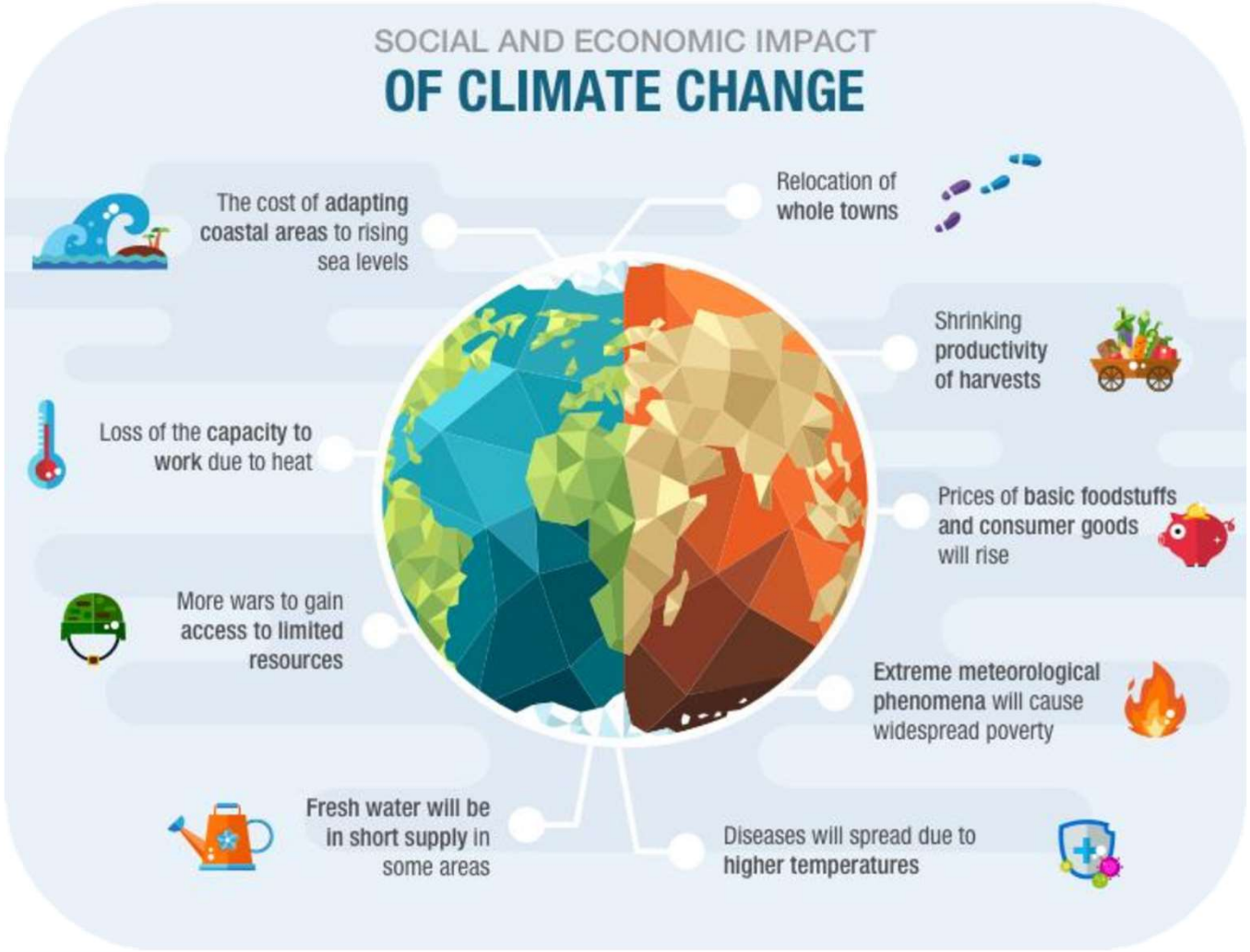
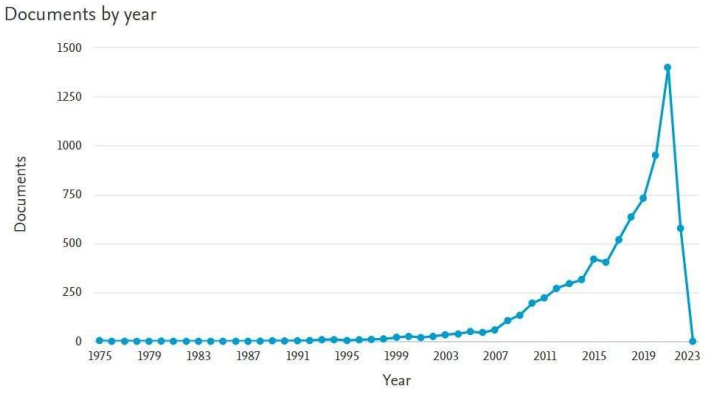
Climate Resilient Waste Management

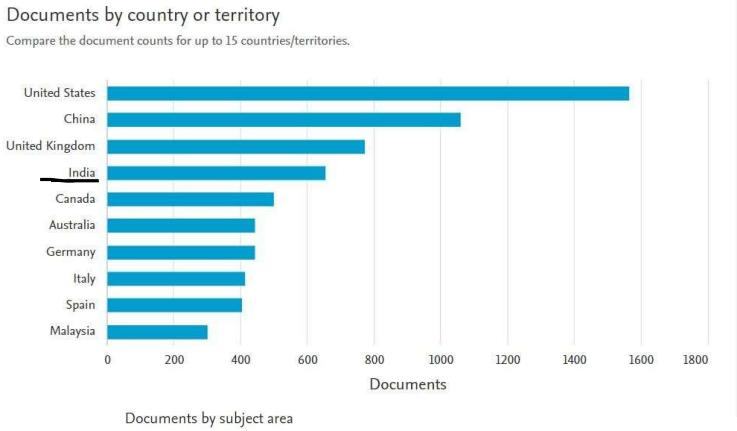
Thoughts by
S.Sudalai
Assistant Professor, Centre for Pollution Control and Environmental Engineering, Pondicherry University



https://www.iberdrola.com/sustainability/impacts-of-climate-change

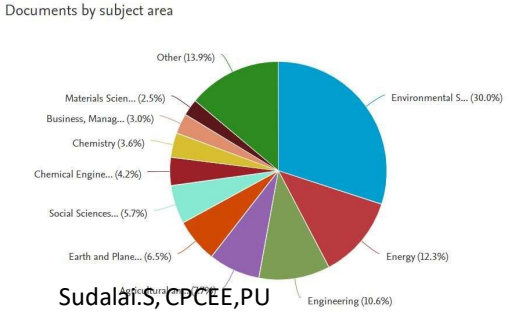
Sudalai.S, CPCEE, PU





456,018 document results
TITLE-ABS-KEY (**climate AND change**)

7,567 document results 1.6 %
(TITLE-ABS-KEY (**climate AND change**)) AND (**solid AND waste**)



Sudalai.S, CPCEE,PU

.Global solid waste generation rates

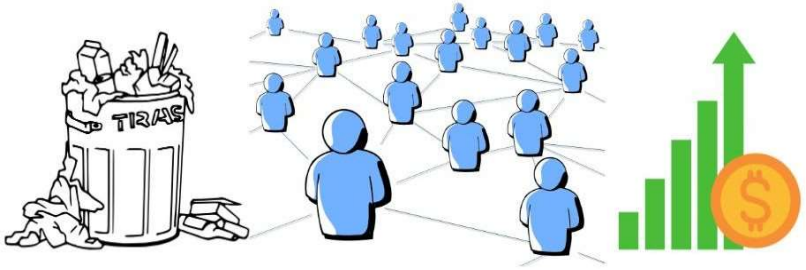
0.1-0.8t/cap/yr (tons per capita per year) low-income,

0.2-0.5 t/cap/yr in middleincome and

0.3-0.8 t/cap/yr in high-income countries

Positively correlated with

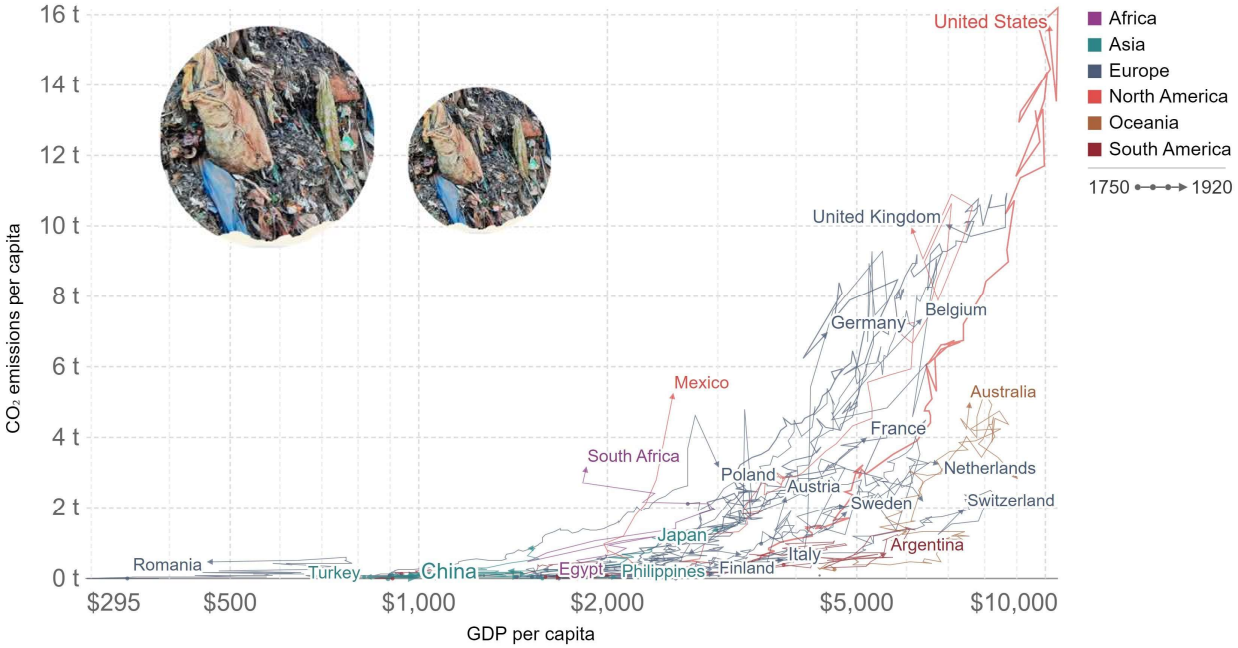
- **Per capita energy consumption,**
- **Gross domestic product, and**
- **Private consumption.**



CO_2 emissions per capita vs GDP per capita, 1750 to 1920

This measures CO_2 emissions from fossil fuels and cement production only – land use change is not included. Gross domestic product (GDP) per capita is measured in international-$ in 2011 prices to adjust for price differences between countries and adjust for inflation.

Our World in Data

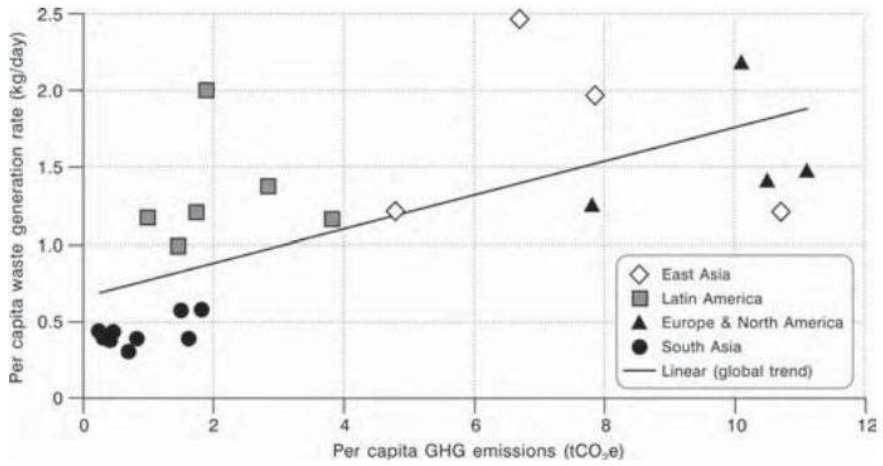


Source: Our World in Data based on the Global Carbon Project, Maddison Project Database 2020 (Bolt and van Zanden, 2020)
OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

The largest impact of climate change is that it could wipe off up to 18% of GDP off the worldwide economy by 2050 if global temperatures rise by 3.2°C, the Swiss Re Institute warns.

Sudalai.S, CPCEE,PU

Per Capita GHG Emissions (tCO2e) and Waste Generation Rate (kg/day)

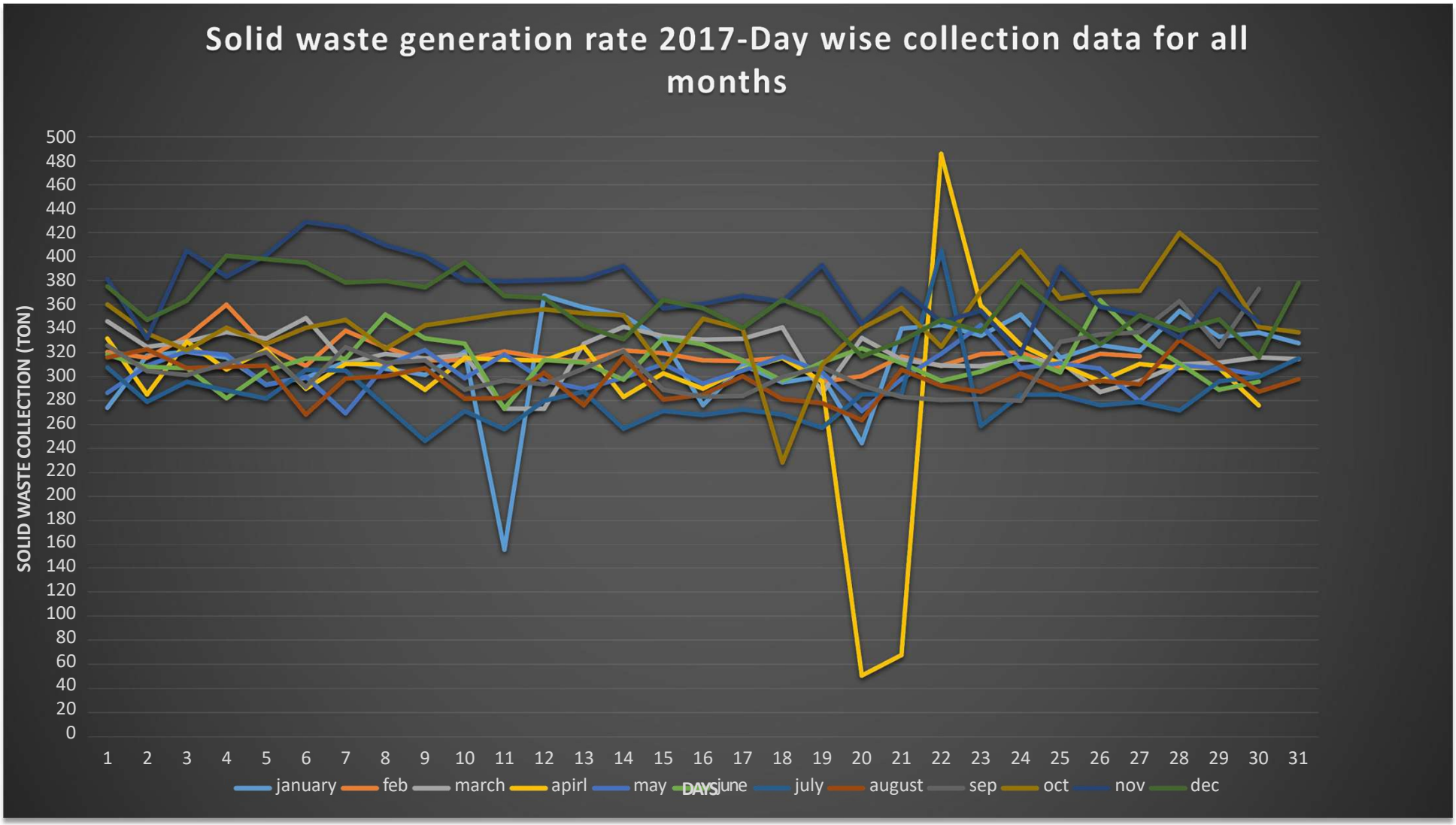


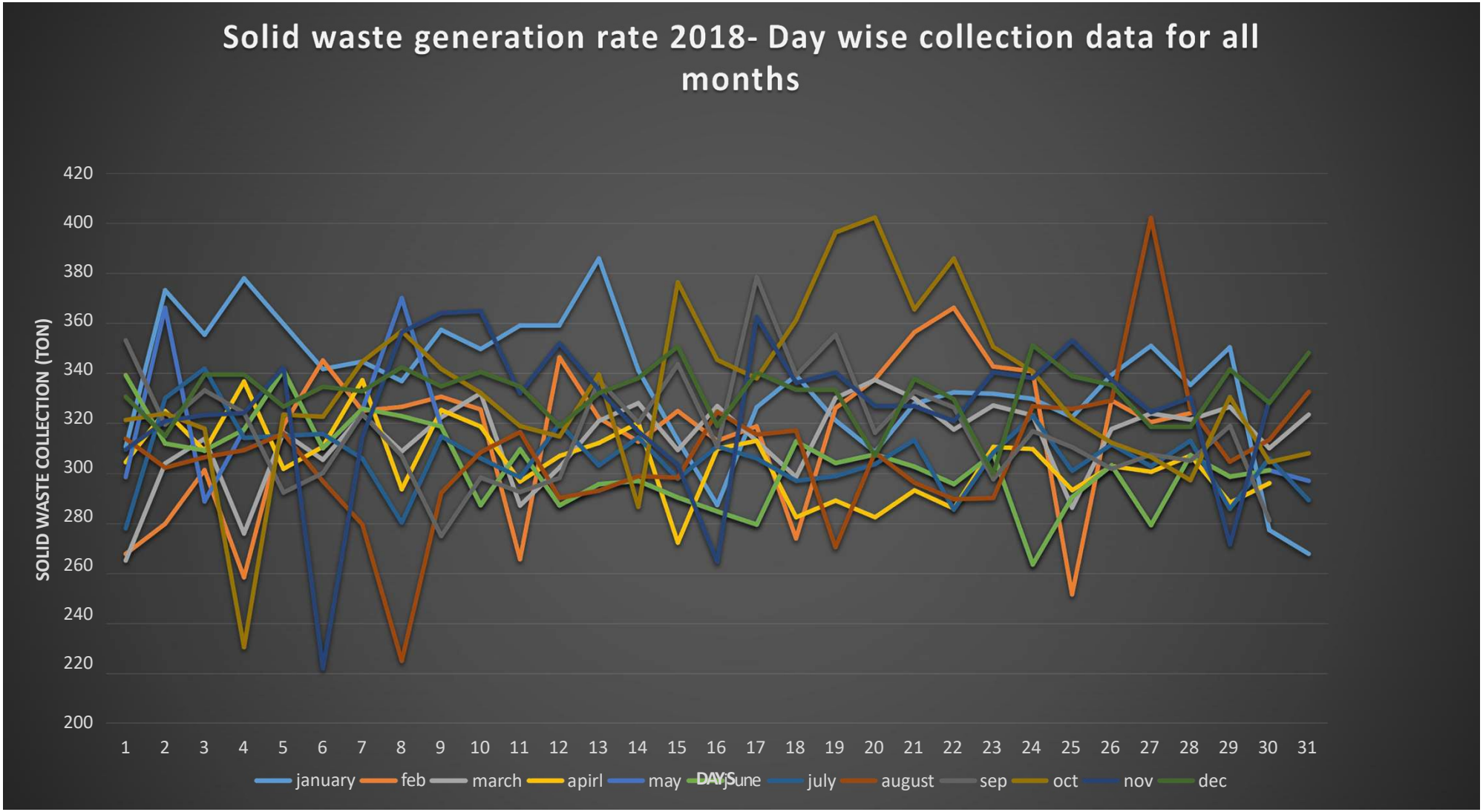
Source: Waste data from World Bank, "What a Waste" 2010; GHG data from Table 4.

Sector	Percentage of global GHG emissions	Justification for estimating the proportion of GHGs from cities, from the perspective of the location of activities that produced them	Percentage of GHGs allocated to cities
Energy supply[a]	25.9	A high proportion of fossil fuel power stations are not in cities, especially the largest cities. One third to one half of emissions from city-based power stations.	8.6–13.0
Industry	19.4	A large proportion of heavy industry (which accounts for most GHGs from industry) is not located in cities, including many cement factories, oil refineries, pulp and paper mills, metal smelters. Two-fifths to three-fifths of emissions in cities.	7.8–11.6
Forestry[b]	17.4	No emissions assigned to cities.	0
Agriculture	13.5	Some large cities have considerable agricultural output, but mostly because of extended boundaries encompassing rural areas. No emissions assigned to cities.	0
Transport	13.1	Private use of motor vehicles a large part of this. Should commuting by car by those living outside cities be assigned to cities? Should city dwellers driving outside city boundaries be assigned to their city? 60 to 70 per cent of emissions assigned to cities.	7.9–9.2
Residential and commercial buildings	7.9	Large sections of middle- and high-income groups in developed countries live outside cities – and a significant and increasing proportion of commercial buildings are located outside cities. 60 to 70 per cent of emissions assigned to cities.	4.7–5.5
Waste and wastewater	2.8	More than half of this is landfill methane; but a proportion of this would be released outside urban boundaries from waste generated inside cities. 54 per cent of emissions assigned to cities.	1.5
~~Total[c]~~	~~100~~		~~30.5–40.8~~

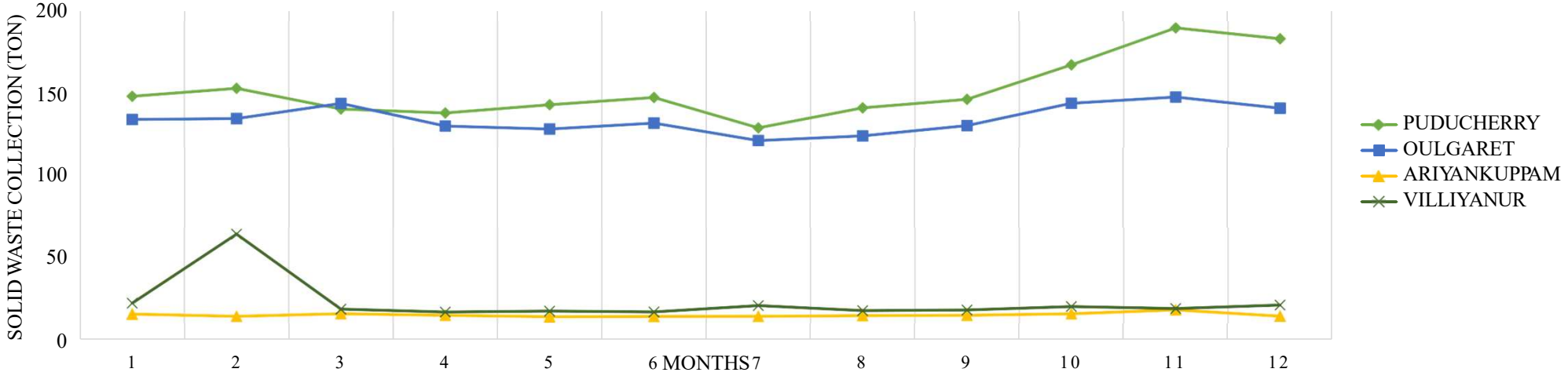
Notes: a A large part of this is from fossil fuel power stations. Excludes refineries, coke ovens, etc., which are included under industry.
b Land use and land-use changes.
c Total emissions for the GHGs covered by the Kyoto Protocol amounts to 49 billion tonnes of CO_2eq.
Sources: based on Barker et al. 2007; Satterthwaite, 2008a, p544

https://mirror.unhabitat.org/downloads/docs/GRHS2011-3.pdf

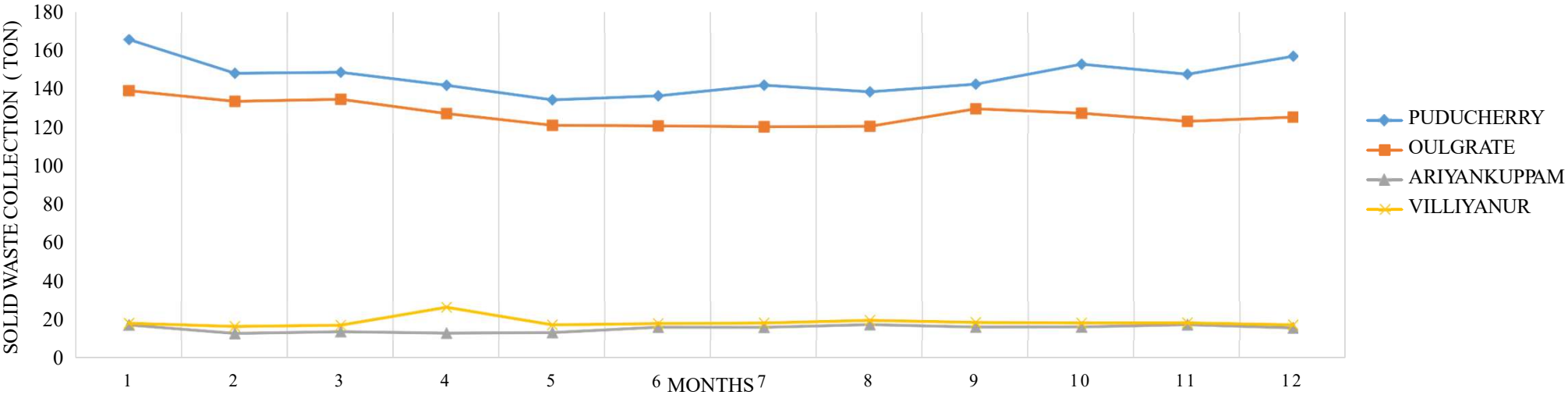

Solid waste generation rate 2017-Day wise collection data for all months
SOLID WASTE COLLECTION (TON)
500
480
460
440
420
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
DAYS
january
feb
march
apirl
may
june
july
august
sep
oct
nov
dec


Solid waste generation rate 2018- Day wise collection data for all months
SOLID WASTE COLLECTION (TON)
420
400
380
360
340
320
300
280
260
240
220
200
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
DAYS
january
feb
march
apirl
may
june
july
august
sep
oct
nov
dec

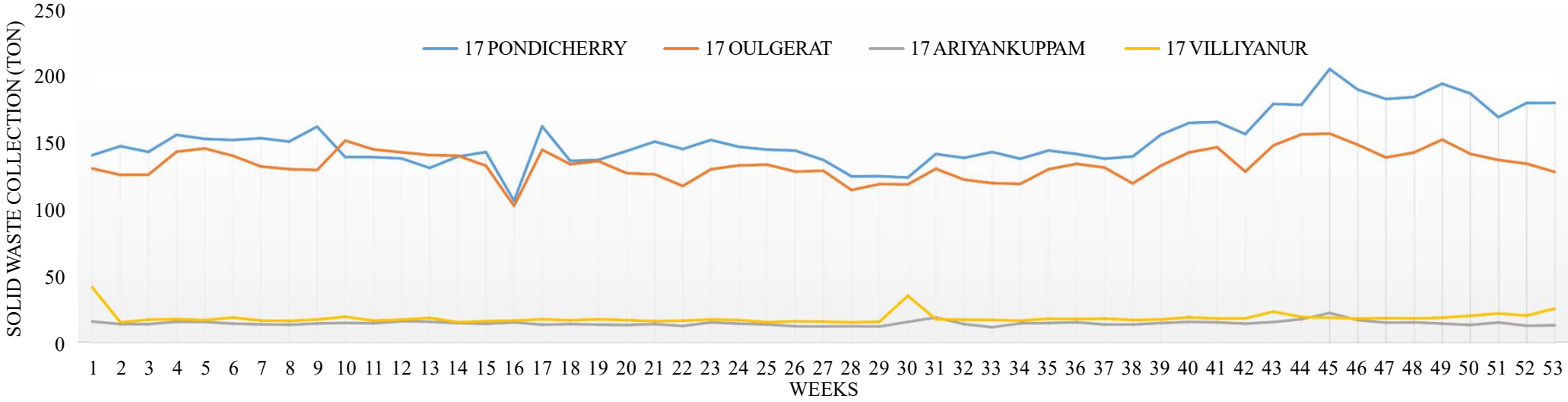
REGION WISE MONTHLY AVERAGE SOLID WASTE COLLECTION 2017



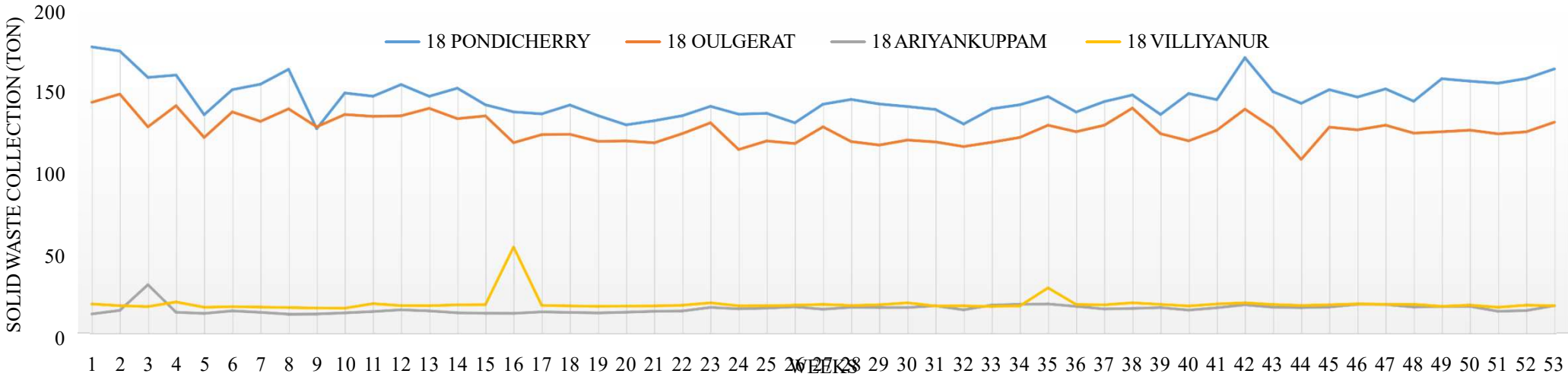
REGION WISE MONTHLY AVERAGE SOLID WASTE COLLECTION 2018



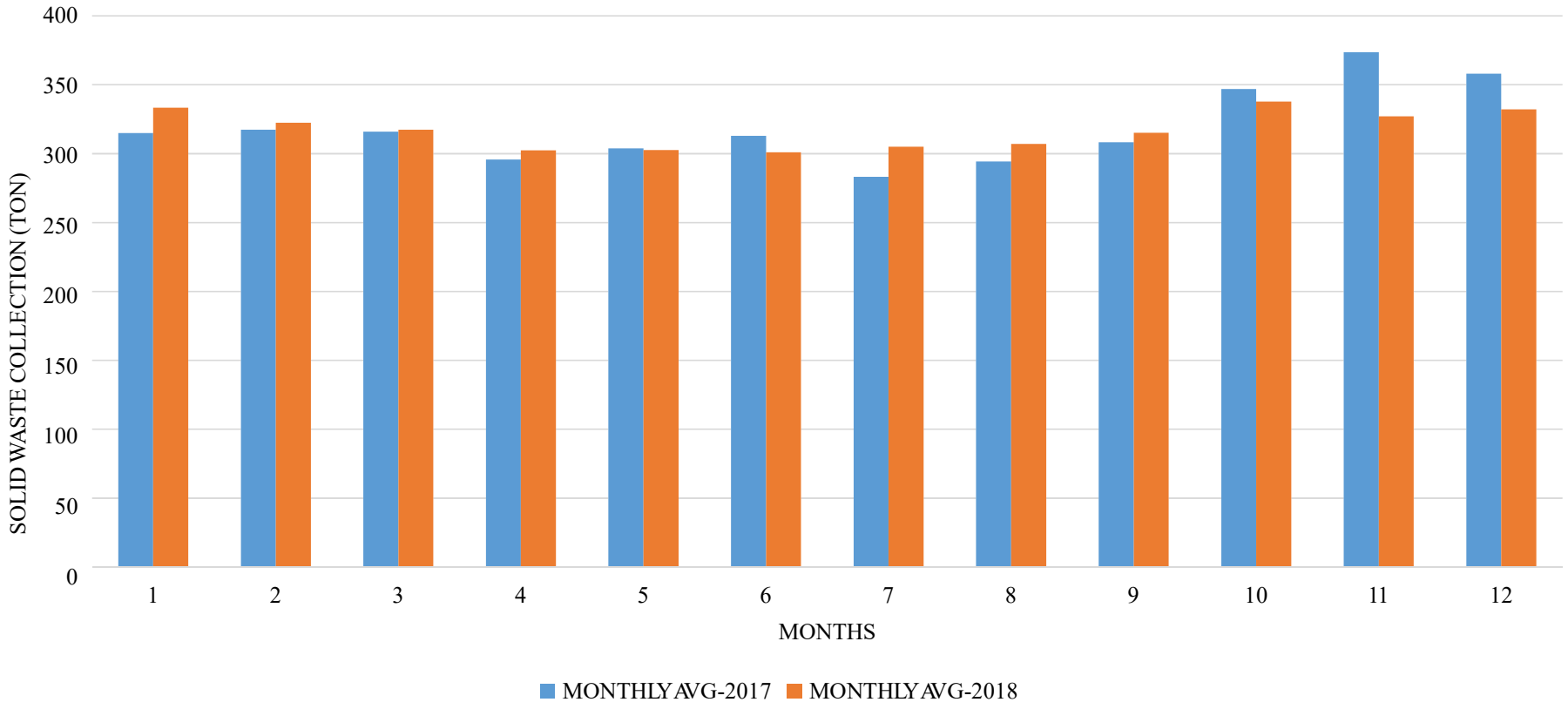
WEEKLY AVERAGE SOLID WASTE COLLECTION-2017



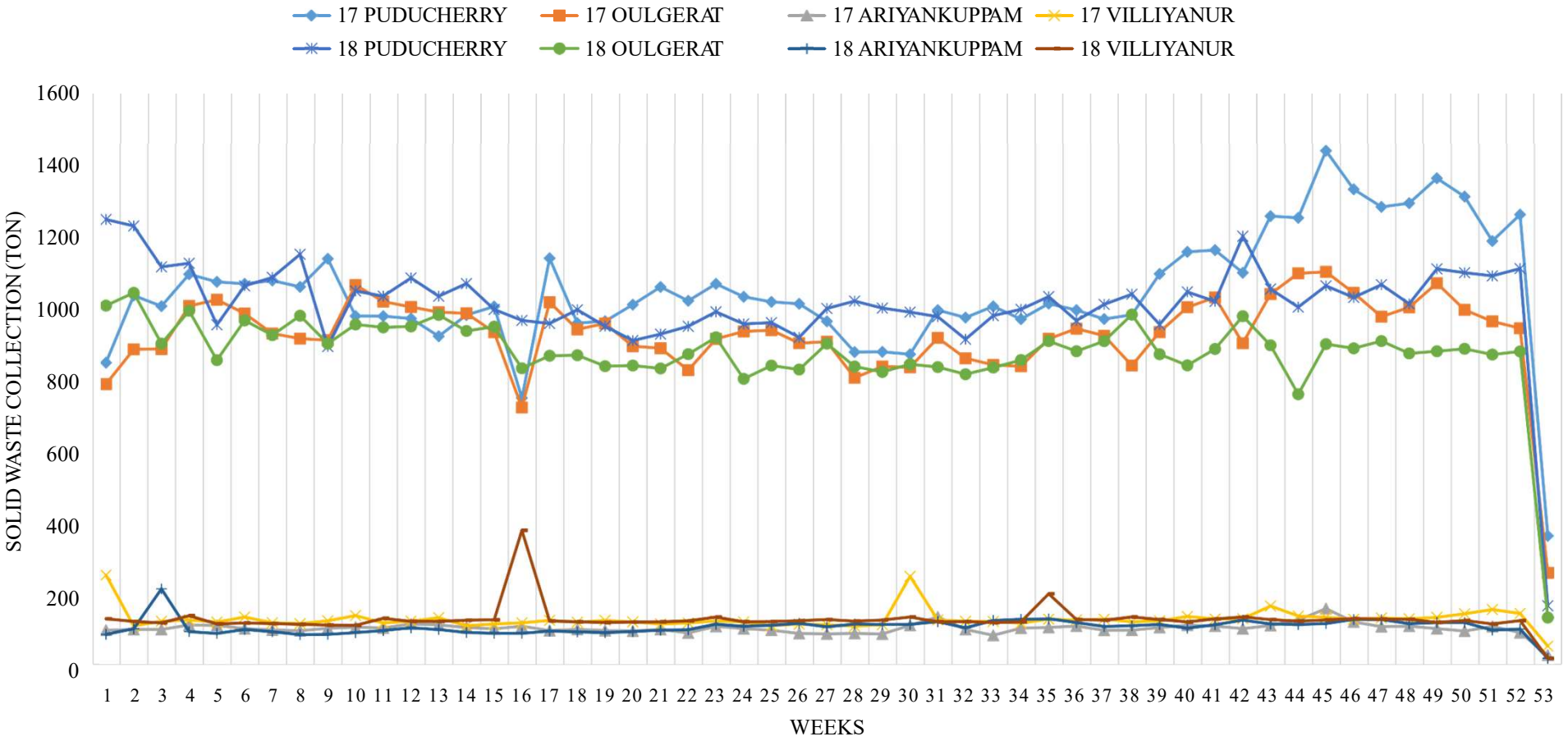
WEEKLY AVERAGE SOLID WASTE COLLECTION-2018



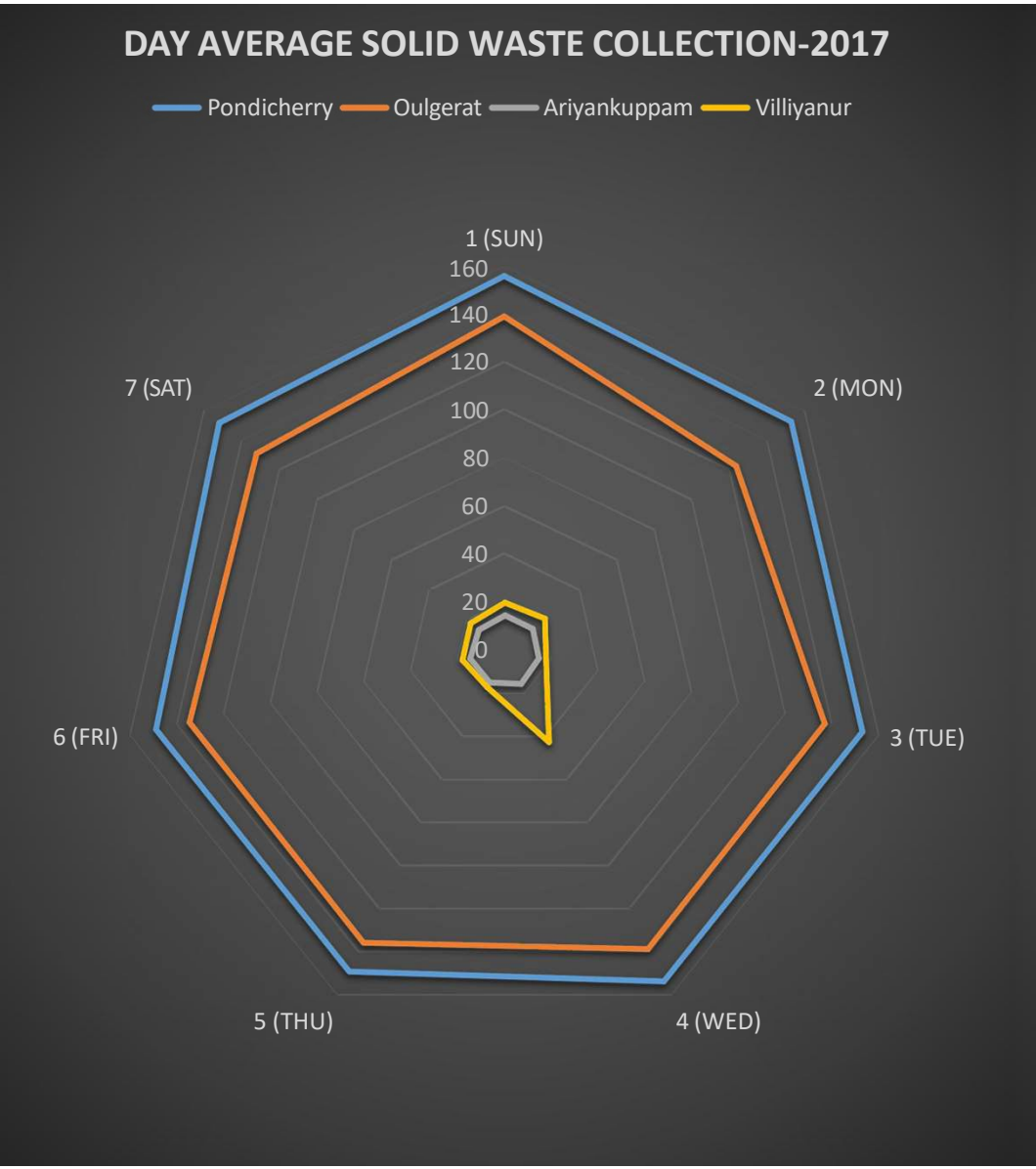
ANNUAL MONTHLY AVERAGE SOLID WASTE COLLECTION FOR 2017 & 2018



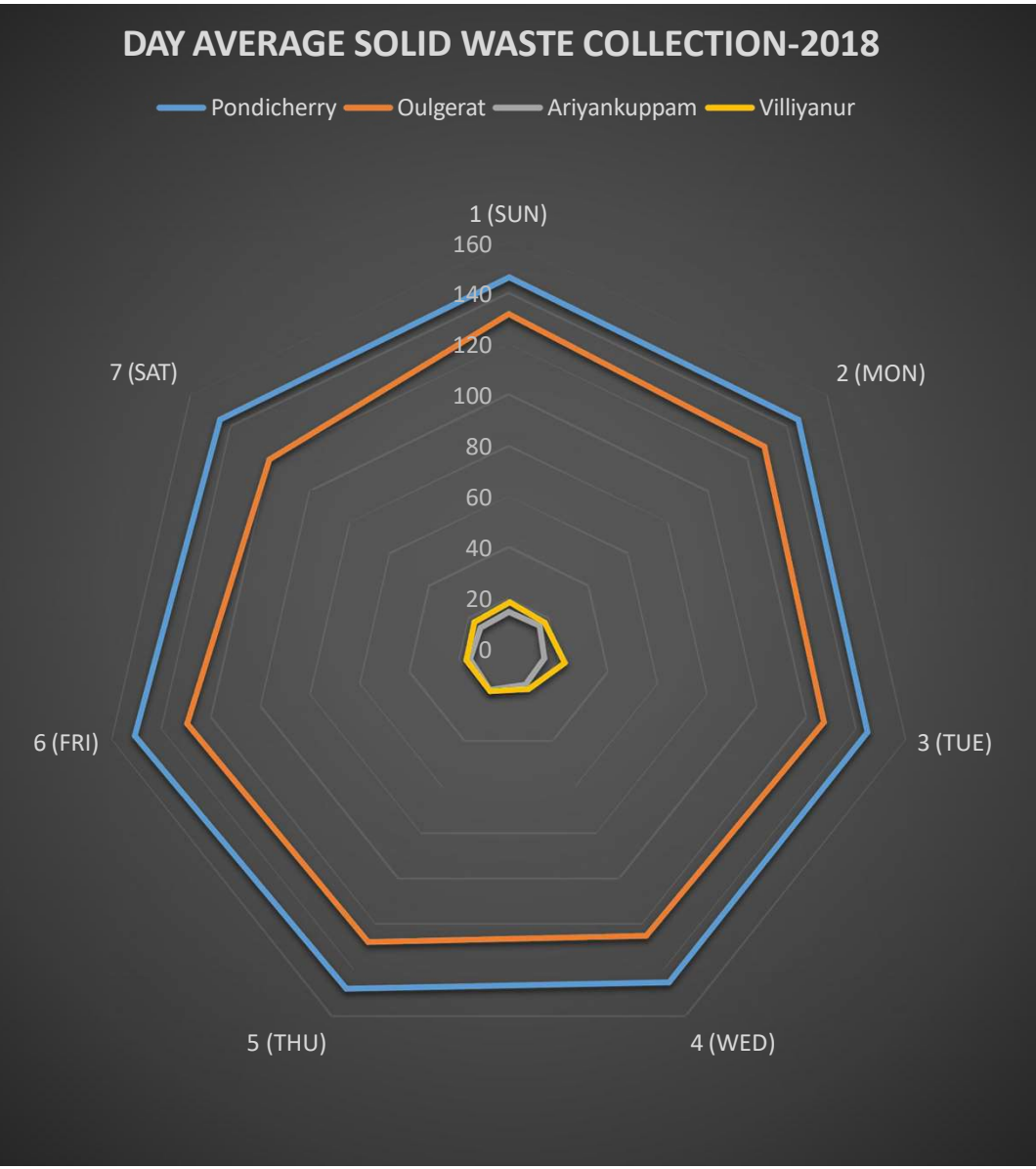
COMPARISION OF REGION WEEKLY SOLID WASTE COLLECTION OF 2017 & 2018



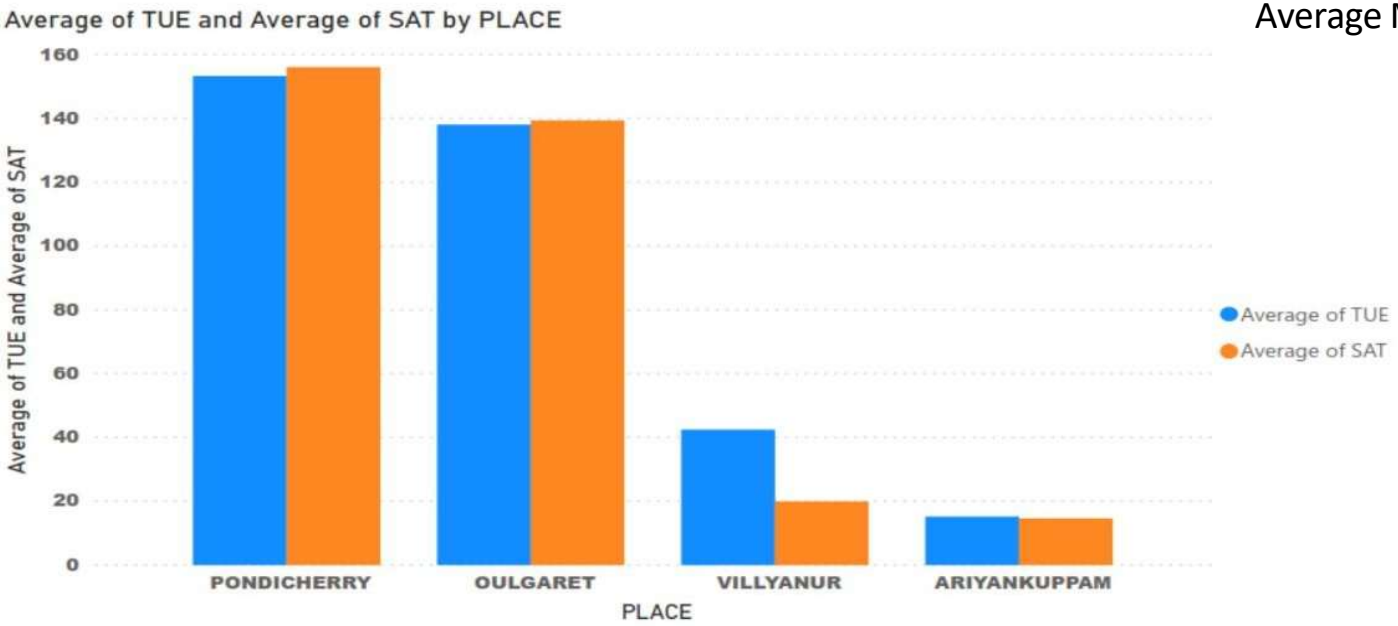
DAY AVERAGE SOLID WASTE COLLECTION-2017



DAY AVERAGE SOLID WASTE COLLECTION-2018



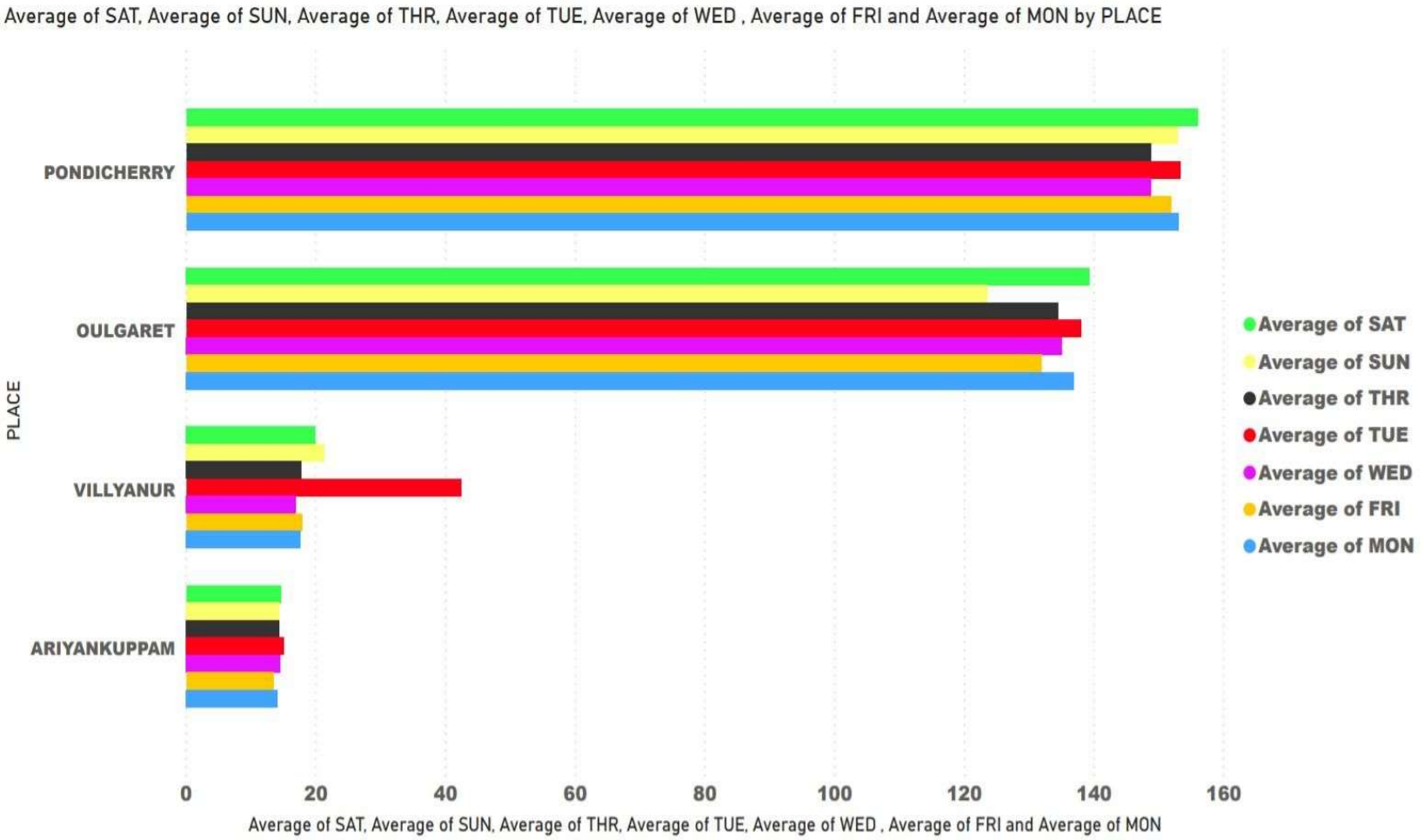
Average Max. day Tues vs Sat



PLACE	SUN	MON	TUE	WED	THR	FRI	SAT
ARIYANKUPPAM	776.88	748.74	801.56	769.35	762.20	713.92	772.57
OULGARET	6,545.14	7,119.87	7,175.80	7,022.75	6,989.89	6,856.91	7,244.62
PONDICHERRY	8,100.90	7,956.70	7,970.83	7,734.47	7,735.06	7,897.12	8,112.63
VILLYANUR	1,128.50	915.02	2,203.27	880.63	921.96	927.32	1,033.26
Total	**16,551.42**	**16,740.33**	**18,151.46**	**16,407.20**	**16,409.11**	**16,395.27**	**17,163.08**

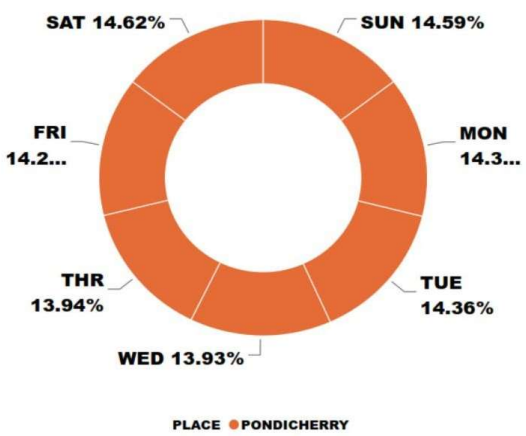
18.15K
TUE

Sudalai.S, CPCEE,PU


Average of SAT, Average of SUN, Average of THR, Average of TUE, Average of WED , Average of FRI and Average of MON by PLACE
PONDICHERRY
OULGARET
VILLYANUR
ARIYANKUPPAM
PLACE
0
20
40
60
80
100
120
140
160
Average of SAT, Average of SUN, Average of THR, Average of TUE, Average of WED , Average of FRI and Average of MON
Average of SAT
Average of SUN
Average of THR
Average of TUE
Average of WED
Average of FRI
Average of MON

Days composition chart

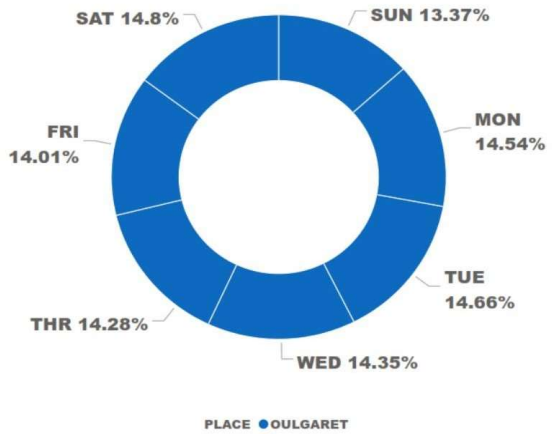
SUN, MON, TUE, WED , THR, FRI and SAT by PLACE



PONDICHERRY
8,100.90
SUN
7,956.70
MON
7,970.83
TUE
7,734.47
WED
7,735.06
THR
7,897.12
FRI
8,112.63
SAT

PONDICHERRY
8,112.63
SAT

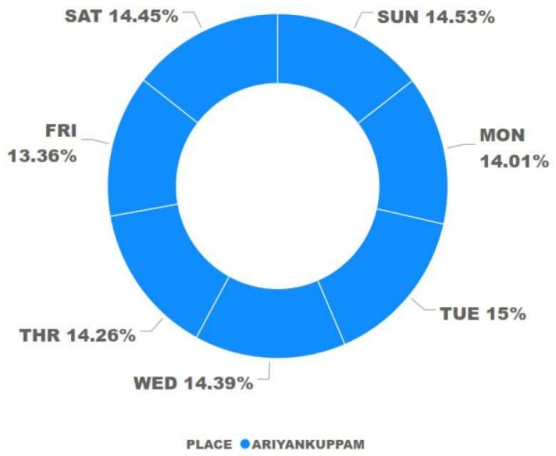
SUN, MON, TUE, WED , THR, FRI and SAT by PLACE



OULGARET
6,545.14
SUN
7,119.87
MON
7,175.80
TUE
7,022.75
WED
6,989.89
THR
6,856.91
FRI
7,244.62
SAT

OULGARET
7,244.62
SAT

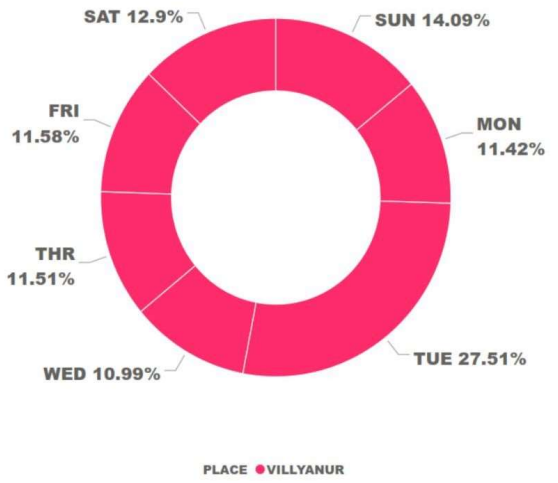
SUN, MON, TUE, WED , THR, FRI and SAT by PLACE



ARIYANKUPPAM
776.88
SUN
748.74
MON
801.56
TUE
769.35
WED
762.20
THR
713.92
FRI
772.57
SAT

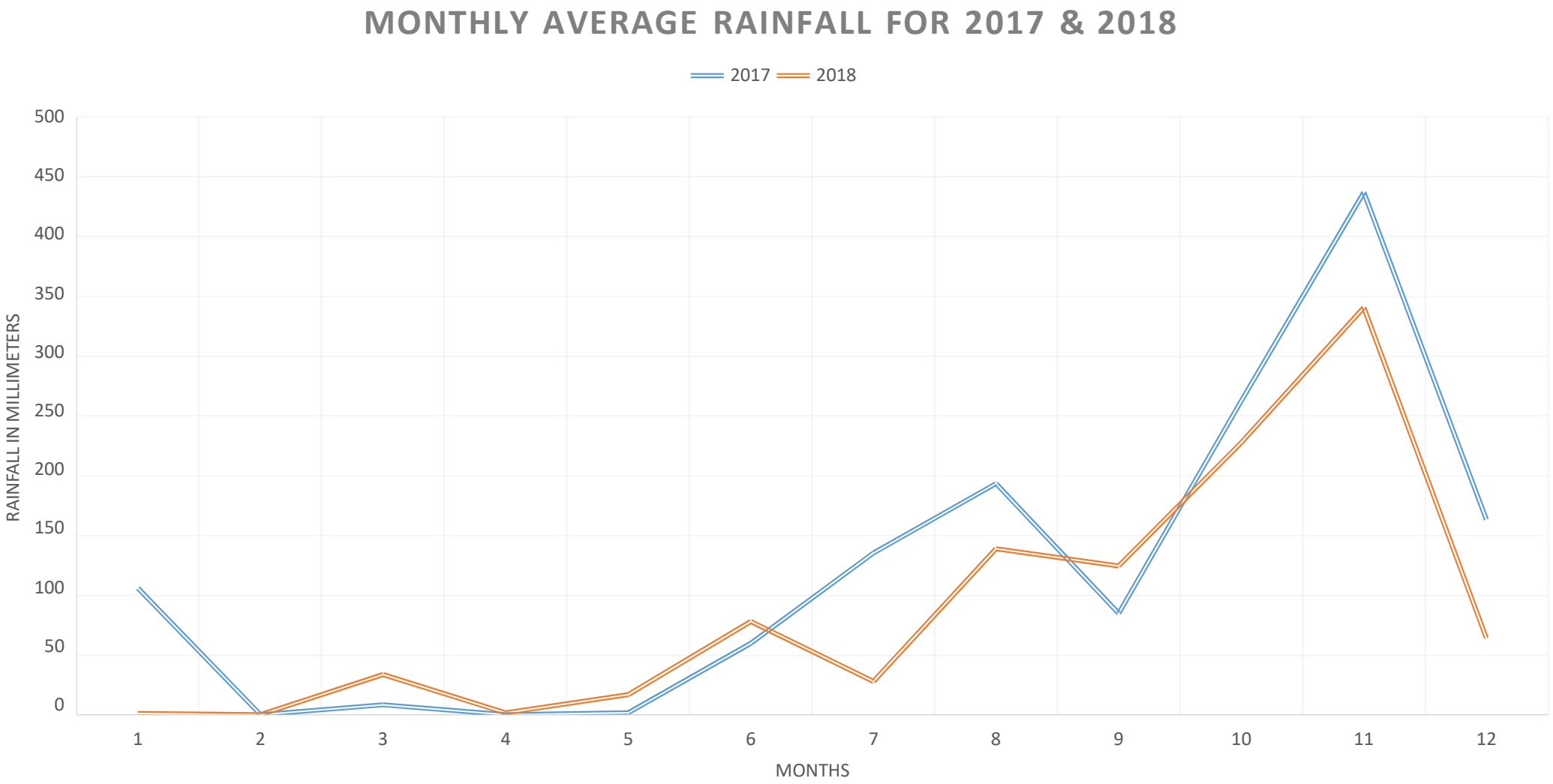
ARIYANKUPPAM
801.56
TUE

SUN, MON, TUE, WED , THR, FRI and SAT by PLACE



VILLYANUR
1,128.50
SUN
915.02
MON
2,203.27
TUE
880.63
WED
921.96
THR
927.32
FRI
1,033.26
SAT

VILLYANUR
2,203.27
TUE


MONTHLY AVERAGE RAINFALL FOR 2017 & 2018
2017
2018
RAINFALL IN MILLIMETERS
500
450
400
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
MONTHS

Climate variables	Potential climate change	Impacts on Solid waste management
Temperature	Very high temperature	Increase water demand for workers and site operation
	More hot days increases in the dry season	Decline in air quality and following negative impacts of heat on vulnerable groups
	The number of cold days decreases in rainy season	Affects biological processes(composting, anaerobic digestion)
Precipitation	An increase of more water days	Increase risk of flooding
	Precipitation intensity increases	Disruption of infrastructure (rail, road)
		Affect slope stability on waste management site
		Affects biological processes(composting, anaerobic digestion)
Sea level	Increase sea level	Inundation of waste management facilities Increase erosion of coastal areas

Climate Change & Solid waste Management

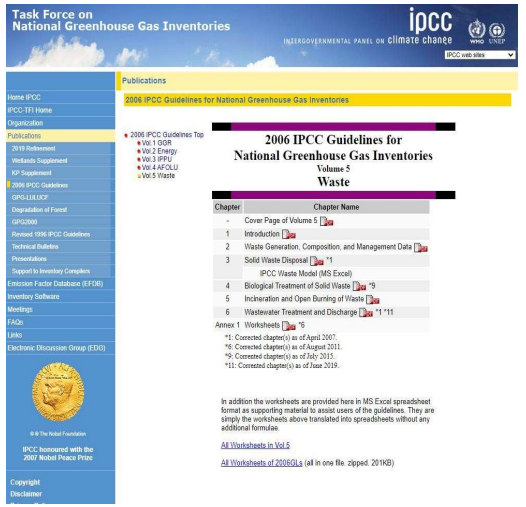
https://www.researchgate.net/publication/332978670_Interrelation_between_Climate_Change_and_Solid_Waste

Solid waste contributes directly to greenhouse gas emissions through the generation of methane from the anaerobic decay of waste in landfills, and the emission of nitrous oxide from our solid waste combustion facilities.

Waste composition is one of the main factors influencing emissions from solid waste treatment, as different waste types contain different amount of degradable organic carbon (DOC) and fossil carbon. Waste compositions, as well as the classifications used to collect data on waste composition in MSW vary widely in different regions and countries.

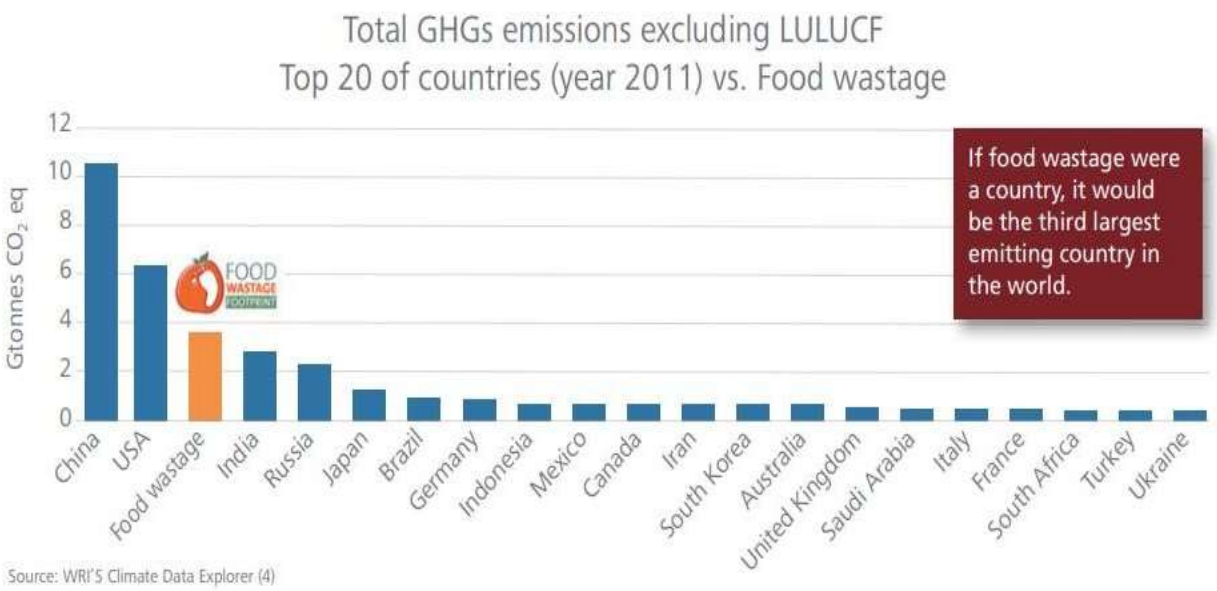
In this Volume, default data on waste composition in MSW are provided for the following waste types:

(1) food waste
(2) garden (yard) and park waste
(3) paper and cardboard
(4) wood
(5) textiles
(6) nappies (disposable diapers)
(7) rubber and leather
(8) plastics
(9) metal
(10) glass (and pottery and china)
(11) other (e.g., ash, dirt, dust, soil, electronic waste)



https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_2_Ch2_Waste_Data.pdf

FOOD WASTE



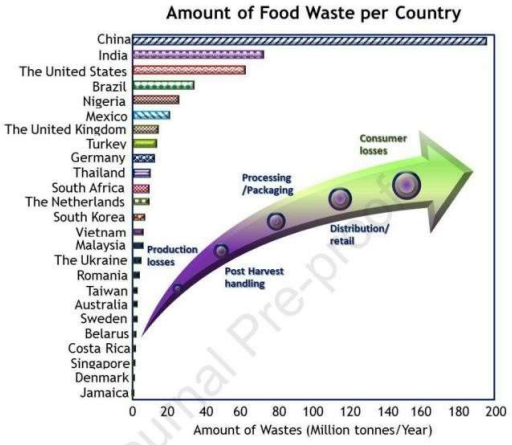
Source: WRI'S Climate Data Explorer (4)

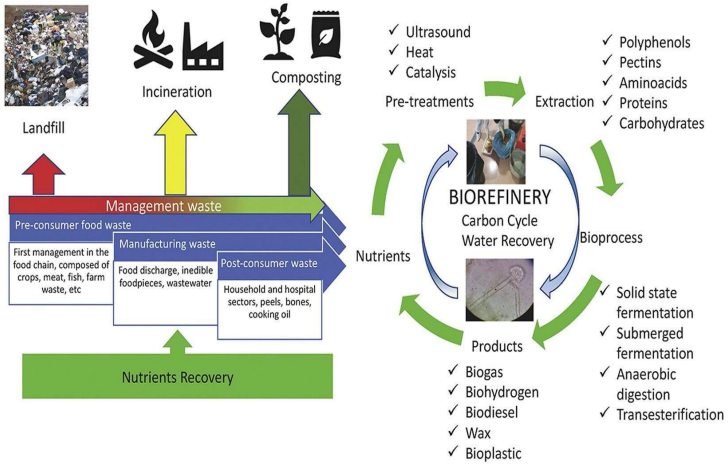
The 2012 market value of food products lost or wasted was **USD 936 billion;** that is in the range of the GDP of countries such as Indonesia or the Netherlands.

Using FAO methodology and estimates (3), the total cost of GHG emissions from global food wastage is USD 411 billion.

Global food loss and waste generate annually **4.4 $GtCO_2$ eq,** or about **8%** of total anthropogenic GHG emissions . This means that the contribution of food wastage emissions to global warming is almost equivalent **(87%) to global road transpor**t emissions

https://doi.org/10.1016/j.envpol.2020.115985





Sudalai.S, CPCEE,PU

https://www.fao.org/3/bb144e/bb144e.pdf

FOOD WASTE

Globally, on average, **65 kg of food is wasted per year by one person** of which 25% is through wasted vegetables, 24% through cereals and 12% through fruits.

Daily wasted amounts of vitamin C, K, Zinc, Copper, Manganese and Selenium are especially high representing 25-50% of their daily dietary recommended intake (DRI) value.

Cereals, fruits and vegetables are the three major food groups contributing the most to wasted nutrients followed by meat, dairy and eggs that contribute substantially to the wasted calcium, choline, riboflavin, zinc, and vitamin B12.

Global average amount of food waste per capita per year contains 18 healthy diets meaning it can fulfil the DRIs of 25 nutrients for one person for 18 days.

The embedded environmental footprints in average person's daily food waste are:
124 g CO_2 eq., **58 Litre freshwater use,** 0.36 m^2 cropland use, 2.90 g nitrogen and 0.48 g phosphorus use.

Cereals, meat, and sugar are major food groups contributing to environmental impacts.

Canxi Chen, Abhishek Chaudhary, Alexander Mathys,
Nutritional and environmental losses embedded in global food waste,
Resources, Conservation and Recycling,Volume 160,2020,104912,ISSN 0921-3449,https://doi.org/10.1016/j.resconrec.2020.104912

How much food is wasted

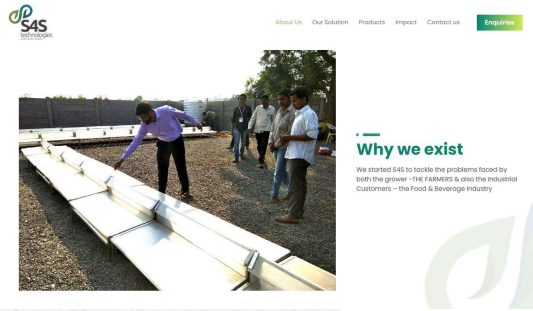
On Average, 40% of food produced were being disposed of. This means that 7.5 tons of food are discarded daily.

Some 84.7% of the whole waste material recorded was thrown within the bin, whereas the remainder was either fed to the poor or some animals.

A big portion of the waste material binned was still in edible condition.

https://www.chintan-india.org/sites/default/files/2019-09/Food%20waste%20in%20India.pdf

https://www.avristech.com/food-waste-management-in-india/



IMPACT :- A win-win for all

Environmental Impact

Preventing food wastage and reduce post harvest losses.

Solar powered processing saves CO_2 from entering the environment.

Economical Impact

Elevating Farmers out of Poverty providing Annual Assured Additional Income (Profit) of $1000-1500.

Increasing the Profits of Farmer Turned Micro-Entrepreneur by 60-110%.

Social Impact

With enhanced technical knowledge and skills, money directly goes in hand of women. These women find new social identities as climate champions and decision-makers in farms, families and communities.

S4S Impact till date

2,600
Installations in 15 countries

800
Micro-entrepreneurs created with assured additional income

12,000
Market linkage to 6000 farmers

40,000
Per year capacity for farm level solar food processor

37,000
Of annual co2 saved

Over 1 million
People supplied nutrition rich food

[Photo: Wtrmln Wtr]

When the founders learned that hundreds of millions of pounds of watermelon stayed in fields to rot because the fruit was judged too unattractive for sale in supermarkets, they decided to create a product that could help avoid that waste. The juice is now available nationally, and the company is growing 30% year-over-year.

snack company founded in 2012 that sells "upcycled" dehydrated banana snacks made from bruised, overripe, or otherwise imperfect bananas that are usually left to rot on banana plantations. Now a multimillion-dollar business, it sells products in both natural and mainstream supermarkets, and has rescued roughly 20 million tons of bananas to date.

Renewal Mill, a public benefit corporation that reduces food waste by transforming fiber-rich scraps from food processing operations into flour that can be sold wholesale.

Sudalai.S, CPCEE,PU

https://www.fastcompany.com/90337075/inside-the-booming-business-of-fighting-food-waste

MAKE SUPER DELICIOUS AND NUTRITIOUS FOODS THAT ALSO MAKE A DIFFERENCE!

REGRAINED
UPCYCLED FOOD LAB

Our award-winning culinary team crafted the world's first baking mixes powered by SuperGrain+®. From our savory pizza to decadent brownies to comforting carrot cake and succulent banana bread, we always put flavor first. An easy solution to enjoy an easy and indulgent twist on your family's favorite baked goods. Thanks to SuperGrain+® each recipe is extra delicious with added fiber and environmental sustainabilty. #EatUp Today!

✓ Available in four different recipes: Brownie, Banana Bread, Pizza & Carrot Cake
✓ Upcycled Certified™
✓ Made With Wholesome Ingredients
✓ Each Pouch Saves 60-100 Gallons of Water!

UPCYCLED CERTIFIED™ · 1% FOR THE PLANET · Certified B Corporation · POWERED BY UPCYCLED SUPERGRAIN

When grain is made into beer,

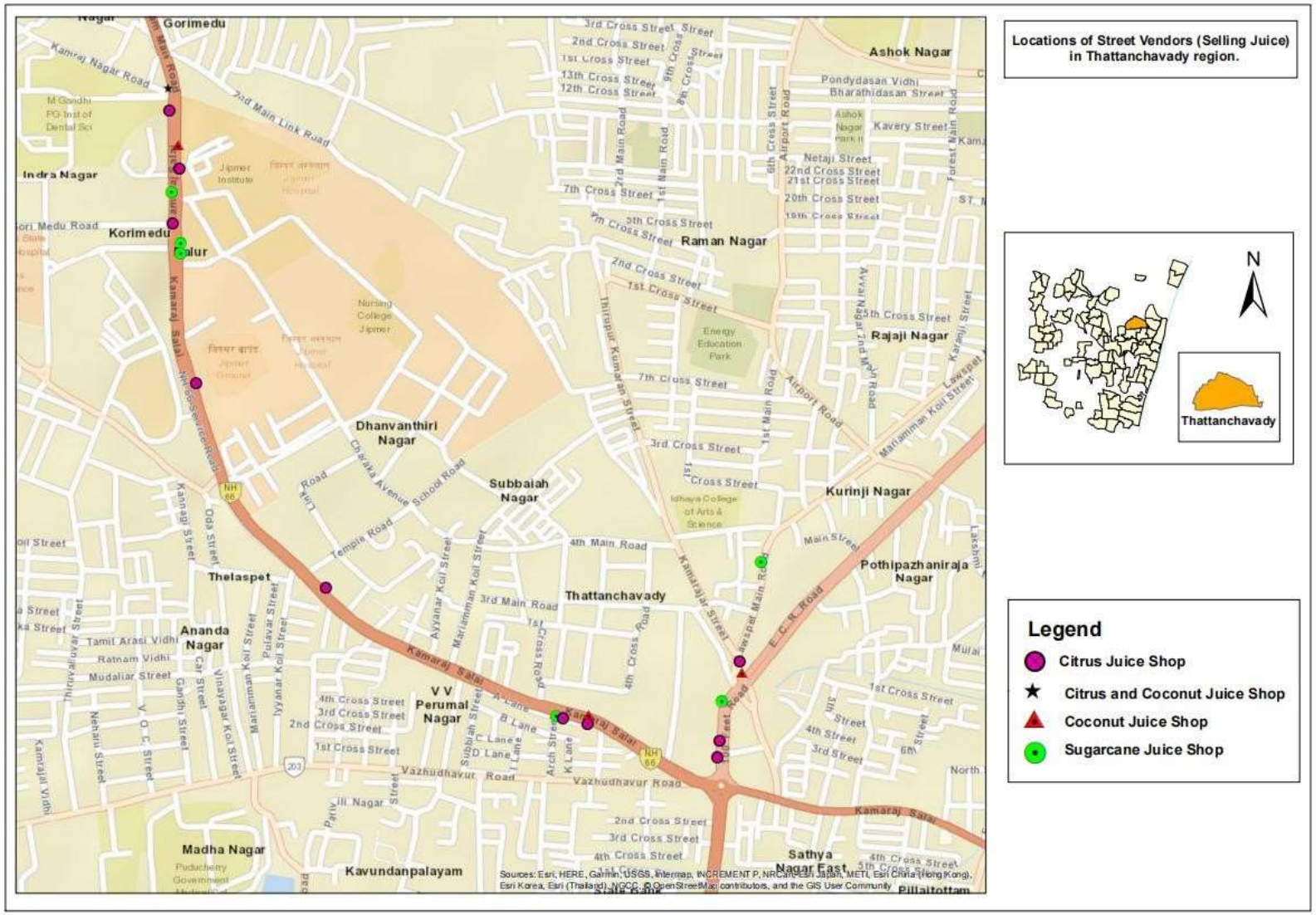
[Photo: Render]

Render

Bryner, a savory drink mix made with upcycled pickle brine that can be used in making a Bloody MaryIn a collaboration with chefs from San Francisco's State Bird Provisions, it recreated a snack that the chefs make for themselves in the restaurant kitchen to make use of leftover quinoa.

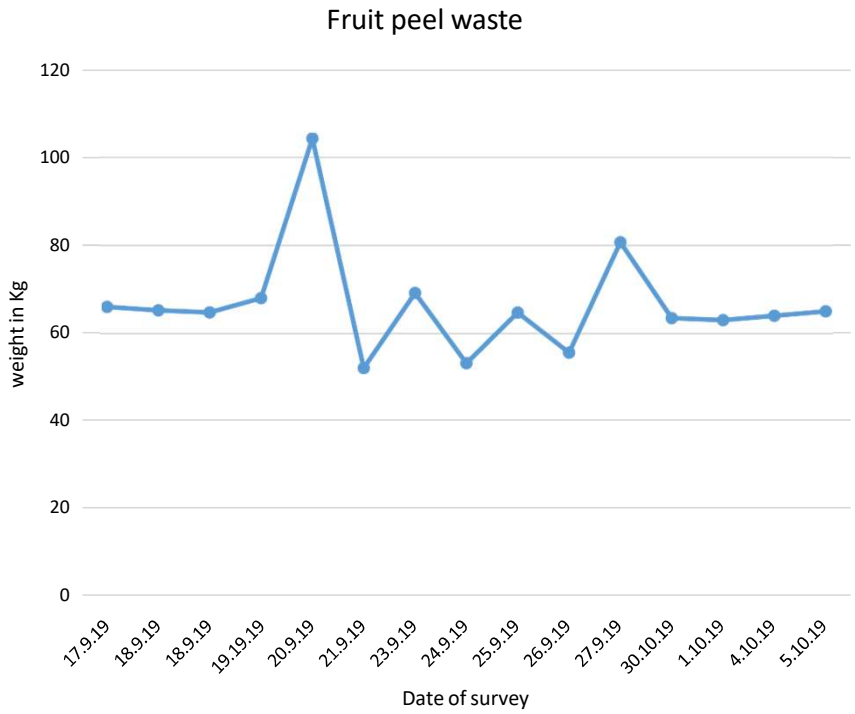
When sunflower seeds are processed for their oil, the end result is a hard, dry, wood-like "oilcake" that's usually used as animal feed. But the ingredient has more protein than meat, and the founders of this startup realized that it had potential as a food for humans. They found a way to process the oilcake with steam, heat, and pressure to puff it up and turn the ingredient into chips.

WHITE MOUSTACHE TREASURE8 RISE PRODUCTS



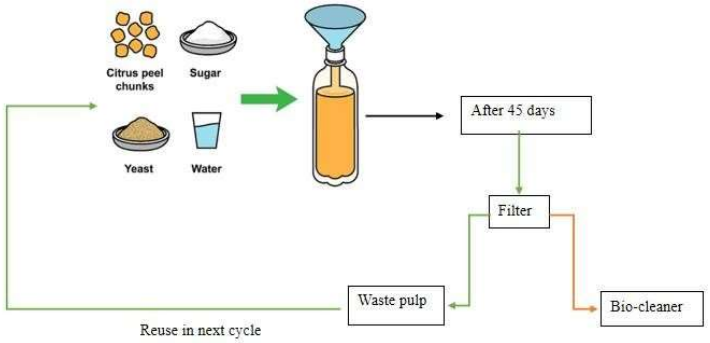
BIO-CLEANER FROM WASTE FRUIT PEELS

Fruits peels waste generation in campus



Before and After decay of Fruits peels waste in PU dump site

PREPARATION PROCESS



The shops located in shopping complex of PU campus alone generate 50 Kg /day. Which are collected at source and mixed with the other waste. It is wet waste

Preparation process picture and mix ratio



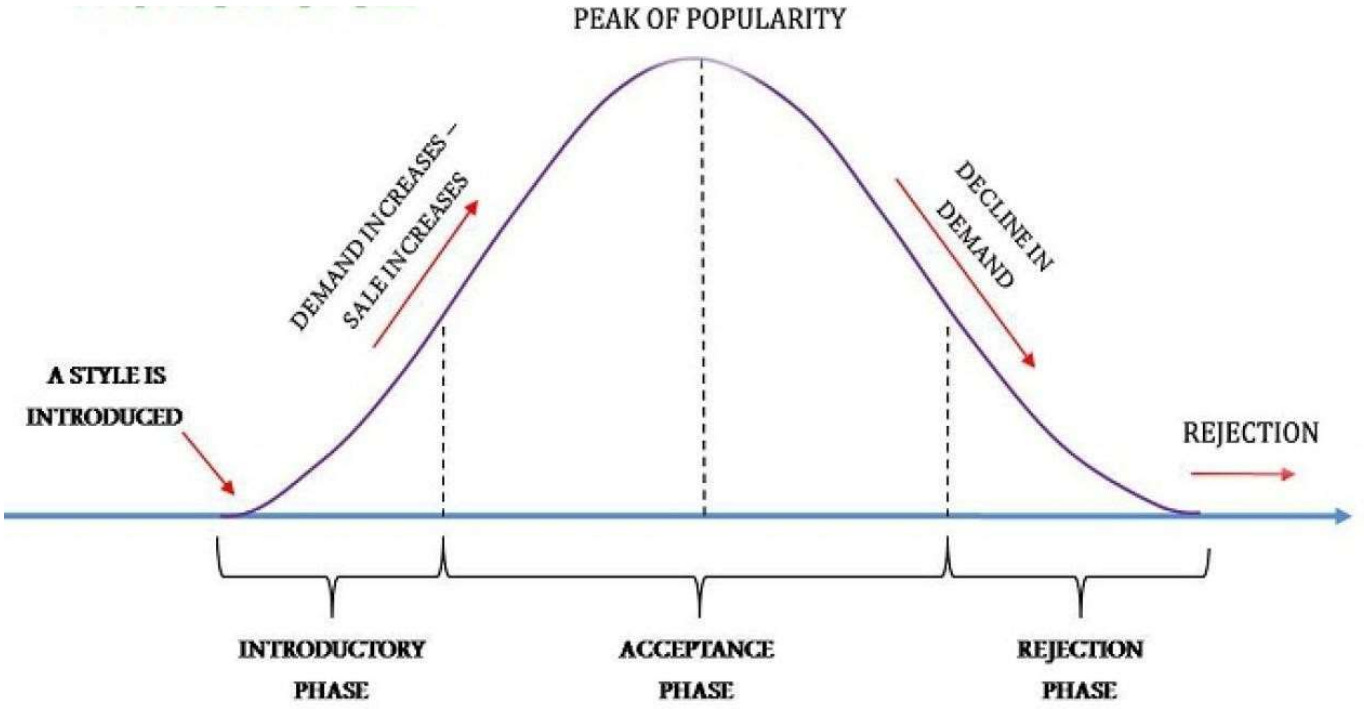


The mixing ration will be 3:1:10 as fruit peels: jaggery: water

SAMPLES	FRUIT PEELS (gram)	JAGGARY (gram)	WATER (Liter)	YEAST
S1	300	100	1	Yes
S2	400	150	1.5	Yes
S3	600	250	2.5	No
S4	900	400	4	No
S5	400	150	1.5	No



Recycling in Fashion and Textiles



Ref: Prof. K.Arul NIFT

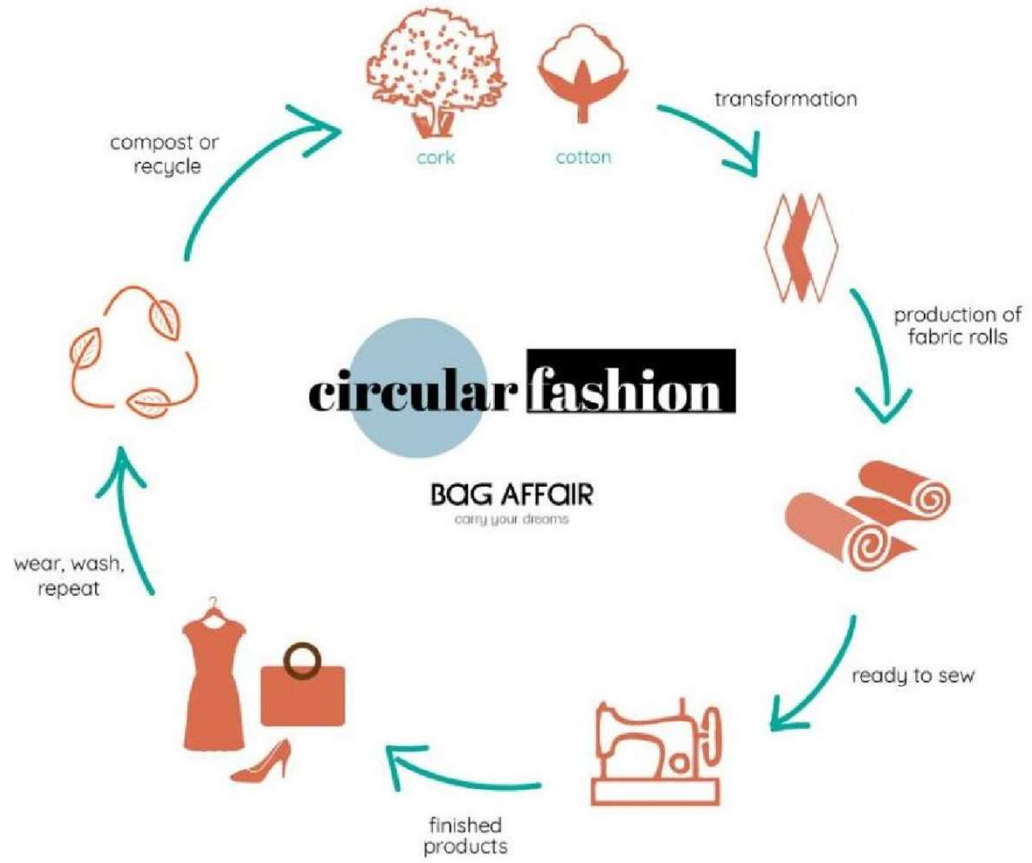
ENVIRONMENTAL IMPACT OF TEXTILES

- **80 Billion garments are produced in each year**
- **Brands release 52 micro collections per year**
- **An average of 35 kg of textile waste is generated by each person per year**
- **To produce one cotton shirt the fashion industry uses 2700 liters of water. That's the equivalent of 2.5 years of drinking water for a person.**
- **In total, up to 85% of textiles go into landfills each year.**

Ref: Prof. K.Arul NIFT

CIRCULAR FASHION

"A circular fashion industry is defined as a regenerative system in which garments are circulated for as long as their maximum value is retained, and then returned safely to the biosphere when they are no longer of use."

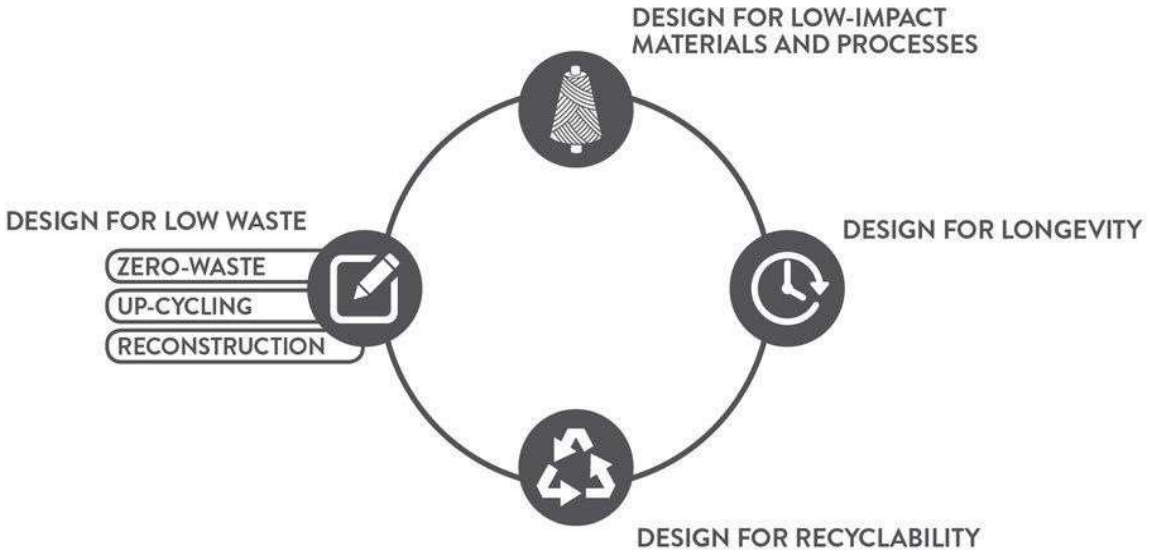


Source: https://www.bag-affair.com/what-is-circular-fashion/

Ref: Prof. K.Arul NIFT

CIRCULAR DESIGN

- Design to facilitate their disassembly or repair, reusing and recycling
- Design with quality materials and with a timeless style to maximize its durability



Source: https://www.redressdesignaward.com/learn/strategies

Ref: Prof. K.Arul NIFT

CIRCULAR PRODUCTION

- **Produced with non-toxic, high quality and preferably biodegradable materials.**
- **Waste generation is minimized during the manufacturing process**
- **Minimizing the extraction and use of new virgin raw material**
- **Produced, transported and marketed using renewable energy**

Source: https://gabrielfariasiribarren.com/en/textile-industry-and-circular-fashion/

Ref: Prof. K.Arul NIFT

CIRCULAR FASHION CONSUMER

Source: https://gabrielfariasiribarren.com/en/textile-industry-and-circular-fashion/

Ref: Prof. K.Arul NIFT

CIRCULAR FASHION CONSUMER

- **Buy items that they really appreciate, with the intention of maintaining and actively using them for a long time, possibly a lifetime.**
- **Buy articles that are organic, non-toxic or recycled materials, preferably with environmental certification**
- **Prefers natural materials (such as wool, linen, silk and viscose) rather than synthetic (such as polyester, acrylic and nylon)**
- **Find fashionable pieces through rental, loan or exchange rather than buying freshly made products**

Source: https://gabrielfariasiribarren.com/en/textile-industry-and-circular-fashion/

Ref: Prof. K.Arul NIFT

DESIGNERS

The 4 fundamental pillars for sustainable fashion strategy adopted by the designer 'Stella McCartney'

- **Respect for nature**
- **Respect for people**
- **Respect for animals**
- **Circular Solutions**

Source: https://varunjainblog.wordpress.com/2015/05/22/stella-mccartney-sustainable-fashion/

REPAIR… To Enjoy The Product For Long Time

“We now offer repairs at all of our stores,” says Nanushuk's Senior Sustainability Manager, Veronica Pravato.

“It's part of our responsibility”

Source: https://www.nanushka.com/sustainability/our-ethos

MARA HOFFMAN

New York based Mara Hoffman designs women's clothing, including swimwear, made from pre and post-consumer waste.

Source: https://www.nanushka.com/sustainability/our-ethos

SUSTAINABLE FASHION BRANDS OF INDIA

- **No Nasties**
- **Doodlage**
- **B-Label**
- **11.11**
- **InSom**
- **Mio Borsa**
- **Nicobar**
- **Ka Sha**
- **Chakori Ethnic**
- **Upsana**
- **Liva**
- **Mix Mitti**

Image Credits: Ka Sha

Image Credits: Upasana

Source: https://www.prakati.in/12-sustainable-fashion-brands-of-india/

DESIGN…

H&M has launched a new denim collection, designed using the principles of circularity

The denim fabric is made from a mix of:

- **Organic cotton**
- **Up to 35% recycled cotton (from post-consumer waste)**
- **Dyes that considerably reduce water waste and energy consumption**

Source: https://www.theindustry.fashion/hm-and-ellen-macarthur-foundation-rethink-design-and-production-of-denim/

BOTTLE to FASHION

Recycled polyester is an artificial fiber made from oil-based waste, like old PET bottles. Then it is blended with organic and recycled cotton to achieve a soft, fleecy fabric.

https://www.hm.com/by/4013a-lets-clean-up-bottle-2-fashion/

RECYCLING PET BOTTLE to GARMENT

Environmental Benefits :

- While Manufacturing
- Made from 5 recycled PET plastic bottles.
- 70% less CO_2 emission.
- Saves 810 litres of water.
- Landfill saving– 6.00 kg / year
- Water saving – 438.000 liters / year
- Co_2 emission saved – 14.60 kg/ year

Source: http://ecohike.in/

RECYCLING PET BOTTLE to FOOTWEAR

Nike

Adidas

Source: https://thelastfashionbible.com/2019/04/29/shoes-from-recycled-plastic/

QUALITY PRODUCT CERTIFICATION

OEKO-TEX®

Consist of 18 independent research and test institutes in Europe and Japan.

Enables consumers and companies to make responsible decisions which protect our planet for future generations.

Source: https://www.oeko-tex.com/en/our-standards/made-in-green-by-oeko-tex

QUALITY PRODUCT CERTIFICATION

GLOBAL ORGANIC TEXTILE STANDARD (GOTS)

Standard is to define requirements to ensure organic status of textiles

Source: https://global-standard.org/press/gots-images

SUSTAINABLE BUSINESS

SUSTAINABLE BUSINESS

SOEX is dedicated to sustainable business through the collection, processing, trading and recycling of used textiles.

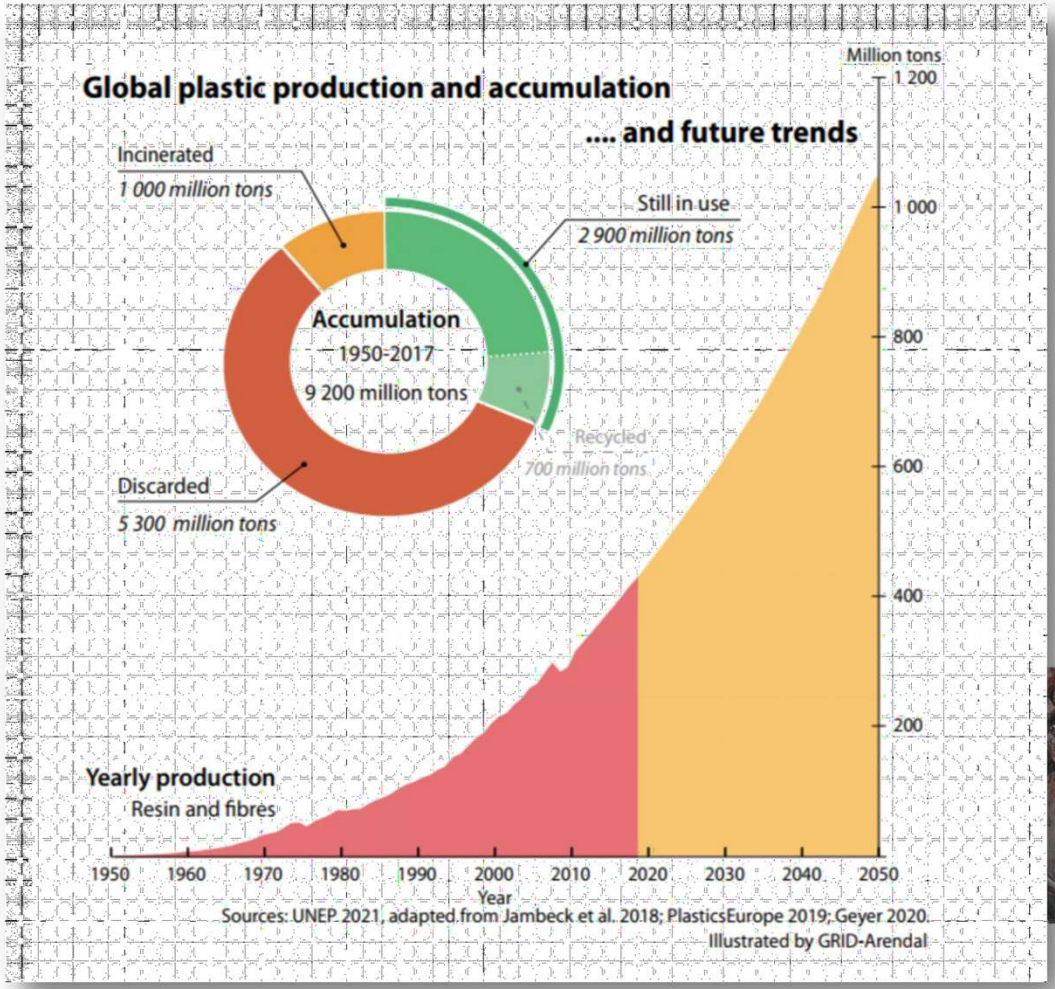
- **Collecting used textiles and shoes throughout Germany, Europe and the world**
- **Sorting, domestic sales and export of second-hand clothing**
- **Trading end-of-line goods, surplus goods, new goods, returned goods and goods with manufacturing flaws**
- **Recycling used textiles**

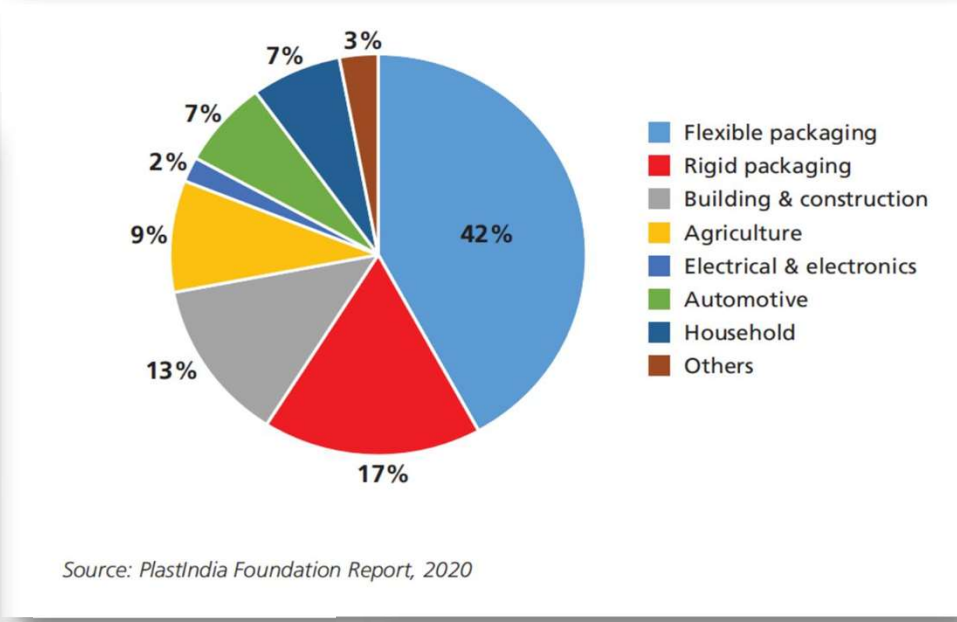
SUSTAINABLE PROJECTS IN EDUCATION

National Institute of Fashion Technology (NIFT) working with different Craft Clusters in Handloom and Crafts of India

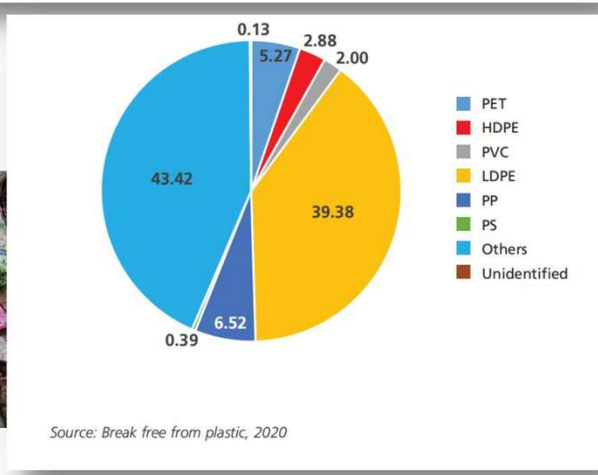
Source: https://nift.ac.in

Plastics- Matter of concern





As of 06 April 2021, only 89 brand owners and four producers have registered under the EPR scheme with the CPCB.



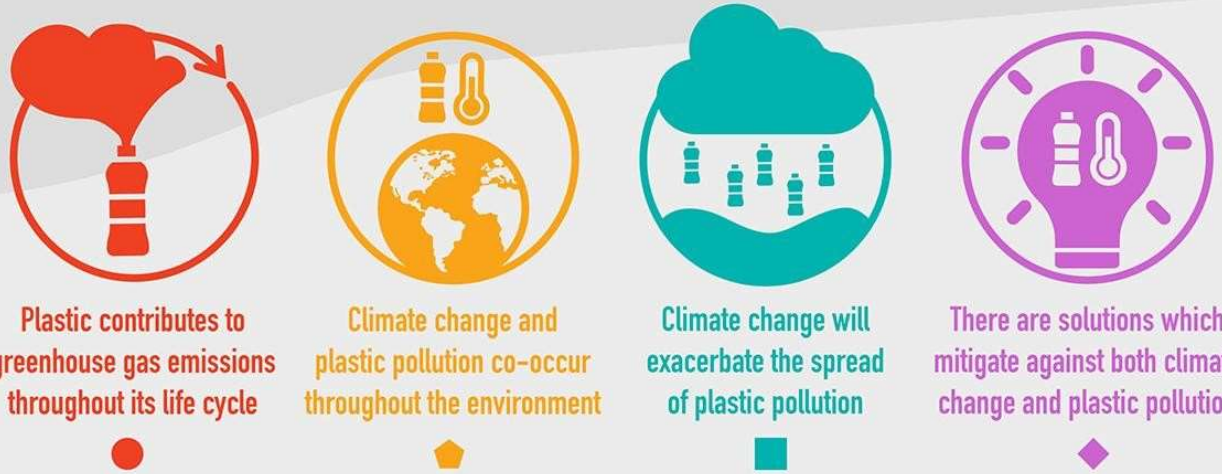
Sudalai.S, CPCEE,PU

Adopted from the report- Plastic recycling decoded by CSE

The fundamental links between climate change and marine plastic pollution

Ford et al., 2021

We have collated evidence that marine plastic pollution and climate change are linked in at least three ways:

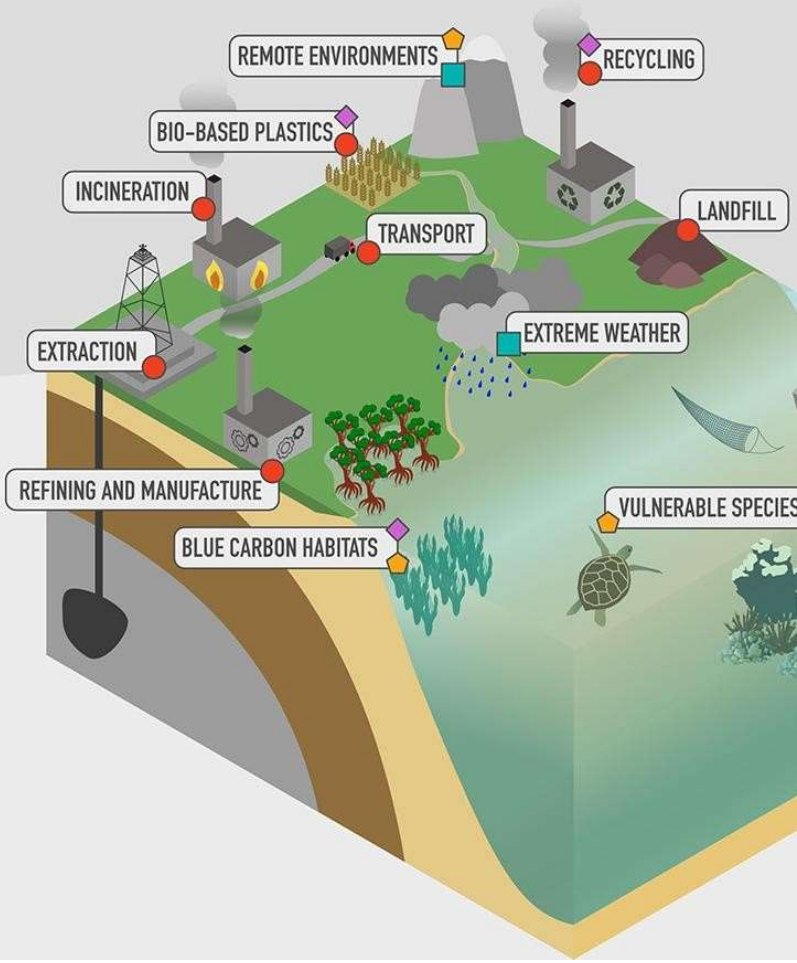


Plastic contributes to greenhouse gas emissions throughout its life cycle

Climate change and plastic pollution co-occur throughout the environment

Climate change will exacerbate the spread of plastic pollution

There are solutions which mitigate against both climate change and plastic pollution



Sudalai.S, CPCEE,PU

Plastics- Matter of concern

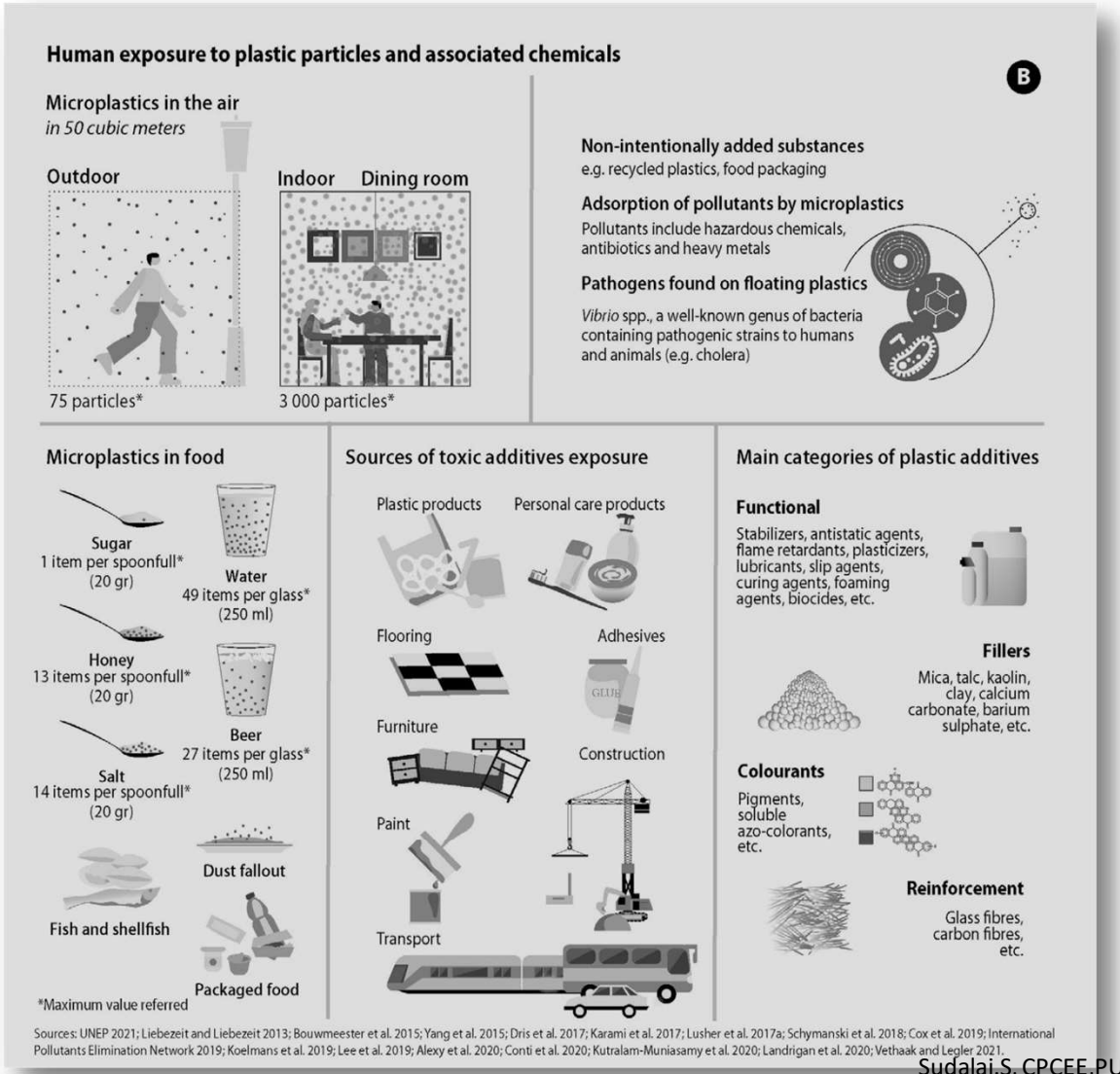
Nearly **700 marine species and more than 50 freshwater species are known to have ingested** or become entangled in macroplastic.

The lower-bound estimate of the economic impact on **costs of plastic pollution** to fishing, tourism, and shipping have been estimated at **$13 billion annually**

United Nations Environment estimates that up to **80 %of all litter in our oceans is made of plastic**, Every year at least 8 million tonnes, the equivalent of one full refuser truck per minute, of plastic find its way into the worlds oceans

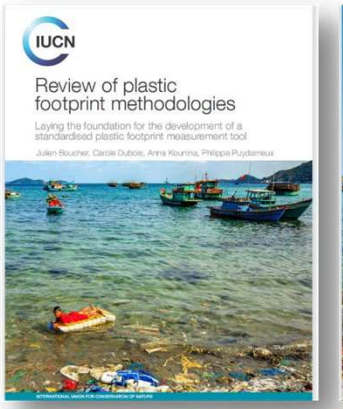
Plastic production accounted for 96% of particulate matter health footprint. *ETH Zurich, a public research.*

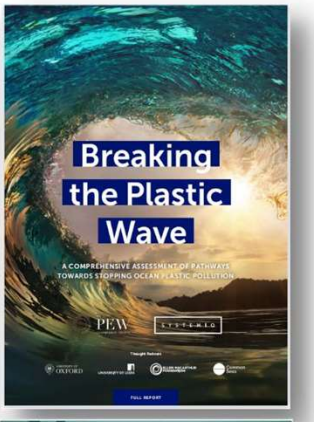
The global carbon footprint of plastic doubled since 1995, reaching two billion GtCO2-tonnes of carbon dioxide equivalent (CO2e) in 2015 and accounting for 4.5 % of global greenhouse gas emissions, according to the study-*Nature Sustainability*. *(13 December 2021- Down to earth)*

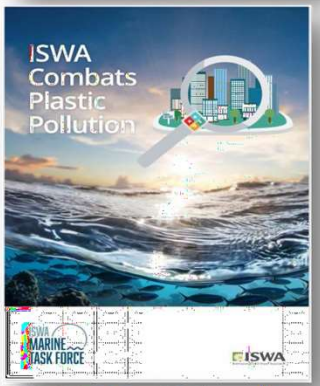


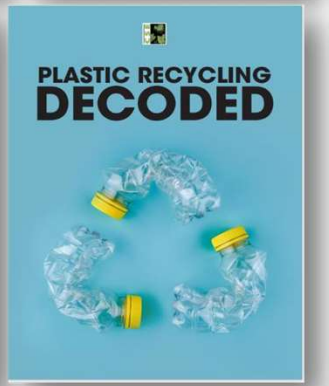
Plastics- Matter of concern

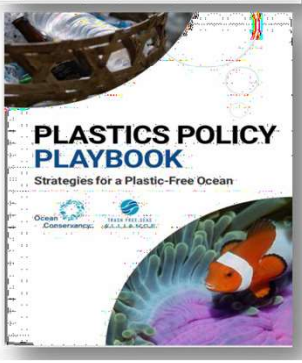
	Name of Methodology	Organisation	Link	Short name	Include microplastics	Date of release
Corporate / Product	Plastic Scan	Searious Business	http://oceanimpact-quickscan.azurewebsites.net	Plastic scan	NO	2017
	Plastic Disclosure Project (PDP)	Ocean Recovery Alliance	http://plasticdisclosure.org	PDP	NO	2016
	Plastic Footprint for Companies	Plastic Soup Foundation	https://www.plasticsoupfoundation.org/en/psf-in-action/plastic-footprint-3/	PSF footprint	YES	2017
	Plastic Scorecard	BizNGO	https://www.bizngo.org/sustainable-materials/plastics-scorecard	Plastic Scorecard	NO	2014
	Marine Plastic Footprint	IUCN / EA	n.a.	Marine Plastic Footprint	YES	n.a. 2019
	Plastic Leak Project	Quantis / EA	https://quantis-intl.com/metrics/initiatives/plastic-leak-project/	Plastic Leak Project	YES	n.a. 2019
	Circularity Indicators Methodology	EMF	https://www.ellenmacarthurfoundation.org/programmes/insight/circularity-indicators	Circularity index	NO	2015
	Plastic Drawdown	Common Seas	https://www.commonseas.com/projects/plastic-drawdown	Plastic Drawdown	YES	2019
	Marine Impacts in LCA	CIRAIG / PUCP / NTNU	n.a.	MariLCA	YES	n.a.
	PlastikBudget	Fraunhofer Institute	n.a.	Plastikbudget	YES	n.a. 2020
	Plastic Pollution Calculator	ISWA	n.a.	Plastic Pollution Calculator	NO	n.a. 2019
	PET Collection, Landfill and Environmental Leakage Rates in South East Asia	GA Circular/companies	https://www.gacircular.com/publications/	PET GA PET Collection	NO	n.a. 2019
	Plastic Life Cycle Assessment (LCA)	JRC	https://eplca.jrc.ec.europa.eu/permalink/plastic lci/plastic lca report/2018.11.20.pdf	LCA	YES	n.a. 2020
Countries / Regions	PiPro SEA	EMF / Companies	n.a.	Project SEA	NO	2019
	National Guidance For Marine Plastic Hotspotting and Shaping Action	UN Environment / IUCN	n.a.	Hotspot + Action	YES	n.a. 2019
	A Global Roadmap to Achieve Near-zero Ocean Plastic Leakage	SYSTEMIQ / PEW	n.a.	SYSTEMIQ Roadmap	YES	n.a. 2019
Individuals	Plastic Footprinter	R4W	http://www.plasticfootprint.ch	R4W	NO	2014
	My Little Plastic Footprint	PSF	http://mylittleplasticfootprint.org	MyLittle Plastic Footprint	YES	2017
	Plastic Calculator	Greenpeace	http://secure.greenpeace.org.uk/page/conte	Greenpeace	NO	2016

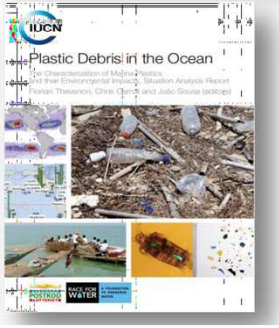




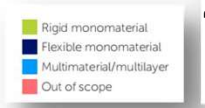


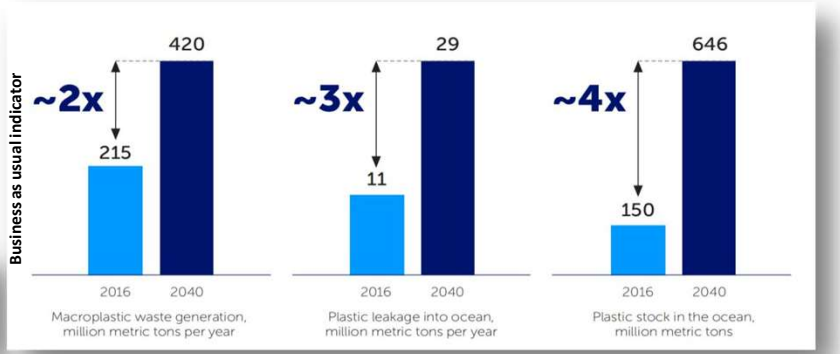


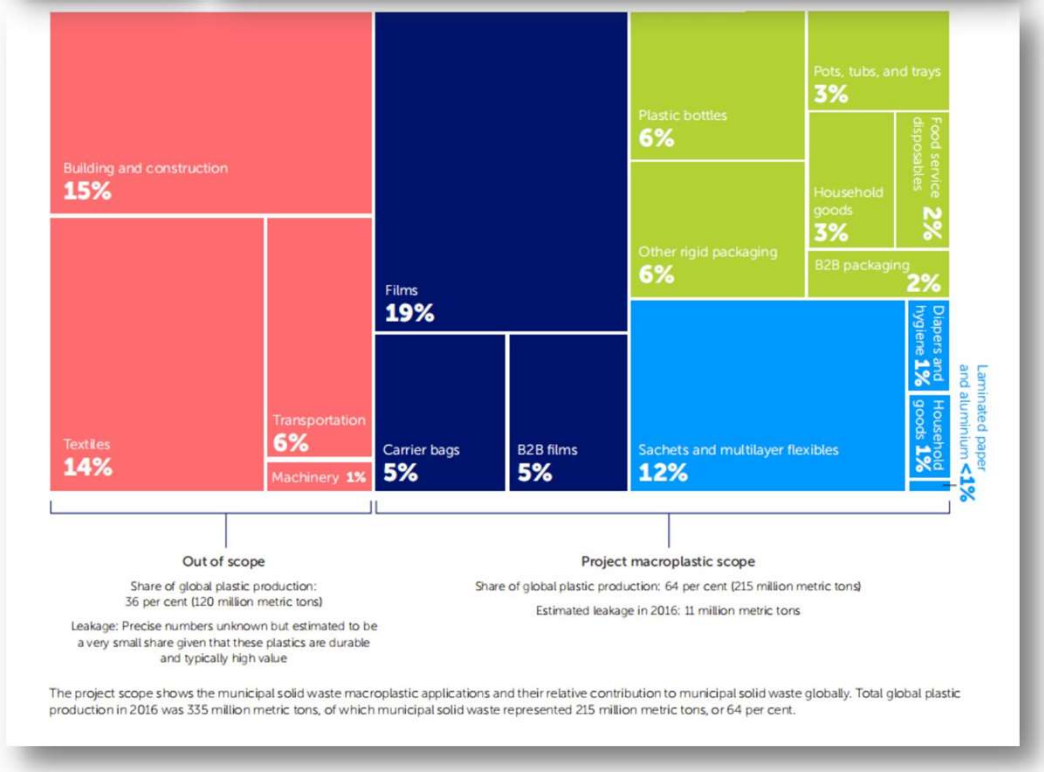




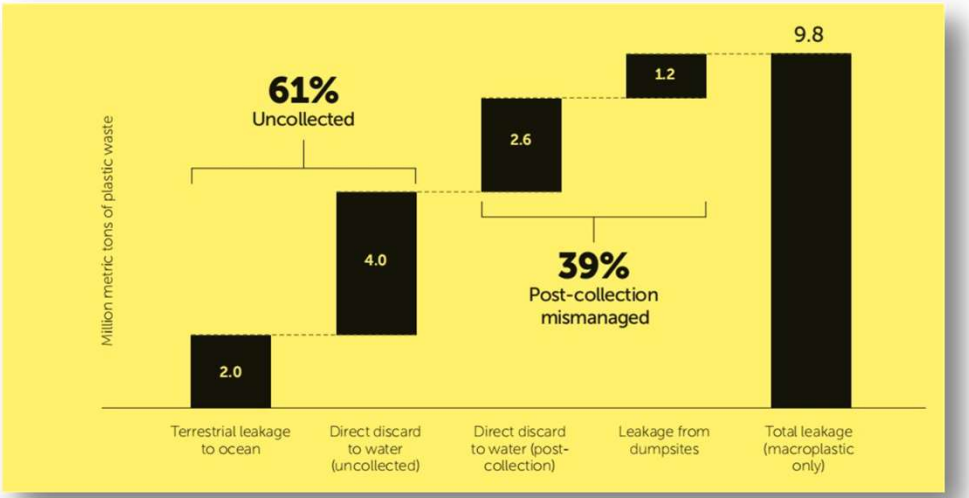
Sudalai S, CPCEE, PU



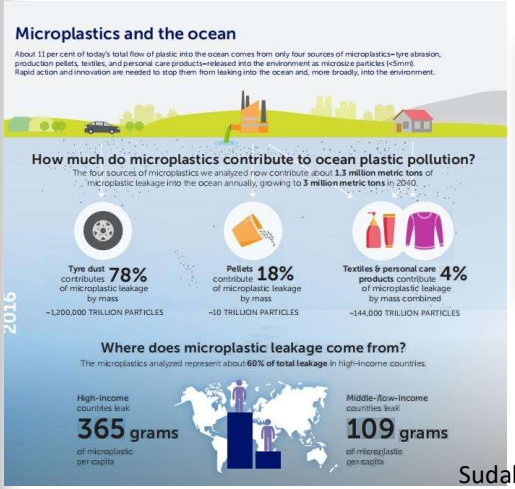


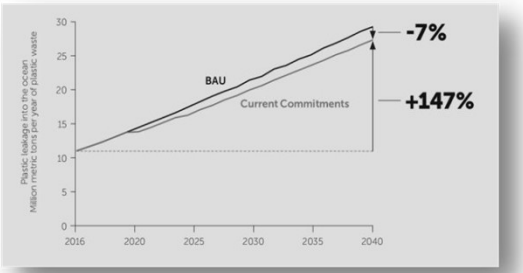


Macroplastic leakage into the ocean globally by leakage route



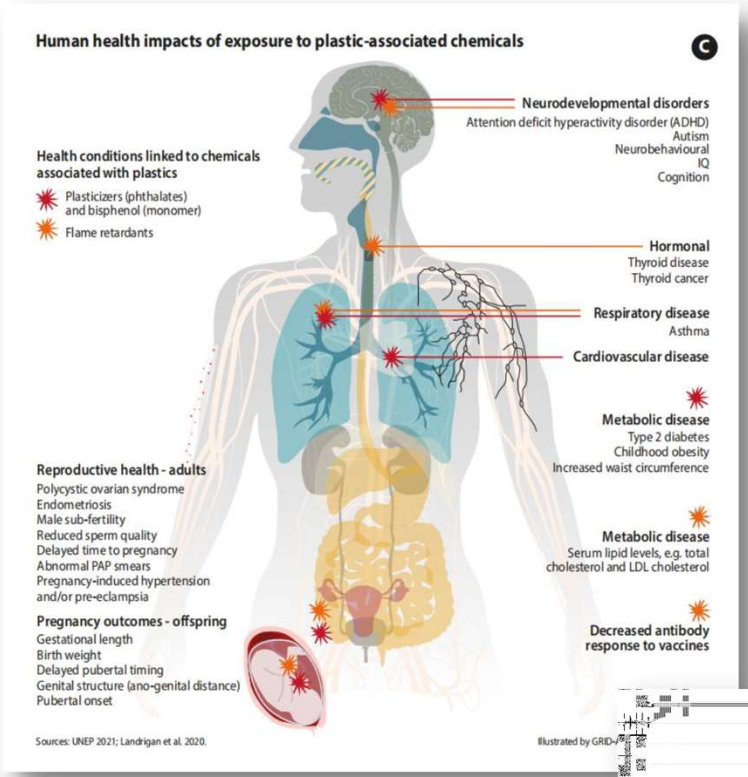
In 2016, uncollected waste contributed 61 per cent of total leakage, while the remaining 39 per cent was waste that was mismanaged after collection

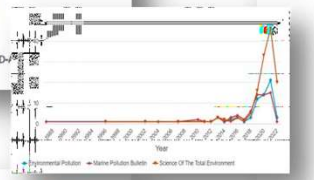




Land-based plastic leakage under the Business-as-Usual and Current Commitments scenarios

Sudalai.S, CPCEE,PU



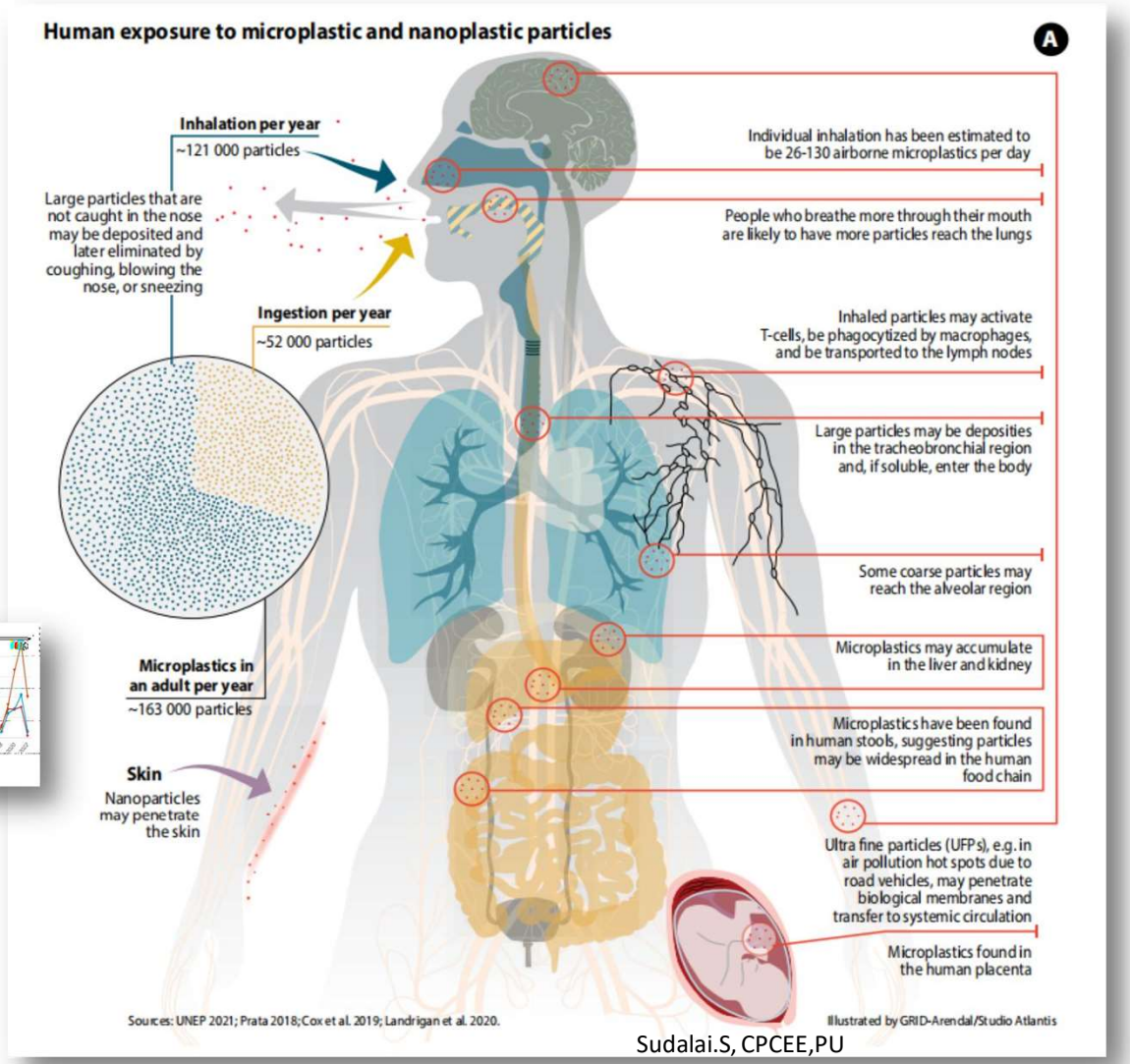


Women with polycystic ovary syndrome have higher BPA blood levels, study finds

Date: June 25, 2010

Source: The Endocrine Society

Summary: Women with the polycystic ovary syndrome (PCOS), the most common hormone imbalance in women of reproductive age, may be more vulnerable to exposure to the chemical bisphenol A (BPA), found in many plastic household items, according to a new study.

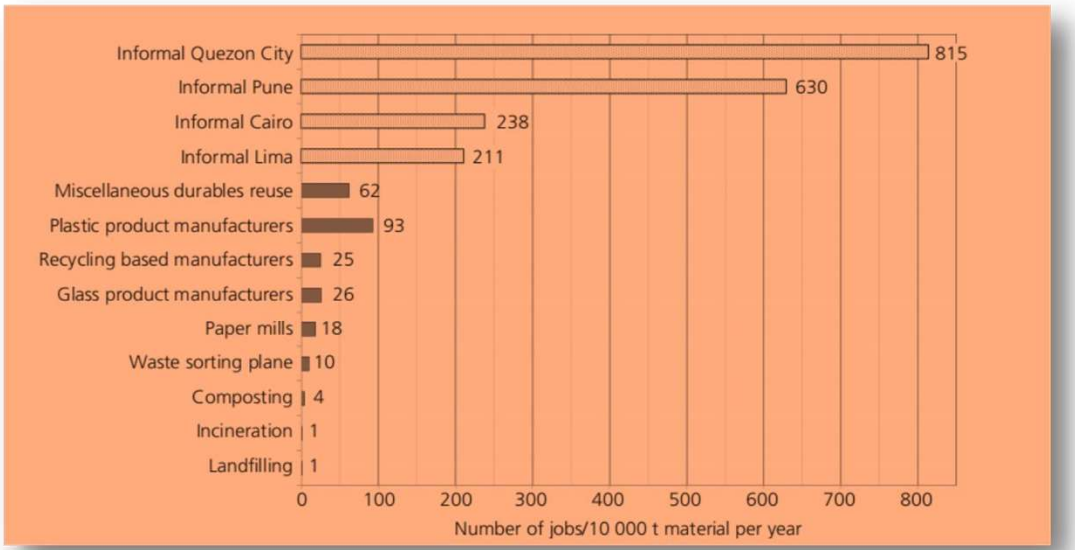


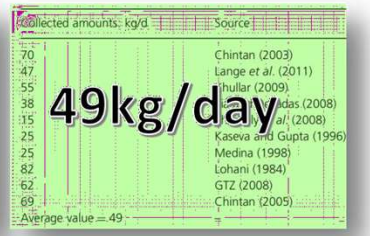
Sudalai.S, CPCEE,PU

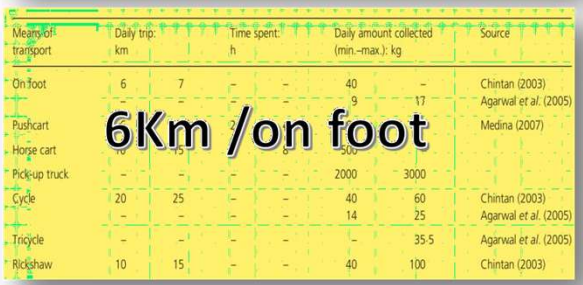
Informal Sector involved in SWM

City	Population range (year)	Number of reported informal workers (range)	Percentage of informal actors in overall population
Ahmedabad	4,800,000–5,570,585 (2003–11)	20,000–50,000	0.36–0.42
Amritsar	1,132,761–1,183,705 (2011)	3,000–3,500	0.25–0.31
Bangaluru	5,000,000–8,425,970 (2000–11)	25,000–70,000	0.30–1.40
Delhi	11,007,835–18,680,000 (2010–11)	80,000–300,000	0.43–2.73
Kanpur	2,767,031–2,920,067 (2011)	15,000–20,000	0.51–0.72
Kolkata	4,486,679–15,100,000 (2010–11)	20,000–80,000	0.13–1.78
Mumbai	12,478,447–19,200,000 (2010–11)	85,000–135,000	0.44–1.08
Overall (India)	364,459,000 (2010)	1,500,000	0.41 %

Source: Linzner and Lange, 2013





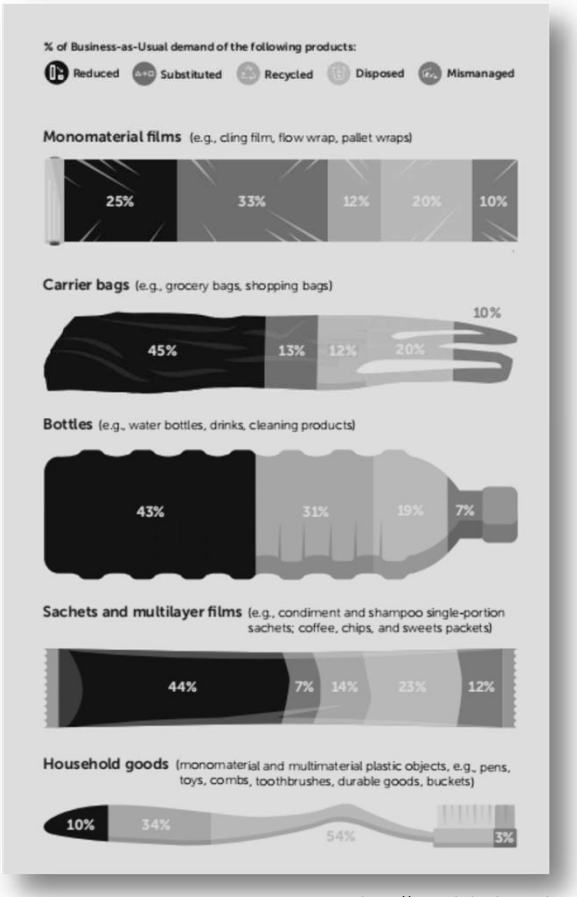


City (Country)	Mass percentage of waste recycled by informal sector: % of total waste generated	Mass percentage of waste recycled by formal sector: % of total waste generated	Source
Wuhan (CN)	21	0	Wilson *et al.* (2009)
Delhi (IN)	17–27	7	Agarwal *et al.* (2005); Scheinberg (2011)
Bangalore (IN)	13	1	Scheinberg (2011)
Dhaka (BD)	18	0	Scheinberg (2011)
Bandung (ID)	13	na	Sembiring and Nitivattananon (2010)
Manila (PH)	6	0	Wilson *et al.* (2009)
Quezon City (PH)	31	8	Scheinberg (2011)
Ormoc (PH)	22	na	Hetz *et al.* (2011)
Phnom Penh (KH)	9	na	Sengh *et al.* (2011)
Karachi (PK)	45	0	Wilson *et al.* (2009)
Ghorahi (NP)	9	2	Scheinberg (2011)
Lusaka (ZM)	2	4	Scheinberg (2011)
Moshi (TZ)	18	0	Scheinberg (2011)
Belo Horizonte (BR)	1	10	Scheinberg (2011)
Cañete (PE)	11	1	Scheinberg (2011)
Varna (BG)	2	26	Scheinberg (2011)

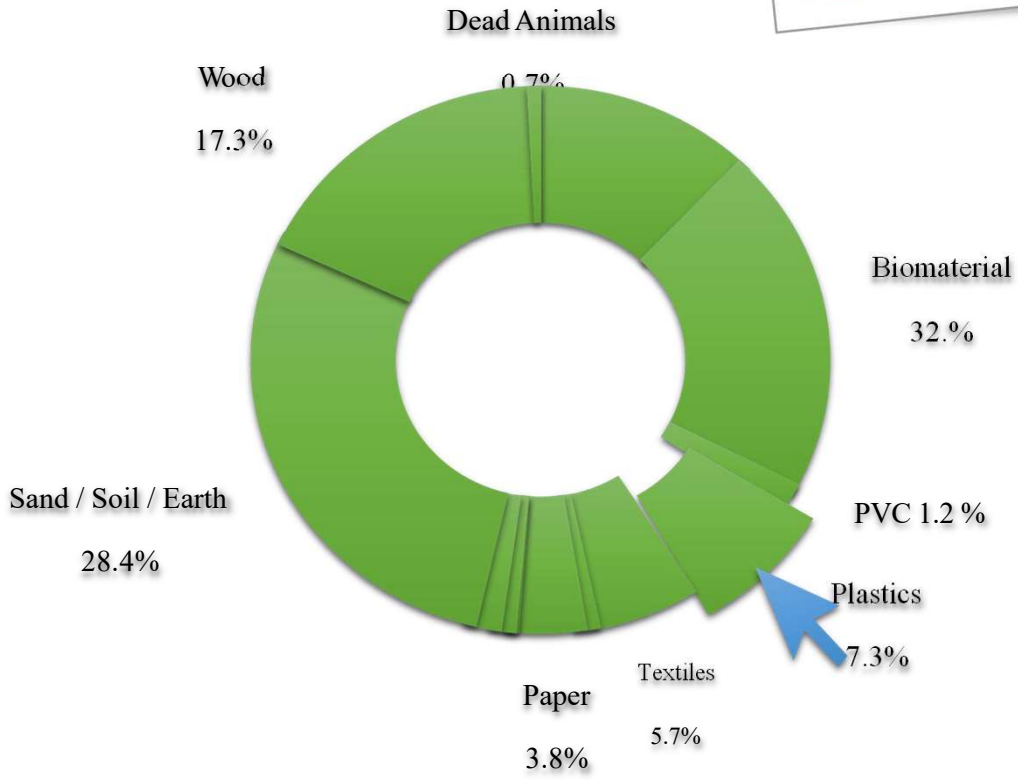
Sudalai.S, CPCEE,PU

INPUTS FROM MHO- SHRI.SHIVAKUMAR

Opportunities for Recycling



https://www.shaktiplasticinds.com/blog/



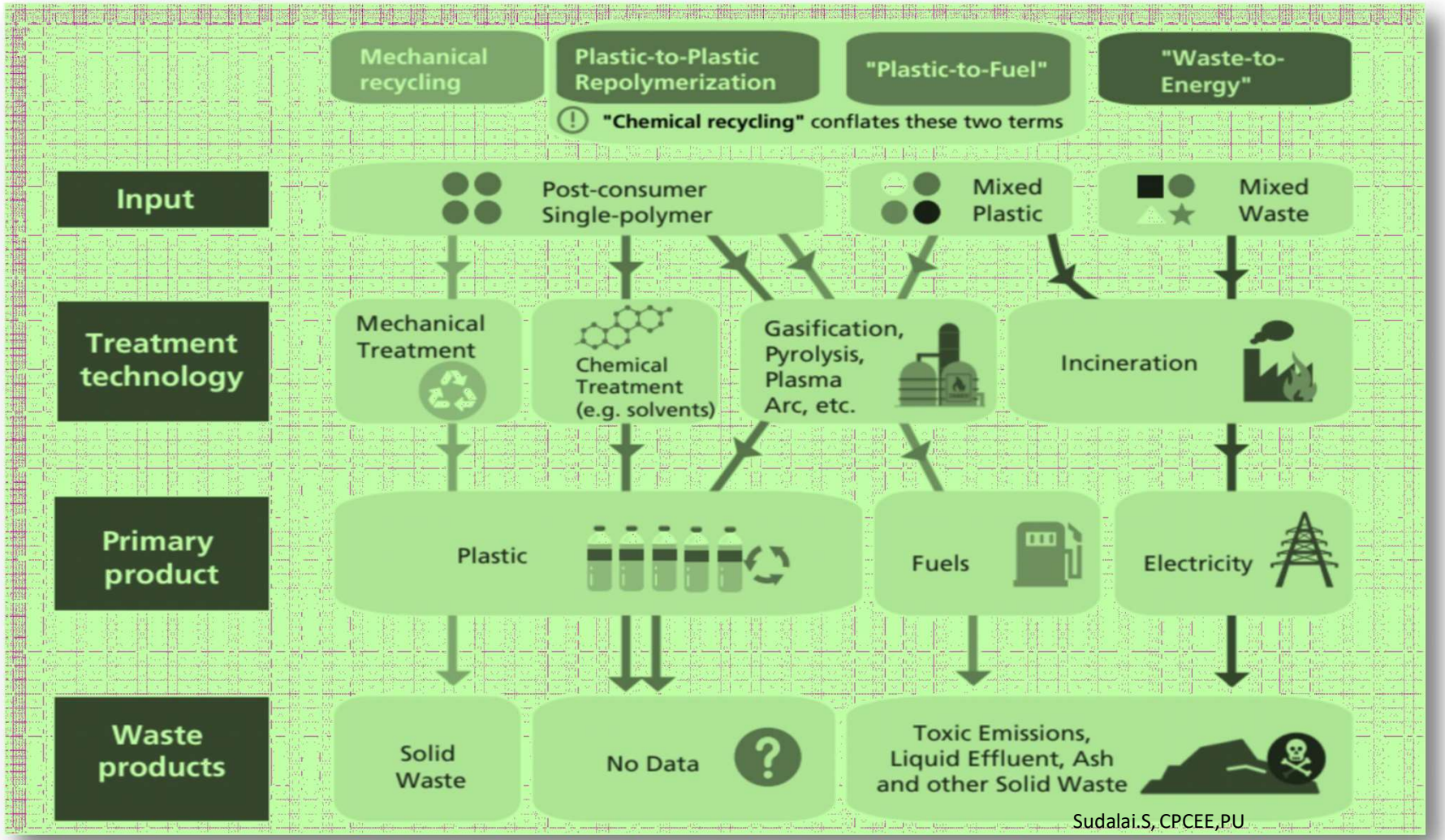
Average Weighted Composition Of Waste Received At Dump Site

Sudalai.S, CPCEE,PU

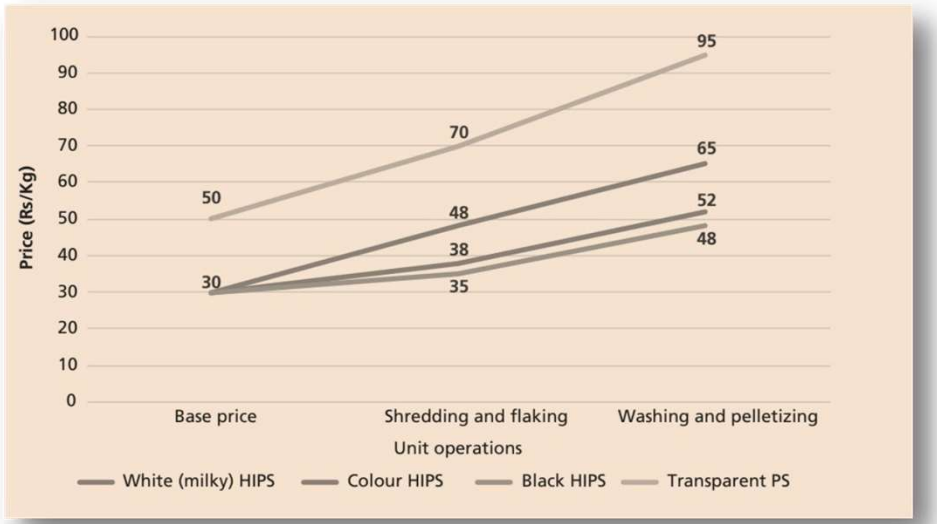
EIGHED PERCENTAGE FOR VARIOUS WASTE GENERATED IN LOCAL BODIES

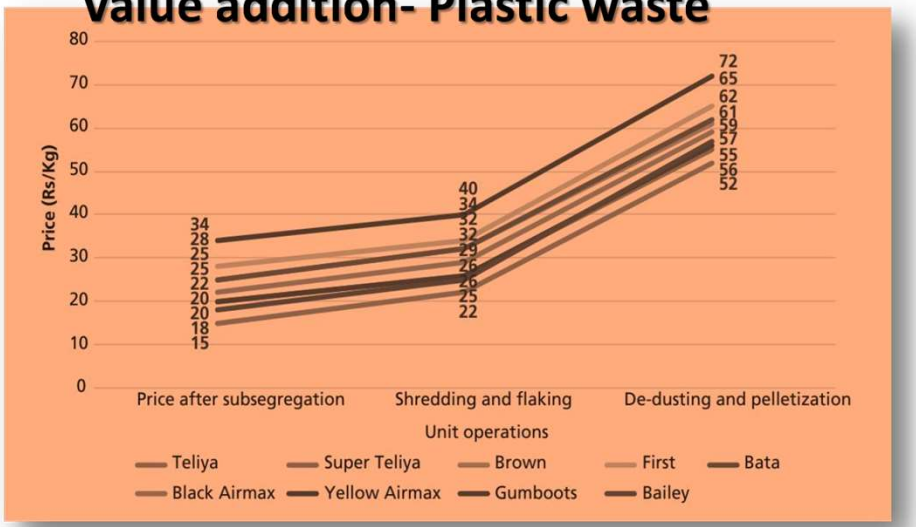
AS PER IL&FS REPORT -2016

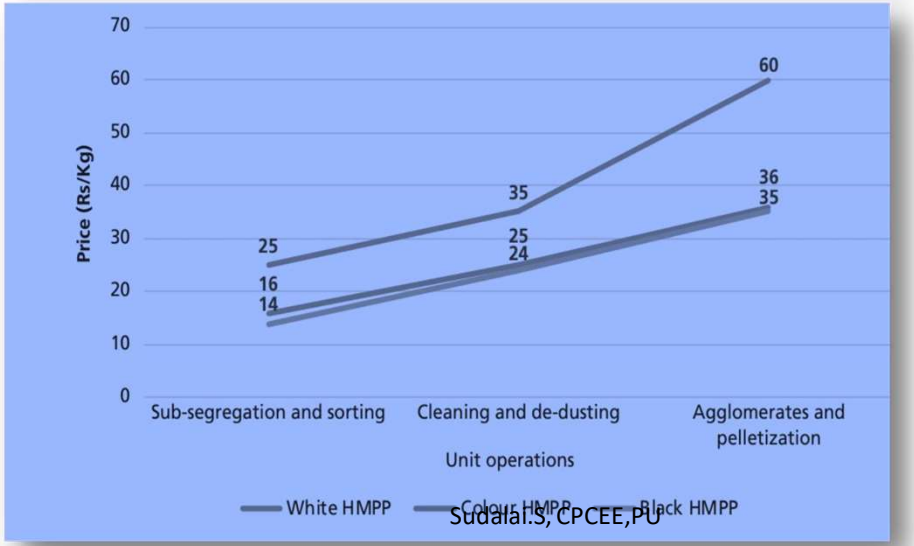
Plastics Recycling Options



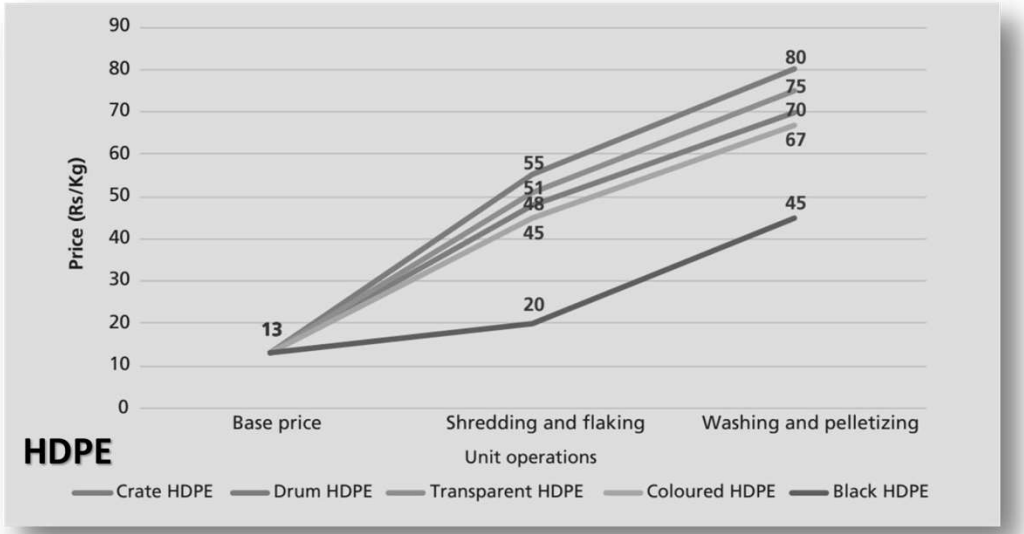
Value addition- Plastic waste

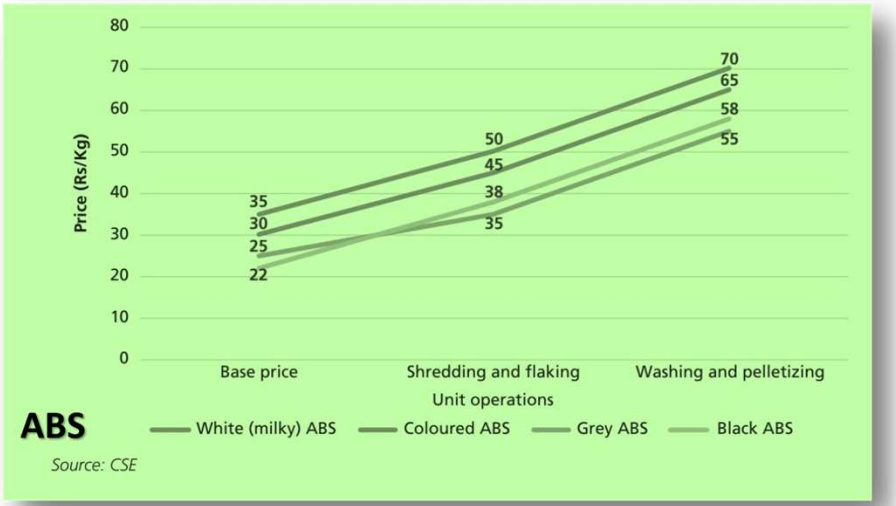


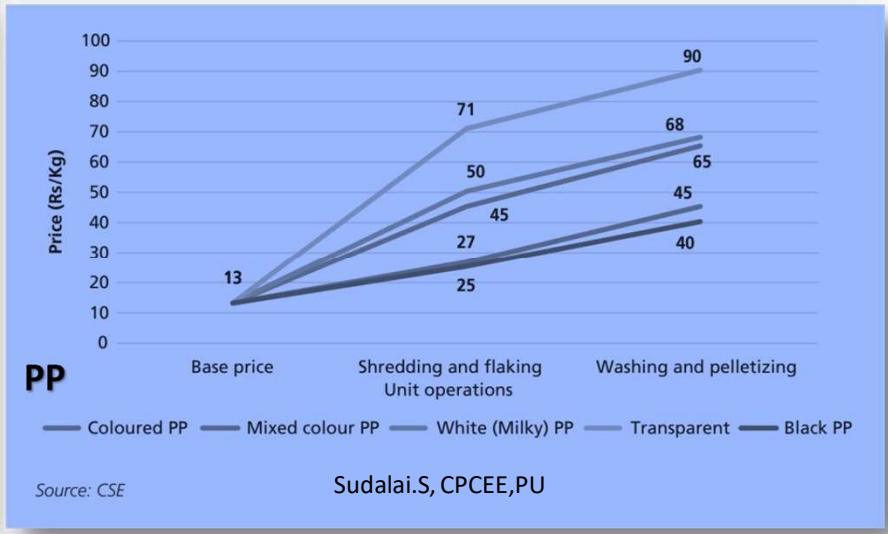




Value addition- Plastic waste







INPUTS FROM MHO- SHRI.SHIVAKUMAR

COST RECOVERY FROM PLASTIC WASTE –PUAA- OULGARET EXPERIENCE

Sl. No	Types of Plastic	% of Plastic	Projected Quantity from total plastic waste/day	Local Rate/KG (in Rs.)		Amount Recoverable (in Rs.)	
				Best Price	Worst Price	Best Price	Worst Price
1	1. PET	3.96	1326.6	15	10	19899	13266
2	2&4. HDPE & LDPE	84.6	28341	15	10	425115	283410
3	3. PVC	2.24	750.4	30	15	22512	11256
4	5. PP	4.31	1443.85	20	12	28877	17326
5	6. PS	4.41	1477.35	15	10	22160	14774
6	7. Others	0.49	164.15	5	3	821	492
Total						**519384**	**340524**

At Present cost recovered from plastic waste by menial employees (Door to Door Collectors and Rag pickers) is around Rs. 28,000 which is not even 10% of the worst value that may be recovered in worst case scenario.

Contribution of informal recycling of waste in achieving SDGs and Circular Economy

Provides waste recycling workers the opportunity to generate income and sustain their families

Waste recycling avoids hazardous emissions-causing incineration

Women form a majority of waste pickers. Women have an equal job opportunity and participate in leadership and decision making

Management of waste by the informal sector helps avoid waste disposal in water bodies, thereby reducing water pollution

The informal waste recycling sector adds value to the economy by transforming waste into tradable goods

Pushes the transition towards a circular economy and encourages technological innovations for recycling

Recycling services provided by waste pickers make cities more sustainable (by reducing the risk of water logging and flooding). Cooperatives promote citizenship building, social inclusion, de-stigmatization, increased self-esteem and community building; making cities more resilient. Costs associated with management of waste by urban local bodies are also reduced

Recycled waste reduces the need of virgin raw material, thereby minimizing resource depletion

Diverting more waste to recycling instead of for incineration or thermal treatment

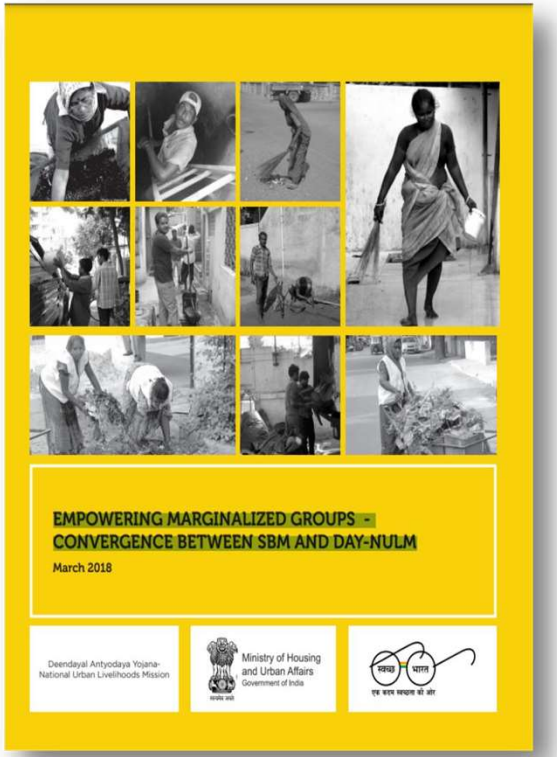
Minimization of recyclables (especially plastics) ending up in the oceans

Source Dr.Richa CSE

EMPOWERING MARGINALIZED GROUPS - CONVERGENCE BETWEEN SBM AND DAY-NULM

- Identification of vulnerable groups
- Skill training of marginalised groups and enterprises
- Formation and handholding of CIGs of marginalised groups, and access to finance
- Recognizing CIGs and SHGs involved in sanitation and/or waste management work in ULB's service frameworks
- Monitoring Mechanisms

Setting up dry waste/resource segregation centres

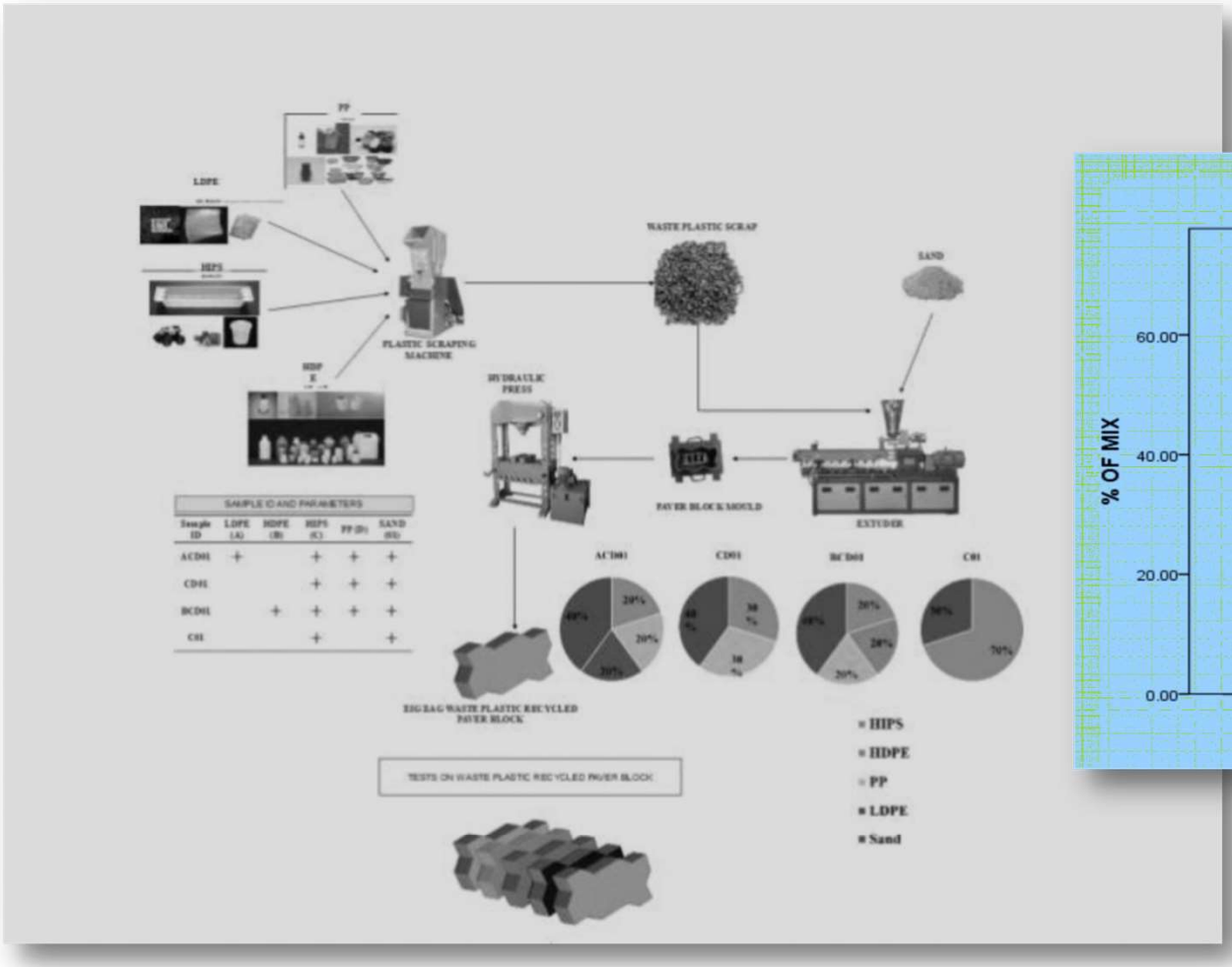


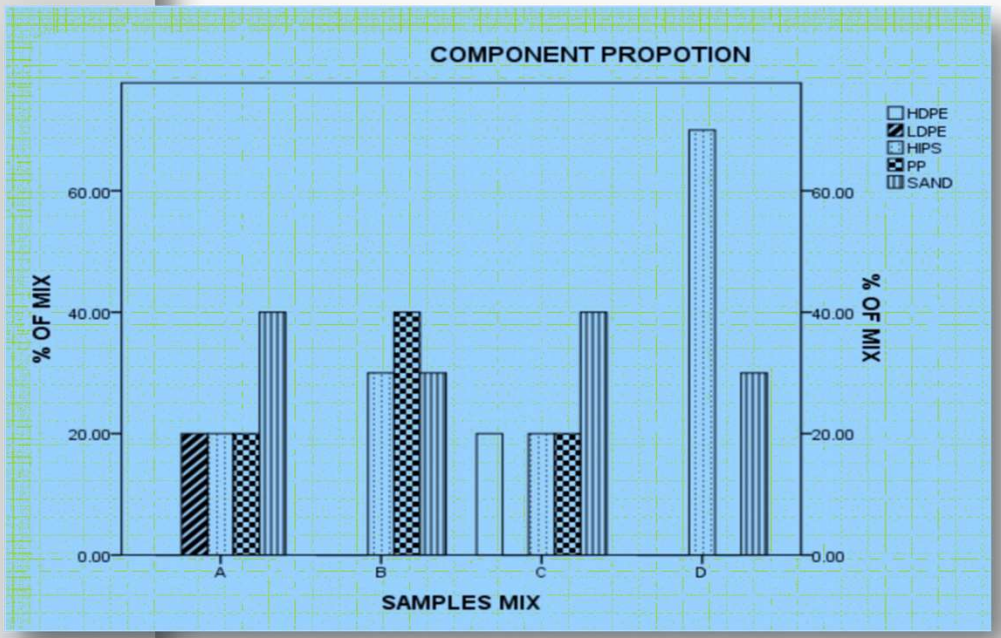
Sudalai.S, CPCEE,PU

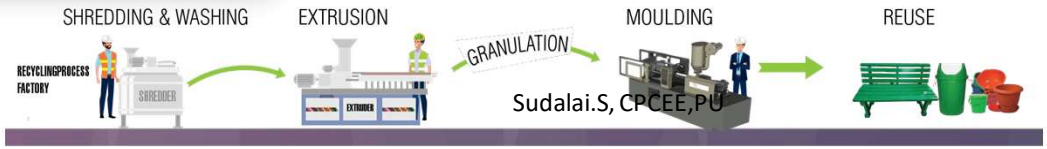
Reference	Study area	Objective	Material for Compaction	Method of preparing
(B. Shanmugavalli et al. 2017)	India	Cement with mixed plastic waste	LDPE plastic	Burn-in open
(Nataraja and Das 2012)	India	Strength properties of paver block	Crushed granite, Kadapa and broken paver	Concrete mix
(Agyeman et al. 2019)	India	Properties of blocks made with RPW	HDPE	Burn-in open
(Ghude et al. 2019)	India	Waste plastic in the building materials	HDPE, LDPE	Burn-in open
(Nivetha et al. 2016)	India	Plastic mixed	PET	Burn-in open
(Ghuge et al. 2019)	India	Comparison of a plastic paver with ordinary paver block	Mixed plastic	Burn-in open
(Pawar and Bujone 2017)	India	Plastic with fly ash	Fly ash with cement, Plastic with crush aggregate	Burn-in open
(Kumi-Larbi et al. 2018)	UK	LDEP with sand	LDPE	Aggregate mix
(Razdan 2018)	India	Cost efficiency	Portland Cement Concrete and Asphalt Concrete	Concrete mix
(Frigione 2010)	Italy	Waste un-washed PET bottles	PET	Aggregate mix
(Hannawi, Kamali-Bernard, and Prince 2010)	**France**		**PET, PC**	**Aggregate mix**

Reference	Study area	Objective	Material for Compaction	Compressive strength (n/mm²)	Tensile strength (n/mm²)	Flexural strength (n/mm²)	Water absorption	Sample size	Mix ratio
(B. Shanmugavalli et al. 2017)	India	Cement with mixed plastic waste ceramic waste	LDPE	13.03	-	-	-	9	1:1:1, (no ceramic waste) 1:1:2:1, 1:1:2:1
(M. C. Nataraja et al.2016)	India	Strength properties of paver block	Crushed granite, Kadapa and broken paver	43.38	2.82	5.66	6.45	15	1:1.5:3
(S. Agyeman et al.2019)	India	Properties of blocks made with RPW	HDPE	5.88-9.99	-	-	0.50-2.9	27	1:1:2, 1:1:2, 1:0.5:1
(Aarti Ghude et al.2019)	India	Waste plastic in the building materials	HDPE, LDPE	10.85-28.48	-	-	-	9	1:4,1:5,1:6
(S. Raju et al. 2019)	India	physical properties of paver block	HDPE	4-26.9	-	-	-	18	
(Nivetha C et al. 2016)	India	Plastic mixed	PET	51	-	-	-	4	1:1:2, 6:5:9, 7:5:8
(Jeevan Ghuge 2019)	India	Comparison of plastic paver with ordinary paverblock	Mixed plastic	16.05	-	-	-	12	
(Sarang Shashikant Pawar et al. 2017)	India	Plastic with fly ash	Fly ash with cement, plastic with crush aggregate	13.5-25	-	-	-	14	1:10,1:5,1:2 (both)

Process- Plastic brick

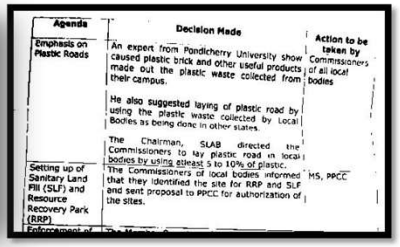






Science to Society

'ஆன் லைன்' பயிற்சி பட்டறை: தொழில்நுட்பக் கல்லூரி தீவிரம்



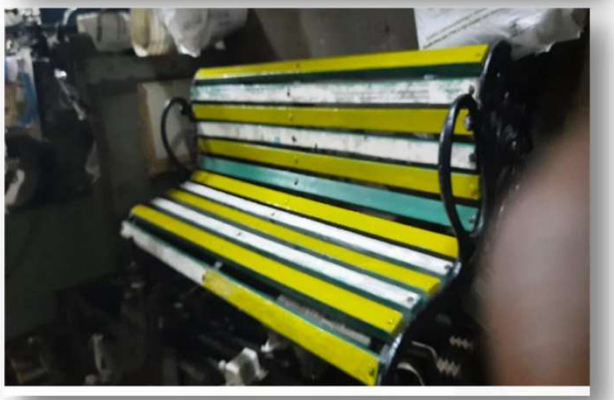
Agenda	Decision Made	Action to be taken by
Emphasis on Plastic Roads	An expert from Pondicherry University show caused plastic brick and other useful products made out the plastic waste collected from their campus. He also suggested laying of plastic road by using the plastic waste collected by Local Bodies as being done in other states. The Chairman, SLAB directed the Commissioners to lay plastic road in local bodies by using atleast 5 to 10% of plastic.	Commissioners of all local bodies
Setting up of Sanitary Land Fill (SLF) and Resource Recovery Park (RRP)	The Commissioners of local bodies informed that they identified the site for RRP and SLF and sent proposal to PPCC for authorization of the sites.	MS, PPCC

Sudalai.S, CPCEE,PU

Thiru. Azaganandam 8300935302

Pavement Raw material Percentage

	90Plastic/10sand	80/20	70/30	60/40
50kg/hr	1.35kg of plastic/p - 150gm sand /p 45kg of plastic/hr - 5kg of sand/hr 360kg - 40kg/day 7920kg - 880kg/month	1.2kg of plastic/P - 300gm sand/p 40kg /hr - 10kg/hr 320kg- 80kg/day 7040 kg - 1760kg/month	1.05 of plastic/pcs - 450gm sand/pcs 35kg/hr - 15kg/hr 280kg - 120kg/day 6160kg - 2640kg/month	800gm of plastic/pcs - 600gm of sand/pcs 30kg/hr - 20kg/hr 240kg - 160kg/day 5280kg - 3520kg/month
120kg/hr	1.35kg of plastic/p - 150gm sand /p 105.6kg/hr - 14.4kg/hr 844.8kg -115.2kg/day 18585.6kg - 2534.4kg/month	1.2kg of plastic/P - 300gm sand/p 96kg - 24kg/hr 798kg - 192kg/day 16896kg - 4224kg/month	1.05 of plastic/pcs - 450gm sand/pcs 84kg - 36kg/hr 672kg - 288kg/day 14784kg - 6336kg/month	800gm of plastic/pcs - 600gm of sand/pcs 72kg - 48kg/hr 576kg - 384kg/day 12672kg - 8448kg/month
250kg/hr	1.35kg of plastic/p - 150gm sand /p 225kg - 25kg/hr 1800kg - 200kg/day 39600kg - 4400kg/month	1.2kg of plastic/P - 300gm sand/p 200kg - 50kg/hr 1600kg - 400kg/day 35200kg - 8800kg/month	1.05 of plastic/pcs - 450gm sand/pcs 175kg - 75kg/hr 1400kg - 600kg/day 30800kg - 13200kg/month	800gm of plastic/pcs - 600gm of sand/pcs 150kg - 100kg/hr 1200kg - 800kg/day 26400jg - 17600kg/month
400kg/hr	1.35kg of plastic/p - 150gm sand /p 460kg - 40kg/hr 3680kg - 320kg/day 80960kg - 7040kg/month	1.2kg of plastic/P - 300gm sand/p 320kg -80kg/hr 2560kg - 640kg/day 56320kg -14080/month	1.05 of plastic/pcs - 450gm sand/pcs 280kg - 120kg/hr 2240kg - 960kg/day 49280kg - 21120kg/month	800gm of plastic/pcs - 600gm of sand/pcs 240kg - 160kg/hr 1920kg - 1280kg/day 42240kg - 28160kg/month
500kg	1.35kg of plastic/p - 150gm sand /p 450kg of plastic/hr - 50kg of sand/hr 3600kg - 400kg/day 79200kg - 8800kg/month	1.2kg of plastic/P - 300gm sand/p 400kg /hr - 100kg/hr 3200kg- 800kg/day 70400 kg - 17600kg/month	1.05 of plastic/pcs - 450gm sand/pcs 350kg/hr - 150kg/hr 2800kg - 1200kg/day 61600kg - 26400kg/month	800gm of plastic/pcs - 600gm of sand/pcs 300kg/hr - 200kg/hr 2400kg - 1600kg/day 52800kg - 35200kg/month
1000kg/h	1.35kg of plastic/p - 150gm sand /p 900kg - 100kg/hr 7200kg - 800kg/day	1.2kg of plastic/P - 300gm sand/p 800kg - 200kg/hr 6400kg - 1600kg/day	1.05 of plastic/pcs - 450gm sand/pcs 700kg -300kg/hr 5600kg - 2400kg/day	800gm of plastic/pcs - 600gm of sand/pcs 600kg - 400kg/hr 4800kg - 3200kg/day

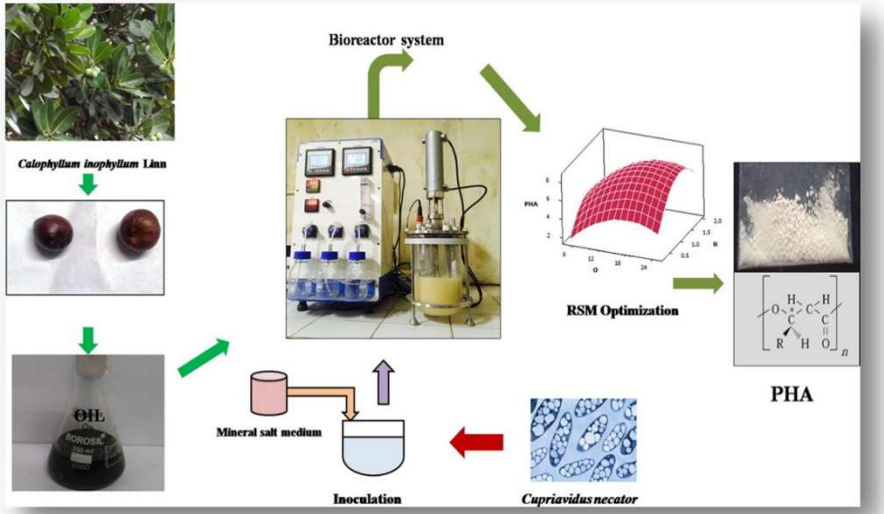


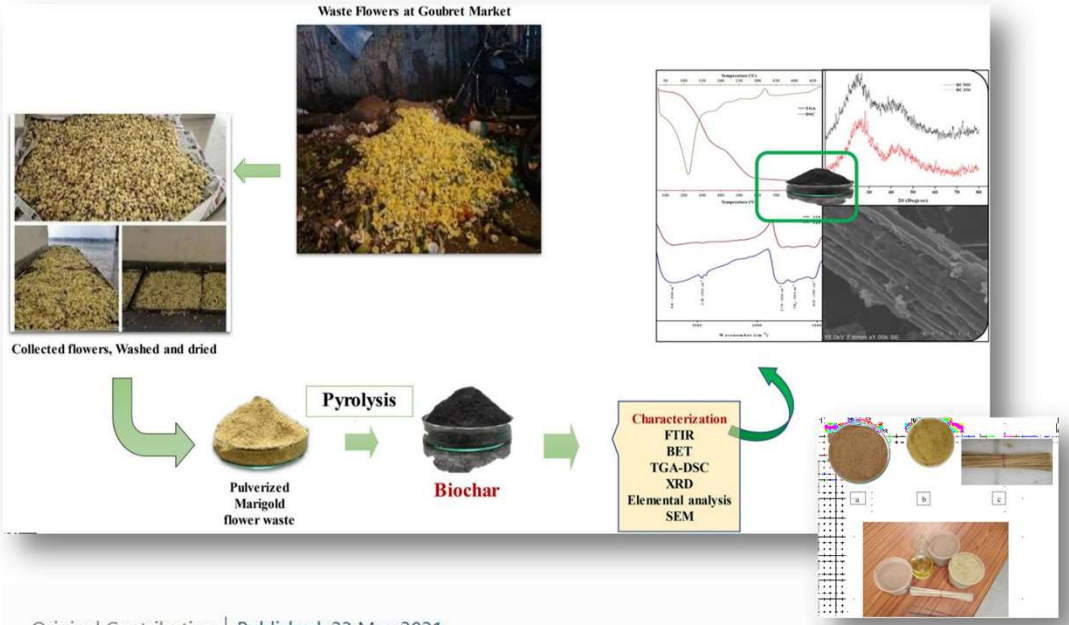
METRO GROUPS
ENGINEERING THE ENVIRONMENT

Pavement Production rate

Output	If 1.5kg product weight	If 2kg product weight	If 2.5kg product weight
50kg/hr	33pcs/hr 264pcs/day 5808pcs/month	25pcs/hr 200pcs/day 4400pcs/month	20pcs/hr 160pcs/day 3520pcs/month
120kg/hr	80pcs/hr 640pcs/day 14080pcs/month	60pcs/hr 480pcs/day 10560pcs/month	48pcs/hr 384pcs/day 8448pcs/month
250kg/hr	166pcs/hr 1328pcs/day 29216pcs/month	125pcs/hr 1000pcs/day 22000pcs/month	100pcs/hr 800pcs/day 17600pcs/month
400kg/hr	266pcs/hr 2128pcs/day 46816pcs/month	200pcs/hr 1600pcs/day 35200pcs/month	160pcs/hr 1280pcs/day 28160pcs/month
500kg/hr	333p/hr 2664p/day 58608p/month	250p/hr 2000p/day 44000p/month	200p/hr 1600p/day 35200p/month
1000kg/hr	666pcs/hr 5328pcs/day 117216pcs/month	500pcs/hr 4000pcs/day 88000pcs/month	400pcs/hr 3200pcs/day 70400pcs/month
2000kg/hr	1333pcs/hr 10666pcs/day 234666pcs/month	1000pcs/hr 8000pcs/day 176000pcs/month	800pcs/hr 6400pcs/day 140800pcs/month

Sudalai.S, CPCEE,PU





Int J Biol Macromol. 2018 Jun;112:598-607. doi: 10.1016/j.ijbiomac.2018.02.012. Epub 2018 Feb 3.

Production and optimization of polyhydroxyalkanoates from non-edible Calophyllum inophyllum oil using Cupriavidus necator

A Arumugam [1], S G Senthamizhan [2], V Ponnusami [2], S Sudalai [3]

Affiliations + expand

PMID: 29408394 DOI: 10.1016/j.ijbiomac.2018.02.012

Original Contribution | Published: 23 May 2021

Renovation of Waste *Chrysanthemum morifolium* (Marigold) into Valuable Biochar: A Study on the Utilization of Solid Waste by Pyrolysis

Tajamul Shafi Panditha, S. Sudalai & A. Arumugam

Journal of The Institution of Engineers (India): Series E **102**, 239–248 (2021) | Cite this article

PRODUCTS:

The Recycled Plastic Granules are manufactured using latest technology. These Recycled Granules are used in various application and products, due to their superior quality. The chemical properties of our recycled granules are equivalent to prime material and is cheaper than virgin plastic. This unique features coupled with the competitive pricing has led to huge demand in the market.

At Shakti Plastic Industries, there is a commitment to provide innovative products and services that bring total satisfaction and considerable value to customers. There's a stringent pro-active quality control procedure. There's a firm commitment on following safety, health and environment measures. There's responsibility towards creating & ensuring a safe and clean environment.

RECYCLED PRODUCTS MADE FROM UPTO 100% PLASTIC WASTE

Sale!

Dustbin small (7ltr) Made out of plastic waste

Buy on amazon

Bulk Enquiry

Sale!

Garden benches made from post-consumer plastic waste

ADD TO CART

Bulk Enquiry

Sale!

Plastic Compass Box

ADD TO CART

Bulk Enquiry

Sale!

Pushbin

ADD TO CART

Bulk Enquiry

Sale!

Super Shakti Medium Size Lid Garbage Waste Dustbin 10 litres (Blue)

Buy From Amazon

Bulk Enquiry

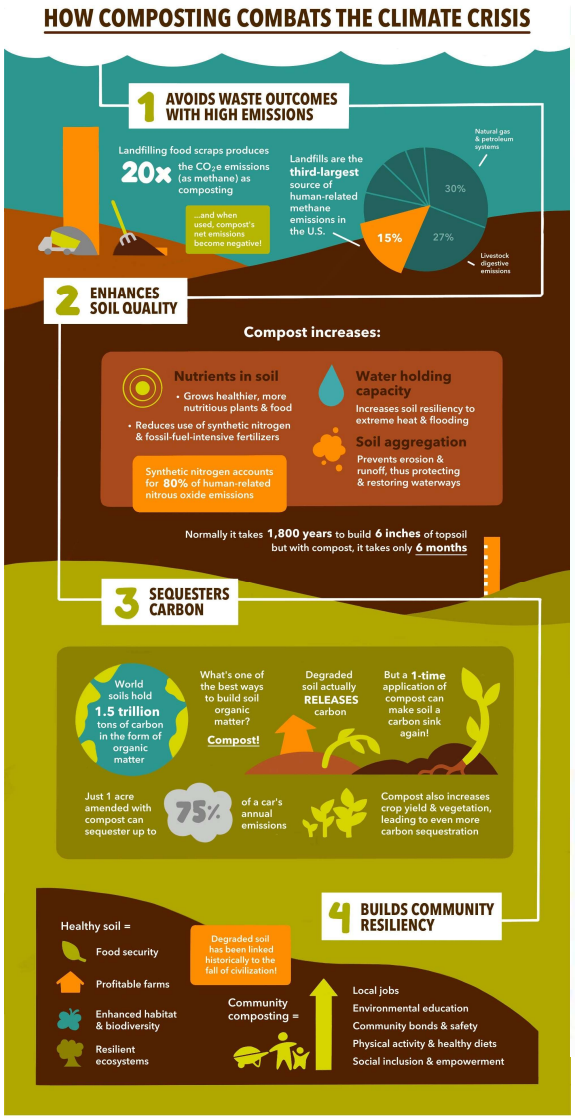
Sale!

Swing Lid Garbage Waste Dustbin 50 Ltr

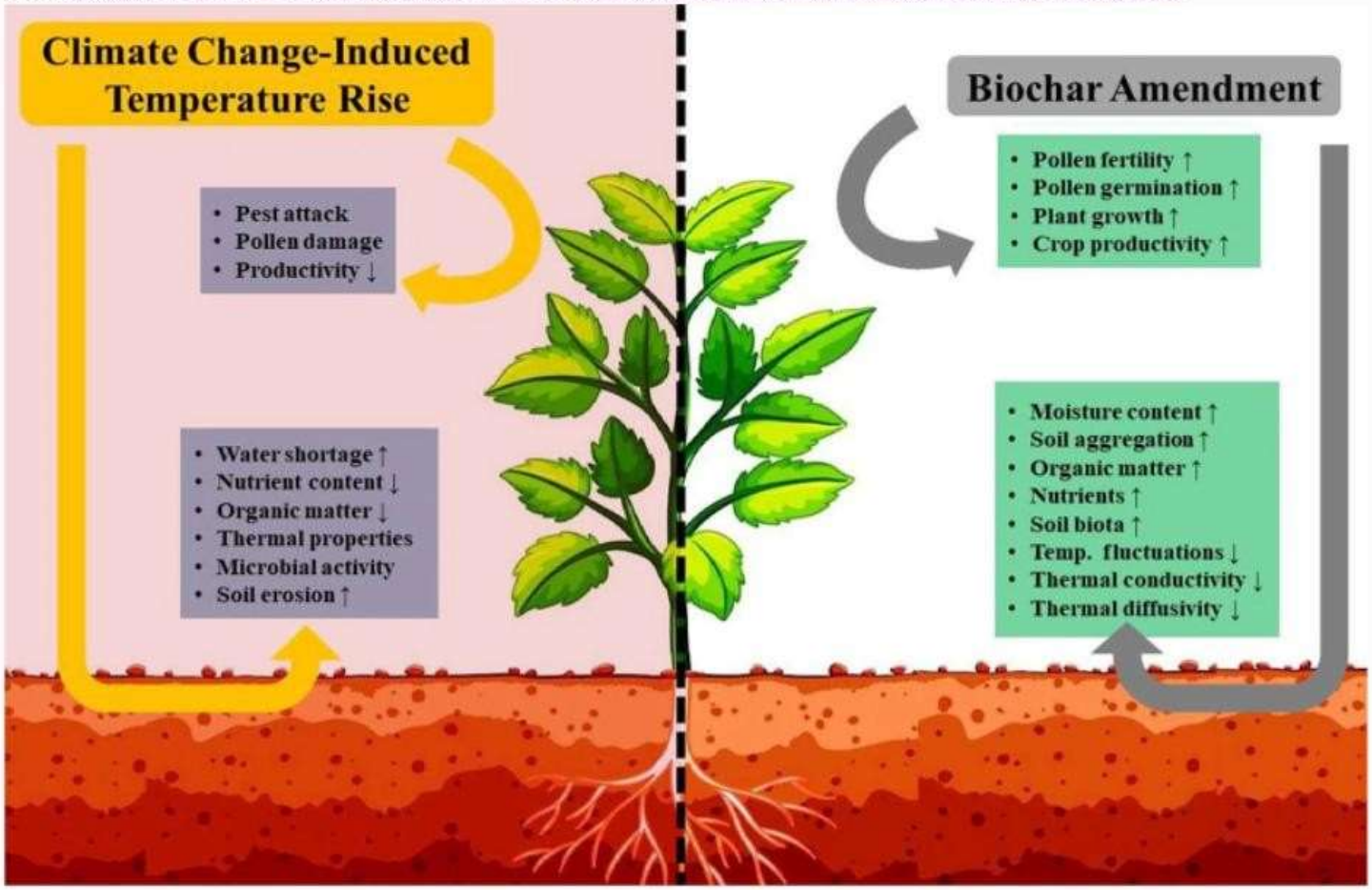
Buy On Amazon

Bulk Enquiry

Sudalai.S, CPCEE,PU



From: A perspective on biochar for repairing damages in the soil–plant system caused by climate change-driven extreme weather events



Mitigation of adverse effects of high temperatures through biochar amendment

A perspective on biochar for repairing damages in the soil–plant system caused by climate change-driven extreme weather events
Abhishek Kumar, Tanushree Bhattacharya, Santanu Mukherjee & Binoy Sarkar
Biochar volume 4, Article number: 22 (2022) Cite this article,776

Sudalai.S, CPCEE,PU

Thank you

Sudalai.S, CPCEE,PU

sudalaijothi@gmail.com