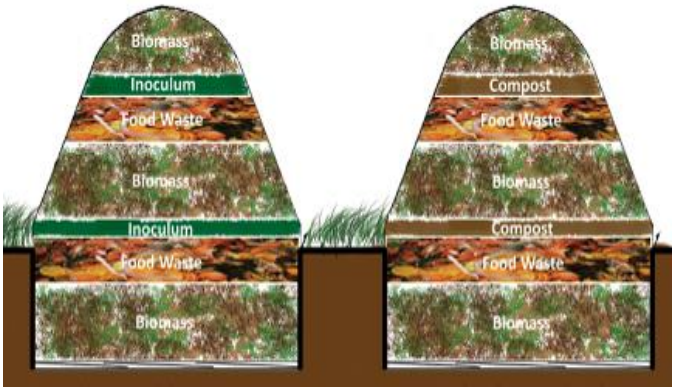
**Lemon gass**

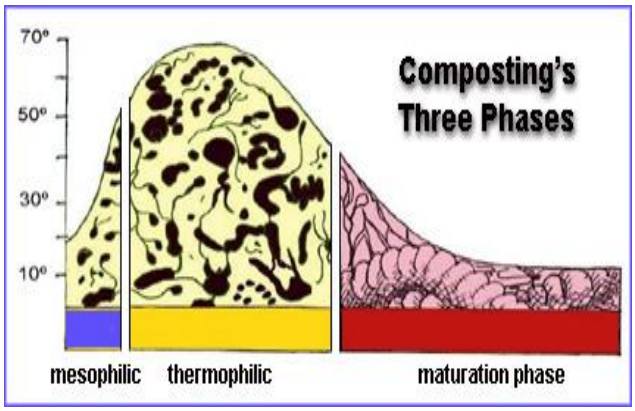
**Basil**

## *Herbal Spiral and South Indian Herbs – Field Experience*

## 8. Waste Resource Management

***Windrow Composting (Step-by-Step Process Flow)***




## *Vermicomposting (Mesocosm) - Vermi Cast & Vermi Wash*
## *Step-by-Step Process Flow*

## *Nutrient Solution Preparation*

## *Bio-pest Repellent Preparation*

## *Characterization and Quantification of Solid Wastes*




## *Resource Conservation - Souvenir from Under Valued Natural Cotton*

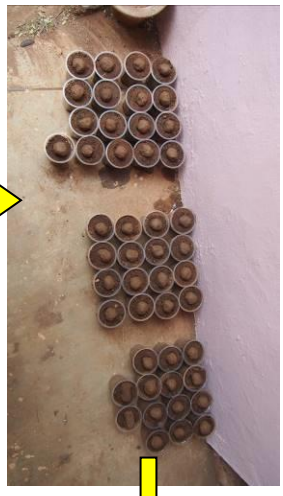







## *Resource Reusing - Discarded Plastic Cups for Seed Ball Germination Study*




## *Resource Reusing - Discarded Coconut Shell for Plant Nursery*





## *Resource Recycling - Conversion of Cotton Backdrop into Carry Bags '2018 - World Environment Day Theme - Beat Plastic Pollution'*

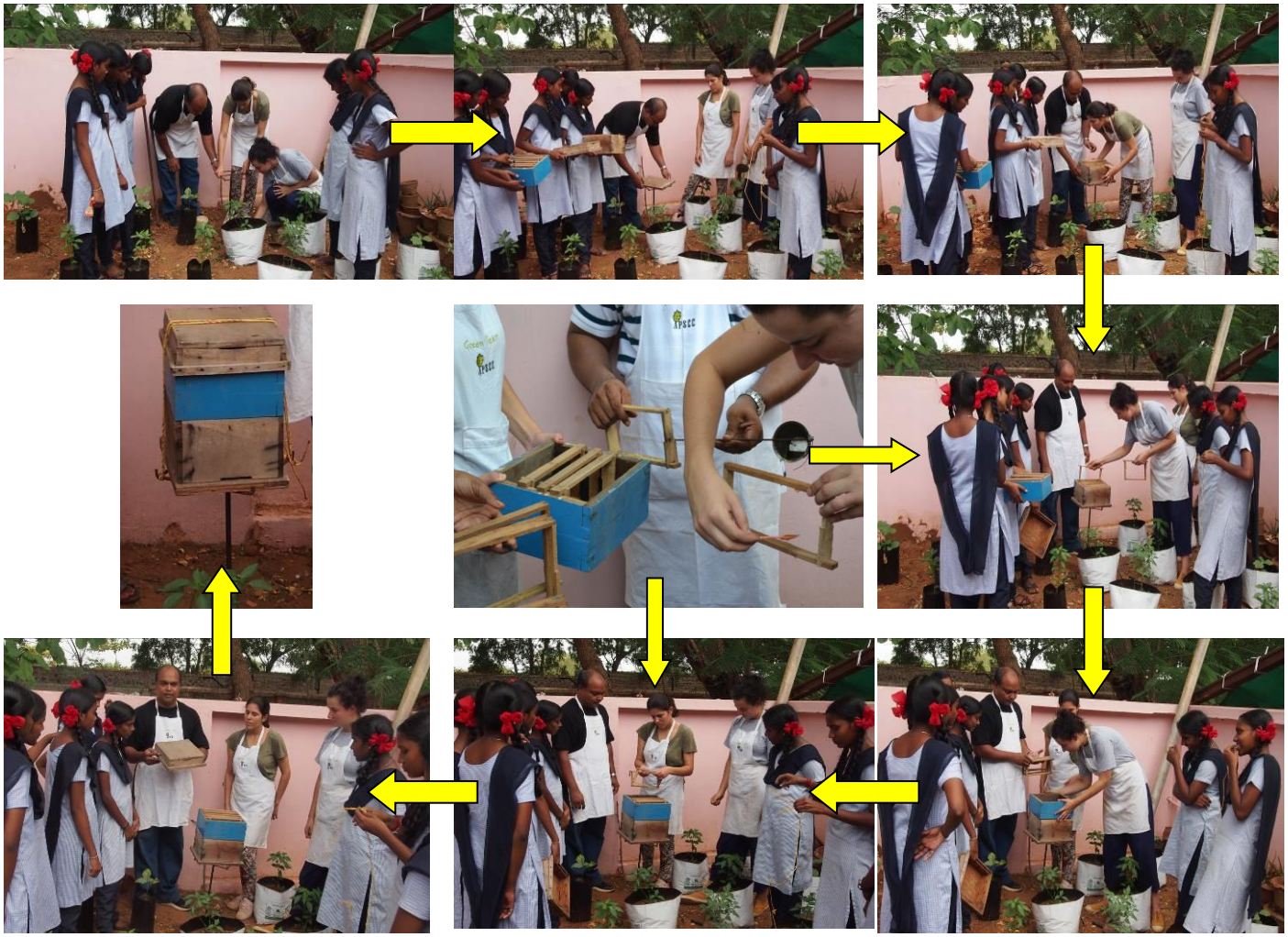

## 9. Entrepreneur Development (Start-Ups & Green Business Ideas)

### *Hands-on Training - Apiculture*





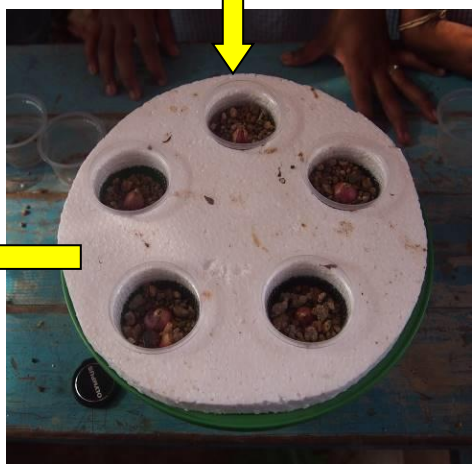
### *Establishing Apiculture Unit*
### *Step-by-Step Process Flow for the Natural Colony Establishment*

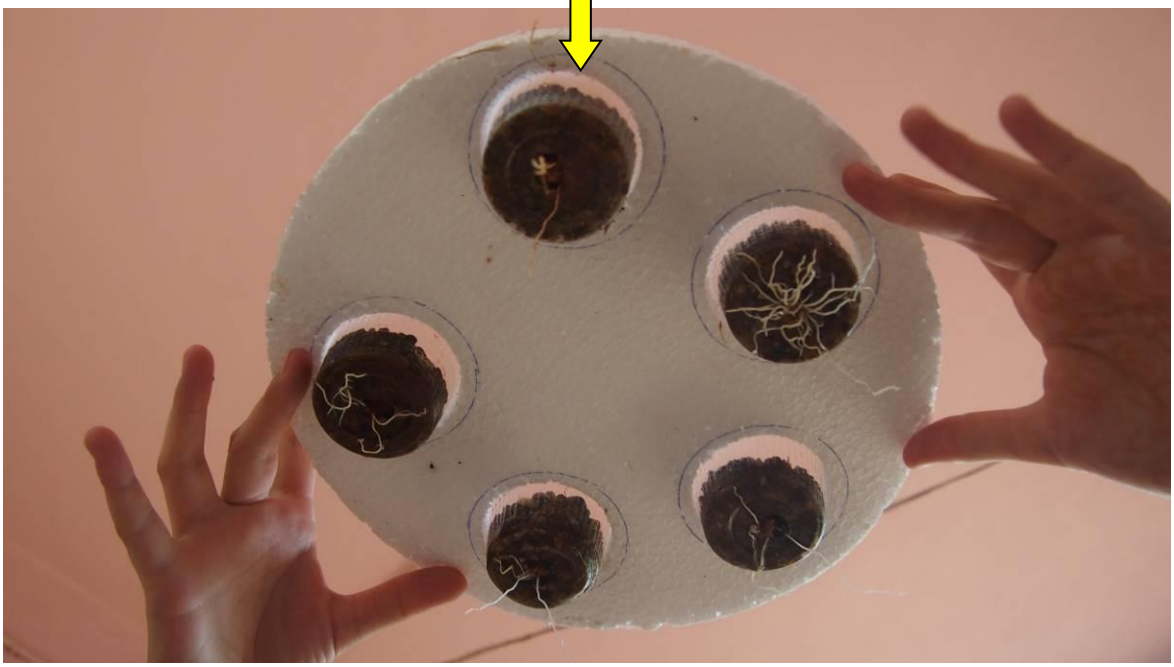


## *Vermiculture (Eudrilus eugeniae)*

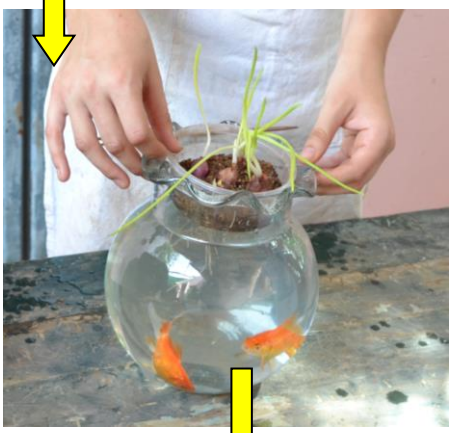
## *Mushroom Culture (Oyster mushroom sp.)*

## *Hydroponics (Microcosm)*





## *Aquaponics (Microcosm)*



***Refabricating Traditional Dying & Printing***
***Dye Pigment Extract from the Waste Products of Plants & Cooking Items;***
***Biogas & Reclaimed Water for Dyeing***
***Other Relevant Solid Wastes such as Human Hair, Cane, Twigs, Thread, Nail, Plastic Pipe, etc. as Accessories***

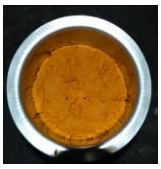
## *Dye Pigments - Resource Extraction from Waste Materials*

***Beetroot Peel*** ***Plant Part*** ***Iron*** ***Coffee Powder***









## *Bathik Pen*




## *Bathik – Wax Drawing*



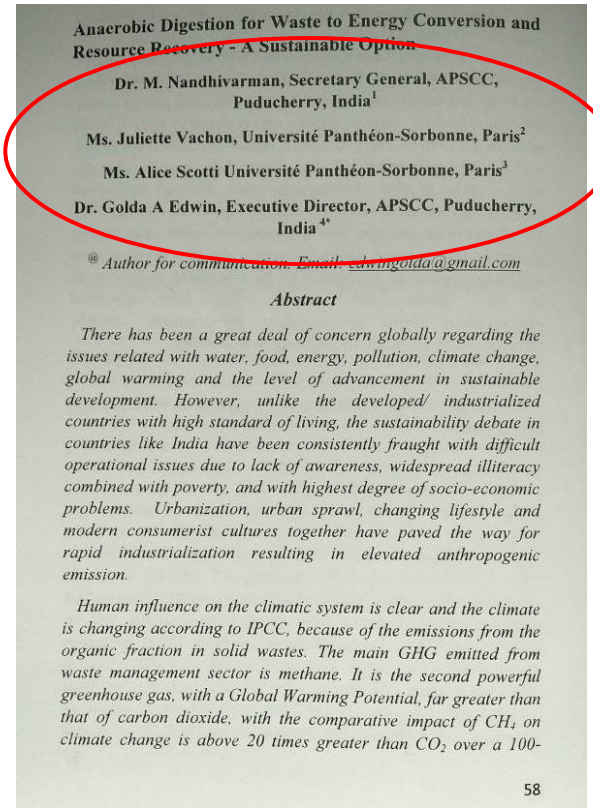



## *Dyeing with Natural Pigment*

## *Tie & Die*

## 10. Educational Visits & Programs

### *Paper Presentation - 3 Day Seminar on Bio-electrochemical Technologies for Waste to Energy Conversion & Resource Recovery, Pondicherry University*

**Anaerobic Digestion for Waste to Energy Conversion and Resource Recovery - A Sustainable Option**

**Dr. M. Nandhivarman, Secretary General, APSCC, Puducherry, India[1]**

**Ms. Juliette Vachon, Université Panthéon-Sorbonne, Paris[2]**

**Ms. Alice Scotti Université Panthéon-Sorbonne, Paris[3]**

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***Abstract***

*There has been a great deal of concern globally regarding the issues related with water, food, energy, pollution, climate change, global warming and the level of advancement in sustainable development. However, unlike the developed/ industrialized countries with high standard of living, the sustainability debate in countries like India have been consistently fraught with difficult operational issues due to lack of awareness, widespread illiteracy combined with poverty, and with highest degree of socio-economic problems. Urbanization, urban sprawl, changing lifestyle and modern consumerist cultures together have paved the way for rapid industrialization resulting in elevated anthropogenic emission.*

*Human influence on the climatic system is clear and the climate is changing according to IPCC, because of the emissions from the organic fraction in solid wastes. The main GHG emitted from waste management sector is methane. It is the second powerful greenhouse gas, with a Global Warming Potential, far greater than that of carbon dioxide, with the comparative impact of $CH_4$ on climate change is above 20 times greater than $CO_2$ over a 100-*



### *Visit to Dakshin Chitra – Culture of Southern India*

## *Visit to Salt Production Unit – Marakkanam*




## *Organizing Climate LaunchPad – Green Business Ideas Competition*






https://www.thehindu.com/news/cities/puducherry/spotlight-on-green-business-ideas-green-business-ideas-pitch-boot-camp-puducherry-chapter-2019/article29378100.ece

http://www.pondiuni.edu.in/sites/default/files/Invitation%20-%20CLP%20Puducherry-09082019.pdf

http://www.pondiuni.edu.in/news/climate-launch-pad-puducherry

## *Discussions with the Vice-Chancellor & Faculties of Pondicherry University, The staff of Jawahar Navodaya Vidyalaya (Central School) and Government of Puducherry - Smart City Team*


## *Media Coverage - Green Business Ideas Competition*

புதுவை பல்கலைக்கழகத்தில்

பசுமை தொழில் பயிற்சி பட்டறை

புதுச்சேரி, ஆக.14–

புதுவை பல்கலைக்கழகத்தின் தொழில்முனைவோர் துறை மற்றும் ஏ.பி.எஸ்.சி.சி. என்ற தொண்டு நிறுவனம் சார்பில் பசுமை தொழில் ஆலோசனைகள் போட்டி மற்றும் பயிற்சி பட்டறை பல்கலைக்கழகத்தில் நடைபெற்றது. இந்த பயிற்சி பட்டறையை பல்கலைக்கழக துணைவேந்தர் குர்மீத் சிங் தலைமை தாங்கி தொடங்கி வைத்தார்.

நிகழ்ச்சியில் புதுவை அரசின் அறிவியல் தொழில்நுட்பம் மற்றும் சுற்றுச்சூழல் துறை இயக்குனர் ஸ்மிதா, பல்கலைக்கழக இயக்குனர் ஹன்னா ரேச்சல் வசந்தி, ஒருங்கிணைப்பாளர் நந்திவர்மன், பயற்சியாளர் சித்திக், ஏ.பி.எஸ்.சி.சி. இயக்குனர் கோல்டா உள்பட பலர் கலந்துகொண்டனர். இந்த பயிற்சியில் புதுவை பல்கலைக்கழகம், ராஜீவ்காந்தி கால்நடை கல்லூரி, ஆச்சார்யா கல்லூரி, மணக்குள விநாயகர் என்ஜினீயரிங் கல்லூரிகளில் இருந்து 25 குழுக்களை சேர்ந்த மாணவ, மாணவிகள் கலந்துகொண்டனர்.

பசுமைத் தொழில் பயிலரங்கம்

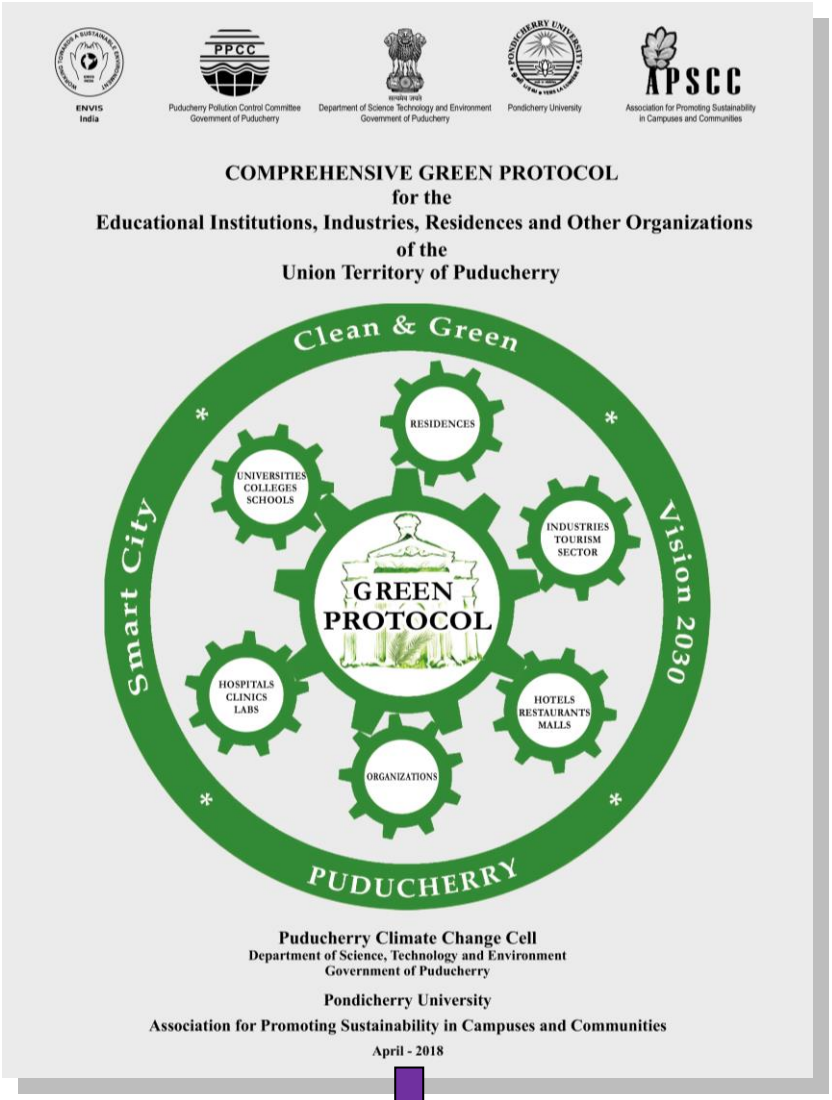
நிகழ்ச்சியில் பயிற்சிக் கையேட்டை வெளியிடுகிறார் துணைவேந்தர் குர்மித் சிங். உடன், ஏபிஎஸ்சிசி ஒருங்கிணைப்பாளர் நந்திவர்மன் உள்ளிட்டோர்.

**புதுச்சேரி, ஆக.14:** புதுவை பல்கலைக்கழகத்தின் தொழில் முனைவோர் துறை, ஏபிஎஸ்சிசி தொண்டு நிறுவனம் இணைந்து நடத்திய பசுமை தொழில் யோசனைகள் போட்டி மற்றும் தொழில் பயிற்சி பயிலரங்கம் பல்கலைக்கழகத்தில் அண்மையில் நடைபெற்றது.

பயிலரங்கை பல்கலைக்கழக துணைவேந்தர் குர்மீத் சிங் தொடக்கி வைத்தார். தொடர்ந்து, காலநிலை அறிவியல் தொழில்நுட்பம் மற்றும் சுற்றுச்சூழல் துறை இயக்குநர் ஸ்மிதா, பேராசிரியர் ஹன்னா ரேச்சல் வசந்தி, ஒருங்கிணைப்பாளர் நந்திவர்மன், பயிற்சியாளர் சித்திக், ஏபிஎஸ்சிசி இயக்குநர் கோல்டா உள்ளிட்டபலர் பங்கேற்றனர்.

இந்தப் பயிற்சியில் புதுவைப் பல்கலைக்கழகம், ராஜீவ் காந்தி கால்நடை கல்லூரி, ஆச்சார்யா கல்லூரி, மணக்குள விநாயகர் பொறியியல் கல்லூரிகளில் இருந்து 25 குழுக்களைச் சேர்ந்த மாணவ, மாணவிகள் பங்கேற்றனர்.

English Version – The Hindu - https://www.thehindu.com/news/cities/puducherry/spotlight-on-green-business-ideas-green-business-ideas-pitch-boot-camp-puducherry-chapter-2019/article29378100.ece





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