IGCS BULLETIN

From the Editors' Desk

VOL 3: ISSUE 2 ◇ ***April** 2014*

Contents

Dear Reader,

The first quarter of 2014 at IGCS has been a busy, brisk and eventful period. There were two short-term IGCS professors in our midst since January 2014. Dr M.P. Schneider stayed with us till end of March and was attached with Department of Biotechnology. Dr (Ms) Franziska Steinbruch is attached to Department of Civil Engineering and is all set to stay with us for the next two years as long-term IGCS professor in the area of Water. IGCS organized successfully the third Winter School during March 3-16 on the theme of Sustainability in theory and practice. During this period, IGCS Steering Committee Meeting and Review of Second Round of DST projects were also held. At the beginning of April IGCS inaugurated its first Industry-Academia collaboration during the one-day theme meeting on 'Research in Sustainable Power Engineering' to formalise the tripartite agreement signed in December 2013. We are indeed happy to include in this issue a feature article: 'Landscape Management: inherently trans-disciplinary' contributed by Dr Nidhi Nagabhatla. She is a research coordinator at Leibniz University, Germany and is an important member of Bio Diva Research group, which conducts inter- and transdisciplinary research on land-use change and agro-biodiversity in South India. The article addresses in a lucid narrative the current challenges of sustainable development and role of trans-disciplinary approach. This issue also includes an interesting report on project work titled: 'A Snapshot Study of Solid Waste Management Practices at IIT-M'. executed by a select team of students during the Winter School. The Editors express their sincere thanks to Mr Manivannan R.Rajan, Ph.D. Research Scholar from Department of Management Studies, IIT Madras, and a participant in the Winter School for compiling the report. The issue includes customary IGCS News and Environment News and other regular contents.

Happy Reading.
Thanking You.
Ajit Kumar Kolar & P. Sasidhar

Editors

Prof. Ajit Kumar Kolar

Dr. P. Sasidhar

IGCS NEWS

IGCS Winter School 2014 — A remarkable learning experience

IGCS Winter School 2014 was held in IIT Madras during 3rd – 16th March 2014 on the theme ***"Sustainability in Theory and Practice*** - *Exploring Sustainable Development".* It was a successful programme , with over 33 participants from German and Indian academic Institutions.

Winter School participants

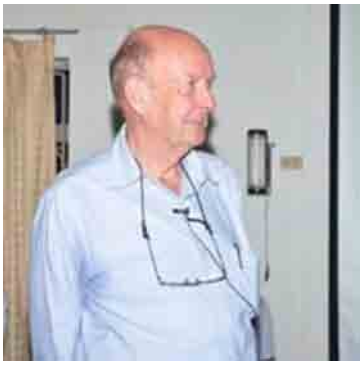
On 4th morning, after Registration and a warm welcome by Prof.Sudhir Chella Rajan, IGCS Centre Coordinator (India), Dr.Ashish Kothari set the stage for the programme through a radical presentation, aptly titled, "Radical Ecological Democracy". He strongly advocated achieving human well-being through empowering all citizens, ensuring equitable distribution of wealth and respecting the 'limits of the earth' and rights of nature. Dr.Sharachchandra Lele emphasised that sustainability is inextricably a normative concept, having both temporal and spatial externalities, as well as inter- and intra -generational impacts.

Dr.Christoph Woiwode, Visiting Professor, IGCS, drew a canvas of the social dimensions of sustainability and brought forth deep insights on a global scale, before moving on to 'Transition Town Movement'. It was heady stuff, but was an ideal mix of eclectic topics that provided the right kind of stimuli for the Winter School.

These were followed by an interesting talk from Prof.Ajit Kolar, IGCS Area Coordinator, Energy (India). He also presented a short film, capturing the historical highlights of IITM's evolution and the deep bonds it enjoys with Germany till date.

Six teams were formed among the participants and assigned short-term project work to be carried out, both within the IITM campus and outside in various parts of Chennai city. The topics ranged from Solid Waste Management Practices in IITM, Status of Solar Power Project in IITM, Mobility & Transport systems in T.Nagar, Land Use in Pallikarnai marsh area, Sanitation in Tambaram, to Food consumption and Security.

The subsequent days brought a galaxy of eminent speakers from various walks of life and professions – serious researchers and academics, lawyers, NGO's, social activists, and journalists. They covered the entire gamut of sustainability, providing a vast spectrum of ideologies, principles and practices. The speakers included Prof. Schneider, Prof. Steinbruch, Prof. Fohrer and Prof. Murthy.



Prof. M. P. Schneider

Prof. Franziska Steinbruch

Prof. B. S. Murty

After a hectic week, during the weekend, the participants headed towards Auroville, near Pondicherry, on a Field Visit. Auroville is a pioneering community which practices sustainability as a way of life. The visit was enormously educative.

The second week saw an array of brilliant speakers again!

Prof. N. Fohrer

The last day was devoted to the participants making presentations on their project work, which were lively and interesting, showing that all the teams had applied themselves diligently. There was also a gala dinner, when the course certificates were presented.

Suddenly, it was over, and time to bid goodbye!

It was a memorable learning experience to participate in the IGCS Winter School 2014, where experts from diverse fields made their pitch and actively engaged with the participants. The diversity of topics and broad spectrum of views were the highlights of the programme. The diverse profile of the participants also added to the flavour.

The Winter School emphatically brought to the fore the daunting and multi-dimensional challenges of sustainability, especially in a developing country like India.

The arrangements were excellent and the IGCS organizing team earned fulsome praise and heartfelt thanks from all the participants for a great programme. The organizers also need to be congratulated on the all-round success of the Winter School 2014.

Dr. P. Sasidhar

Contributed by:
Manivannan R.Rajan,
Ph.D.Research Scholar,
Dept. of Management Studies, IIT Madras.

Forthcoming Conferences…

1.AquaConSoil2015 — International conference on Sustainable use and management of soil, sediment and (ground) water resources. Jun 9- 12 Jun 2015, Copenhagen, Denmark

Weblink: http://www.aquaconsoil.org

AquaConSoil 2015 provides great opportunities for scientists, companies and policy makers to extend and enforce their network, start new cooperation activities and be informed of and inspired by the latest developments in the field of sustainable use and management of soil, sediment and (ground) water resources.

2.Sustainable Development Conference 2014: Green technology, Renewable energy and Environmental 5- 7 July 2014, Bangkok, Thailand

Website: http://www.sdconference.org

Organized by: Tomorrow People Organization
Deadline for abstracts/proposals: 10th June 2013

SDC 2014 is intended to be a forum, discussion and networking place for academics, researchers, professionals, administrators, educational leaders, policy makers, industry representatives, advanced students, and others interested in related topics.

IGCS Steering Committee Meeting

The IGCS steering Committee Meeting was held on March 10, 2014 at Conference Hall, Centre for Continuing Education, IITM. The meeting was presided over by Prof Sudhir Chella Rajan and it was attended by Prof. Rafig Azzam, Prof. Ajit Kolar, Prof. B.S. Murty, Prof. Ligy Phillip, Dr. Mohan Kanda, Prof. Nicola Fohrer, Ms. Miriam Conde, Dr. P. Sasidhar Ms. Eva Portius, Dr Christoph Woiwode and Dr Franziska Steinbruch, Prof. Sudhir Chella Rajan welcomed the members and invitees. Among other things, the dates for Summer School at Stuttgart (June 16 to June 29, 2014) and IGCS Theme meeting on Sustainable Power Engineering at IITM (April 11, 2014) were finalized.

IGCS Steering Committee members with office bearers

IGCS Seminar on Indian Energy Scenarios

Mr.Himanshu Gupta, Project Leader, Energy, in the Planning Commission, Government of India, presented a seminar on **Indian Energy Security Scenarios-2047** on 22 April 2014 at IIT Madras. Faculty and students of IIT Madras participated. He reported that the Planning Commission of India has developed an energy scenario building tool, the India Energy Security Scenarios , 2047 (www.indiaenergy.gov.in), which explores a range of potential future energy scenarios for India, for diverse energy demand and supply sectors leading up to 2047. The energy initiative is available to the public through an interactive, graphical web interface, as well as an excel-based model, and extensive sector-wise documentation.

The IESS 2047 explores India's possible energy futures across energy supply sectors such as solar, wind, biofuels, oil, gas, coal, and nuclear, and energy demand sectors such as transport, industry, agriculture, cooking, and lighting and appliances. The model allows users to interactively make energy choices, and explore a range of outcomes for the country – from carbon dioxide emissions and import dependence to land-use.

The IESS 2047 initiative has been a collaborative effort, with contributions from a range of national and international think tanks, research organizations, governmental and not-for-profit bodies.

One possible energy scenario predicts that the energy import dependence in 2047 could be as high as 84% (compared to today's figure of 35%) and as low as 21%.

The IGCS Research Programme on Sustainable Power Engineering

The IGCS Research Programme on Sustainable Power Engineering was inaugurated on April 11, 2014. His Excellency Dr. Weckbach, the German Consul was the guest of honour for the function. Prof. Sudhir Chella Rajan, and Prof. Azzam the coordinators of IGCS welcomed the dignitaries. The relevance of sustainability in the Power Sector also was underscored by Prof. Bhaskar Ramamurthi, Director, IITM in his address. The research programme is being funded by M/s Maschinenfabrik Reinhausen (MR), an industry in Germany which is a world leader in high voltage equipment, notably the tap-changer used in transformers. Mr. Rohde, the Managing Director of MR, spoke at length about the goals of the programme and the involvement that MR would have in the research collaboration. It was brought out that a first research proposal has already been discussed and approved for funding. Dr. Weckbach, in his address elaborated on the German support for the efforts on sustainability and especially the IGCS programme. Mr. Burgtorf, from the GIZ, also brought out the significance of cooperation in the programme. The programme was formally inaugurated with a handshake between the Director, IITM and the Managing Director, MR. A book on On-load Tap-Changers for Power Transformers was also released by MR on this occasion. Prof. Krishna Vasudevan, who will head this research programme, presented the power scenario in India and the relevance of the first research proposal to this. Dr. Kaltenborn from MR spoke about the energy scenario and Prof. Kolar elaborated on the energy vision for India. The inauguration ended with a vote of thanks from Prof. Krishna Vasudevan.

Prof.Bhaskar Ramamurthi (Director, IITM)
and
Mr. Michael Rohde (Managing Director, MR Gmbh)

Prof. Bhaskar Ramamurthi, Dr . Weckbach and Mr.Rohde with other guests at the Inauguration

FEATURE

Landscape Management: inherently transdisciplinary

Nidhi Nagabhatla

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I believe that in this new era of integration science, creating knowledge for transformation is not about the effort of one person or another; it is the result of a joint effort. What do I mean by this? For nations or organizations engaged in resource management and development planning, in whatever sector or thematic area of interest (agriculture, forest, water) it is an oversight not to take account of both economic and ecological footprints. In order to address current challenges of sustainable development, further attention should be given to exploring and realizing the potential of a transdisciplinary approach that aligns closely with the spheres of interest of key stakeholders, such as government agencies, non-governmental organizations, research communities and think tanks. Transdisciplinary research extends beyond disciplinary domains and promotes the active involvement of stakeholders at all levels, constituting itself as a progressive approach towards understanding and addressing complex problems of natural resource management and conflicts in the nature-society nexus. It is thus a promising option for resource management in the context of diverse perspectives and even conflicting interests.

The BioDIVA project placed emphasis on geospatial analysis as a means to understand biophysical aspects of land use/cover change, and on socioeconomic analysis of cultural, economic, and institutional policy aspects, specifically with the aim of contributing towards the sustainable use of agrobiodiversity. Knowledge was generated by the association between researchers and farmers at multiple administrative levels and scales *viz.,* district, taluk, panchayats and wards. It is often observed that the units and scale of ecological analysis do not necessarily coincide with the areas of interest to social research. For example, a natural scientist might work at a field scale or focus on particular ecosystems, while a social science expert is likely to be interested in what is happening at a village or at household level. In recent times, the landscape approach has emerged as a framework for application in interdisciplinary and multi-disciplinary projects and programs to create a common ground for a joint investigation. In such a context, landscape refers to a selected area of interest that represents a mosaic of ecological components and social elements in interaction. Still the question remains: How should a geographically relevant boundary for a landscape be defined?' Defining boundaries is a prerequisite for geospatial analysis. If the aim is to generate multi-disciplinary research outcomes, surveying the landscape is fundamental in order determine whether or not a boundary in the landscape can be identified that approximates to an administrative boundary such as district, panchayat or taluk. In this case the administrative unit can be taken as representative of the ecological and socio-economic diversity in the region.

The transdisciplinary framework outlined by BioDIVA (www.biodiva.uni-hannover.de) employed a landscape level geospatial approach to examine agroecosystem management challenges in Wayanad district, Kerala, India. The agroecosystem in Wayanad provided a good case study for achieving the overarching aim of the project, which was to contribute vision and knowledge towards a sustainable development agenda for agroecosystem management. Sustainable development in this context implies achieving the twin goals of sustainable management of agroecosystems and sustainable livelihoods of the communities that depend upon them. Geospatial applications are widely understood to have an increasingly important role to play in natural resource management projects and programs. Digital representation of scientific data and stakeholder

knowledge enables new perceptions of complex and heterogeneous ecological systems, giving geospatial approaches a key role in support systems for decision makers worldwide. Geospatial outputs derived for Wayanad during the course of the project (i) provided a visually explicit characterization of past and current scenarios of land use change in the region; (ii) facilitated quantitative assessment of the trends, rates and trajectories of change derived from geospatial statistics/modeling; (iii) generated inputs for long-term evidence–based decision making for landscape (agroecosystem) management; and (iv) provided baseline data for long-term monitoring of performance measures of land management programs.

Interpretation of geospatial outputs and other results of the project was grounded in the concept of socio-ecological research, which combines the outcomes from different disciplinary experts to create common knowledge products that can contribute towards a desired (or required) transformation. Landscapes are conceptualized as social-ecological systems that integrate a range of ecological functions and provide multiple ecosystems services for human society, particularly for subsistence social groups in rural areas. This understanding informed the project's theoretical and practical approach to agroecosystem transitions in Wayanad. In societies today, change in land use systems is primarily driven by economic rationales rather than ecological wisdom. In such a situation it is appropriate to monitor and the rate of change and intervene to manage change wisely before ecological tipping points are reached, beyond which the change is irreversible. To address this need, land use/cover change was agreed on and adopted as a common framework for research undertaken by the different disciplinary experts involved in the project. This attribute of change was central to the work of researchers from different disciplines involved in the project: economists studying the production and marketing of goods derived from land use systems, conservationists and ecologists engaged in biodiversity profiling, and social scientists working with communities that have land-based livelihoods. Thus land use systems or landscapes serve as a focus of attention and interest for various disciplinary specialists; thus managing landscapes is inherently transdisciplinary.


Typical multilayer landscape of Wayanad-Kerala

Highlights of the geospatial approach engaged in the study

Land use/land cover classification is a widely used approach and has a range of applications. Often, patterns of land use, cover and change are determined by the combined actions of different stakeholders, for example by government policies and local management practices. Different stakeholders have different understandings of land use and of the drivers of change. While perceptions on land use may vary, none may be considered 'better' than the others: clusters of understanding feed into the process of land use change concurrently. Classification of land use using spatial data provides a way of integrating these knowledge clusters in order to derive an output that is reflective of multiple understandings. The assumption is that, based on the common understanding of land use patterns on the ground, a unit can be classified as a particular land use type in a digital image.

Geospatial analysis for Wayanad (Figure1) presents a visual image of patterns of agriculture that can also be analysed quantitatively using spatial statistics derived from classified images. Visual evidence from the classified images shows a prominent trend over the last two decades (post 1990s) towards conversion of rice fields to other uses, mainly banana (*Musa* sp.) and areca nut (*Areca catechu*) plantations. The 'paddy field culture' that characterized traditional agriculture in the district seems to be waning, raising questions about the impact of this change on local-level food security, and its possible contribution to loss of agrobiodiversity and declining livelihood opportunities for the landless.

It is important to note that this spatially-explicit analysis of land use cover change needs to be complemented by an analysis of the drivers of change. Land use changes are influenced by mix of factors: social, biophysical, economic, and climatic, among others. Additionally, changing land use patterns also reflect the changing mindset of farmers and land managers. In the case of Wayanad, farmers increasingly favor cash crop systems that guarantee high rates of returns on low (compared with rice) input costs. Biophysical analysis based on time-series of remote sensing data shows the process of unregulated landscape transition in Panamaram, a sub-administrative unit in Wayanad district (Figure 1b). The fragmentation depicted in this region is representative of the general situation in Wayanad. The visual fragmentation in the satellite imagery is the result of discontinuities in agricultural land use, in what was previously a more homogenous landscape, dominated by rice cultivation, providing clear evidence of disruption of the ecological and hydrological services that were provided by a rice-based ecosystem. Whilst the technical method used for mapping at multiple levels provided a valuable overview of landscape structure and dynamics, it could not depict the cultural factors that are a key influence on patterns of land use, and need to be given due consideration in agroecosystem management plans. For example, the farming communities in Wayanad, and communities in other parts of India, still cultivate indigenous rice varieties and other native crops because of their symbolic sociocultural significance, thus contributing to the conservation of agrobiodiversity. Recent trends, which have seen economic indicators taking precedence over ecological and social considerations, have led to changes to traditional patterns of land use, associated with (mostly adverse) changes affecting the multifunctional role of the landscape in maintaining, for example, water recharge, soil fertility and nutrient flows. Considering the range of dimensions involved in land use systems, multifunctional landscapes demand transdisciplinary attention and a holistic understanding. The first ever 'Global Landscape Forum' held from 16-17 November-2013 in Warsaw on the side-lines of COP 19 provided further support for this argument. Participants made the case for the inclusion of a standalone sustainable development goal for landscapes in the post-2015 development agenda. A transdisciplinary mindset can be a stepping stone towards addressing landscape management issues as it facilitates an all-inclusive interpretation of landscape dynamics (including stakeholders perceptions), that is a prerequisite for managing the landscape sustainably.

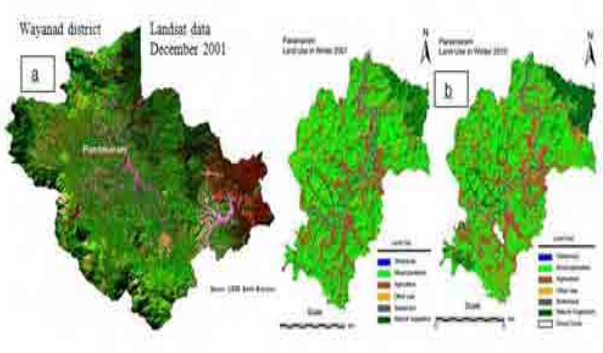


Figure 1:(a) Landsat TM data of the Wayanad district. The data has a spatial resolution of about 30 meters, which is fine enough to delineate different land uses/land covers such as forests, agriculture, water bodies and settlements.(b) Larger-scale analysis of land use change in the Panamaram Panchayat between 2001 and 2010.The time series images are derived using ASTER data with spatial resolution of 15 meters. The imaging technique was able distinguish between some of the different agricultural land use categories. The extent of agriculture (shown in brown color) does not appear greatly reduced in the later image; however there is evidence of a significant trend towards fragmentation (circled areas) in the agrarian (Punja rice crop) land use category.

Concluding Remarks

A great deal more effort is required to gain a clear understanding of the interconnectedness between science and society. To this end, the experience of applied research projects such as BioDIVA demonstrates the case for practical involvement by scientists with stakeholders on the ground. This was made possible in the case of BioDIVA through the collaboration with the Community Agro Biodiversity Centre (CABC), a Wayanad-based institute run by the M. S. Swaminathan Research Foundation. The outcome of this collaboration can be seen as a good starting point towards integrated thought and action for wise and sustainable landscape management. In summary, BioDIVA was a transdisciplinary research project that employed a mix of conceptual approaches, integrating theoretical and applied research. The project was successful in creating evidence based knowledge, while exemplifying the advantages of geospatial technology driven methods.The knowledge products in the project were designed to cater for specific groups of stakeholders: for instance, peer-reviewed publications for the scientific world, policy briefs or briefing notes for other stakeholders, handbooks that present scientific concepts in simple language for *practitioners* and short articles for publication online and in the print media. Bearing in mind that scientific knowledge created for decision making needs to be constructively debated and discussed with stakeholders at all levels, a series of multi-stakeholder dialogue session were organized over the implementation period of the project (2010-2014). Further feedback on the project was received from academic colleagues in a variety of settings, through internal workshops, and interactions during field surveys.Though no single method can be expected to capture the full complexity of a dynamic system such as Wayanad, the landscape-based approach presented in this article can make a significant contribution to systemic knowledge of the area and help address the variety of challenges faced by resource users and managers.

This article is based on: Nagabhatla, N. and Kumar, A. 2013. Developing a joint understanding of agrobiodiversity and land-use change. Chapter 2: In: Christinck, A. and Padmanabhan, M. (eds). *Cultivate Diversity: A Hand Book on Transdisciplinary Approaches to Agro Biodiversity Research*. Margraf Publishers, Welkersheim, Germany, pp. 27-51.

Associated web link : http://www.stakeholderforum.org/sf/outreach/index.php/component/content/article/191-uncategorised/cop-archive/cop-19/cop19-day-4-forests-and-agriculture/11561-an-argument-for-a-sustainable-development-goal-on-landscapes

Project Report — Winter School March 2014

Snapshot Study of Solid Waste Management Practices at IITM

Project team: Irina Bartmann, University Kiel; Tamara Drewes, RWTH Aachen University; Rachna Dhingra, and Shishi Khawlneikim, University of Delhi; Manivannan R.Rajan, DoMS, IITM.

1.0 The Context:

1.1 IIT Madras (IIT-M) is a residential institute with nearly 550 faculty, 8000 students and 1250 administrative & supporting staff and is a self-contained campus of beautiful wooded land of about 250 hectares.

1.2 IGCS had organized a Winter School on the theme "Sustainability in Theory & Practice – Exploring Sustainable Development", at IIT-M during March, 2014. As a part of the course work, the team had been assigned the project of studying the Solid Waste Management (SWM) practices in the campus.

2.0 Objectives and Methodology of the Study:

2.1 The objective of the study was to critically study the current system of SWM at IIT-M, and identify both the good practices and areas for improvement.

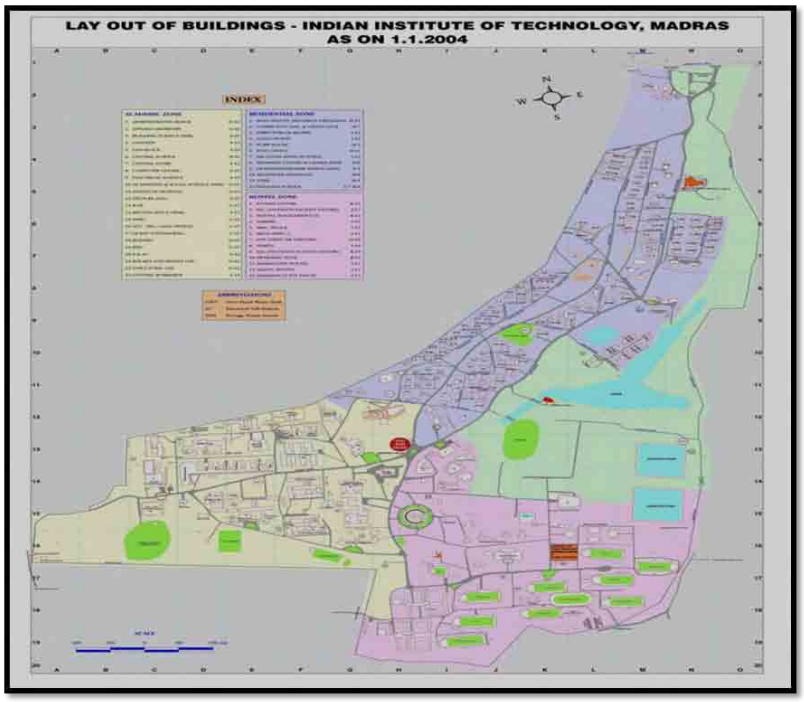
2.2 The methodology adopted by the project team consisted of:

1. Studying the zone of operation with the help of a map of the Institute
2. Discussing with the operators.
3. Various zones within the Institute from where the wastes originate and are collected.
4. Interviewing internal customers – residents, students, and academics, with the aid of checklists.

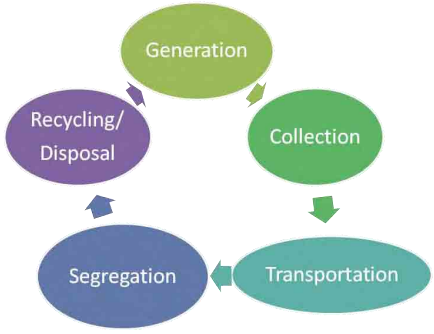
3.0 Overview of the Current Process:

3.1 The governing principle on SWM system is called "Owzone", i.e., "Zero Waste Zone", which essentially means the Institute aspires to operate as a zero waste entity.

3.2 In the SWM system, the entire Institute is divided into three zones: (1) Academic – Departments and Laboratories; (2) Residential – the living quarters of teaching and non-teaching staff; and (3) Hostels for students.



3.3 The process of SWM is:
Segregation at source as recyclable and non-recyclable waste → Daily collection by teams of collectors → Transport to Sorting Centres → Sorting of recycle waste into various categories → Disposal to recyclers.



3.4 The non-recyclable wastes are sent to the dump yard at the Velacherry Gate, from where they are periodically removed by the Municipality.

3.5 The following streams of solid wastes do not enter the above processing system: (a) Bio-medical wastes from the Institute Hospital; (b) E-waste from the Departments; (c) Foliage from the forest areas, which are left undisturbed; (d) Foliage from road sides and residential areas, which are raked, collected and piled in the bio-compost pits at various locations; (e) food waste from messes in the hostel area, which are collected and fed into the Biogas Plant.

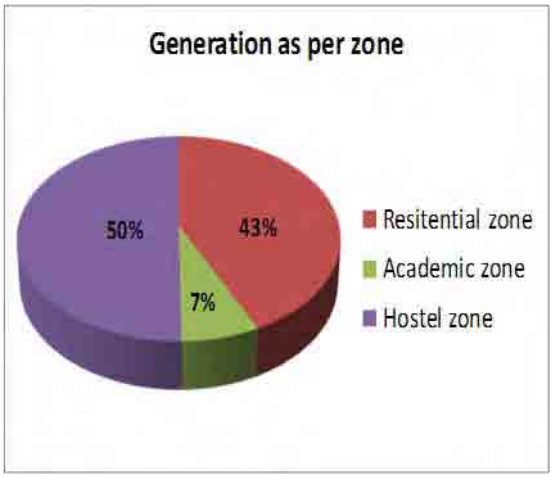
3.6 The SWM process has been outsourced, operating under the aegis of the Campus Welfare Trust. The work is carried out by five Self-Help Groups. About 75 persons are involved in the door-to-door collection operations. They are provided with the necessary appurtenances such as brooms, tricycles, etc., uniform and personal protective equipment (gloves, masks, and aprons).

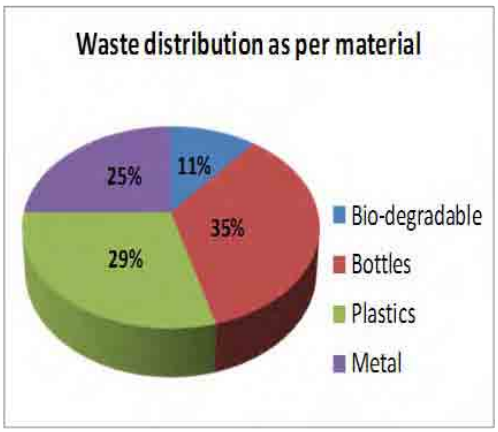
3.7 There are three sorting centres located at: a) Velacherry / Nandhini Gate, (b) Shopping Centre, and (c) Warden Quarters, near Himalaya Mess.

3.8 The various types of wastes that are generated in the campus are:

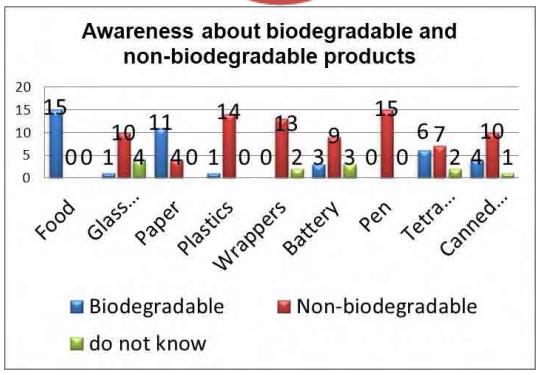
a.Aluminium foils, Aluminium cans
b.Steel scrap
c.Plastics
d.Wood
e.Paper: Books, Notebooks, Newspaper, paper plates and cups, paper boards, wrappers
f.Glass bottles
g.Electric wires and cables
h.Mica sheets

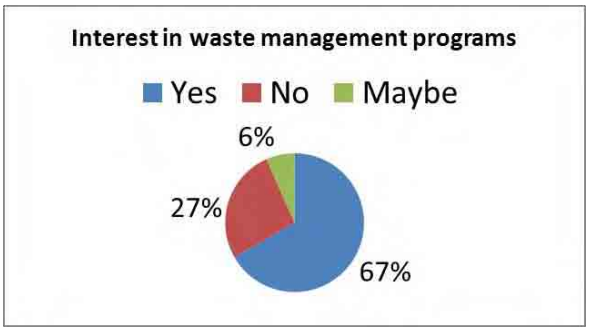
3.9 The major constituents are: Paper, Plastic, Glass Bottles, and Mica. The Institute generates about 6,000 Kgs. of recyclable wastes monthly, and realizes about Rs.50,000/- through disposal.





3.10 Interviews were conducted with students in the hostel zone. The key findings are:





Broadly there was agreement that SWM is a concern of the campus. Ideas for improvement proposed by students: provision of different dustbins, information regarding segregation, more bins, signs to show where next dustbin, measures against monkeys' access, and joint initiatives from administration and student body.

4.0 Observations / Findings:

4.1 Good features / Note-worthy efforts:

1. Wastes are segregated at source as recyclable and non-recyclable.
2. The sorting centres are well-designed facilities that are well ventilated, with natural light, and without odour.
3. The workers are paid monthly salary and bonus twice a year, and provided with appropriate personal protective equipment.
4. Housekeeping is good at all the collection and sorting centres.

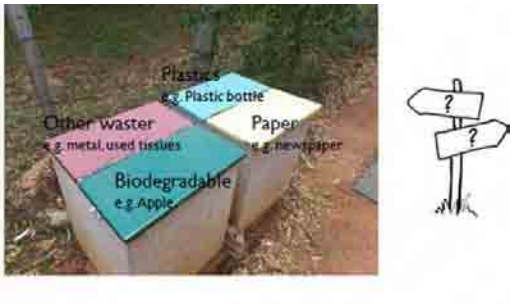
On an overall basis, the quality of service is good, with no pile-up of waste observed anywhere in the campus.

4.2 Opportunities for Improvement:

1. The quantities of all forms waste, besides recyclable waste, need to be tracked, recorded and analysed, though a waste inventory.
2. The per capita generation of waste the area(s) where they arise, locations of concern, trends, etc. are not known.
3. Besides some members of the Ladies Club, there does not seem to be any participation from any of the other residents in the campus. Volunteers from students and faculty are required to sustain the initiatives.
4. An assorted variety of waste collection bins of various colours, shapes and sizes are being used in the campus.

There can be some standardisation in this aspect: Colour-coded bins for waste collection - Green: biodegradable, Blue: recyclable and Red: Hazardous or Non-recyclable. Use monkey-proof dustbins (the last one given below).

The following type of Auroville design for waste segregation can be considered for IITM:



5. Improve signage.
6. Every day about 2 tonnes of food waste is produced on the campus. Food waste in dining halls / messes, canteens, guest

house, etc. can be monitored and controlled, through weighing the final disposal quantity, which may be displayed to create awareness on food conservation and responsible consumption. This will be an initiative by IIT-M in line with the current year theme of UN for World Environment Day celebration of "**Think.Eat.Save. Reduce Your Foodprint".**

7. Can the option of reusable cups be considered? For instance, in Food courts: *bring your own cup and pay less, else: use biodegradable cups and plates.*
8. Organize a 'Waste Hunting' campaign to unearth various types and sources of waste that get generated in the campus.
9. Set targets for year-on-year waste reduction, both in absolute and per capita terms.
10. Conduct Internal customer satisfaction surveys every year to assess the performance of the function and to elicit suggestions for improvement.
11. Appoint area coordinators from each hostel and zone to improve accountability and wider participation.

5.0 Conclusions & Recommendations:

5.1 IIT-M can consider implementing the suggestions given above under 'Opportunities for Improvement'. Besides, it can consider covering other resources such as water and energy through similar mechanisms, probably through implementation of a comprehensive Environmental Management System, which can be certified under ISO 14001:2004.

5.2 IIT-M can also monitor and measure its all-round sustainability performance with appropriate metrics, to set improvement targets and track progress on a continuous basis.

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