Working Paper 497

Eco-Innovations in Waste Management - A Review of High Point Cases

S Manasi
Harshita Bhat

October 2020

Institute for Social and Economic Change (ISEC) is engaged in interdisciplinary research in analytical and applied areas of the social sciences, encompassing diverse aspects of development. ISEC works with central, state and local governments as well as international agencies by undertaking systematic studies of resource potential, identifying factors influencing growth and examining measures for reducing poverty. The thrust areas of research include state and local economic policies, issues relating to sociological and demographic transition, environmental issues and fiscal, administrative and political decentralization and governance. It pursues fruitful contacts with other institutions and scholars devoted to social science research through collaborative research programmes, seminars, etc.

The Working Paper Series provides an opportunity for ISEC faculty, visiting fellows and PhD scholars to discuss their ideas and research work before publication and to get feedback from their peer group. Papers selected for publication in the series present empirical analyses and generally deal with wider issues of public policy at a sectoral, regional or national level. These working papers undergo review but typically do not present final research results, and constitute works in progress.

Working Paper Series Editor: **M Balasubramanian**

ECO-INNOVATIONS IN WASTE MANAGEMENT

A REVIEW OF HIGH POINT CASES

S Manasi[1] and Harshita Bhat[2]

Abstract

Eco-innovation is a new concept of immense importance to trade and policy makers that cover many innovations providing environmental advantage. This paper looks at a few interesting eco-innovation cases in the Indian context specific to solid waste. Solid waste management is one of the critical challenges facing urban India. These eco-innovations have made impacts at various levels on the ground and demonstrate little pathways of transformations towards sustainable development initiatives.

Keywords: Eco-innovation, Solid Waste, Solid Waste Management Policy, waste reduction, technology, environmental auditing, landfill, Municipal Solid Waste Management, composting, Waste-to-Energy, Incineration, gasification, informal recycling

Introduction

Currently, 54 per cent of the world's population live in urban areas and this is expected to increase to 66 per cent by 2050 considering the intensity of urbanisation trends. Urbanisation creates pressure on urban infrastructure facilities. The magnitude and intensity of environmental problems have severe implications on society. Innovative and effective systems are needed to resolve the challenges. The quality of life of the urban population will depend on the quality of services provided in maintaining city environs, access to clean drinking water and sanitation facilities, reliability of power supply besides services like education and health. Twenty-first century faces one of the pertinent development challenges of managing urban areas. However, cities can also take advantage of urbanisation and flourish and make it liveable. Cities have several opportunities to get smart in improving city infrastructure, planning and governance. Technology has played an important role in transforming cities in getting smart, improving public services and quality of life of the people. People have become more aware comparatively and need to change and renew existing technological production and social behavioural patterns that are emphasised. These changes bring about innovative response that transforms society to move towards more sustainable pathways. Innovations are of various kinds and some suit certain locations while some are of global suitability and acceptance. There are several analytical tools developed in environmental management viz, eco-efficiency, industrial ecology, design for environment, eco-effectiveness, natural capital, bio-mimicry and eco-innovation. Eco-innovation is a new concept of immense importance to trade and policy makers that covers many innovations providing environmental advantage. In most common terms, eco-innovation refers to new technologies that improve economic and environmental performance and also some definitions include organisational and

[1] Associate Professor, Centre for Research in Urban Affairs, Institute for Social and Economic Change, Bangalore. Email: manasi@isec.ac.in

[2] Research Intern, Economics, Jain University, Bangalore.

The authors are thankful to the two anonymous reviewers for their valuable comments and suggestions on the earlier version of the paper. However, usual disclaimers apply.

social changes for improving competitiveness and sustainability and its social, economic and environmental pillars.

The definitions of eco-innovations can be general; hence, classifying eco-innovations for better understanding is required to understand their special characteristics. Andersen's classification on eco-innovation reflects on typologies of eco-innovations – integrated eco-innovations, alternative product eco-innovations, macro-organisational eco-innovations, general purpose eco-innovations, many more are being proposed as well. Some of the eco-innovation definitions are viz - 'Eco-innovation is any form of innovation aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or achieving a more efficient and responsible use of natural resources, including energy' Competitiveness and Innovative Framework Programme (2007-2013), European Commission. 'Eco-innovation is the creation of novel and competitively-priced goods, processes, systems, services and procedures designed to satisfy human needs and provide a better quality of life for all, with a lifecycle minimal use of natural resources (materials, including energy, and surface area) per unit output, and a minimal release of toxic substances' Europa INNOVA Thematic Workshop, Lead Markets and Innovation, June 29-30, 2006, Munich, Germany. 'Eco- innovation is the process of developing new products, processes or services which provide customer and business value but significantly decrease environmental impact' Fussler, C and James, P (1996) Eco-innovation: A Breakthrough Discipline for Innovation and Sustainability (Pitman Publishing).

Arundel, *et al* argue that eco-innovation research should not be limited to environmentally-motivated innovations but should encompass all products, processes or organisational innovations with environmental benefits. Attention should include innovation in resource use, energy efficiency, greenhouse gas reduction, waste minimisation, reuse and recycling, new materials and eco-design. Research should cover drivers, patterns and benefits of eco-innovation should look at all these factors as they all differ and are different methods that should be used to measure eco-innovation.

In the past, recycling of waste was done to reduce the cost of production by industries. At present, it is practiced to reduce the environmental impact (Beukering, Sehker, Gerlagh, & Kumar, 1999). One of the major challenges to every government that comes and goes is to manage solid waste effectively. There are several studies in this context that have highlighted the issues and suggested solutions for solid waste management. Solid waste management is a matter of growing concern for developing countries. On an average, developing countries generate as much as 109.5 – 526.6 kg per person a year (Karak, Bhagat, & Bhattacharyya, 2012). Studies reveal that most of the populations in developing countries do not have access to waste collection from the municipal body which poses threats to health. Thus, such countries must use strategies of solid waste management that look into land use, economic aspects, social, environment, and health. Also attention must be given to various stages in solid waste management. A few strategies for minimum waste were suggested by (Kansal, 2002). Reduction of waste at source by reusing and recycling by households has proved successful in countries like Germany. This can be mandated on the citizens or can be through voluntary or educational means. Technological interventions for collection, segregation and disposal of waste (plants for incineration, gasification, anaerobic fermentation) impacts waste reduction to large extents.

Global municipal solid waste generation is 2 billion per year. Most countries follow the practice of disposing waste into landfills. Land being limited in supply and the generation of waste ever increasing, waste reduction or minimisation strategies are necessary. Alternatively, countries can produce energy from municipal solid waste. Suitable waste processing technique must be used according to the type of waste (organic, inorganic and electronic). There are two practices of waste processing -- thermo-chemical conversion and bio-chemical conversion, which can be done on a small scale at home or at a bio-chemical unit. Some of these technologies are already being utilised in many countries. China, a rapidly developing country, faces the problem of municipal waste disposal due to rapid urbanisation. Waste-to-Energy (WTE) with the help of incineration is playing an important role in SWM by recovering renewable source of energy from solid waste. Currently, 13 percent of MSW generated in China is used for WTE facilities. The major challenges in expanding WTE is it requires high capital and operational costs, air pollution, equipment corrosion, and fly ash disposal (Cheng & Hu, 2010). Turkey is another such country working towards efficient collection, transportation and making environmental-friendly waste disposal efforts. There are deficiencies in provision of waste collection services in many cities of Turkey leading to open dumping of waste. As much as 70.57 percent of the total amount of MSW is disposed off without any control despite existence of landfills, composting and incineration units (Turan, Çoruh, Akdemir, & Ergun, 2009).

The informal sector too plays a key role in solid waste management. It is a labour intensive and small scale run unit. The informal recyclers go scavenging for waste door-to-door or waste picking from streets and dumps. The economic benefit of informal waste recycling systems is that it reduces the cost of formal waste management systems. It also provides employment and livelihood to deprived and marginalised individuals and social groups. Integrating informal sector into the formal municipal solid waste management can have much larger benefits (Wilson, Velis, & Cheeseman, 2006).

Environmental Audit (introduced in India in 1992 with the aim of minimising waste) conducted in Bangalore (Ramachandra & Bachamanda, 2007) indicates that out of the stages in municipal waste management, collection and transport are efficient while storage facilities in layouts are insufficient, treatment and disposal of municipal waste are unsatisfactory. Therefore, the issue requires some innovative methods, coupled with strict monitoring by legislative and control measures in municipal management of waste, else they cause further hindrances in the system.

The existing body of studies, conducted in solid waste management, address issues with regard to legislative efforts and use of technology in waste management, typically gasification and incineration. Furthermore, there are scarce or barely any studies conducted in this domain. In this backdrop, this paper looks at Eco-innovation as a good solution for solid waste management. This paper documents some of the best innovative practices in solid waste management, thus, drawing options for up-scaling such improved interventions in larger city contexts. Part of the case studies are documented with personal visits (Case study 1 and 6), interviews while rest of them are based on review of literature.

Case Study 1

Context

Bengaluru city, located in Karnataka state, India, is a home for more than 10 million population. The city witnessed a growth rate of 46.68 per cent during the period 2001-11 (Census 2011) indicating an increase of 4.68 per cent growth of urban population. Bengaluru Urban is the most urbanised district with 91 per cent of its population residing in urban areas spread over an area of 800 sq kms. Amongst the various challenges that Bengaluru faces, 'solid waste management' is one of the serious concerns that the state government encounters. The 74th Constitution Amendment (12th schedule) Act one, indicates addressing sanitation and solid waste management as one of the important functions of the urban local bodies (ULBs). In Bangalore it is the Bangalore Bruhat Mahanagar Palike (BBMP), which is the Urban Local Body responsible for solid waste management. In India, there are comprehensive standards laid down in the Municipal Solid Waste (Management and Handling) Rules, 2000, however, compliance has remained an issue.

The city generates around 3,000-4,000 metric tonnes of waste per day of which 74 per cent is organic (Ramachandra et a.l 2014). Waste generated per household, as reported by BBMP (2015), is 1.24 kg. There are several initiatives by the government to streamline the process, however, they are yet to achieve the goal of maintaining a garbage-free city. The BBMP has also addressed the problem in several ways by focusing on creating value to waste by making it compulsory for residential buildings, who have more than 50 flats, to manage their own waste, agreement on setting up a biogas plant along with Bruhat Bangalore Hotel Association, establishment of dry waste collection centres by involving rag pickers, training them and also providing them with identity cards, seven locations for installing composting plants have been identified. Coconut shell plant is installed at Freedom Park, Thermocole recycling plant is underway, and several of such initiatives.

However, there are numerous governance issues. The generation of solid waste continues to grow and the City Corporation's capacity to manage it has become a challenging task at all levels, be it segregation, collection, transportation, disposal and treatment. Although waste segregation has been made mandatory for households it is not effectively practised due to lack of awareness. Trucks carrying waste do not have separate sections for segregated waste resulting in the mixing of waste. Most of the trucks carrying waste are overloaded, scattering waste along the way spreading foul odour and leakage on the streets. There are about 60 known dumping sites, 300 unauthorised sites and many unrecorded sites that have increased. The road corners today act as buffers of illegal waste disposal. Only some portion of the waste generated is treated completely. The rest percolates into the soil, water and food with serious environmental and health consequences. The existing waste treatment system has not proved to be effective in the city. Landfills have failed as they were over burdened; also there are not enough sites to have landfills. Besides these, BBMP also faces shortage of skilled manpower, lack of guidelines to suit contexts as well. The city has witnessed a huge scam in garbage collection and transportation with breaching of rules by private contractors.

As a result of all this, the city suffers from aesthetic, health and environmental concerns due to inefficient handling of waste. Mixing of plastic waste with municipal waste produces harmful effects on the environment. Most of the lakes, tanks or public/open drains remain clogged and polluted due to

seepage and dumping of untreated waste. The easy method resorted to is indiscriminate burning of waste on roadside adding to the already prevailing severe air pollution in the city leading to health impacts. For instance, 313 dengue cases have been reported in Bengaluru between January 1, 2014 and June 2, 2014, with 82 cases in May alone (Kamath, 2014). Air pollution in Bengaluru is a matter of concern as the respirable suspended particulate matter (RSPM) level is four times higher beyond the limits in certain parts of the city (Sridhar, *et al*, 2015).

Several Non-Governmental Organisations (NGOs), Resident Welfare Associations (RWAs) and citizen forums have been involved in responding to resolve the crisis through awareness creation, segregating at source, setting up decentralised composting units etc,. However, the problem of garbage has coverage on national media extensively and has drawn global attention too. Even after the implementation of various initiatives and funds allocation, the administration has not been able to give a sustainable solution to waste management.

Even other cities in India are not free from the waste menace. An analysis of waste disposal in 22 Indian cities by the Federation of Indian Chambers of Commerce and Industry (FICCI) shows that 14 out of 22 Indian cities disposed more than 75 per cent of waste at dumpsites with Mumbai disposing 100 per cent of its waste at dumpsites, while Delhi recorded 94 per cent. Only six, out of 22 cities surveyed, have sanitary landfills. Even high waste generating cities like Delhi (6,800 TPD) and Greater Mumbai (6500 TPD) do not have sanitary landfills. The concept note on smart cities by the Government of India (GOI) also clearly acknowledges that Indian cities are facing serious issues with respect to solid waste.

Amidst this disarray, the interesting eco-innovation that took shape is the 'Daily Dump' based on the important question on 'How design can make a difference? Poonam Bir Kasturi[3] from Bengaluru is a former student of National School of Design and the inventor of this eco-friendly product that converts garbage into nutrient compost. This also emphasises the fact that it is the responsible citizens, who do their bit for contributing to the city by showing the way for others to follow. Sustainable craft-based livelihoods and new ways of doing business was the trigger for this new venture.

Innovative Eco-waste Processor

'Daily Dump' is a unit that manufactures eco-friendly composter models for making compost. Daily Dump offers a series of products that are of unique design to suit local conditions by using locally-available material, low-cost, space-effective and aesthetically appealing. In India, there were no commercial home composters available until the launch of Daily Dump. Waste-to-Wealth is possible, reducing burden on environment and economy. It reiterates the fact that awareness and by being consciously responsible, it is possible to set up locally-sustainable frameworks. Given its interesting features, there is large scope for replication in urban contexts, particularly, among the upper class and middle class households, besides, supporting local livelihoods and promotion of hygiene. Daily Dump is actively involved in promoting this interesting concept by creating a series of awareness programmes

[3] Poonam Bir has worked in a small scale manufacturing company after college and set up an enterprises on making products from home on Playnspeak, besides, she was also the founding faculty of Srishti School of Art, Design and Technology, later she founded the Daily Dump in May 2008.

about the method, approach and technology and sale of its products. Interestingly, the income generated from sales is used to enhance support to the potters' community, who make the composting units, sale and distribution of products across cities, research and to popularise the spirit of composting. It makes the citizens responsible, involves NGOs to promote awareness, and promotes livelihoods and green entrepreneurship, thus, aiding the local government. Daily Dump has been catering to residents living in individual homes, flats, communities, schools and offices. It has a service backup facility along with customer support which makes the whole process feasible and convenient. Being an exclusive design that suits local conditions of cities in developing countries, where the calorific value of waste is low, Daily Dump can be a sustained design initiative.

Technology and Process

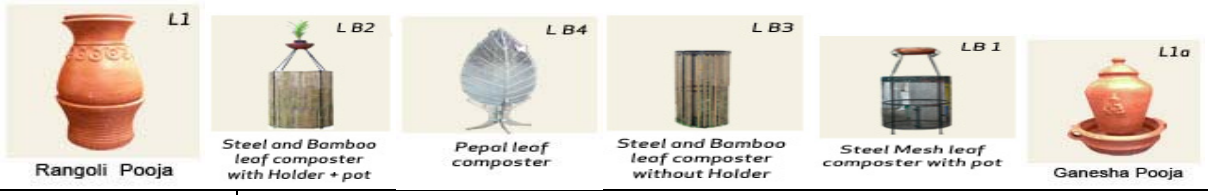
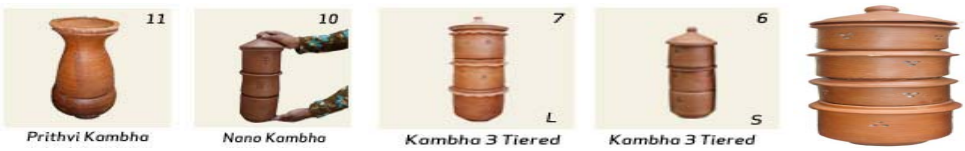
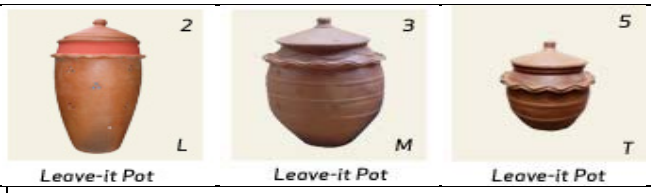
The technology is simple and user-friendly low-tech manufacturing process and high-impact solutions. Daily Dump products are designed to make sure that the composting is done at home, conveniently and hygienically. The process is to collect and separate the organic waste and put it in the top chamber of the Khamba and to put in dry leaves or sawdust or shredded newspapers equal to at least half the volume of the waste to supply carbon. When the process is repeated the next day, it will be obvious that the input would have shrunk by about 20 per cent due to loss of water. This matter is to be stirred by a stirrer provided. Every week, a mixture provided (made of chilli powder and baking soda) acts as an accelerator (microbial culture) and neem is added and stirred. The process gets transferred in terms of rotation across the three pots and by the end the first pot processed would have turned its contents into fine compost. The mixture can also be purchased at a cost of Rs. 75 to Rs. 100 per month. The pots are made by local potters and can be made anywhere. The process of composting organic matter, or treatment of waste through decomposition, results in nutrient-rich compost sourced from kitchen and garden waste which is otherwise dumped into the garbage bins causing hygiene and health problems. Composting process takes between 3-6 months and reduces the volume of waste by 80 per cent and the best thing is each household's contribution to Bengaluru city's waste will be reduced by 60 per cent. This innovative method will take care of segregation, collection, disposal and treatment stages of waste management.

Products and Varieties

There are several models that include garbage composting units, leaf composting units, designed to suit specific leaf types, and culture-friendly composting units, that can be used to process flower waste generated after prayer rituals every day. Daily Dump has a range of Terracotta products ('Khamba' and 'Leave it Pots' in varied forms and sizes and can be installed in small spaces of 2 sq. feet. Community composting units (Manthans) are designed in a way to function without electricity or chemical additives. These products can cater to about 10-12 families and occupy little space, about 4 sq feet. This newly-introduced community composting produce called 'Aaga' is a simple large scale composter with a capacity of 550 litres each, a pair can handle 30 kgs of waste per day that requires no mixing, shifting of contents or stirring. Wet waste from homes has to be layered with Remix powder which is also provided by Daily Dump, and rich compost will be ready in 6 weeks. Leaf Composter units ensure that

the dried leaves are not burnt or dumped, but can be composted effectively. These composters, along with accelerator powders, make the composting process a comfortable exercise that is convenient, quick, and free of hassles. Daily Dump does have gardening products, organic toiletries to serve a complete package to the customers. Products are cost-effective and range from $10 to $73 across a variety of models, that are affordable. Daily Dump also provides a range of monthly and one-time service plans to aid customers with easy and effective maintenance of composting units.

Picture 1: Clay Pot Models at Daily Dump

MODELS	DESCRIPTION AND TYPES
LEAF AND FLOWER COMPOSTERS	LEAF AND FLOWER COMPOSTER ARE DESIGNED TO SUIT SPECIFIC LEAF TYPES AND WASTE GENERATED FROM CULTURAL TRADITIONS/ RITUALS
	
GAMLA POTTED PLANTS	MODIFIED POTTED PLANT. PLANTS SURROUND THE ORGANIC WASTE DURING THE PROCESS OF DECOMPOSTITION
	
KAMBHA COMPOSTER	KITCHEN WASTE COMPOSTER IS TO BE PLACED OUTDOORS, WEATHER PROOF AND USER FRIENDLY
	
LEAVE IT POT	DESIGNED AS A STORE AS WELL AS A COMPOSTER
	
AAGA (COMMUNITY COMPOSTER)	WEATHER PROOF, ROTATING COMMUNITY COMPOSTER DOES THE HOMOGENISATION AND AERATION OF COMPOSTING.
	

Source: http://www.dailydump.org/convince_me

RECOGNITIONS[4]

Impacts

Environment

Aesthetically Appealing **–** The products are designed well to make it visually appealing as it is made of earth, close to nature. Owning and handling the process of waste-to-resource is a journey and users expressed a sense of satisfaction of having contributed less to the city's garbage and helping the city's healthy environs. The Daily Dump composters, specifically the *Khambas* (the three-tier small composter) made the waste visible and aided in driving home the point to the householder that she was in command and contributing to the environment and the country, a powerful concept.

Waste-to-Resource – Converting waste to resource aids the environment considerably by reducing land and water pollution. Daily Dump products divert 60 per cent of trash from reaching the landfill. On an average, an Indian home produces organic waste of ½ to 1.5 kilograms per day which is about 30 kilograms a month. Composting generates about 12 kilograms of compost every two months. Daily Dump has so far has enrolled 26,000 Daily Dump users across Bengaluru, Chennai, Mumbai, Pune, Hyderabad and Delhi and has been able to keep away around 15,000 kgs of organic waste from the landfills each day.

Cleaner Resources for Reuse – Dry waste collection for resale value is a livelihood option for more than 30,000 rag pickers and informal sector recyclers in Bengaluru city. Segregation at source will help the wet waste and dry waste separate, making it more accessible and usable to the recycling community.

Economy

Sustained Livelihoods – Daily Dump trains potters to make composters with a buyback facility and these are sold through different mediums - shops, online stores, outlets across cities and organic exhibitions. The community of potters, who make Daily Dump products, have doubled their turnover within a short span of two years by making the products. They have been able to have a stable market along with working capital which is interest free. Initially, a cluster of potters were engaged in Hyderabad. Lately, they are working with another group at Pokhran, Rajasthan. In 2013, the first group made Rs. 25 lakh ($ 3,66,93) by making Daily Dump composters. Land was purchased to aid them and they have been able to pay it back. The potters want to build and create assets and see hope for a better life.

Reduced burden on the Municipal finances – The local City Corporation (Bengaluru Mahanagara Palike) spends more than Rs 4 crores ($587,154) to collect, transport and dispose municipal waste annually. This is a huge expenditure that can be diverted for more productive uses to improve the city. Promoting

[4] ***Awards and Honours*** Nominated for the INDEX Awards 2007 – an international award to improve the quality of life**,** Awarded the Green Product of the Year by Anchor Better Interior Excellence Awards 2007**,** Indira International Innovation's 'Star Entrepreneur of the Year Award' – 2009**,** Made it to the final round of the Sankalp Social Enterprise and Investment Forum Award 2009**,** final round of the TATA NEN Hottest Startups 2009**,** Shortlisted for the Social Entrepreneur of the Year India Awards 2015 by Jubilant Bhartia Foundation and Schwab Foundation for Social Entrepreneurship, a sister organisation of the World Economic Forum

Daily Dump can aid in reduction expenditure on waste management as significant amount of waste can be put to use in a resourceful manner. Besides expenditure, there have been several issues concerning waste management budgets. Lately, they introduced garbage cess on all households keeping in view the polluters pay principle. Associated with this, there are other issues, for instance, unable to manage the waste, private contractors are involved in various levels to collect, transport, dispose waste, which has been a racket in misuse of finances.

Business Opportunities – Daily Dump promotes business opportunities by providing clone models which is open to others for duplicating the business. Designs are open source indicating that anybody could locally produce and sell the products by paying a small royalty fee, thus, encouraging micro enterprises. There are 21 clones in Bengaluru city and 17 clones across different cities in India which is an interesting concept that is getting popular to promote related green services, thus, promoting ethical and conscious consumer behaviours. Trash Trails are also organised by the Daily Dump team to educate more people and influence them to convert garbage into compost. The Trash Trails are practical in nature with hand-on seeing, discussing, debating, observing, questioning, understanding and learning experience, hence, makes it interesting for the participants. It supports people with flexible service plans to achieve the goal of becoming a green citizen. It is about influencing behaviour change, to understand, what we buy and throw each day and about the people who work with waste, and the whole process of what happens to waste once it is generated. The trail helps in enriching the participant in going back home capable of making more informed choices to start a micro-enterprise or at least contribute to the movement.

Challenges for Daily Dump

Perceptions and Attitudes

Mindset of the people is a matter of concern and a challenge. Majority of the people consider waste management has to be the responsibility of the government. Also, most urbanites are not aware that composting can be done at home. Lack of space is another reason as they do not have open space/garden space. Composting at home is evaded due to fear of attracting rats, dogs besides bad smell attracting flies and mosquitoes. Composting is considered non-doable given their busy schedules. Daily Dump team works hard to break down all the possible barriers and excuses of the people so that they adopt waste management. Volunteers explain the process to customers and make follow-up home visits. They buy extra compost produced and make it work in cheap steel drums and plastic buckets that can be picked up in a local shop.

At a larger level, Ms. Poonam observes that the issue of knowledge creation is a lot of competition in devising their own way of the same thing, rather, when knowledge should be shared. Hence, she has worked on the easy to get a prototype done for an idea involving huge amount of precision work quite easily. However, issues like equal distribution of opportunity and wealth are yet to be resolved. Poonam has a greater philosophy, ‘that ecology does not belong to her, that progress in this world has to be shared’. The challenge is ‘how best to generate wealth’, a holistic idea that encompasses, production, consumption and ecology.

Leaders find convincing people difficult

People do not get convinced easily. It needs enormous commitment, dedication and perseverance to ensure that people adapt to newer ways of doing things for which the leaders have to be patient. Besides, they have to be proactive and be able to handle challenges. Sharing the experience of Ms. Shraddha of Railway Officers Colony, Gandhinagar, who has been able to motivate a few apartment owners, reflects that she is still struggling to convince all the apartment residents to resort to composting at home, as it is not an easy task. At Sarovar Apartments, L.B. Shastri Nagar, Bengaluru, the lead takers, faced the problem of convincing people to purchase equipments, powders required for making compost. Besides, educating people on what materials could be composted needed perseverance. Issues about storing dry waste was an issue as some residents were uncomfortable with the sight of dry waste in common courtyards.

Newer ways were evolved to resolve the issues. For instance, the option of purchasing more pots were not acceptable as people did not want to pay more, hence, a huge cement bin was used as a leave it pot for semi-composted matter. Another situation arose, wherein the composters got full and the team leaders did not want to break the habit of segregation, which would mean more difficult to reinstate again. They consulted Ms. Poonam who helped them with making piles of organic waste on the open space at end of the roads. The compost was smelly and had maggots, which was handled by stuffing them with layers of wet and dry matter by adding dry leaves available in abundance around the trees in Bengaluru. The practice of composting continued without further interruption.

Creating Service Backups at various levels for sustenance

It is important that there is proper back up facility set up to see the success of the programme, else it would easily fall apart. People do not like to face any inconvenience and keeping in view all their cultural and belief systems is challenging. For instance, in Gopalan Royal Palms, HAL apartments, who adapted Daily Dump facility, faced problems at the beginning till the system got streamlined. At the initial process of segregation, families had to keep their wet waste and dry waste separate. The wet waste was to be stored in steel buckets with lids and kept separate from dry waste. However, the people who accepted to be part of this effort were uncomfortable with keeping the steel buckets back in their kitchen. The perception was that the containers may be contaminated as it could get mixed up across households. Kitchen is believed to be a place of sanctity and people were not willing to let go of some belief systems irrespective of the buckets being washed and cleaned by the housekeeping staff. Besides, they would prefer to have the same container that they owned and not the container of anyone else. Hence, they had to label the containers and lids to ensure it went back to the same persons. However, the newer problem was that, the housekeeping staffs were illiterate and could not read, so they resolved it by beginning a literary programme for the staff. This implies the strong belief systems that have to be considered in making a programme sustainable keeping in view the sentiments of the users. Similarly, all members of Ferns Paradise, Marathahalli Apartments, felt that providing service back up was critical to get a buy-in. People needed that reassurance that someone will come and look after the composter and attend to all issues concerned.

Creating Sustainable Revenue Streams

The team faces the challenge of creating sustainable revenue streams for all the research and design work that has been invested upon. The team is working on possibilities of working with NGOs to network and enable waste to be managed all over the city and the country as well. Initially, it was seeded by personal funds of the inventor Bir Kasturi, however, Daily Dump has received Rs. 20 lakhs ($ 2,936,6) and Rs. 5 lakhs ($ 7342)from venture capitalists KL Felicitas Foundation in 2012 and Ankur Caipital in 2013.

Challenges in Up-scaling

To upscale the idea, several options are being explored since Daily Dump has a robust design and an easily replicable model that can be adapted by most people all over India. Daily Dump is trying out process of prototyping a mechanical composter to be retrofitted into homes across India. The team is working with builders and exploring avenues to see if the product can be installed in every household as a standard fitting in balconies or utility spaces. Another avenue has been to design a new mechanical composter so that it follows the cradle to cradle philosophy, economically viable and fits into the informal manufacturing setup that dots the Indian urban landscape.

Working along with Other Stakeholders Needs Perseverance and Commitment

Commitment to change is important and addressing challenges is for a lifetime. Perceiving waste in a different light is how the issue has been pursued. The informal recyclers are considered as green warriors and they take business risks by being entrepreneurs. While in other countries, the waste pickers are paid, here, they do it for free, as it is their source of livelihood. Recycling is important and Wipro, the software company, mentioned that they have engaged 1 lakh employees in waste management alone, hence, to see an impact on society, recycling has to be facilitated and implemented meticulously. Equipping and empowering the recyclers, named as ‘recycle gurus’ have to be provided with platforms that enable them to understand what the customers seek. The business is looked at closely, keeping in mind all stakeholders on how best can the recycler benefit, customers benefit and also how the city could benefit. In summation, waste is not seen as waste but a misplaced resource.

Awareness Creation and Networks

There is need for promoting and implementing Daily Dump networks across homes to make people responsible in managing their waste effectively. More innovative ways of awareness creation is required. For instance, promoting Daily Dump in ‘Home Gardens Meet’ was a welcome initiative. There was good response as Bengaluru is also vibrant for promoting urban agriculture through home gardens. Backyards and roof tops are used for growing vegetables and varieties of fruits that are organic and provide the family healthy food.

Understanding Local Contexts

The poor cannot be seen as consumers alone but as producers as well. India is complex as Poonam argues further, 'we can go to war by creating complex stuff, but we have to be subversive to create solutions'. She feels it is important and have the ability to understand political economy. There can be opposition by contractors as the alternate solution can be a competition. It is important to have a personal point as a designer, entrepreneur and innovator besides understanding the type and extent of choices to make. Hence, she resorted to make it an open source project and sees open source as the only way to bring about long-lasting change.

Working towards a greater autonomy

Inventor of Daily Dump Poonam, views that the point is to contribute towards 'commons' as solutions do not exist in legacy mindset. Commons are to be entwined into sustainable business models, where commons gets new lease of life. While the government wants to dump the garbage into the farthest village, scientists have to invest crores into making the technology work, while at the ground level, people are segregating waste already, hence, emphasis has to be on intertwining the commons.

Case Study 2

Edible Cutlery

Plastics contains toxic and carcinogenic substances and research studies have indicated that plastic products, used in canteens, and other similar products contains polystyrene which discharges a volatile chemical 'styrene' that increases the risk of cancer, particularly lymphoma and leukemia. Reuse of plastic spoons is also common, causing bacterial contamination. Plastic manufacturing process of cutlery is not good. There are no norms for manufacturing plastic utensils in India.

Hygiene has become the primary victim of cost-cutting. The process of cleaning the cutlery by manufacturing units in India is usually just a cloth to wipe the final product that is taken out of the mould in which molten plastic is injected, hence, consumers are at risk of plastic intake. Even after wiping off, residues of extra plastic remains.

Product

Bakey's Food Private Limited are makers of edible cutlery. It is a all-women enterprise based in Hyderabad.

Narayana Peesapati, a former scientist at ICRISAT (International Crops Research Institute for the Semi-Arid Tropics), Hyderabad, came up with this interesting solution to the much distressing problem of usage of plastic cutlery in urban areas. Troubled by the immense problems caused due to plastics in the environment and its toxins, that cause harmful implications to health, he came up with this eco-alternative, an innovation, par excellence, the world's first edible cutlery to minimise waste production. Bakey's cutlery has become internationally renowned and getting orders from US and UK as well.

The cutleries are made from edible ingredients like rice, carom seeds, wheat, jowar and black pepper, hence, can be eaten after use. Even if discarded, they are decomposable and are food for insects or rodents. The cutlery does not get soggy while eating, they soften (after 10-15 minutes) and can be eaten easily towards the end of the meal.

Spoon varieties include Spicy Spoons, Sweet Spoons and Plain Spoons and are priced at Rs. 300 for 100 spoons.

Investments and Turnover

Bakey's Food Private Limited was started in 2010, although the idea was conceptualised in 2006. More than Rs.60 lakh was spent on developing the machinery and further to this, it had to spend Rs. 3 crores to set up the unit. After some struggle in the early years; they have gradually reached an annual turnover of Rs. 2 crores. The pathway to this stage was opined to be rough.

Challenges

Since it was a new concept, there was no time-honoured technology, it all had to be evolved and developed with learning and research.

Trading these spoons was a challenge. When Mr. Narayana Beesapathi launched the product, he would personally promote it to joggers and walkers in parks, explain the ill-effects of plastic cutlery. People were not willing to invest Rs. 40 for 25 spoons. With no business and demand, besides bogged down with debt, he did think of quitting, at times.

Using spoons is also a behavioural issue, switching to edible spoons is a challenge as people have to be convinced about the ill-effects of plastic.

Story in the media about his products improved his sales enormously. Currently, the product has global demand catering to huge demand besides delivering on time became difficult. So, machines were automated.

As many as 12 people are employed in the unit and were manufacturing 5,000 pieces per day, but it has has increased to 30,000 spoons. Mr. Narayana is working towards improving the machinery that could manufacture 150,000 spoons in 24 hours.

Picture 2: Samples of Edible Curtlery

Case Study 3

Eco Pens

Pens made of plastic are used most commonly and are not visibly glaring to cause pollution, however, add to the tonnes of plastic waste that is polluting the planet. The callousness of using and throwing away of pens is a problem, well-addressed by the environmentalist Lakshmi Menon, an envioronmentalist from Kochi. She came up with a concept of Entree by linking pens and trees by placing a seed in pens made from waste paper which has gained immense popularity. After the lifetime of a pen, it can be planted and the seed in the pen will grow into a Agastya (Sesbania grandiflora) seed sapling.

Product – Pen is made from waste paper, crafted well using her design skills, placed with Agastya seeds. Agastya tree is also mentioned in the Puranas.

Entree is an initiative by environmentalist and designer Lakshmi Menon from Kochi. Pen drive is another initiative of hers where she aims to quantify the useless plastic pens, spread the message of its negative impacts and encourage the use of refillable ink pens. The idea behind this innovation is to reuse and thereby administer waste creation. Interestingly, she was able to collect 9,325 pens from a school where 2,000 students studied in a span of three months. These pens were displayed to create awareness in Kochi muziris biennale and retain it as a permanent illustration of its implication.

Picture 3: Seed Pens

Case Study 4

Eco-friendly Ganeshas

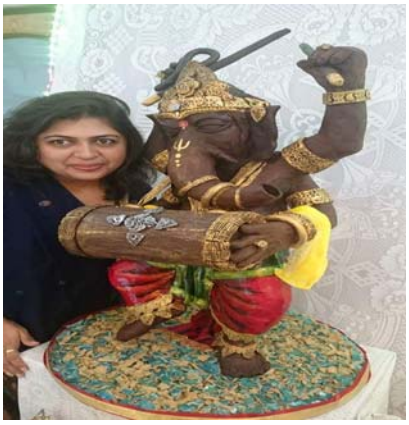
Ganesha festival has become a concern as it is causes severe environmental pollution of water bodies. The issue becomes complex given the sensitive nature of the problem as it has a religious dimension. Ganesha idols made of clay, without toxic paints, is not a problem as they are eco-friendly and dissolve in the water, however, largely used are the Ganesha idols made of paper mache with polluting paints that harm marine life.

Eco-friendly Ganeshas that have entered the market are the Tree Ganesha or the Green Ganesha which is made of red soil and organic fertilisers with seeds as its base. Even when the idol is

not immersed, the water can be used to disintegrate the Ganesha which would turn into soil that nurtures the seeds. 'Sprouts', an environmental trust based organisation from Mumbai that has been working on cleaning the beaches, has come up with an interesting initiative called 'fish-friendly Ganesha idols'. These idols are filled with dried corn, spinach and are made of papier mache and clay that dissolve in water, besides, they are painted with natural dyes that are not harmful to the environment.

Ganesha idols made of cow dung is also getting popular. At Rajasthan, Nilesh Tupe, an auditor and cow shelter owner, is selling Ganapati idols made from cow-dung sourcing them from gaushalas.

Picture 4: Chocolate Ganesha Idol



There are isolated cases of interest that are taken up by individuals, however, do draw interest and awareness among people given the social media popularity. Mrs. Rintu, a designer, baked a very special Ganesha idol made of chocolate using 35 kgs of chocolate made over 50 hours. The cake had no preservatives and was decorated using edible colours. The cake was kept in an air-conditioned room. The idol was immersed in 90 litres of milk and served as 'prasad' to underprivileged children in Mumbai. Similarly, a bakery in Ludhiana, is also making chocolate Ganesha idols.

Another interesting example has been the making of the Ganesha idol by using 'Alum'. Alum is used to purifying potable water and removing particulate matter. To remove polluted water in water bodies, Mr. Vivek Kamble, a sculptor from Pune, made Ganesha idols from Alum. They are made from food colours and weigh between 1 and 1.5 kg.

Earth-sensitive Ganesha idols, promoted by Bimba the Art Ashram, is made by traditional potters got from nearby river or pond silt. The focus is to retain nature's beauty through responsible celebration, paying reverence to earth and maintaining the sanctity of nature. Their clay idols celebrate and venerate nature and sensitise people to be compassionate about the world they live in (Down to Earth, 2016).

With increasing awareness about the need of using eco-friendly Ganesh idols, the demand for such idols has gone up in the city. Both government-run and private bodies that sell eco-friendly Ganesh idols have reported an increase in the sales (Indian Express 2016, Sept 11).

Case Study 5

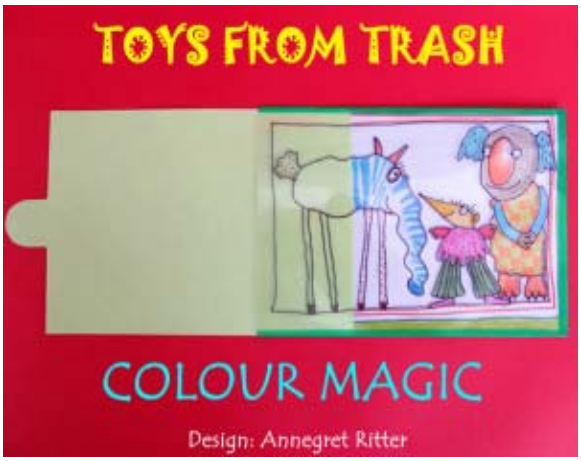
Teaching Children with Toys Made from Waste

It has been debated time and again that children are not taught science through practical methods but mostly through text books which have implications on their analytical and logical thinking skills. To improve concept-based learning, several organisations have been developing educational kits and are quite popular among children. Mr. Arvind Gupta has developed interesting educational toys from trash.

Mr. Arvind Gupta, at a loss by the lack of teaching material for science, during the 1970s, realised the need for making science fun based and easy to learn. Picking from the tradition of India, where indigenous toys are popular, he emphasised on creating simple toys from trash, reusing and recycling waste into productive toys to make learning fun. Simple materials were turned into innovative useful recycled waste material where people could do it themselves while learning the principles of science and design. Learning by doing is the principle that he strongly believes in. Organising tools and learning physics in the process is what he aims to teach.

Toy varieties include air and water, electricity and magnetism, toys, based on concepts of pressure, light, mathematics, sound, spinning toys, motor etc. are some basic models while there are other toys like powered bottle car, Ball Trampoline, Polythene parachute, etc.

Picture 5: Design Picture of Toys from Trash



This popular toy inventor has had children spellbound all over the country. He has also translated his 150 books into Hindi so that language does not act as a barrier for learning and reaches the rural areas across the country. Some of his books have been reprinted in 12 languages.

He has several videos uploaded on You Tube to educate people on how to manage waste in an eco-friendly way. His TED Talk on converting waste to toys for educating children is equally popular.

Case Study 6

E-Parisara

E-Parisara, the first formal e-waste recycling unit in India, spread over an area of 1.5 acre was established at a capital cost of 2.5 crores in 2005. It was founded by Dr. P. Parthasarathy, Ph.D in Earth Science and Resource Management, who has more than three decades of experience in chemical processing of metals with specialisation in precious metals. He is specialist in Micron and Guaranteed high-quality gold plating. E-Parisara's current e-waste processing capacity works out to 3 tonnes /day and a full-scale capacity of 10 tonnes/day with energy consumption of 66 HP per day and water consumption of 700 litres per day. About 78 employees work in the firm with a scope for more. E-waste at E-Parisara is derived from different kinds of electronic materials, especially computer components. Around 194 companies and three government sector firms have got registered with E-Parisara. Being a formal recycling unit, E-Parisara has got a number of big companies such as, IBM, Sony, Philips, ABB and Motorola, HP, Lucent, Mphasis as its sources of e-waste. Once registered with E-Parisaraa, the institutions have to abide by certain terms and conditions. Some of the conditions specified by the Company are: (a) security of the data in the hard drive (varies across companies). Employees of techno companies wait till all the materials are destroyed so as to ensure that they are really recycled and not reused; (b) On spot data destruction by E-Parisara; (c) Quantity of e-waste generated to remain confidential; (d) E-Parisara is accountable to the government. Its main aim is to work towards maximum material recovery, non-incineration, minimum power and water use and also minimum landfill. The plant also has an environmental policy that is "committed to conduct electronic waste management in an environmentally-responsible manner" (E-Parisara, 2009).

Salient Features

- E-Parisara goes through all the Environmental Health and Safety audits by its customers and their counterparts from abroad. Illegal imported wastes are not handled as a policy.
- E-Parisara collects e-waste on payment, follows safety procedures, assures data destruction and defacing and light destruction and provides logistics support apart from guiding customers on legal procedures. It follows the Form 9 manifest of Hazardous Management Rules. E-Parisara charges its customers based on the type of waste and purchases not less than one tonne.
- E-Parisara's downstream vendors are approved by PCB. As E-Parisara does not have the required technology to recover metals from circuit boards, it is sending the shredded circuit boards to Belgium with due permission from the MoEF.
- With regard to environmental initiatives, E-Parisara is an ISO 14001:2004 company certified by TUV sud. Company. It monitors air, water and noise pollution levels periodically. It also conducts periodic training programmes for workers and evaluation besides conducting environmental awareness training programmes to educate employees.
- With respect to health and safety initiatives, it conducts periodic health checkups for all employees, emergency response plans, mock drills, first aid trainings and provides insurance cover. Safety nets

are in order with appropriate equipments like fire extinguishers, fire buckets, emergency showers etc.

- As part of its initiatives towards corporate social responsibility, it has participated in various exhibitions, video shooting promoted through telecasts, sponsored awareness programmes at schools, donation of computers to schools, trainings to informal recyclers in adopting safety measures and alternative methods during extraction. Training requirements for workers are periodically monitored and adequate hand and power tools provided.

Surface Chem Finishers is a sister concern set up by E-Parisara which makes attractive gold plated idols out of E-waste collected. Surface Chem Finishers was established by Dr. Parthasarathy in 1995. The project is situated on a 5,000 Sq.ft land at Peenya Industrial Estate, Bangalore, and is a ISO-9001-certified company. Surface Chem takes immense pride in its growth and successful performance. Their goal is to become a world-class Goldplater and the success of the company has been based on a resourceful combination of technological innovation, professionalism and commitment to excellence.

Picture 6: Gold Plated Idols Produced Out of E-waste

Source: E-Parisara, 2009

According to Mr. Parthasarthy, Director, E-Parisara (2009), "the waste is not actually a waste but a source of resource recovery in an environment-friendly way". The company collects e-waste, which is sorted at the plant and distributed among recyclers, but only 1% of it is not used. Equally important and challenging in this sector is to spread this initiative around the whole country due to the presence of a large number of informal recyclers. It is clear from some of the studies carried out by E-Parisara that about 95% of e-waste is recycled informally resulting in serious health and environmental problems. In addition, child labour, lack of information and presence of hazardous materials are some of the drawbacks concerning informal recycling activities. It is also observed that new computer models have reduced the use of costly metals like Gold, Platinum etc.

The issue that needs more attention, as indicated by E-Parisara, is that E-waste is not available in large quantities as against studies conducted by NGOs, however, the disposal of certain types of e-waste is a problem like the disposal of lamps, batteries, especially lithium. Apart from this, it is the lack of C2B collection and logistics, adequate number of organised recyclers and policy and rules for e-waste management that needs more attention. It has also been emphasised that there is a need for further R&D suitable to Indian conditions.

Table 1: An Overview of Case Studies

Number of case studies	Case Study	Focus
1	Daily Dump	Creating compost at home with the waste generated at home
2	Edible Cutlery	Reducing the use of plastic cutlery with edible cutlery made from biodegradable materials
3	Eco Pens	Pens made from recyclable materials that can be planted after its lifetime. Reduce use of use-and-throw plastic pens
4	Eco-Friendly Ganesha	Ganeshas made from environment-friendly materials to replace Ganeshas made of toxic paints and materials that are immersed into water bodies as part of rituals.
5	Toys from Trash	Simple toys made out of waste to make learning fun.
6	E-Parisara	Collection and making resourceful products or goods out of electronic waste.

Table 2: Brief Analysis of Case Studies

Number of case studies	Case Study	Generation	Segregation	Collection	Transportation	Disposal	Treatment	%
1	Daily Dump		✓	✓		✓	✓	66
2	Edible Cutlery	✓				✓		33
3	Eco Pens	✓				✓	✓	50
4	Eco Friendly Ganesha	✓				✓	✓	50
5	Toys from Trash			✓		✓	✓	50
6	E-Parisara		✓	✓	✓	✓	✓	83

The above table indicates the stages of waste management that innovative methods discussed in this paper satisfy. Satisfaction of the stages alone does not make them efficient. Popularity of the method, as well as, its capacity to reduce waste are some of the other factors.

Conclusion

Across the world, results of technological changes are apparent everywhere. However, the greatest struggles encountered by mankind have been not with the sword but with ideas that diffused into their daily lives and emerged as cultural changes (Reed, 1961). Four essential elements in diffusion of any idea are – (i) the innovation (ii) its communication from innovation to another, (iii) in a social system and (iv) over time (Rogers, 1965). Our reviews of eco-innovations indicate an array of cases with several dimensions. While some focus on design, some focus on service and some others on governance and communication. All of these play an important role in promotion and management of eco-innovation. In our case, 'Daily Dump' also had to go through all these processes to ensure that the

innovation is diffused into the social system. Given the varied contexts, concerns and challenges in the cities of India, Daily Dump, for sure, is an interesting and important eco-innovation that is finding its place slowly but steadily into the urban sphere of resolving garbage menace. Daily Dump looks into all stages of solid waste management. Furthermore, since the technique is simple and easy, it can be inplemented at household levels efficiently. Implementation of this in urban areas can be a good model to reduce the burden on the municipal body. Similarly, we have edible spoons that are getting popular and with tie-ups, that are on the trials with Cafe Coffee Day, some hospitals, event management companies and caterers in southern India and organic bazaars, exhibitions, there is hope to eliminate plastic away from the food scene partially. The elimination of plastic pens and its replacement with perfectly substitutable eco-friendly pens with seeds in them is another interesting initiative and a novel idea too. While the chocolate Ganesha turned into 'prasad' for children is social and humane in its character, serves a great purpose of non-polluting the water bodies. Following the rituals, Ganesha idols must be immersed in water after the festival as a sign of bidding goodbye. Eco-friendly Ganeshas make this process environment-friendly. Popularising this innovation will achieve festivity without any unfavourable environmental impacts and without having to miss out on the culture and tradition. Edible cutlery, Eco Pens and Eco-Friendly Ganeshas fully curb waste production. Also, the toys from trash are an innovative educative tool that can address the most pressing issue of educating children in a cost-effective way. Finally, it is the electronic waste that is processed into recycled and reused goods is an interesting initiative of the new era. It makes use of e-waste in the most-efficient and responsible manner. Addressing the waste problem at large, and specifically addressing these different streams of waste, will add a lot of value to waste, reduce waste creation in the first place, and also, consciously create a product of use that is eco-friendly. These are interesting business opportunities for young entrepreneurs who contribute to society by bringing about transformations for sustainability. However, it is important that they get support and encouragement as their success depends on a lot of factors based on the response they get from various stakeholders in the process.

References

Reed, C A (1961). *The Impact of Mass Society on Rural Communities* (Doctoral dissertation, Ohio State University)

Registrar General, I (2011). Census of India 2011: Provisional Population Totals-India Data Sheet. *Office of the Registrar General Census Commissioner, India.* Indian Census Bureau.

Lakshmikantha, H (2006). Report on Waste Dump Sites around Bangalore. *Waste Management*, 26 (6): 640-50.

Parvathamma, G I (2014). An Analytical Study on Problems and Policies of Solid Waste Management in India: Special Reference to Bangalore City. *Journal of Environmental Science Toxicol. Food Technol.*, 8: 6-15.

Rogers, E M (1965). *Diffision of Innovations*. New York: The Free Press.

Ramachandra, T V and S Bachamanda (2007). Environmental Audit of Municipal Solid Waste Management. *International Journal of Environmental Technology and Management*, 7 (3-4): 369-91.

Sridhar, K S, K Smitha and S Manasi (2015). Bengaluru City Surveys – 2. A Pilot Study for a Ward. Centre for Research in Urban Affairs, Institute for Social and Economic Change, Bangalore, *CRUA Final Report 1* Arundel, A and R Kemp (2009). Measuring Eco-innovation. UNU MERIT

Beukering, P V, M Sehker, R Gerlagh and V Kumar (1999). Analysing Urban Solid Waste in Developing Countries: A Perspective on Bangalore, India. *International Institute for Environment and Development.*

Cheng, H and Y Hu (2010). Municipal Solid Waste (MSW) as a Renewable Source of Energy: Current and Future Practices in China. *Bioresource Technology*, 3816-24.

Kansal, A (2002). Solid Waste Management Strategies for India. *Indian Journal of Environment Protection,* 22 (4): 444-48.

Karak, T, R Bhagat and P Bhattacharyya (2012). Municipal Solid Wsate Generation, Composition and Management: The World Scenario. *Critical Reviews in Environmental Science and Technology,* 42 (15): 1509-1630.

Ramachandra, T and S Bachamanda (2007). Environmental Audit of Municipal Solid Waste Management. *International Journal of Environmental Technology and Management,* 7: 369-91.

Turan, N G, S Çoruh, A Akdemir and O N Ergun (2009). Municipal Solid Waste Management Strategies in Turkey. *Waste Management,* 29: 465-69.

Wilson, D C, C Velis and C Cheeseman (2006). Role of Informal Sector Recycling in Waste Management in Developing Countries. *Habitat International*, 797-808.

Websites

http://www.samhita.org/social-organisation/daily-dump/

http://www.thebetterindia.com/962/daily-dump/

http://www.karmany.org/company/daily-dump/9

http://india.ashoka.org/daily-dump-organize-trash-trail-28-may-bangalore\

http://www.livemint.com/Leisure/pRNLH8cGf1ZkUFsa8tgURN/Daily-Dump-Peel-power.html

http://www.theweekendleader.com/Success/2624/getting-spoon-fed.html

https://timesofindia.indiatimes.com/city/kochi/lets-plant-a-garden-with-eco-friendly-pens-seed-calendars-and-green-ganeshas/articleshow/56984598.cms

https://www.thebetterindia.com/65505/ganesha-idols-eco-friendly/

http://indianexpress.com/article/cities/pune/eco-friendly-ganesh-idols-a-huge-draw-demand-beats-supply-3024912/

http://indianexpress.com/article/trending/trending-in-india/mp-from-bengaluru-ananthkumar-is-remininding-us-why-it-is-important-to-use-eco-ganesha-idols-4805692/

http://www.downtoearth.org.in/news/in-pursuit-of-eco-friendly-ganesh-chaturthi-55554

http://www.arvindguptatoys.com/toys.html

https://link.springer.com/chapter/10.1057/9780230244856_2

http://collections.unu.edu/view/UNU:324

Recent Working Papers

439 Income and Vehicular Growth in India: A Time Series Econometric Analysis
Vijayalakshmi S and Krishna Raj

440 A Critical Review of Apprenticeship Policy of India
K Gayithri, Malini L Tantri and D Rajasekhar

441 Sustainability Concerns on Sugarcane Production in Maharashtra, India: A Decomposition and Instability Analysis
Abnave Vikas B

442 Economic, Occupational and Livelihood Changes of Scheduled Tribes of North East India
Reimeingam Marchang

443 Need for a Study of State Policies towards the Development of Religious Minorities in Karnataka
Azhar Khan C A

444 An Analysis of Bilateral Trade Between Canada and India
Malini L Tantri and Preet S Aulakh

445 Should they Avoid the Middlemen? An Analysis of Fish Processing Firms in India
Meenakshmi Rajeev and Pranav Nagendran

446 Growth and Consolidation of Kerala Non-Gazetted Officers' Union: From Its Formative Years to Union Militancy Phase
Jithin G

447 The Relationship Between Economic Growth and Carbon Emissions in India
Kaumudi Misra

448 Tax Revenue in India: Trends and Issues
Pratap Singh

449 Technical Efficienc of Unorganised Food Processing Industry in India: A Stochastic Frontier Analysis
Padmavathi N

450 Demonetisation 2016 and Its Impact on Indian Economy and Taxation
Pratap Singh

451 Impact of Perform-Achieve-Trade Policy on the Energy Intensity of Cement and Iron and Steel Industries in India
Kaumudi Misra

452 Impact of Non-Cognitive Skills on Cognitive Learning Outcomes: A Study of Elementary Education in India
Indrajit Bairagya and Rohit Mukerji

453 Assessment of Vulnerability to Floods in Coastal Odisha: A District-Level Analysis
Niranjan Pradhan and S Madheswaran

454 Who Benefits from Higher Education Expenditure? Evidence from Recent Household Survery of India
Ramanjini and Karnam Gayithri

455 How the Modern Food Retail Chains Emerging as Alternative Channels of Agricultural Marketing? Evidence from Karnataka
Kedar Vishnu, Parmod Kumar and A V Manjunatha

456 Educational Development, and Household and Public Expenditures on Education in Manipur
Reimeingam Marchang

457 Social Audit of MGNREGA - A Panacea or a Placebo? Issues and Ways Forward in Karnataka
Sanjiv Kumar and S Madheswaran

458 State, Religion and Society: Changing Roles of Faith-Based Organisations in Kerala
Abdul Raoof

459 Single Child Families in Tripura: Evidence from National Family Health Surveys
N Pautunthang and T S Syamala

460 MGNREGA Ombudsman a Forlorn Scarecrow: Issues and Ways Forward in Karnataka
Sanjiv Kumar and S Madheswaran

461 Dynamics of Procurement of Modern Food Retail Chains: Evidences from Karnataka
Kedar Vishnu and Parmod Kumar

462 Determinants of Micro-Level Decisions of Sugarcane Farmers
Lavanya B T and A V Manjunatha

463 Assessing Quality of Higher Education: An Empirical Study of Commerce Graduates, Kerala State
Indrajit Bairagya and Bino Joy

464 Farmers' Perception on Risk and Management Strategies in Mahanadi River Basin in Odisha: An Economic Analysis
Jayanti Mala Nayak and A V Manjunatha

465 An Analysis of Revenue Diversification Across Select Indian States
J S Darshini and K Gayithri

466 Urban Governance in the Context of Urban 'Primacy': A Comparison of Karnataka and Andhra Pradesh
Anil Kumar Vaddiraju

467 Urban Financing and Accountability Structures - Case Study of Bruhat Bengaluru Mahanagara Palike
Shankari Murali and S Manasi

468 Status of Unorganised Food Processing Industry in Inida - A Study on Key Performance Indicators
Padmavathi N

469 Sustainability of India's Current Account Deficit: Role of Remittance Inflows and Software Services Exports
Aneesha Chitgupi

470 BCIM Economic Corridor and North East India
Reimeingam Marchang

471 The Nation and Its Historical Mediations: Towards Typologies of Regions/States
Anil Kumar Vaddiraju

472 Structure and Functions of Social-Ecological Systems: A Case Study from Indian Sundarbans
Sneha Biswas

473 **Multiple Vulnerabilities in Utilising Maternal and Child Health Services Across Regions of Uttar Pradesh, India**
Prem Shankar Mishra and T S Syamala

474 **Fertility at the Crossroads of Ethnicity and Gender: Understanding Oraon Tribe in Jharkhand, India**
Ujjwala Gupta

475 **Complexities of Collaboration, Negotiation and Contestation: Agragamee and the State**
Ambuja Kumar Tripathy

476 **International Best Practices of pprenticeship System and Policy Options for India**
K Gayithri, Malini L Tantri and D Rajasekhar

477 **Public Healthcare Infrastructure in Tribal India: A Critical Review**
Mohamed Saalim P K

478 **Whether Caste Impedes Access to Formal Agricultural Credit in India? Evidence from NSSO Unit Level Data**
Karthick V and S Madheswaran

479 **Harmonization of Intellectual Property Rights Across the Globe: Impact on India's Pharmaceutical Exports**
Supriya Bhandarkar

480 **Decentralization and People's Participation in Educational Governance: A Review of Internatonal Experiences**
Mahima Upadhyay and D Rajasekhar

481 **Initiatives in Solid Waste Management: A Case Study of the City of Bengaluru**
Natasha Kalra and S Manasi

482 **Agrarian Change in Bihar: A Study of Two Villages**
Prashant Kumar Choudhary

483 **Information Asymmetry, Exclusion and Inclusion Errors and Elite Capture of MGNREGA: Critical Examination of IEC Strategies in Karnataka and Ways Forward**
Sanjiv Kumar, S Madheswaran and B P Vani

484 **Political Regimes and Religious Minorities in Karnataka: 2008-2018**
Azhar Khan Chikmagalur Akbar

485 **Economic Estimation of Health and Productivity Impacts of Traffic Congestion: A Case of Bengaluru City**
Vijayalakshmi S and Krishna Raj

486 **Economic Development in the Princely State of Jammu & Kashmir (1846-1947)**
Sardar Babur Hussain

487 **Local Government and Decentralized Natural Resource Management**
Mahima Upadhyay

488 **Agrarian Distress and Farmer Suicides in Kerala**
Ance Teresa Varghese

489 **Ownership of Firms and Their Implication for Productivity: An Empirical Investigation in to Indian Mining Industry**
Meenakshi Parida and S Madheswaran

490 **Determinants of Agricultural Credit in Rural India by Social Group**
Karthick V and S Madheswaran

491 **Knowledge and Practice of Ethno-Medicine by Jaunsaris in Jaunsar-Bawar Region of Uttarakhand**
Geeta Sahu

492 **MGNREGA Quality Monitoring and Multiplier 'Malai' for the Richer States and Regions: Evidence on Elite Capture of Assets in Karnataka and Ways Forward**
Sanjiv Kumar, S Madheswaran and B P Vani

493 **Interests and Participation of Elites in MGNREGA: Lessons from Elite Capture in Karnataka**
Sanjiv Kumar, S Madheswaran and B P Vani

494 **Values Concerning Children and Fertility Behaviour: Method, Respondents and Preliminary Insights from the Field in Jharkhand, India**
Ujjwala Gupta

495 **Preparedness to Monsoon Diseases in Kuttanad (Kerala)**
Bejo Jacob Raju and S Manasi

496 **Livelihood and Social Capital in Vulnerable Ecosystems: A Case Study from Indian Sundarbans**
Sneha Biswas and Sunil Nautiyal

Price: ₹ 30.00

INSTITUTE FOR SOCIAL AND ECONOMIC CHANGE
(ISEC is an ICSSR Research Institute, Government of India
and the Grant-in-Aid Institute, Government of Karnataka)
Dr V K R V Rao Road, Nagarabhavi P.O., Bangalore - 560 072, India
Phone: 0091-80-23215468, 23215519, 23215592; Fax: 0091-80-23217008
E-mail: balasubramanian@isec.ac.in; Web: www.isec.ac.in