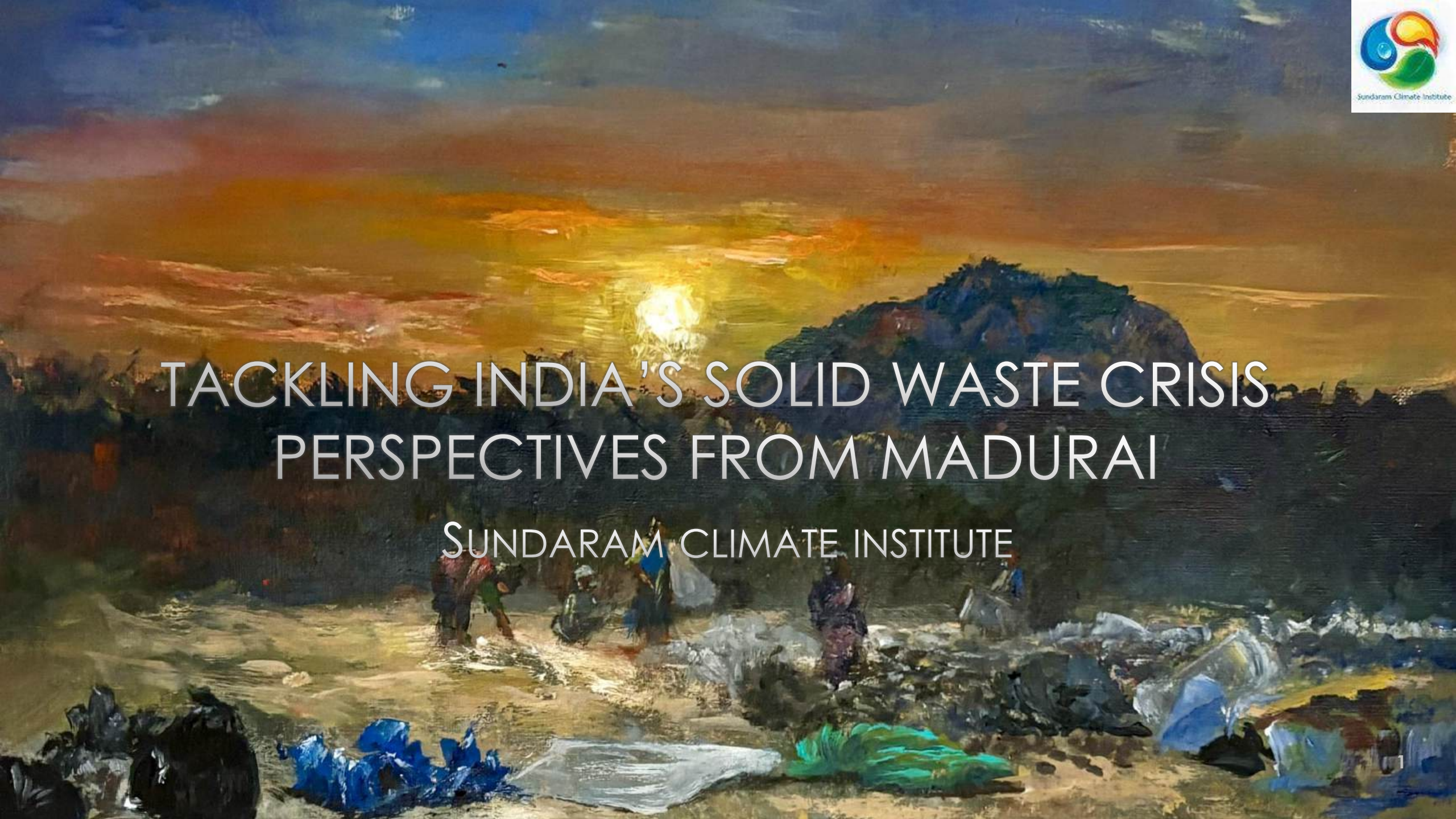


TACKLING INDIA'S SOLID WASTE CRISIS PERSPECTIVES FROM MADURAI

SUNDARAM CLIMATE INSTITUTE

ACRONYMS

- CH4: Methane
- CO2: Carbon di oxide
- GHG: Greenhouse gas(es)
- HDPE: High Density Polypropylene
- IPCC: Intergovernmental Panel on Climate Change
- LDPE: Low Density polypropylene
- Mlp: Multilayered plastic
- MSW : Municipal solid waste
- N2O: Nitrous oxide
- PCB: Polychlorinated Biphenyl
- PET: Polyethylene Terephthalate
- PVC: Polyvinyl Chloride
- RDF: Refuse-derived fuel
- SCI: Sundaram Climate Institute
- SUP: Single-use plastic

WHY READ THIS?

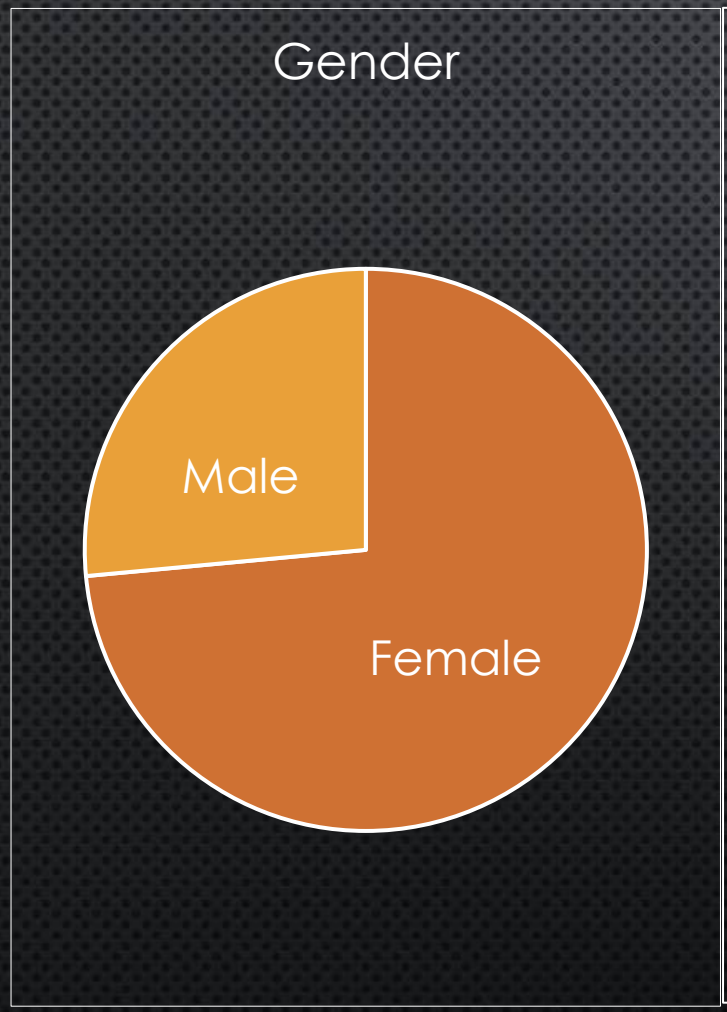
- DESPITE DECLARED INTENT, HIGH-LEVEL COMMUNICATION, AND INVESTMENT, PROGRESS ON TACKLING INDIA'S MUNICIPAL SOLID WASTE (OR MSW) PROBLEM HAS SEEN UNEVEN PROGRESS. SOME CITIES, LIKE INDORE, HAVE DRAMATICALLY CLEANED UP THEIR ACT, WHILE OTHERS HAVE LANGUISHED QUITE LITERALLY IN THE DUMPS.
- THIS IS A HUMAN PROBLEM, AND SO NEEDS A DEEP UNDERSTANDING OF URBAN RISKS CONFRONTING INDIAN CITIES BASED ON EXTENSIVE, GRANULAR, GROUND-LEVEL DATA TO DESIGN INTERVENTIONS TO ALLEVIATE THIS CRISIS.
- WHAT FOLLOWS IS A LAYING OUT OF INDIA'S SOLID WASTE CRISIS FROM THE PERSPECTIVE OF OVER 2000 CITIZENS OF ONE CITY SUPPLEMENTED WITH EXPERT PERSPECTIVES. THIS UNPACKS THE CRISIS IN RICH DETAIL THAT POINTS OUT WHAT IS BROKEN, WHERE WHEN AND WHY.
- WE CONCLUDE WITH AN OVERVIEW OF SOLUTIONS THAT HAVE BEEN PROVEN TO WORK AT SCALE, AND WHAT NEEDS TO HAPPEN TO TACKLE THE WASTE EMERGENCY.
- WE PLACE OUR RESEARCH IN A GLOBAL AND NATIONAL CONTEXT, TO SHOW WHICH CAN WORK WITHIN THE MANDATES OF POLITICAL FEASIBILITY AND FINANCIAL VIABILITY.
- FOR POLICY MAKERS, LEADERS AND EVERY CITIZEN OF INDIA, OUR HOPE IS THAT THIS REPORT HELPS YOU UNDERSTAND AND BUILD URBAN RESILIENCE IN YOUR NEIGHBOURHOOD.

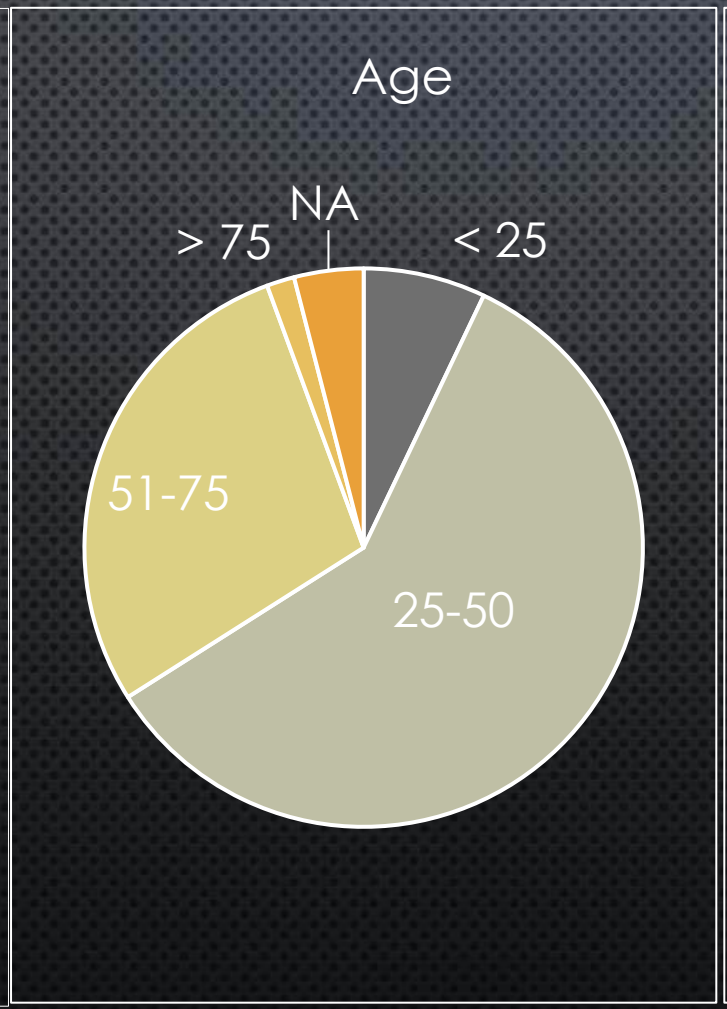
Sundaram Climate Institute

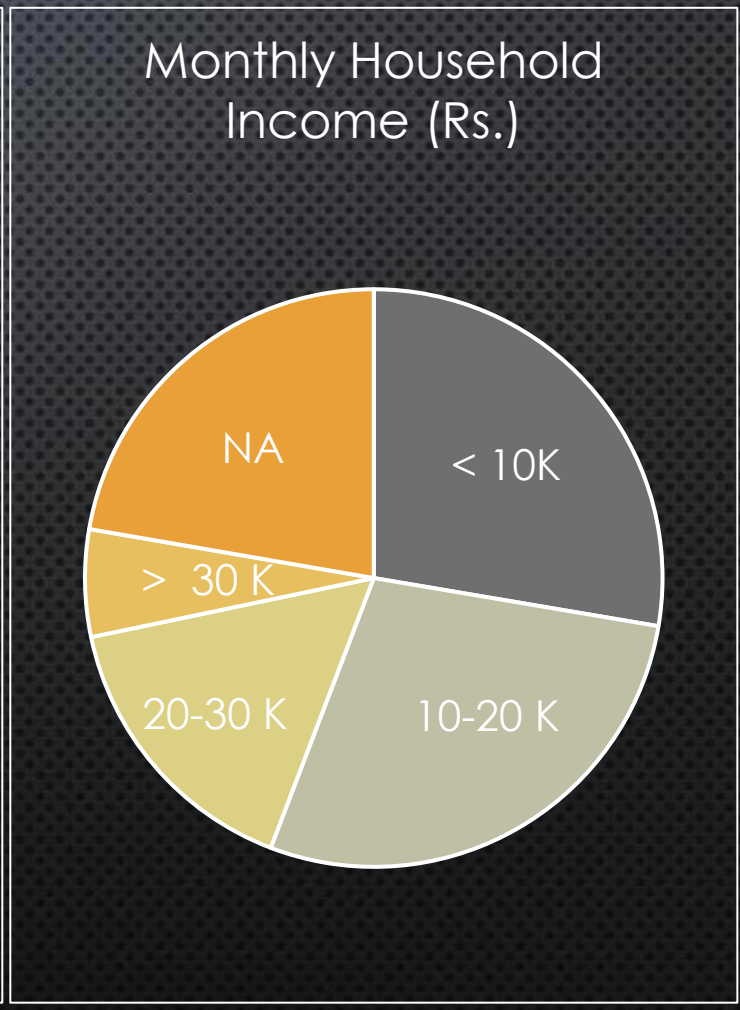
BACKGROUND

- This report is based on the SCI Madurai Waste & Water Study 2018-2023 studying the waste and water realities and perceptions of 2389 households over a 6-year period in Madurai.
- All change begins in the mind: as such, this report focuses on how people perceive waste – whether they even see solid waste as a problem, what they think of possible solutions and where they see themselves playing a role.
- The report was refined with inputs from a wide variety of experts from the solid waste ecosystem.
- Suggested Citation: 'Tackling India's Solid Waste crisis – perspectives from Madurai', Sundaram Climate Institute, 2024.

UNDERSTAND THEIR WASTE & WATER REALITIES. WE FOCUSSED ON ECONOMICALLY VULNERABLE SEGMENTS SINCE THEIR VOICES ARE OFTEN MUFFLED IN POLICY DISCUSSIONS.







Source: Sundaram Climate Institute Waste & Water Survey 2018-21 (n=2389); K='000; NA = Not aware/No response.

CONTENTS

EVERY YEAR, THE WORLD GENERATES BETWEEN 2.1 TO 2.3 BILLION TONNES OF SOLID WASTE, OR ABOUT 1.3 MILLION ELEPHANTS WORTH OF WASTE BEING GENERATED DAILY.

Source: United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource. Nairobi.

WASTE GENERATION INCREASES WITH WEALTH, POPULATION AND URBANIZATION. IF WE CONTINUE WITH 'BUSINESS AS USUAL', THE AMOUNT OF WASTE GENERATED WILL NEARLY DOUBLE BY 2050.

Source: United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource. Nairobi.

IN URBAN INDIA, WASTE GENERATION COULD DOUBLE IN FOURTEEN YEARS.

"PER CAPITA WASTE GENERATION IS INCREASING BY ABOUT 1.3% PER YEAR. WITH AN URBAN GROWTH RATE OF 3.0%–3.5% PER YEAR, THE ANNUAL INCREASE IN WASTE QUANTITIES MAY BE CONSIDERED AT 5% PER YEAR."

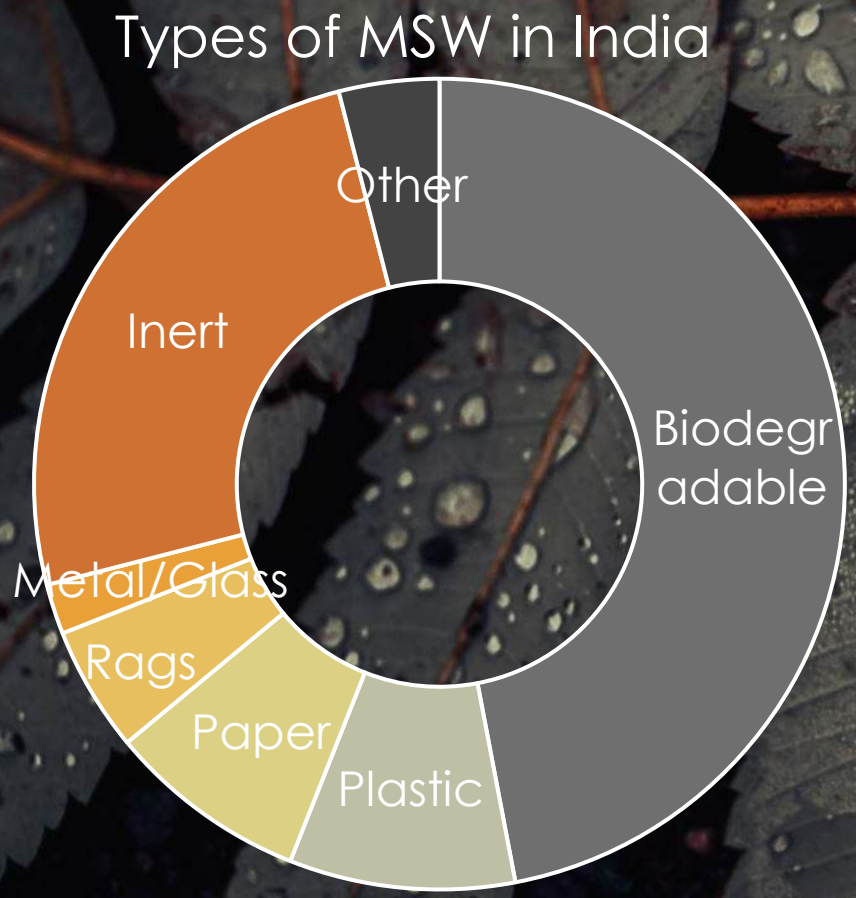
SWACHH BHARAT MISSION (2016)

Source: Swachh Bharat Mission, Ministry of Urban Development, Government of India (2016) Municipal Solid Waste Management Manual, Part II

BEFORE WE MOVE FORWARD, LET US DEFINE WHAT WE MEAN BY SOLID WASTE.

- Anything left over while making something or after doing something.
- Anything that went wrong.
- Anything that has been used already and cannot be used again for the same purpose.

THE KEY TO SOLVING THE WASTE CRISIS LIES IN SEGREGATING WASTE INTO DIFFERENT TYPES.

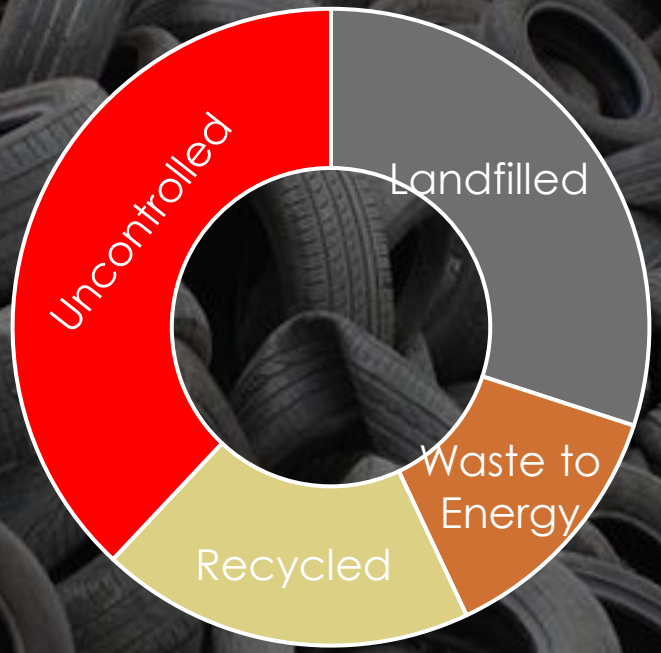


- **BIODEGRADABLE**: COMPOSTING, BIO METHANATION; ACTION BY BLACK SOLDIER FLY LARVAE ETC.
- **RECYCLABLE:** MANAGEMENT VARIES BY WASTE TYPE; INCLUDES PAPER, PLASTIC, GLASS, RAGS, METAL.
- **INERT:** SAND, DEMOLITION WASTE. SOME PART, WHEN APPROPRIATELY SEGREGATED, CAN BE MADE INTO CONCRETE.
- **HAZARDOUS:** CAREFUL HANDLING AND DISPOSAL, INCLUDING INCINERATION/ DISINFECTION.

Source: CPCB, 2006. Assessment of Status of Municipal Solid Waste Management in Metro Cities and State Capitals; Swachh Bharat Mission, Ministry of Urban Development, Government of India (2016) Municipal Solid Waste Management Manual, Part II. The composition study data is from 2004-2005. Given the development and urbanization of India, it is likely that the non-biodegradable fraction has increased since then.

GLOBALLY, LESS THAN 65% OF SOLID WASTE IS CONTROLLED, MEANING THAT IT IS COLLECTED AND THEN EITHER LANDFILLED RESPONSIBLY, CONVERTED INTO ENERGY OR RECYCLED.

Percentage of global solid waste that is



Source: United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource. Nairobi. To be truly categorized under controlled, landfills, waste to energy plants and recyclers have to have controls to ensure environments are protected. This is not always the case. As such, the fraction of uncontrolled waste is likely higher. As others have commented, what passes off as recycling in developed countries is often the export of waste to developing countries.

WHILE NEARLY ALL OF THE WASTE IN NORTH AMERICA AND WESTERN EUROPE IS CONTROLLED, A FAR SMALLER FRACTION IN DEVELOPING COUNTRIES IS CONTROLLED.

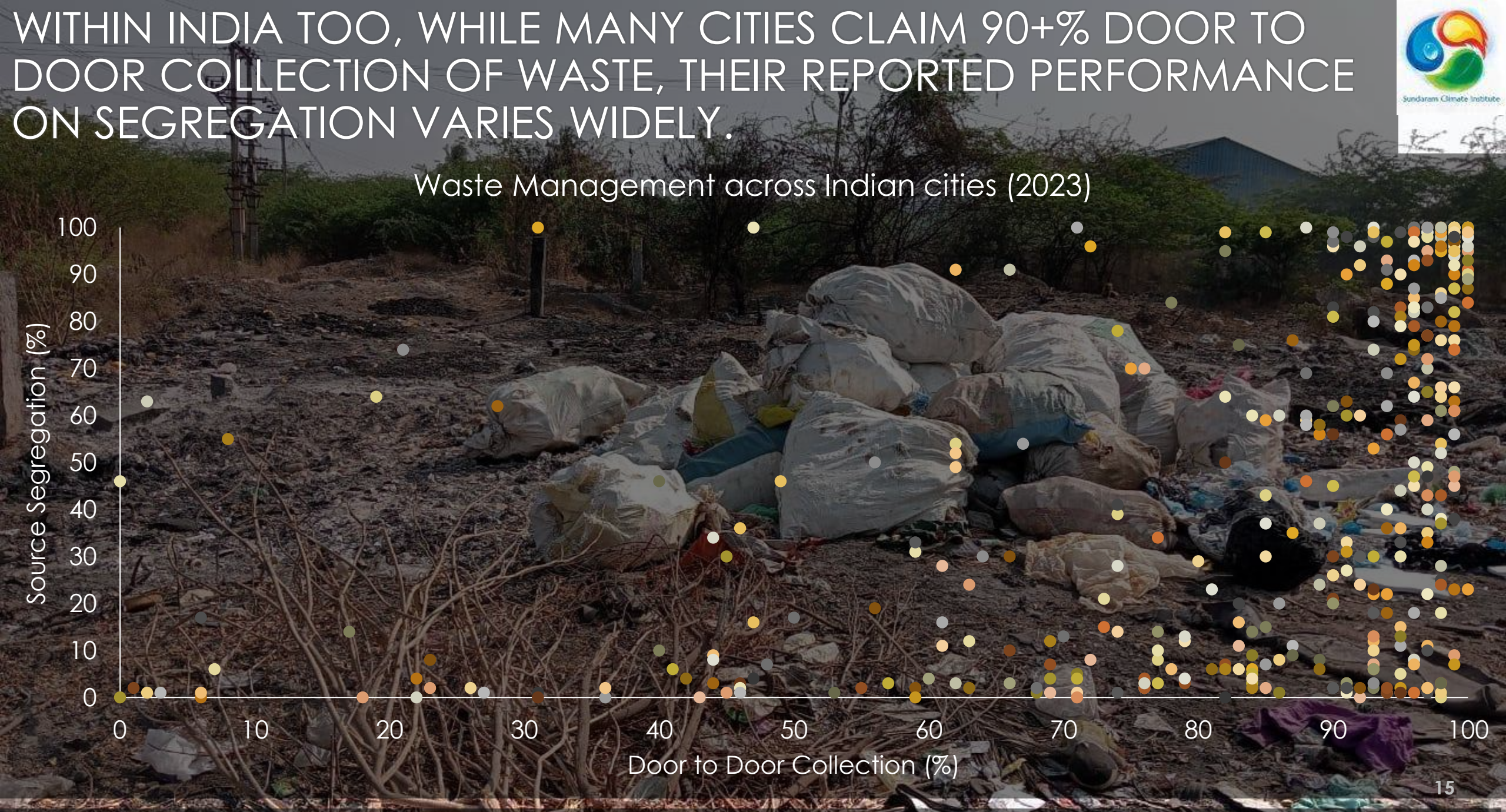
Source: United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource. Nairobi;

GLOBALLY, ONLY A FRACTION OF COLLECTED SOLID WASTE IS RECYCLED. SOME OF THE "RECYCLED" FRACTION OF DEVELOPED COUNTRY WASTE IS, IN REALITY, EXPORTED TO DEVELOPING COUNTRIES. THIS IS "EXPORTING" RATHER THAN SOLVING THE PROBLEM.

Half of the plastic collected for recycling in the EU is exported out of the EU.

Source: United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource. Nairobi; **CPCB (2021)**. However, as per the CPCB report, the recycling percentage in India could be far higher, at 23%. Some also pointed out that what passes off as recycling in developed countries is merely exporting the waste to developing countries. https://www.europarl.europa.eu/topics/en/article/20181212STO21610/plastic-waste-and-recycling-in-the-eu-facts-and-figures#:~:text=Half%20of%20the%20plastic%20collected,33%20million%20tonnes%20in%202021.

WITHIN INDIA TOO, WHILE MANY CITIES CLAIM 90+% DOOR TO DOOR COLLECTION OF WASTE, THEIR REPORTED PERFORMANCE ON SEGREGATION VARIES WIDELY.



Source: Swachh Survekshan Rankings (2023). As many pointed out, the source segregation data may be optimistic in some cases.

HANDLING WASTE IS NOT CHEAP: IT COST THE WORLD $252 BILLION IN 2020 TO MANAGE SOLID WASTE.

Source: United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource. Nairobi.

BUT MISMANAGED WASTE EXTRACTS A HIGHER AND DEADLIER PRICE.

MISMANAGED WASTE CAUSES A WIDE RANGE OF PROBLEMS

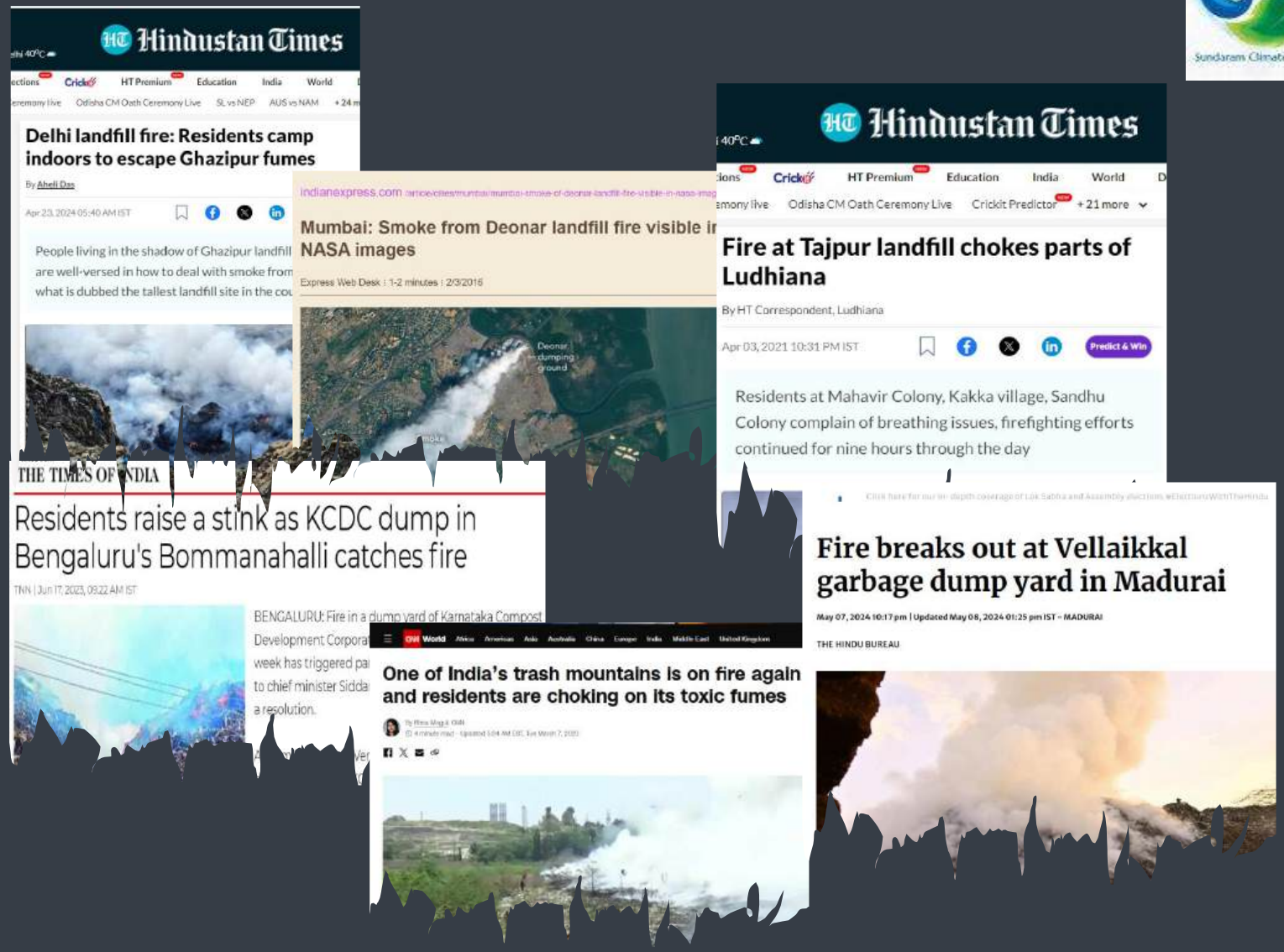
- Air pollution
- Production of Forever chemicals
- Global warming
- Lower urban climate resilience, including flooding
- Impact on marine health
- Stray animal population
- Mosquito-borne infection
- landfills

POORLY MANAGED WASTE IS A MAJOR DRIVER OF AIR POLLUTION.

- POORLY MANAGED MUNICIPAL SOLID WASTE CONTRIBUTES TO AIR POLLUTION IN TWO WAYS:
  - LANDFILLS BURSTING INTO FLAME.
  - POLLUTION FROM OPEN BURNING.
- THIS IMPACT WILL LIKELY RISE AS THE SHARE OF UNCONTROLLED WASTE DISPOSAL (DUMPING & OPEN BURNING) RISES.
- GLOBALLY 8.3 MILLION DIE PREMATURELY BECAUSE OF LONG TERM EXPOSURE TO PARTICULATE MATTER POLLUTION AND OZONE IN 2019. IN INDIA 2.18 MILLION DIE PREMATURELY BECAUSE OF THIS.
- BURNING WASTE IS A MAJOR SOURCE OF PARTICULATE MATTER POLLUTION (CONTRIBUTING BETWEEN A THIRD TO A FIFTH OF TOTAL ANTHROPOGENIC PM POLLUTION).
- IN ADDITION, OPEN BURNING PRODUCES METHANE (CH4), CARBON DIOXIDE (CO2), NITROUS OXIDE (N2O), VARIOUS ALDEHYDES, HCL, MERCURY, DIOXIN, FURANS, ETC.
- BURNING CONTINUES DESPITE EXPLICIT REGULATION AGAINST IT BECAUSE MOST SEE IT AS QUICK, CHEAP AND EFFECTIVE.

Source:Lelieveld, J., Haines, A., Burnett, R., Tonne, C., Klingmüller, K., Münzel, T., & Pozzer, A. (2023). Air pollution deaths attributable to fossil fuels: observational and modelling study. *bmj*, *383*.; Wiedinmyer, C., Yokelson, R. J., & Gullett, B. K. (2014). Global emissions of trace gases, particulate matter, and hazardous air pollutants from open burning of domestic waste. *Environmental science & technology*, *48*(16), 9523-9530.

AS THE CLIMATE HEATS UP, ACROSS INDIA, INCREASINGLY, LANDFILLS ARE BREAKING OUT INTO FLAMES…



SADLY, BURNING WASTE RELEASES FOREVER CHEMICALS INTO THE ENVIRONMENT.

FOREVER CHEMICALS

- BURNING PLASTIC WASTE GENERATES DIOXINS, FURANS, PCBS.
- BECAUSE THESE CAN LAST FOR DECADES IN THE ENVIRONMENT, THEY HAVE BEEN CLASSIFIED BY THE STOCKHOLM CONVENTION AS PERSISTENT ORGANIC POLLUTANTS (POPS) WHOSE UNINTENDED PRODUCTION MUST BE MINIMIZED.
  - INDIA IS A SIGNATORY.
- THESE FOREVER CHEMICALS BIOACCUMULATE IN FAT.
- THESE CHEMICALS HAVE BEEN ASSOCIATED WITH A HIGHER RISK OF A RANGE OF DISEASES, INCLUDING CANCER, BIRTH DEFECTS, HEART DISEASE, RESPIRATORY ISSUES, NEUROLOGICAL DISORDERS.

Sundaram Climate Institute

Source: Multiple sources as cited in Pathak, G., Nichter, M., Hardon, A., Moyer, E., Latkar, A., Simbaya, J., Pakasi, D., Taqueban, E. and Love, J., 2023. Plastic pollution and the open burning of plastic wastes. Global Environmental Change, 80, p.102648.

SOLID WASTE IS A MAJOR CONTRIBUTOR TO GLOBAL WARMING

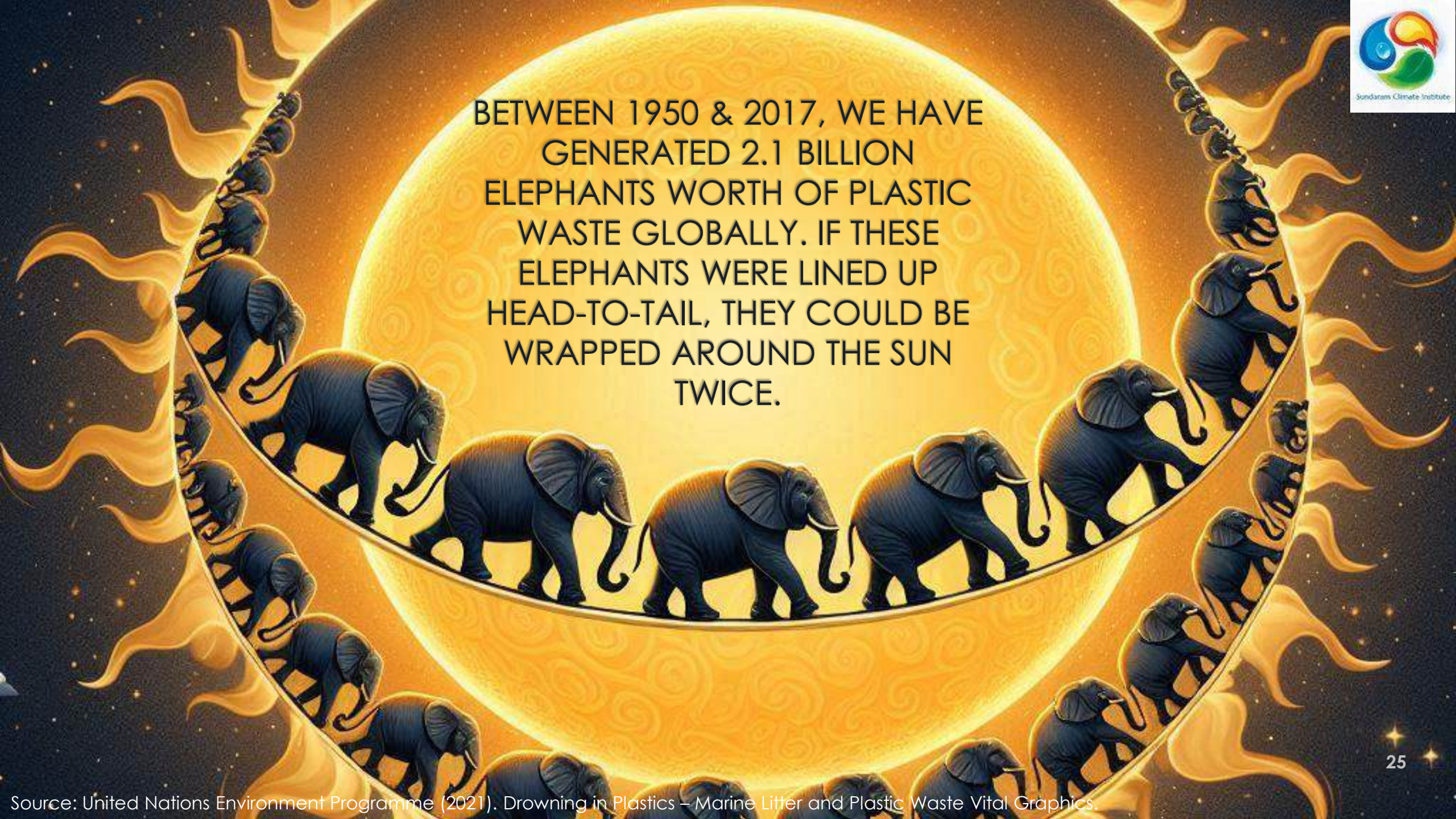
- PER THE IPCC, THE WASTE SECTOR CONTRIBUTED 2-3% OF ANNUAL GLOBAL GHG EMISSIONS.
  - THIS DOES NOT INCLUDE EMISSIONS FROM OPEN BURNING. ESTIMATES OF CO2 EMISSIONS FROM OPEN BURNING EXCEED GHG EMISSIONS FROM LANDFILLS & INCINERATION.
- IN TRUTH, THE WARMING IMPACT OF SOLID WASTE MAYBE HIGHER (11% OF BENGALURU'S GHG EMISSIONS CAME FROM MUNICIPAL SOLID WASTE) AND WILL GROW AS INDIA BECOMES WEALTHIER AND MORE URBANIZED.
- UNMANAGED WASTE, ESPECIALLY, IS A POTENT SOURCE OF GLOBAL WARMING:
  - LANDFILLS EMIT PRIMARILY CH4 WITH A LITTLE N2O AND CO2, WHILE OPEN BURNING RELEASES CO2, CH4, N2O AND BLACK CARBON. IN CONTRAST, COMPOSTING RELEASES SOME CO2 AND LITTLE CH4 (WHILE REDUCING FERTILIZER USE).WASTE-TO-ENERGY RELEASES PRIMARILY CO2 AND CO, WHILE OFFSETTING ENERGY USE BY BURNING FOSSIL FUELS.
- SOME SAY THAT BETTER WASTE AND RESOURCE MANAGEMENT CAN REDUCE 15-25% OF GLOBAL GREENHOUSE GAS EMISSIONS. WHILE THAT DOES SEEM A BIT OF A STRETCH, BETTER WASTE MANAGEMENT IS AN UNDEREXPLOITED WAY FOR DEVELOPING COUNTRIES TO MEET BOTH MITIGATION AND ADAPTATION GOALS.

Source: United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource. Nairobi ; Wiedinmyer, C., Yokelson, R. J., & Gullett, B. K. (2014). Global emissions of trace gases, particulate matter, and hazardous air pollutants from open burning of domestic waste. *Environmental science & technology*, *48*(16), 9523-9530. https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg3-chapter10-1.pdf; Multiple sources as cited in Pathak, G., Nichter, M., Hardon, A., Moyer, E., Latkar, A., Simbaya, J., Pakasi, D., Taqueban, E. and Love, J., 2023. Plastic pollution and the open burning of plastic wastes. Global Environmental Change, 80, p.102648. https://waste-management-world.com/recycling/the-significant-potential-of-better-waste-and-resource-management-for-climate-mitigation/; 'Towards a Net Zero and Climate Resilient Bengaluru – Summary of Bengaluru's Climate Action and Resilience Plan', 2023; IPCC: Intergovernmental Panel on Climate Change.

Source: SCI Analysis

MISMANAGED SOLID WASTE INCREASES CLIMATE VULNERABILITY

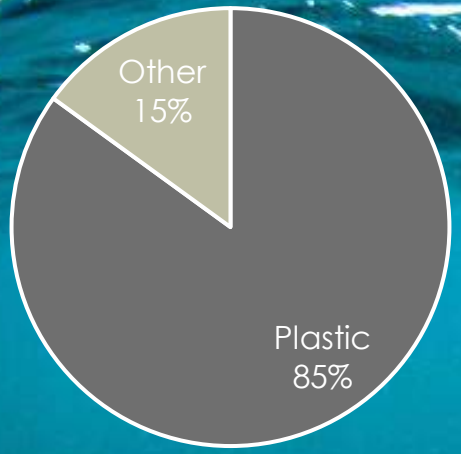
- Solid waste is often dumped into water bodies and in drains, which has several consequences:
- Clogged drains and water bodies:
  - This increases flooding risks because it reduces the amount of water a drain can carry away or a water body can hold.
  - Increases water shortages because when a clogged drain prevents water from reaching a downstream lake, the groundwater of that region falls.
- Water Pollution: Harmful substances in the waste can leach into the water in a drain or lake polluting that water and any groundwater that it, in turn, contaminates.



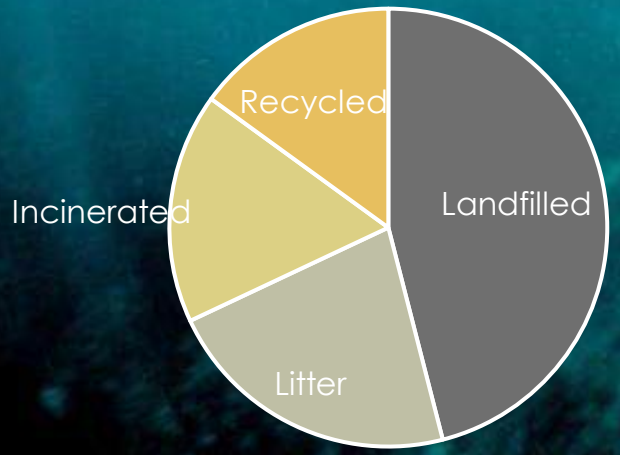
Source: United Nations Environment Programme (2021). Drowning in Plastics – Marine Litter and Plastic Waste Vital Graphics.

PLASTIC POLLUTION MAKES OUR OCEANS LESS HEALTHY.

% of marine litter



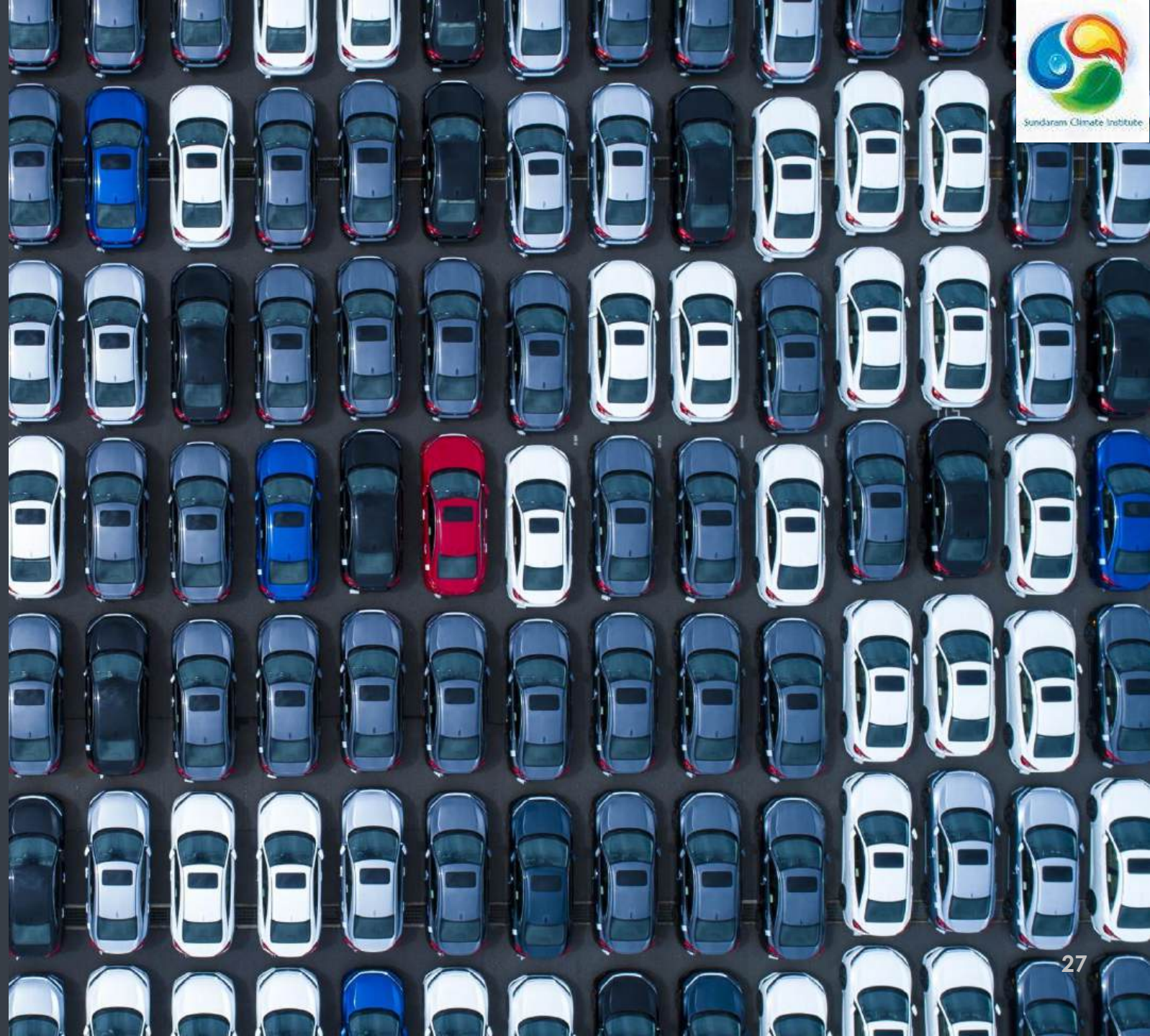
Fate of Plastic Waste



- Most plastic waste is landfilled, incinerated or becomes litter.
- Every day, 19-23 million tonnes of plastic enter the world's oceans, rivers, and lakes.
- Plastics make up 85 per cent of total marine waste.

Source: https://www.un.org/sustainabledevelopment/blog/2023/08/explainer-what-is-plastic-pollution/#:~:text=Plastics%20account%20for%2085%20per,in%20the%20next%20twenty%20years.

INDIA GENERATES ABOUT 20,000 SMALL CARS WORTH OF PLASTIC WASTE EVERY DAY.



Source: Dhodapkar, R., Bhattacharjya, S., Niazi, Z., Porter, N.B., Retamal, M., Sahajwalla, V. and Schandl, H., 2023. National Circular Economy Roadmap for Reducing Plastic Waste in India.

OF WHICH, ONLY ABOUT 8% IS RECYCLED.

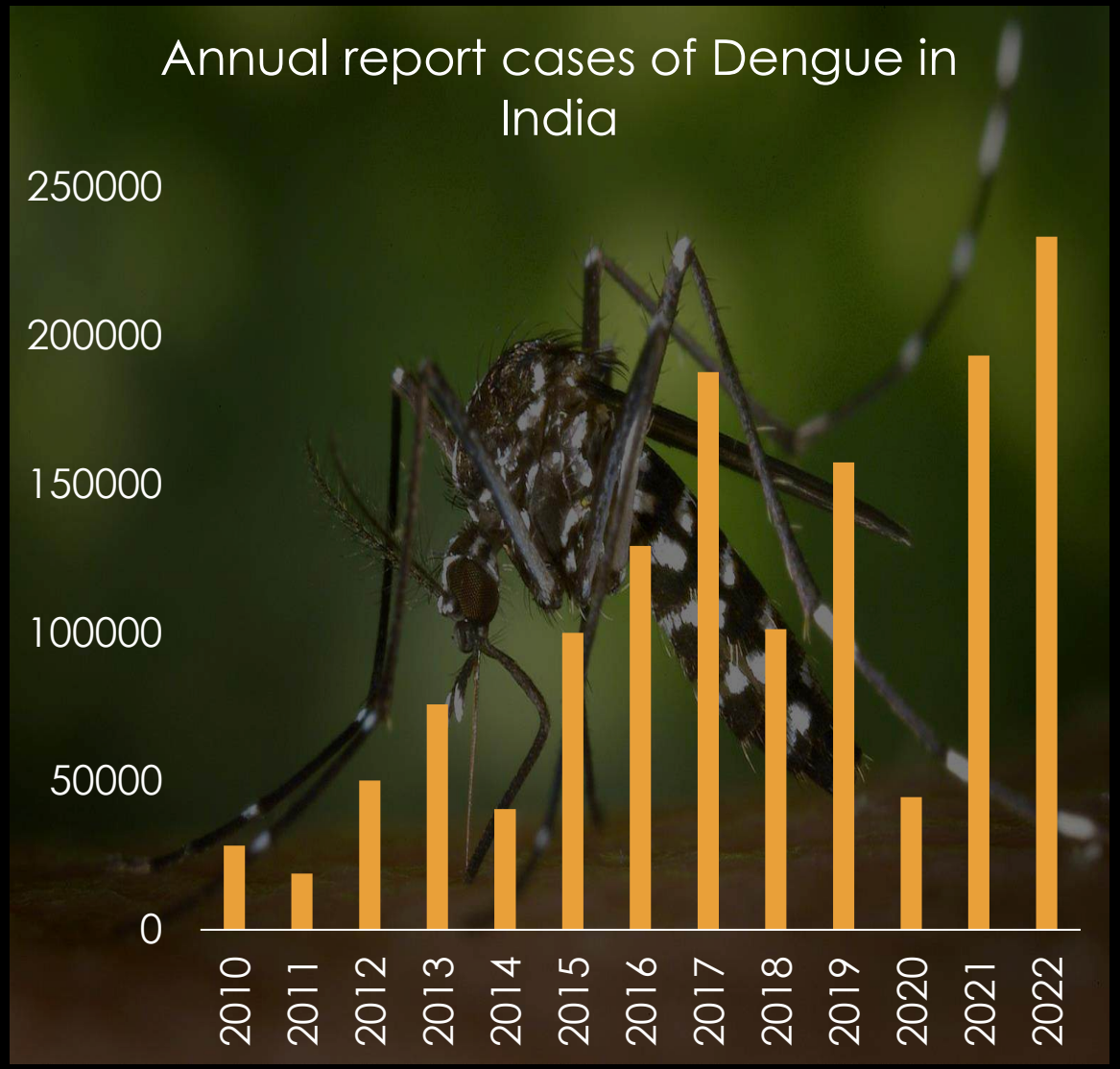
- Waste Categories like PET bottles with ready destinations fetch higher prices and so have recycling rates close to 100%. Some of the recycling can release microplastics into the environment, however.
- MLP (multi-layered plastic), LDPE (low density polyurethane) and some forms of single use plastic see very few alternate uses, and therefore are largely uncontrolled (burned or dumped).

Source: Dhodapkar, R., Bhattacharjya, S., Niazi, Z., Porter, N.B., Retamal, M., Sahajwalla, V. and Schandl, H., 2023. National Circular Economy Roadmap for Reducing Plastic Waste in India.

UNMANAGED WASTE SUPPORTS HIGHER STRAY DOG POPULATIONS THAN OTHERWISE MIGHT HAVE BEEN.

- There are an estimated 52 million stray dogs in India. In some cases, they form packs and can become violent . There were 2.75 million dog bites in 2023 alone.
- India is a rabies hotspot. According to the World Health Organization, the country accounts for 36% of the 59,000 dog-mediated rabies cases reported annually (*). Within India, Kerala is a Rabies hotspot, where one study found 56% of samples taken from stray dogs tested positive for the virus. Rabies has no cure, but can be prevented by vaccination.
- While weak implementation of regulation, lack of sterilization/vaccination of stray dogs contribute to the problem, without this much food waste, stray dog populations may not have swelled to the extent they have.
- Stray dogs also exacerbate the litter problem by rummaging in the common dustbins for food.

Source: Goel, K., Sen, A., Satapathy, P., Kumar, P., Aggarwal, A.K., Sah, R. and Padhi, B.K., 2023. Emergence of rabies among vaccinated humans in India: a public health concern. *The Lancet Regional Health-Southeast Asia*, 9.; https://stateofpethomelessness.com/latest-report/?Country=India; SCI Analysis & conversation with experts. * The National RabiesControl Programme reported a far smaller figure of 6644 cases between 2012 & 2022. . https://indianexpress.com/article/india/record-dog-bites-caused-by-stray-pet-dogs-separately-govt-to-states-9218431



UNMANAGED SOLID WASTE ALSO ENABLE MOSQUITO-BORNE DISEASE EPIDEMICS.

- DENGUE INCIDENCE HAS RISEN EIGHT-FOLD IN 2022 VS. 2010.
- DENGUE IS A DREADFUL DISEASE – PAINFUL AND CAN HAVE COMPLICATIONS IF NOT PROPERLY TREATED. THERE IS NO CURE, AND AVAILABLE VACCINES ARE PROBLEMATIC, PREVENTING THEIR WIDESPREAD ADOPTION.
- STUDIES HAVE SHOWN THAT AEDES AEGYPTI TYPICALLY TRAVEL SHORT DISTANCES (<100 M).
- MULTIPLE STUDIES HAVE SHOWN POORLY MANAGED WASTE PROVIDES CONTAINERS THAT ACT AS MOSQUITOES BREEDING SITES TO HELP SPREAD THE DISEASE.

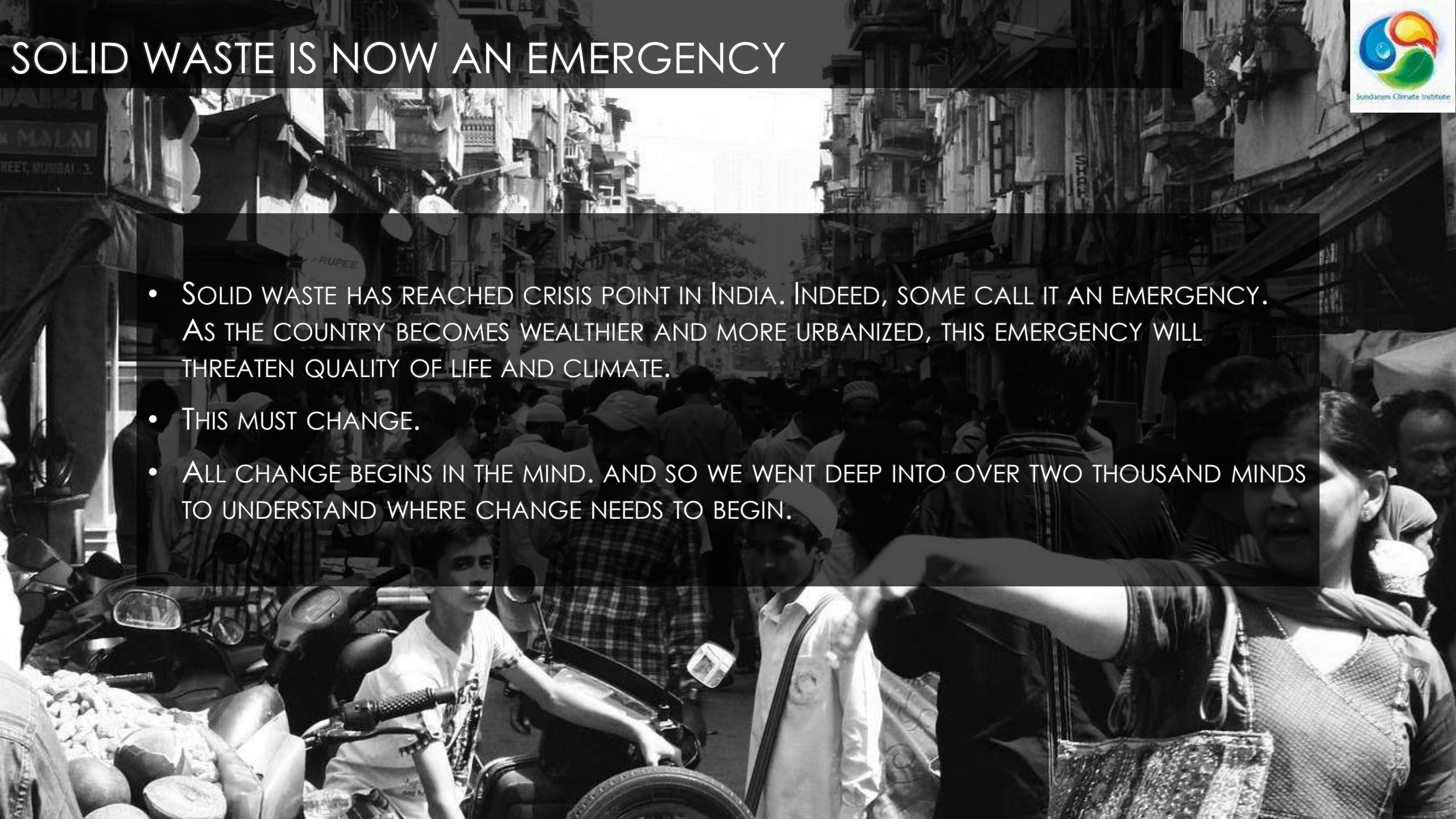
Source: National Vector Borne Disease Control Programme; Seidahmed OME, Lu D, Chong CS, Ng LC, Eltahir EAB. Patterns of Urban Housing Shape Dengue Distribution in Singapore at Neighborhood and Country Scales. Geohealth. 2018 Jan 26;2(1):54-67. doi: 10.1002/2017GH000080. PMID: 32159000; PMCID: Banerjee, S., Aditya, G. and Saha, G.K., 2013. Household disposables as breeding habitats of dengue vectors: linking wastes and public health. Waste management, 33(1), pp.233-239. PMC7007139.

LANDFILLS ARE PROBLEMATIC, IN A VARIETY OF WAYS.

- In 2024, India had 2416 dumpsites holding about 224,200,000 tonnes of waste spread over 28,547 acres.
- Landfills are problematic – because of the rotting organic waste, they emit methane, a potent greenhouse gas. This also makes them burst into flame periodically – spewing a host of chemicals, including forever chemicals, into the air.
- When rain falls on a landfill, it slowly trickles through it, gathering the soluble toxins and carries them into the groundwater or nearby stream.
- Unsurprisingly, most people living next to landfills want them gone. But if we don't manage our waste, they will grow, and leading to more burning or dumping.

Source: https://sbmurban.org/swachh-bharat-mission-progess; Accessed 30/07/24; SCI Analysis

SOLID WASTE IS NOW AN EMERGENCY



- SOLID WASTE HAS REACHED CRISIS POINT IN INDIA. INDEED, SOME CALL IT AN EMERGENCY. AS THE COUNTRY BECOMES WEALTHIER AND MORE URBANIZED, THIS EMERGENCY WILL THREATEN QUALITY OF LIFE AND CLIMATE.
- THIS MUST CHANGE.
- ALL CHANGE BEGINS IN THE MIND. AND SO WE WENT DEEP INTO OVER TWO THOUSAND MINDS TO UNDERSTAND WHERE CHANGE NEEDS TO BEGIN.

CONTENTS

HOW DID WE TRY TO UNDERSTAND WASTE REALITIES?

- Sundaram Climate Institute designed and used a rigorous questionnaire to understand the waste and water realities of 2389 households between 2018-2023.
- The study covered 62 wards (41 "interior" wards and 21 "peripheral" wards) of Madurai's 100 wards.
- In each ward, we surveyed at least 30 households to ensure representativeness. Clustering households also helped understand if a given response was an outlier and why. Our survey focused on the typically understudied – the average annual income of our study group was Rs. 98,162, substantially less than the average annual per capita income of Madurai (Rs. 127115 in 2018-19 extrapolated from 2011 Census income using the historical income growth rate). Our respondents covered a wide spectrum and included petty shop keepers, auto drivers, household helps, flower-vendors, pushcart vendors, teachers, office goers and business people.
- We spoke to every household at their doorstep. All interviews were conducted in person by trained Sundaram Climate Institute researchers.

WE TRIED TO ANSWER QUESTIONS ON BOTH LIVED EXPERIENCE, UNDERSTANDING AND PERCEPTION.

- We studied perceptions:
  - Does waste bother you?
  - What do you consider your role in managing waste?
  - What do you think of waste burning?
- knowledge
  - Do you know about segregation? If so, do you know why you need to segregate? Have you received any training on segregation?
- And lived experience:
  - Have you or anyone in your house experienced <condition related to mismanaged waste> in the recent past?
  - How do you dispose of waste?
  - How often does the corporation collect your waste?
  - Has the plastic ban affected you?
  - DO you pay for waste collection? If so, How much?

OUR QUESTIONS PROBED THREE AREAS:

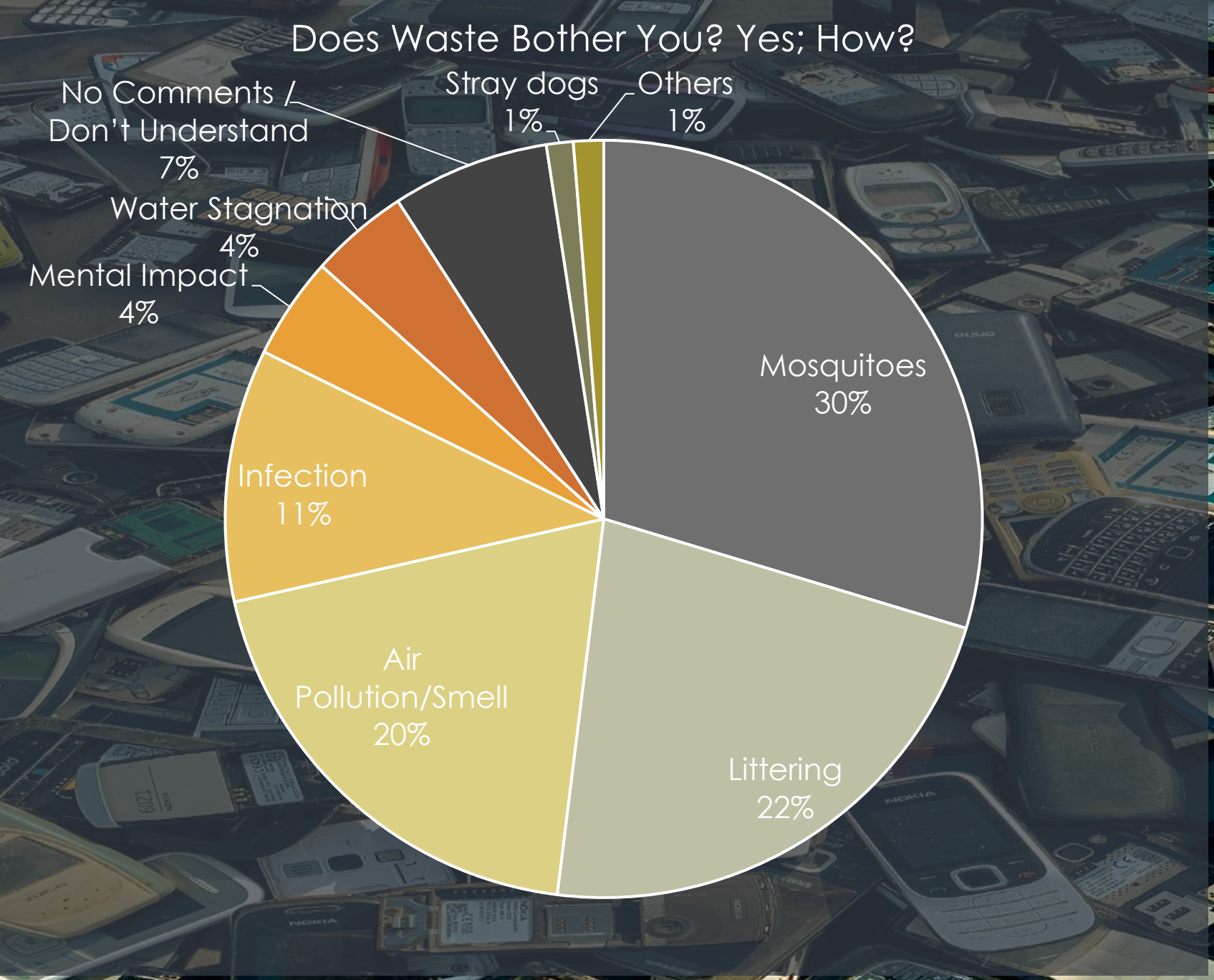
1. HOW WAS WASTE PERCEIVED? WAS IT SEEN AS A PROBLEM?
2. HOW WASTE WAS HANDLED?
3. HOW DID PEOPLE UNDERSTAND AND PERCEIVE POTENTIAL SOLUTIONS LIKE PLASTIC BANS, COMPOSTING, AND THEIR OWN ROLE IN MANAGING WASTE.

1. PERCEPTION OF WASTE

A THIRD OF THE RESPONDENTS FELT THAT SOLID WASTE DID NOT BOTHER THEM.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2186; Does not include responses where no response or an illegible answer was given.

DOES WASTE BOTHER YOU? HOW?



MOSQUITOES, LITTER AND AIR POLLUTION WERE THE PROBLEMS MOST COMMONLY ASSOCIATED WITH SOLID WASTE.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1399

DOES WASTE BOTHER YOU? HOW?

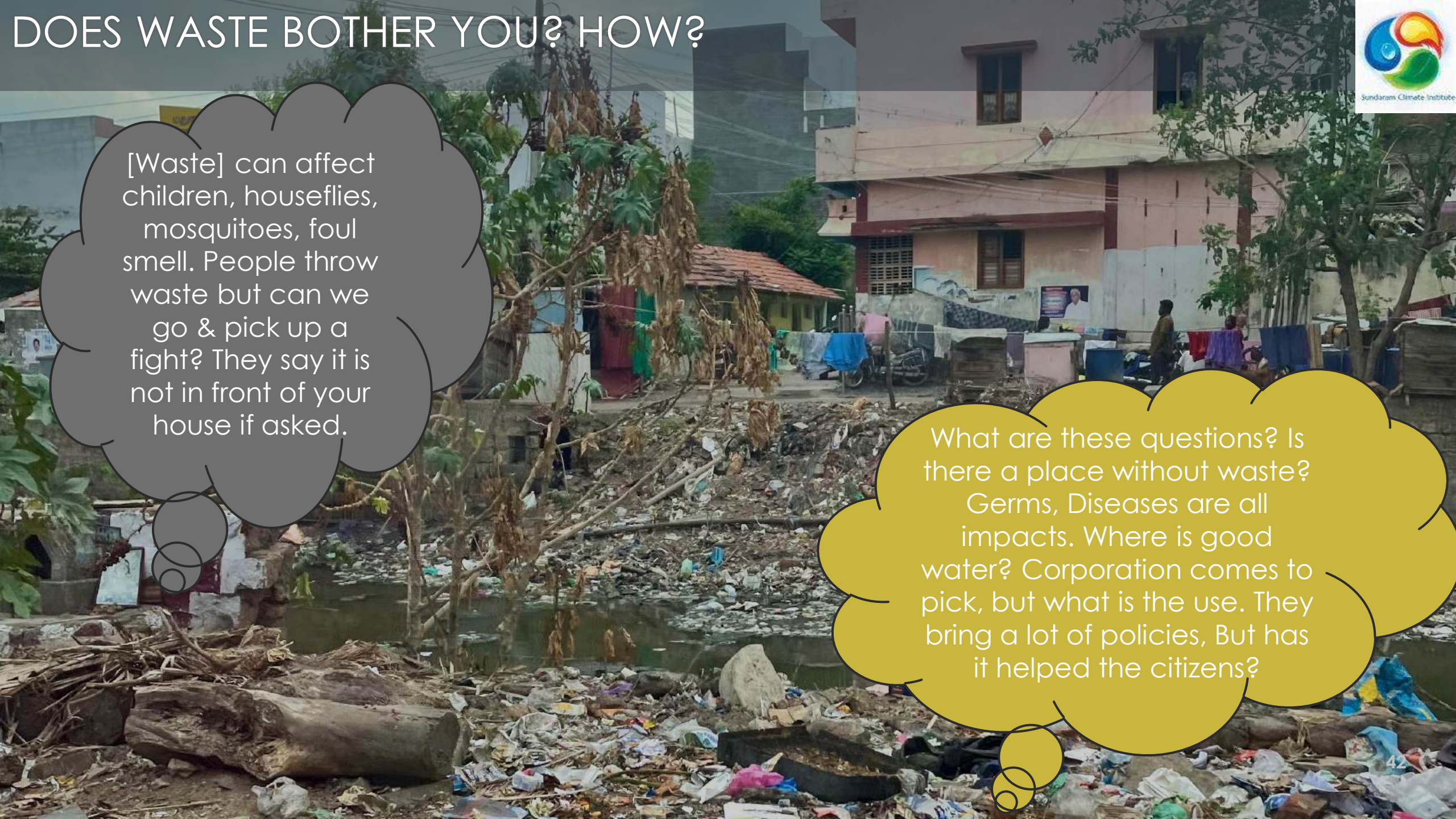
We had a "Odai" (Stream) in front of our street. Now, it has changed to open drainage that smells a lot ; lot of mosquito problems due to that.

Throwing wastes in water leads to insects, cockroaches, Mosquitoes & diseases. And kids always want to play in water.

You should have seen, the whole place is littered, the sewers are blocked. Mosquitoes, Smell, No one comes to clean, Please register this, let me know if I have to sign somewhere, make us heard.

Open drainage littering all of them throwing their waste into the drainage.

DOES WASTE BOTHER YOU? HOW?



DOES WASTE BOTHER YOU? HOW?


No sweeper come to collect the waste so we are all throwing it to empty land & after that we burn it.

DOES WASTE BOTHER YOU? HOW?

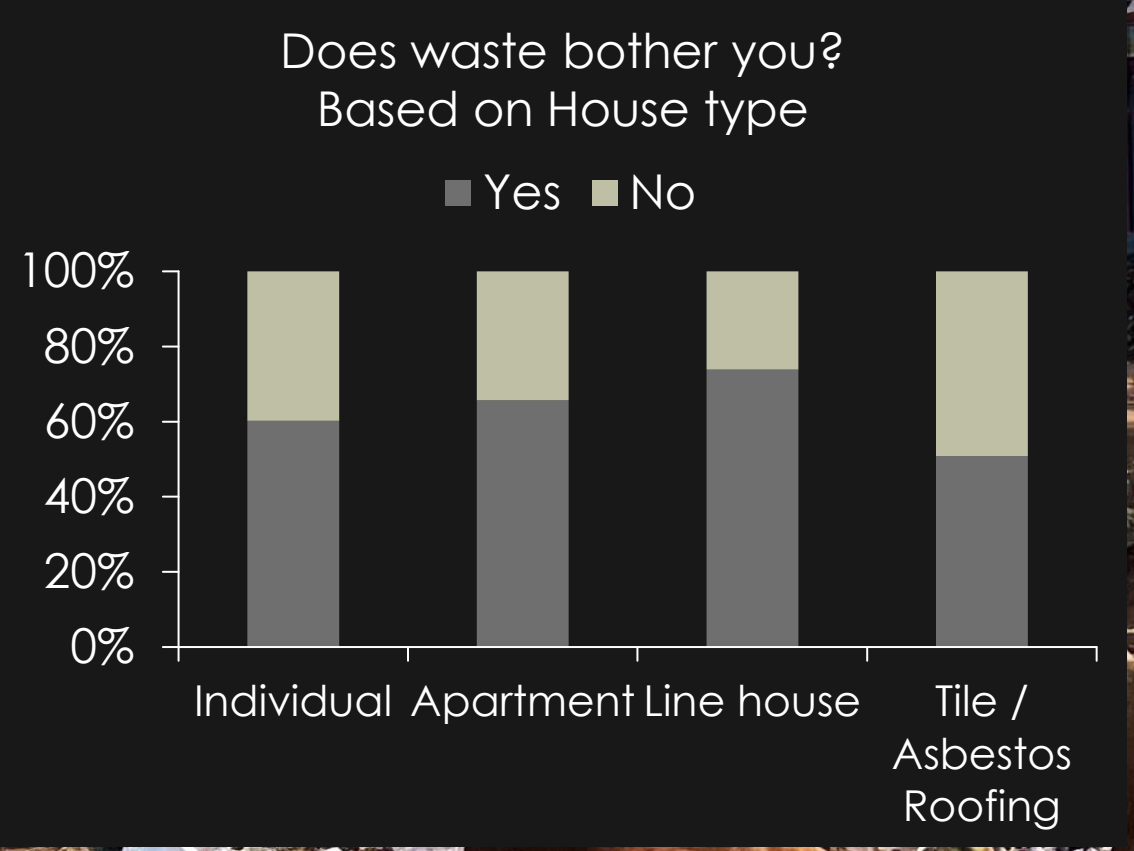
DOES WASTE BOTHER YOU? HOW?

DOES WASTE BOTHER YOU? HOW?

Bad appearance everyone sweeps the houses & throws the dirt In the street.

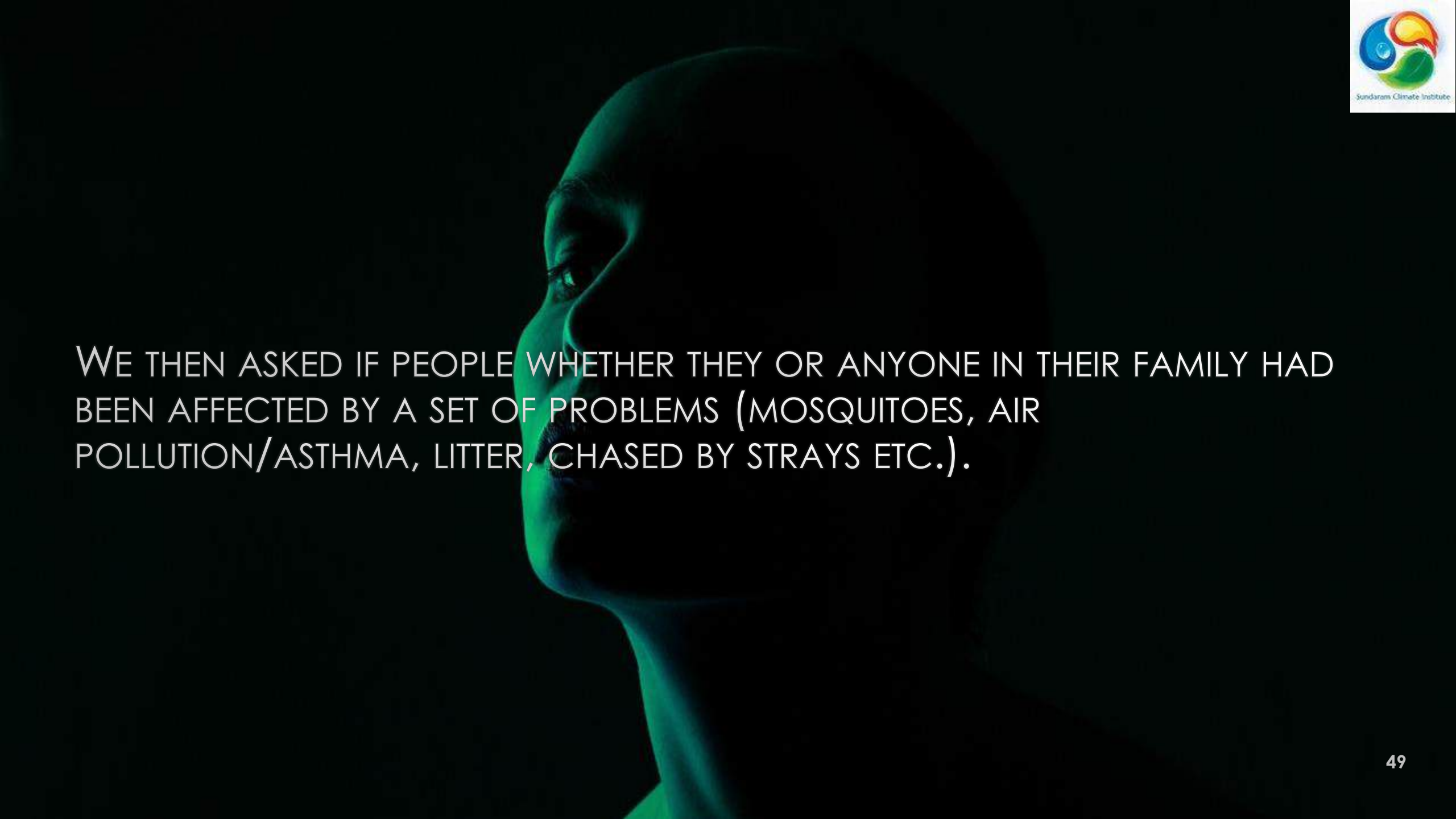
Common Dustbin overflowing.

We try segregating at times, but we are lazy to do always. If no one is there to tell me, I'd rather throw trash on road.



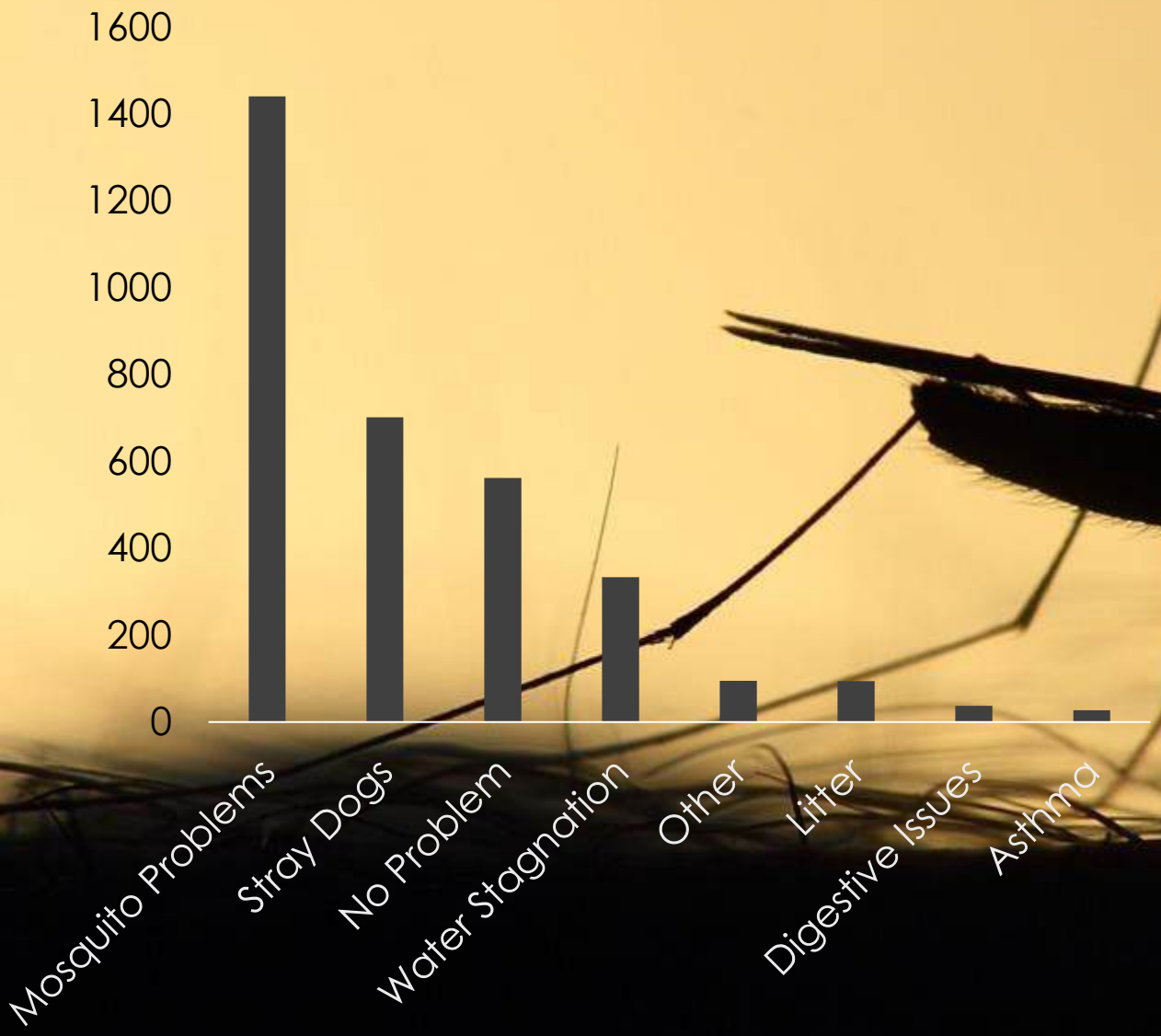
ALTHOUGH THE FRACTION OF RESPONDENTS WHO SAID THEY WERE NOT BOTHERED BY WASTE REMAINED LARGELY CONSISTENT ACROSS INCOME GROUPS, A LARGER FRACTION OF RESPONDENTS IN INFORMAL NEIGHBOURHOODS SAID THEY WERE NOT BOTHERED BY WASTE, SUGGESTING A FORM OF LEARNED HELPLESSNESS – A FEELING OF 'I CAN'T DO ANYTHING ABOUT IT, SO I MIGHT AS WELL ACCEPT IT'

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2186



We then asked if people whether they or anyone in their family had been affected by a set of problems (mosquitoes, air pollution/asthma, litter, chased by strays etc.).

Responses to the question. 'In recent times have you or anyone in your family been bothered by'

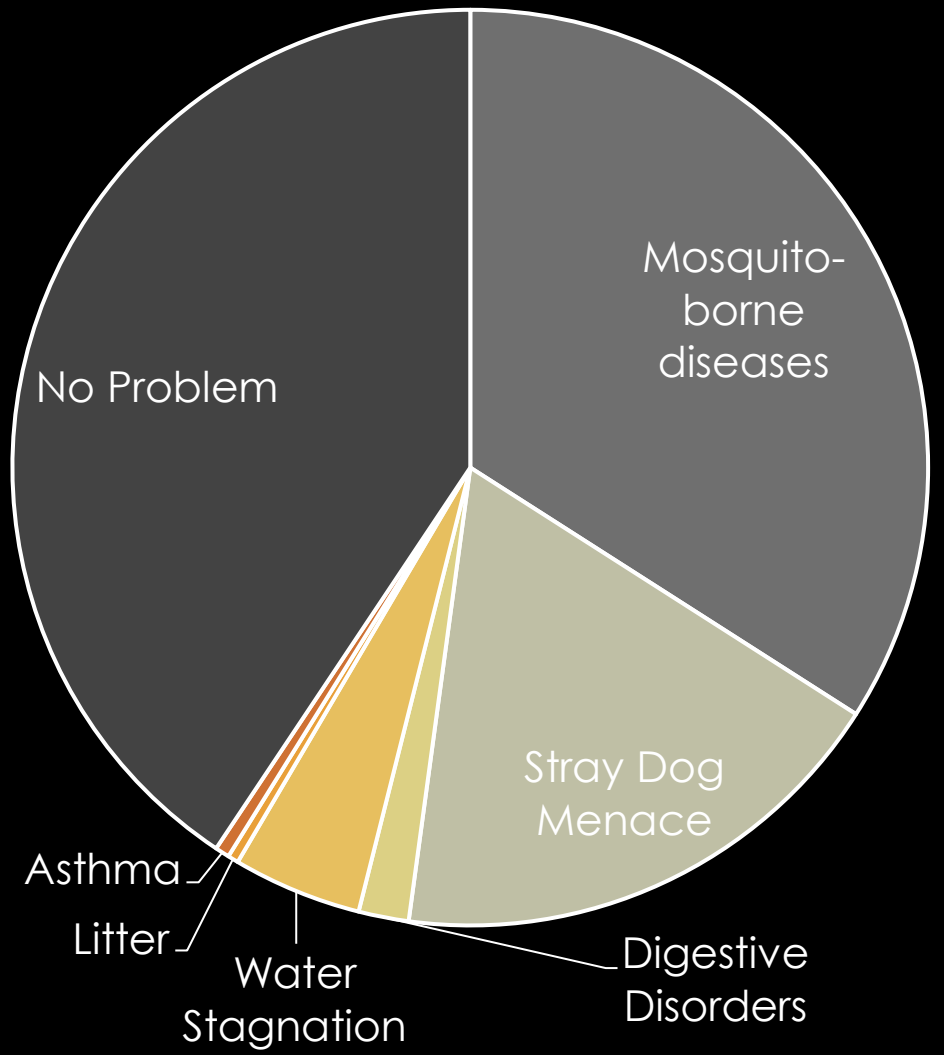


MORE RESPONDENTS SAID THEY HAD BEEN IMPACTED BY MOSQUITOES & STRAY DOGS.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389

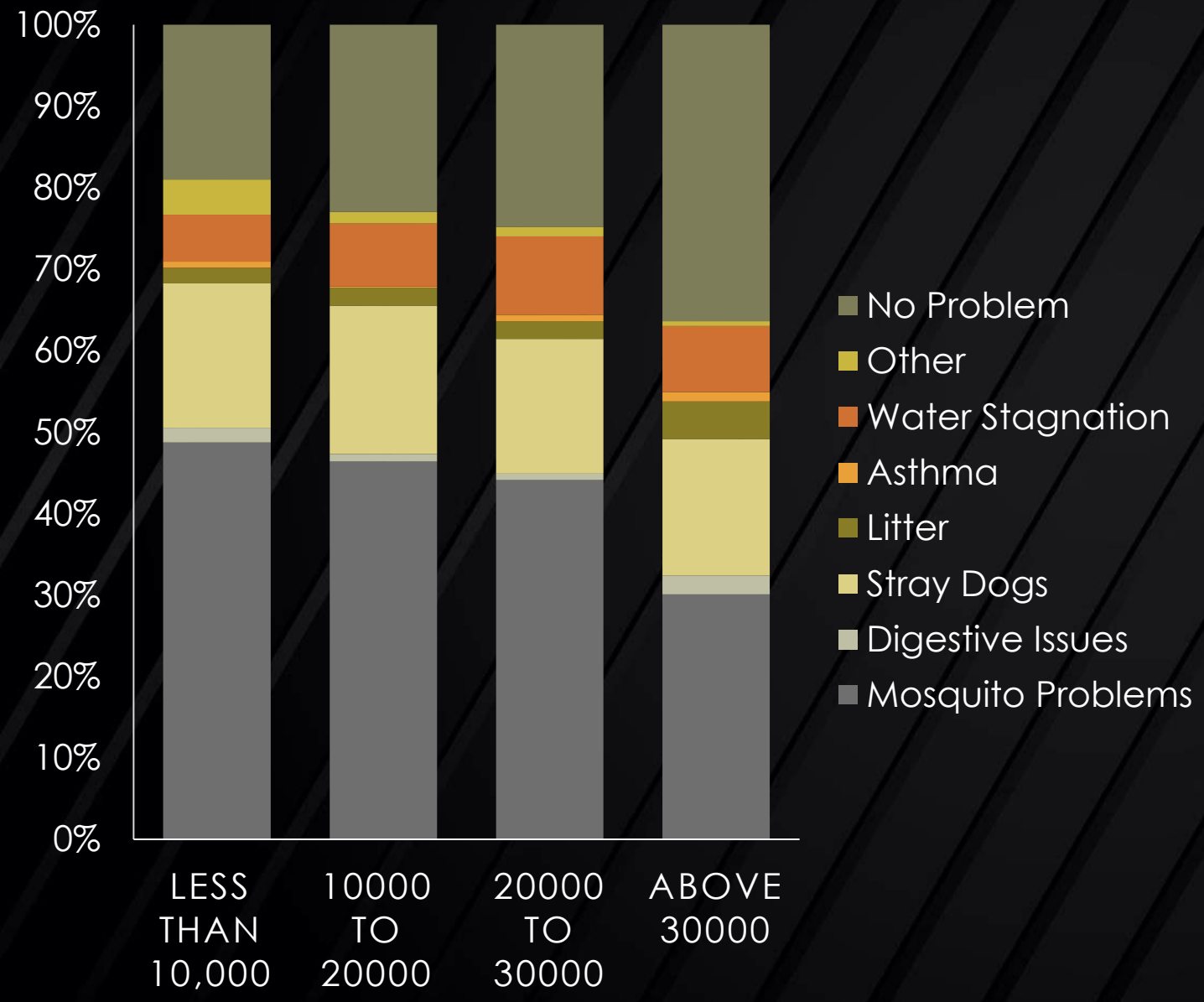
IMPORTANTLY, MORE THAN HALF OF THE PEOPLE WHO HAD REPLIED THAT WASTE DID NOT BOTHER THEM TO OUR FIRST QUESTION, SUFFERED FROM PROBLEMS THAT STEM FROM POORLY MANAGED WASTE.

Does waste bother you? "No" + answered "Yes" to Have you or anyone in your family in the last 6 months been bothered by:



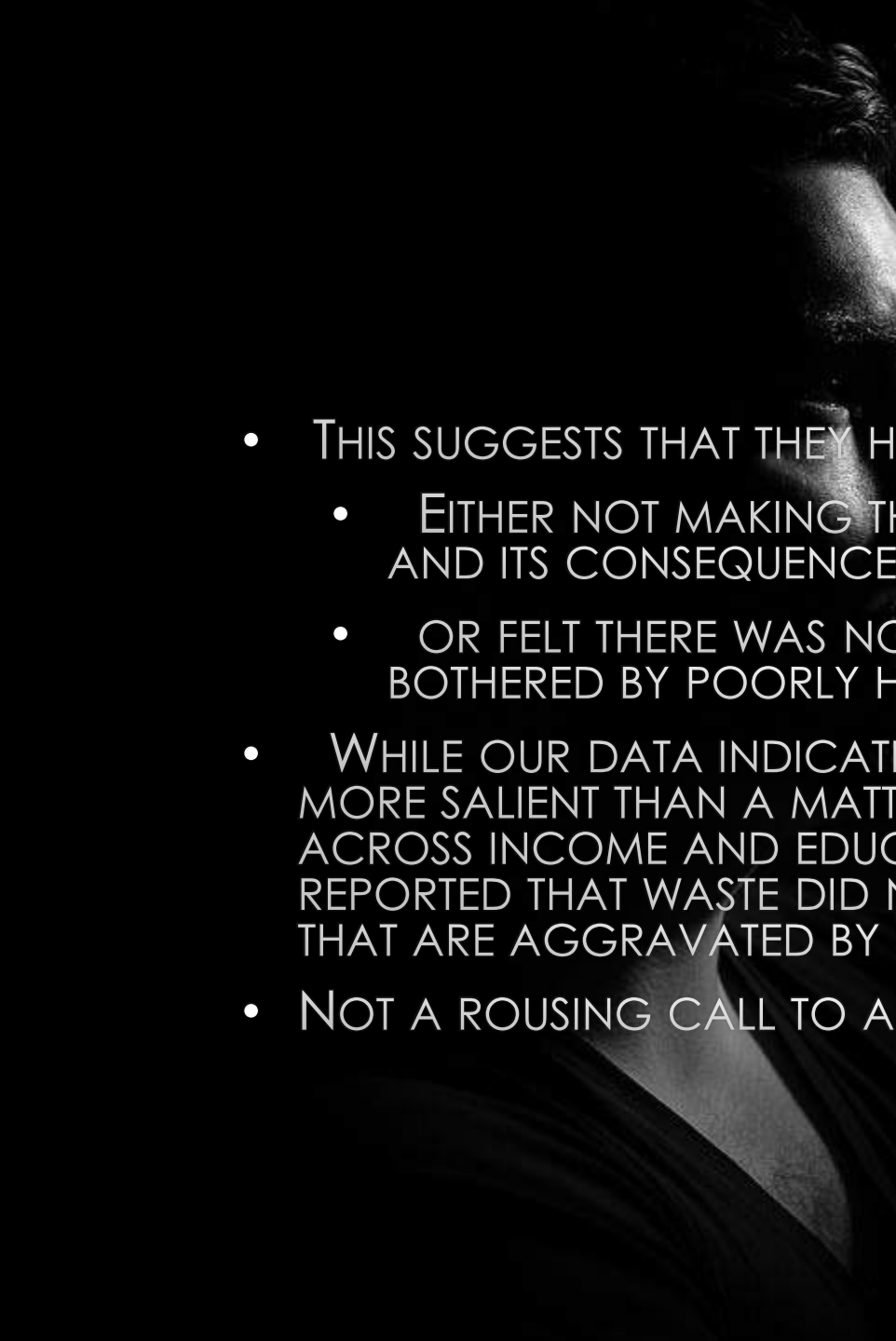
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 787

IN RECENT TIMES, HAS ANYONE IN YOUR FAMILY BEEN AFFECTED BY...



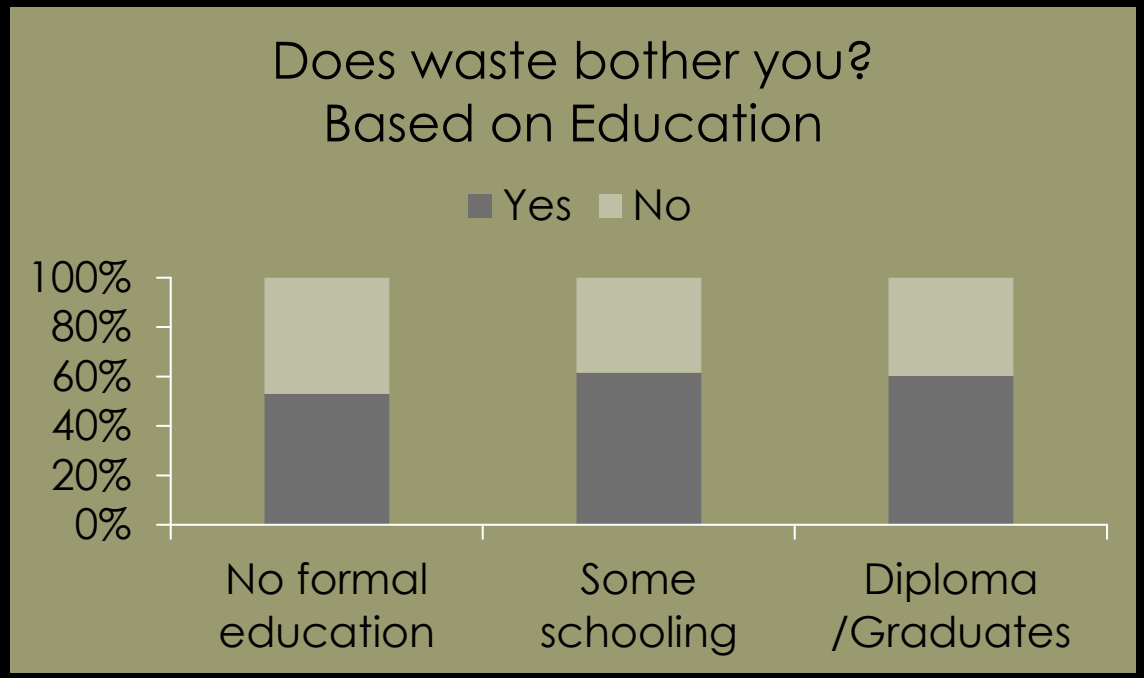
MOREOVER, OUR DATA SHOWED ECONOMICALLY WEAKER POPULATIONS WERE LIKELIER TO REPORT MORE PROBLEMS THAT STEM FROM MISMANAGED WASTE EVEN THOUGH THEY WERE LIKELIER TO SAY THAT WASTE DID NOT BOTHER THEM.

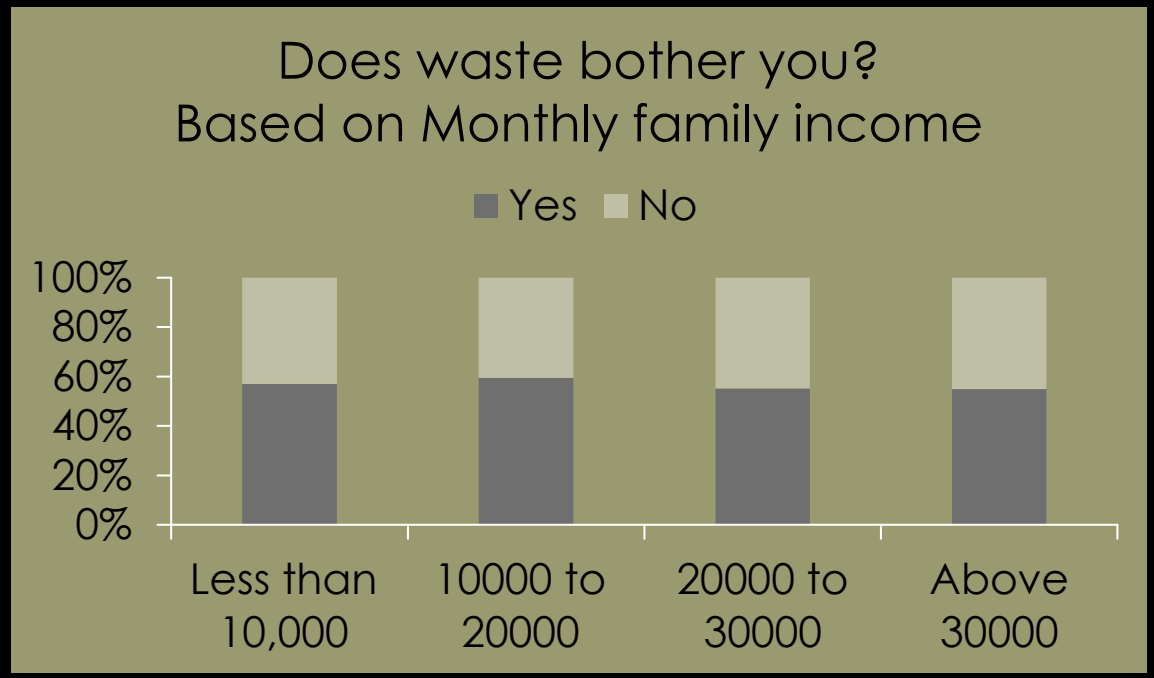
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389



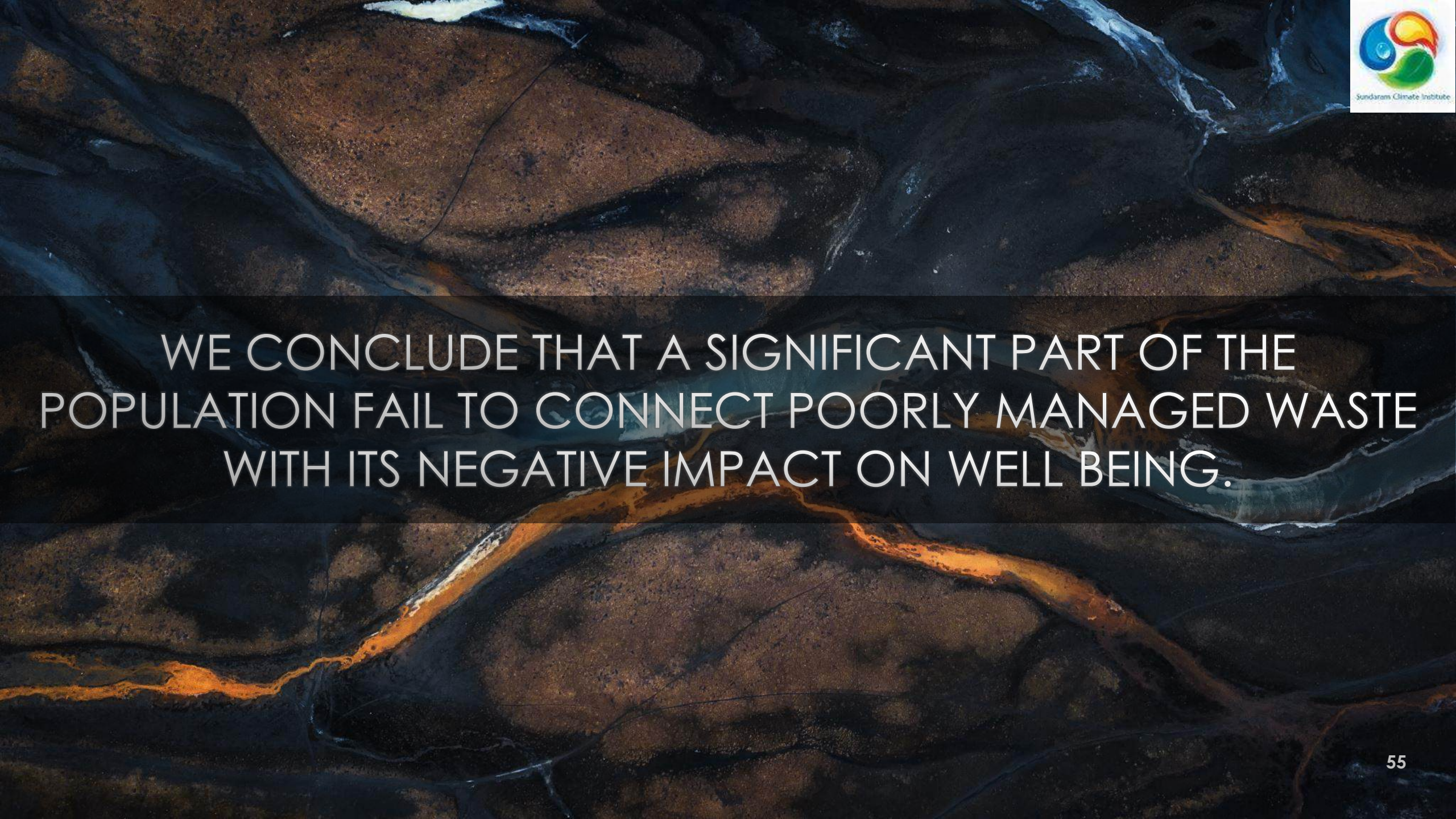
- This suggests that they had been bothered by solid waste but were:
  - Either not making the connection between poorly managed waste and its consequences on wellbeing.
  - or felt there was nothing they could do and so stopped being bothered by poorly handled waste.
- While our data indicates, at the margin, a lack of awareness may be more salient than a matter of helplessness, the more important point is that across income and educational levels, a significant proportion of people reported that waste did not bother them, despite being affected by problems that are aggravated by poorly managed waste.
- Not a rousing call to arms by any means.

ACROSS INCOME GROUPS, A SIGNIFICANT FRACTION DID NOT FIND WASTE BOTHERSOME. THERE APPEARS TO BE A MILD INFLUENCE OF EDUCATION ON WHETHER OR NOT SOMEONE FINDS WASTE BOTHERSOME.





Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. n = 1186 (for education) and n= 1715 (for income); Education information was collected only 2019 onwards; Data does not include responses without an answer or those where the answer was unintelligible.



WE CONCLUDE THAT A SIGNIFICANT PART OF THE POPULATION FAIL TO CONNECT POORLY MANAGED WASTE WITH ITS NEGATIVE IMPACT ON WELL BEING.

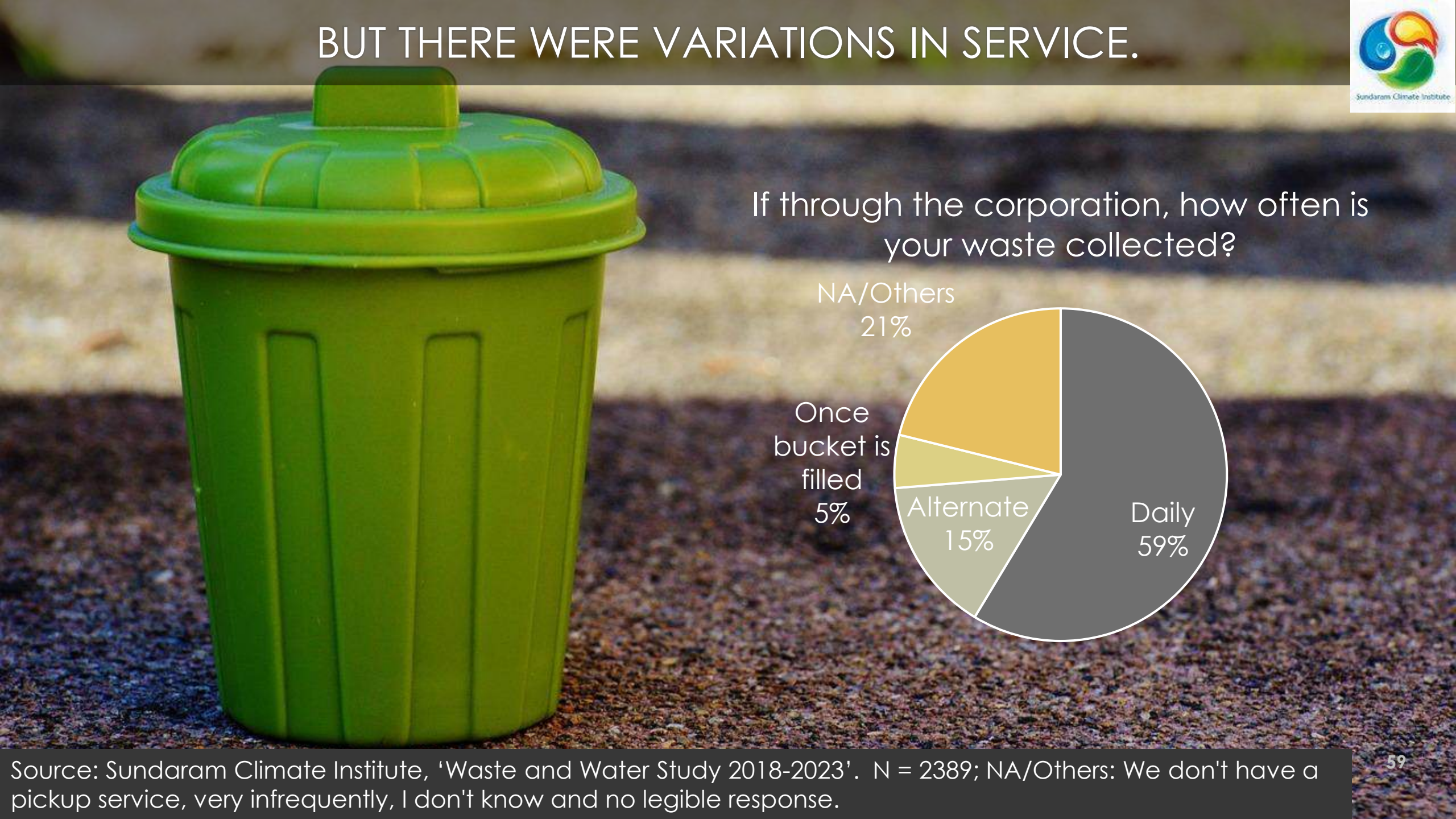
2. HANDLING WASTE

WE THEN ASKED HOW PEOPLE HANDLED OR DISPOSED OF THEIR WASTE. PEOPLE DISPOSED OF THEIR WASTE THROUGH THE MUNICIPAL CORPORATION, OR THREW IT OUT INTO THE STREET OR AN EMPTY PLOT, OR BURNED IT OR DROPPED IT INTO A CORPORATION COMMON DUSTBIN.

MOST PEOPLE DISPOSED THEIR WASTE THROUGH THE MUNICIPAL CORPORATION.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389; Other = Disposing into the common corporation dustbin, I don't know, NA/did not give a legible response.

BUT THERE WERE VARIATIONS IN SERVICE.



If through the corporation, how often is your waste collected?

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389; NA/Others: We don't have a pickup service, very infrequently, I don't know and no legible response.

MOST OF THOSE WHO DO NOT HAVE THEIR WASTE COLLECTED DAILY/ALTERNATE DAYS, THROW OUT THEIR WASTE OR BURN IT.

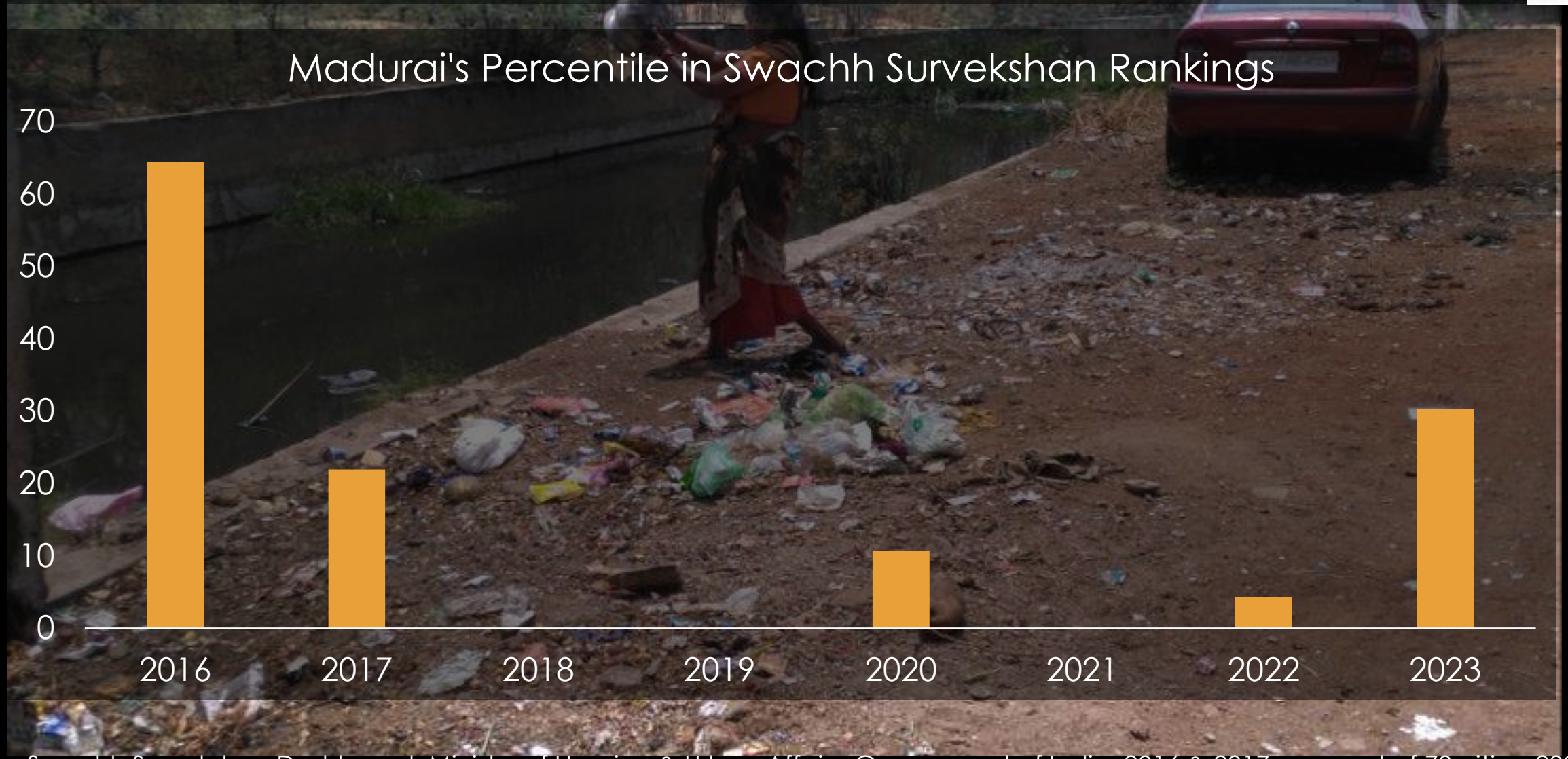
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389

ALSO, A QUARTER OF THE HOUSEHOLDS IN INFORMAL NEIGHBOURHOODS TOLD US THAT THEY HANDLE THEIR WASTE BY BURNING OR THROWING IT OUT.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389

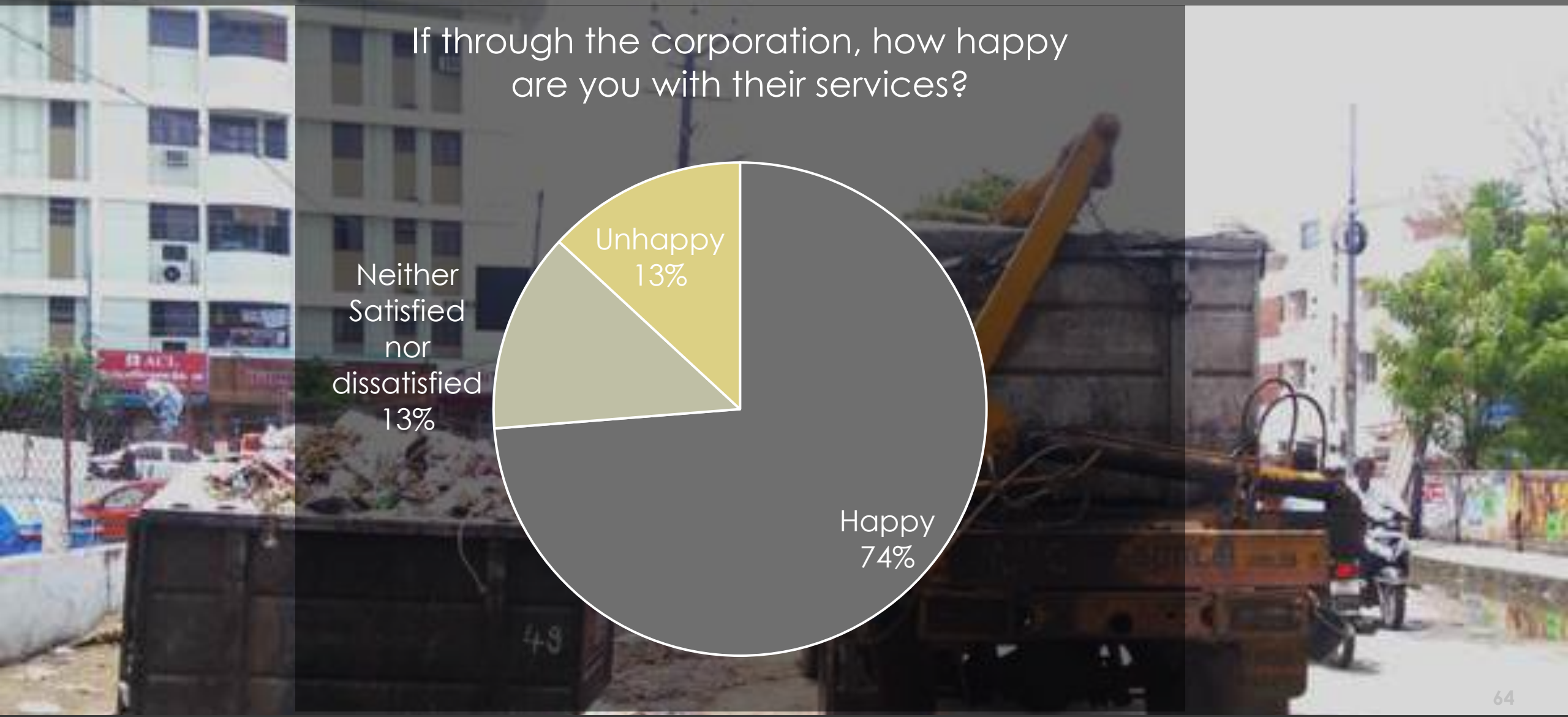
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389

THIS TREND APPEARS TO BE SUPPORTED BY THE CHANGES IN PERCENTILE RANK OF THE CITY IN THE SWACHH SURVEKSHAN SURVEYS.



Source: Swachh Survekshan Dashboard, Ministry of Housing & Urban Affairs, Government of India. 2016 & 2017 were out of 73 cities, 2020 - 2022 out of 47 cities while 2023 percentile was out of 446 cities. Methodology and weightages changed across surveys slightly making strict comparisons difficult.

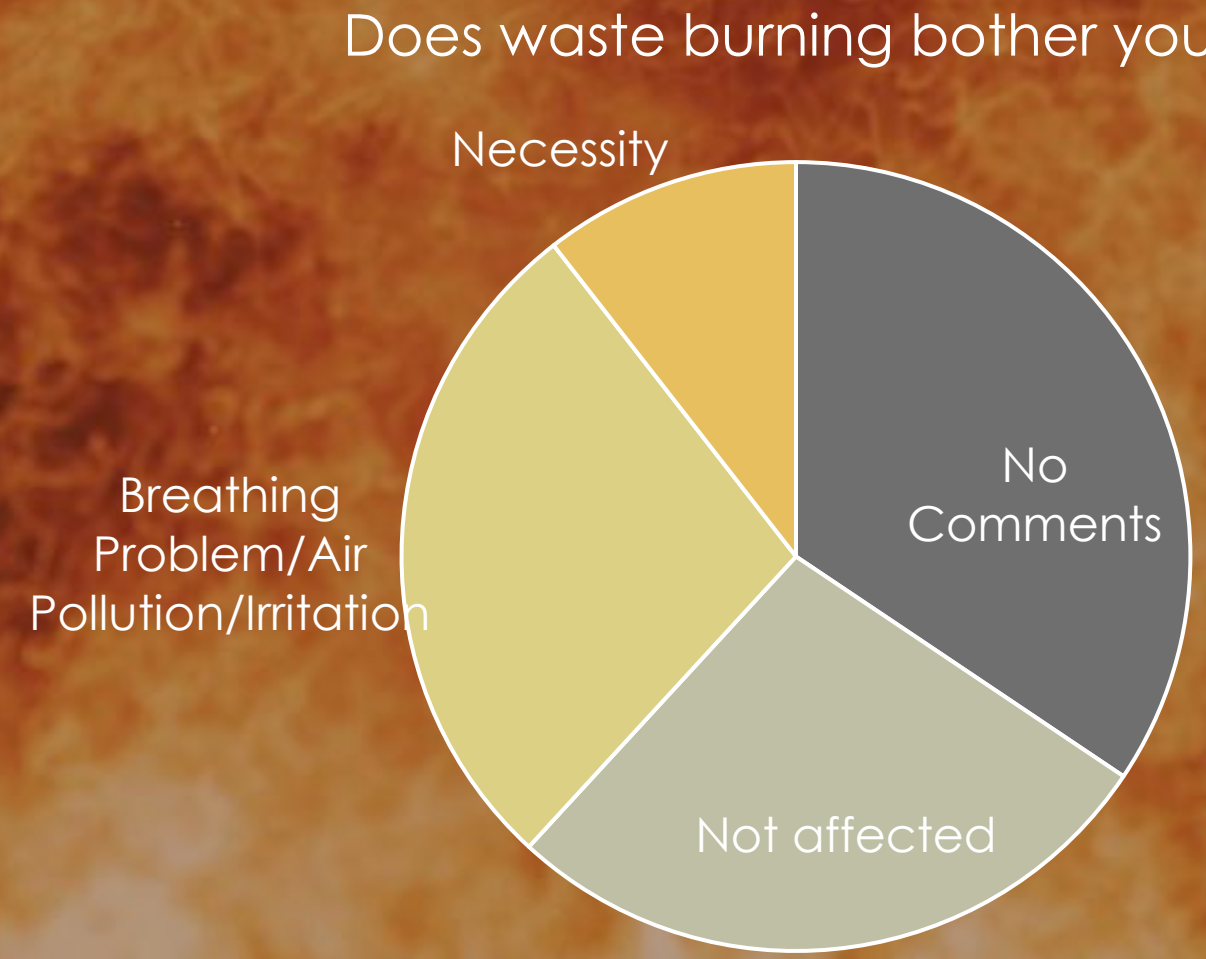
STILL, MOST PEOPLE REPORTED BEING HAPPY WITH THE CORPORATION PERFORMANCE ON WASTE MANAGEMENT.



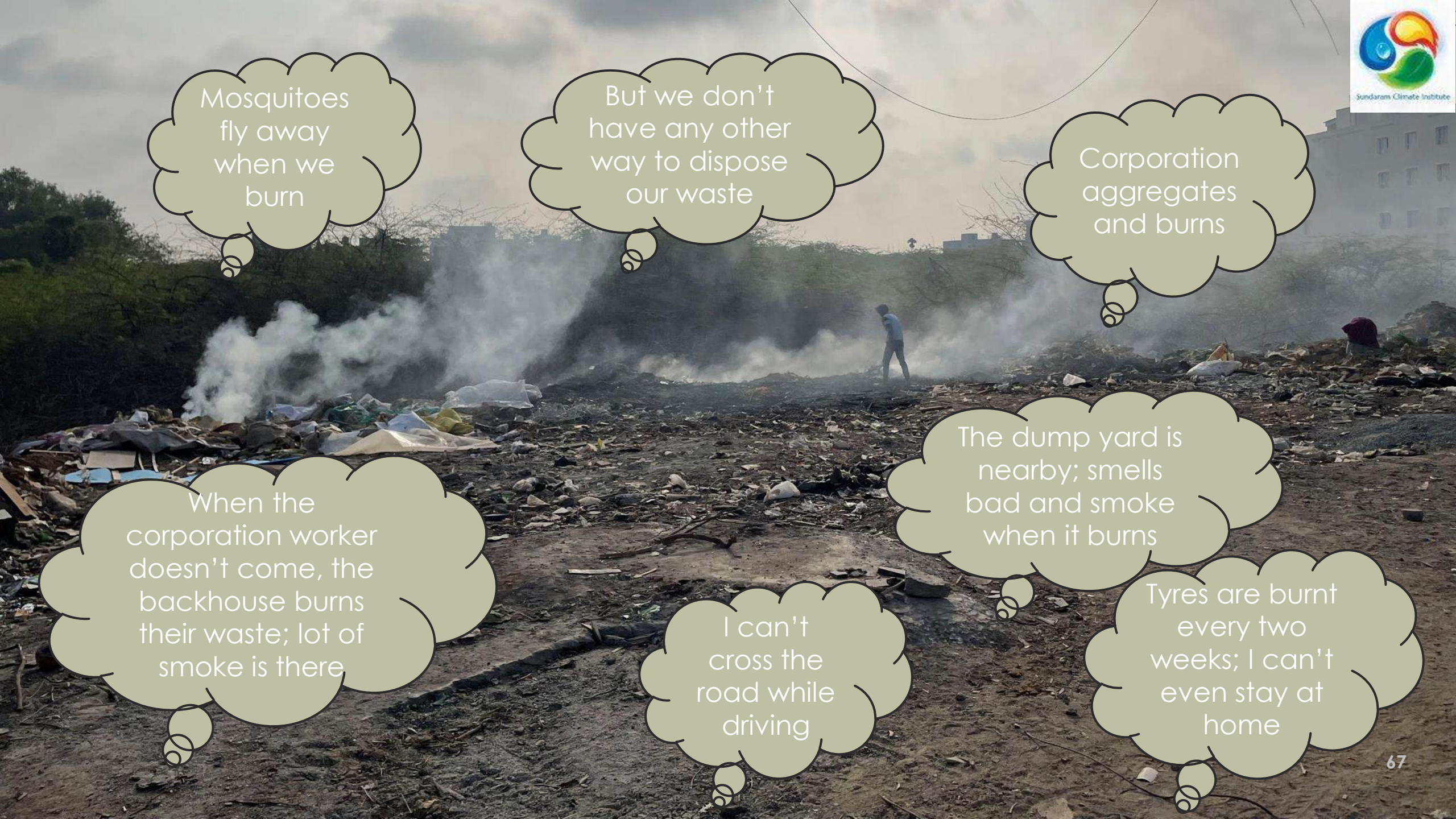
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2034; Does not include NA responses.

WE THEN PROBED THE ISSUE OF BURNING WASTE.

DESPITE THE OVERWHELMING EVIDENCE OF HEALTH PROBLEMS OF BURNING WASTE, NEARLY HALF OF THE RESPONDENTS EITHER DID NOT SEE A PROBLEM WITH BURNING WASTE OR SAW IT AS A NECESSITY.

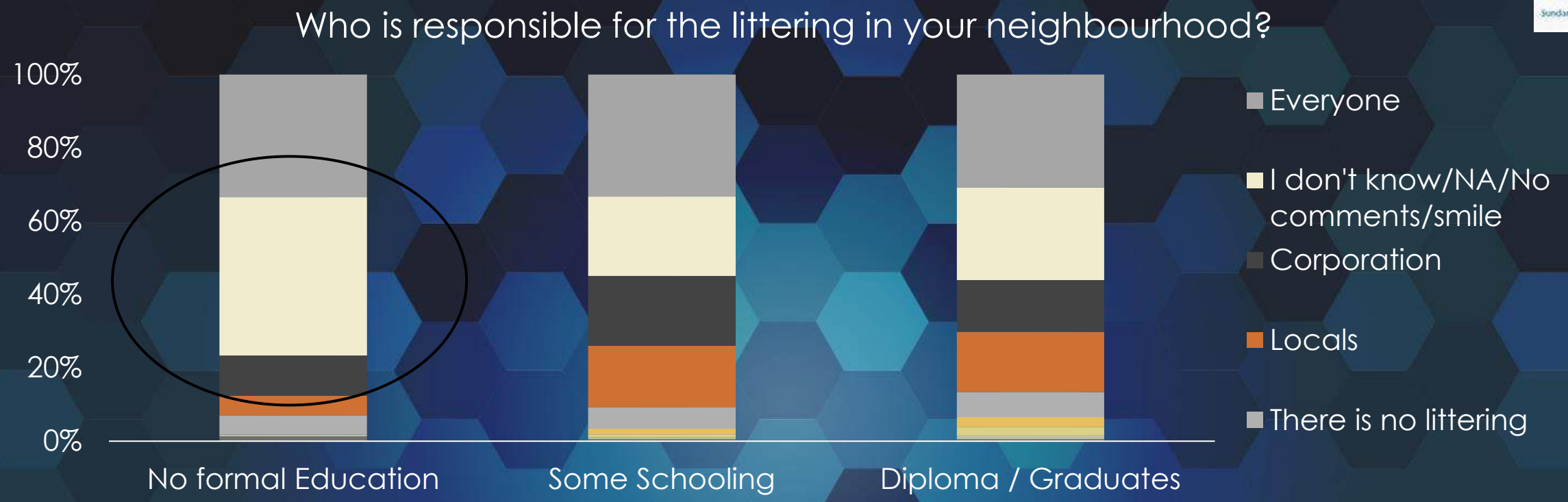


Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1491, does not include responses of "we don't burn".


Mosquitoes fly away when we burn
But we don't have any other way to dispose our waste
Corporation aggregates and burns
When the corporation worker doesn't come, the backhouse burns their waste; lot of smoke is there
The dump yard is nearby; smells bad and smoke when it burns
I can't cross the road while driving
Tyres are burnt every two weeks; I can't even stay at home

MOST PEOPLE SAID THERE WERE MULTIPLE ACTORS RESPONSIBLE FOR LITTERING

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389

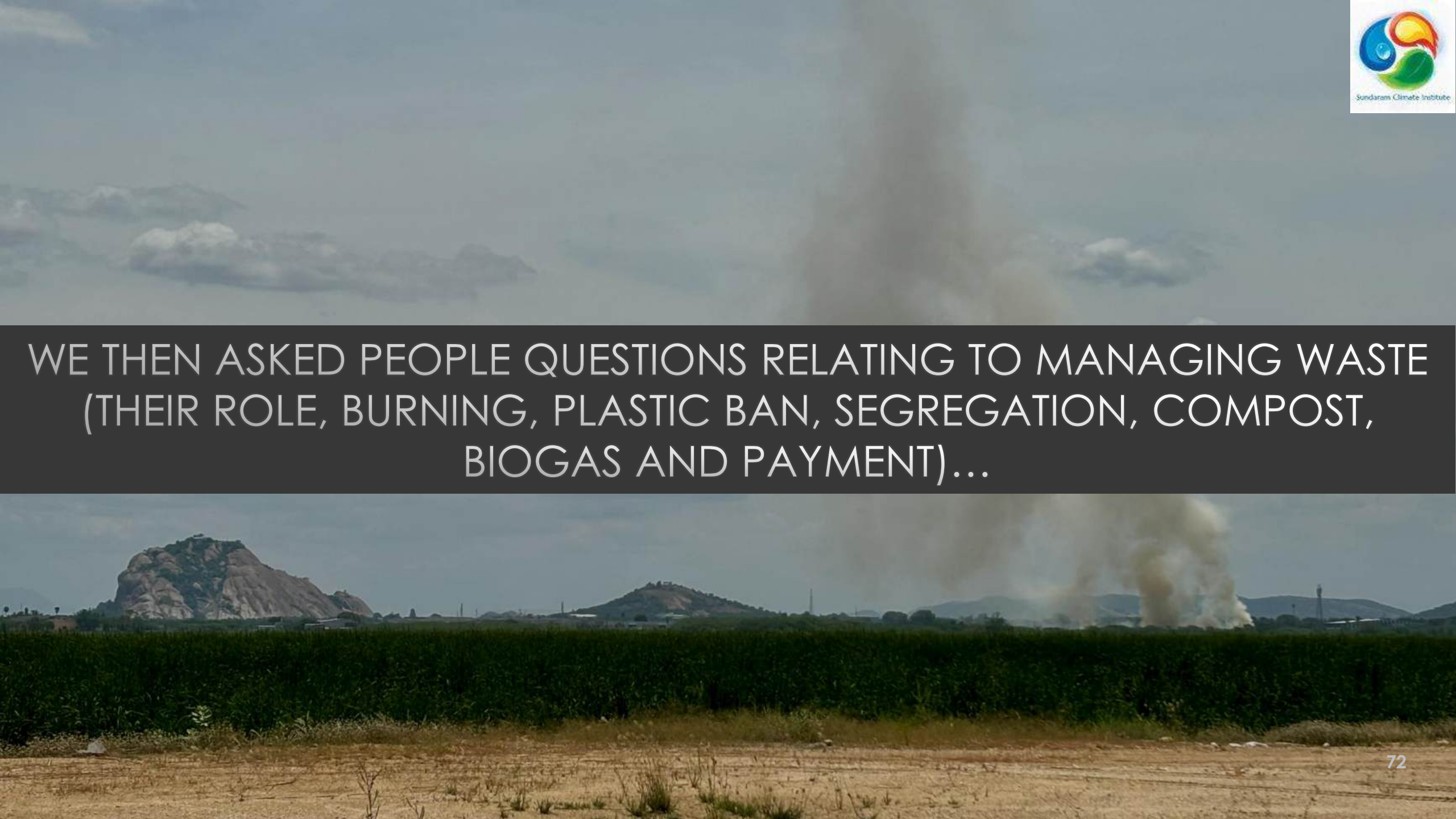


HOWEVER, RESPONDENTS WITH NO FORMAL EDUCATION WERE FAR MORE LIKELY TO SAY THEY DID NOT KNOW THE CULPRIT OF LITTERING.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1389, education data was collected only from 2019 onwards.

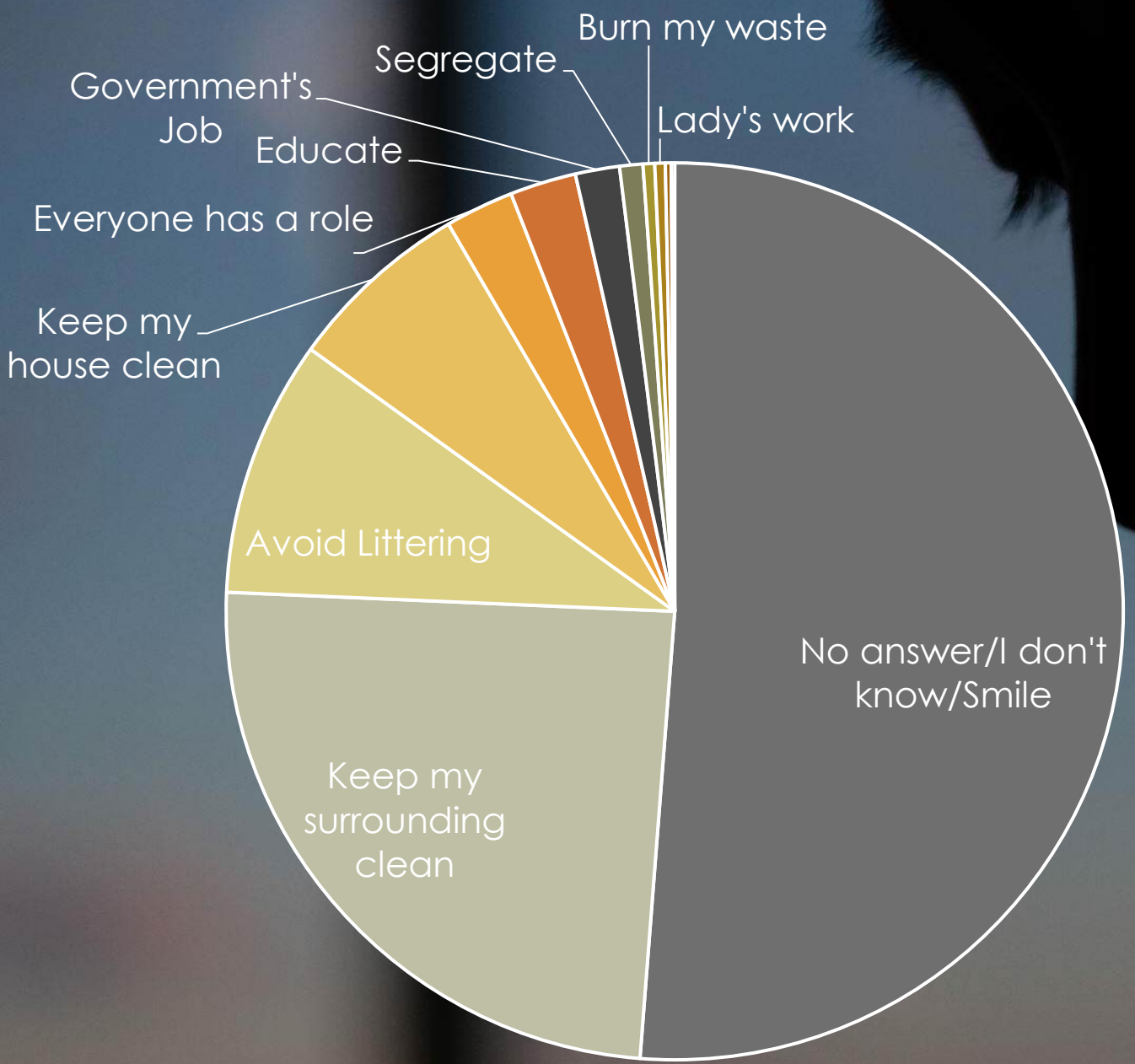
IN SUMMARY, MOST PEOPLE DISPOSED OF THEIR WASTE THROUGH THE MUNICIPAL CORPORATION, AND THEY WERE BROADLY SATISFIED WITH THE SERVICES OF THE MUNICIPAL CORPORATION. BUT WHEN THE CORPORATION DID NOT COLLECT WASTE REGULARLY, BURNING WASTE OR DUMPING IT IN AN EMPTY PLOT OR WATER CHANNEL BECAME MORE COMMON.

3. MANAGING WASTE



WE THEN ASKED PEOPLE QUESTIONS RELATING TO MANAGING WASTE (THEIR ROLE, BURNING, PLASTIC BAN, SEGREGATION, COMPOST, BIOGAS AND PAYMENT)…

What is your role in managing waste?



ABOUT HALF THE PEOPLE COULD NOT ARTICULATE WHAT THEIR ROLE WAS IN MANAGING WASTE.

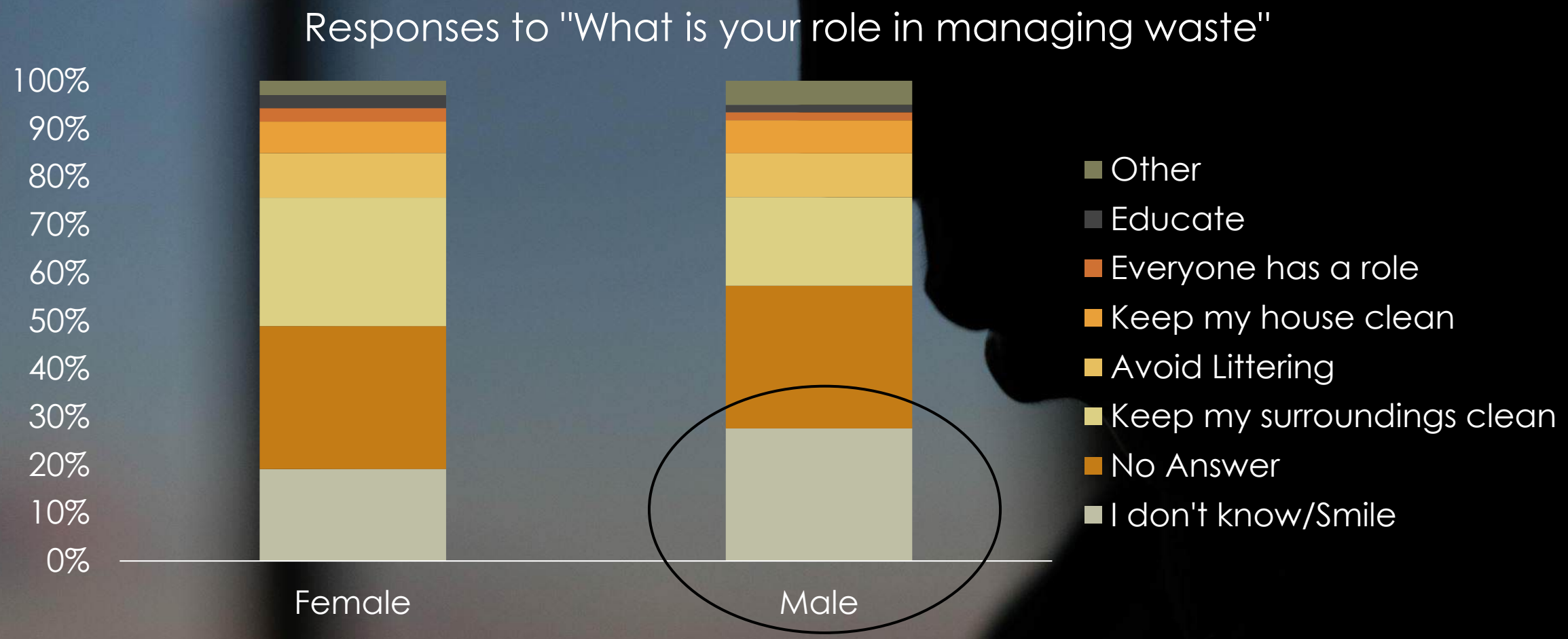
MOST OTHERS RETURNED A VERY GENERIC ANSWER LIKE "KEEP CLEAN".

VERY FEW WERE ABLE TO CLEARLY ARTICULATE WHAT THEY NEEDED TO DO.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389

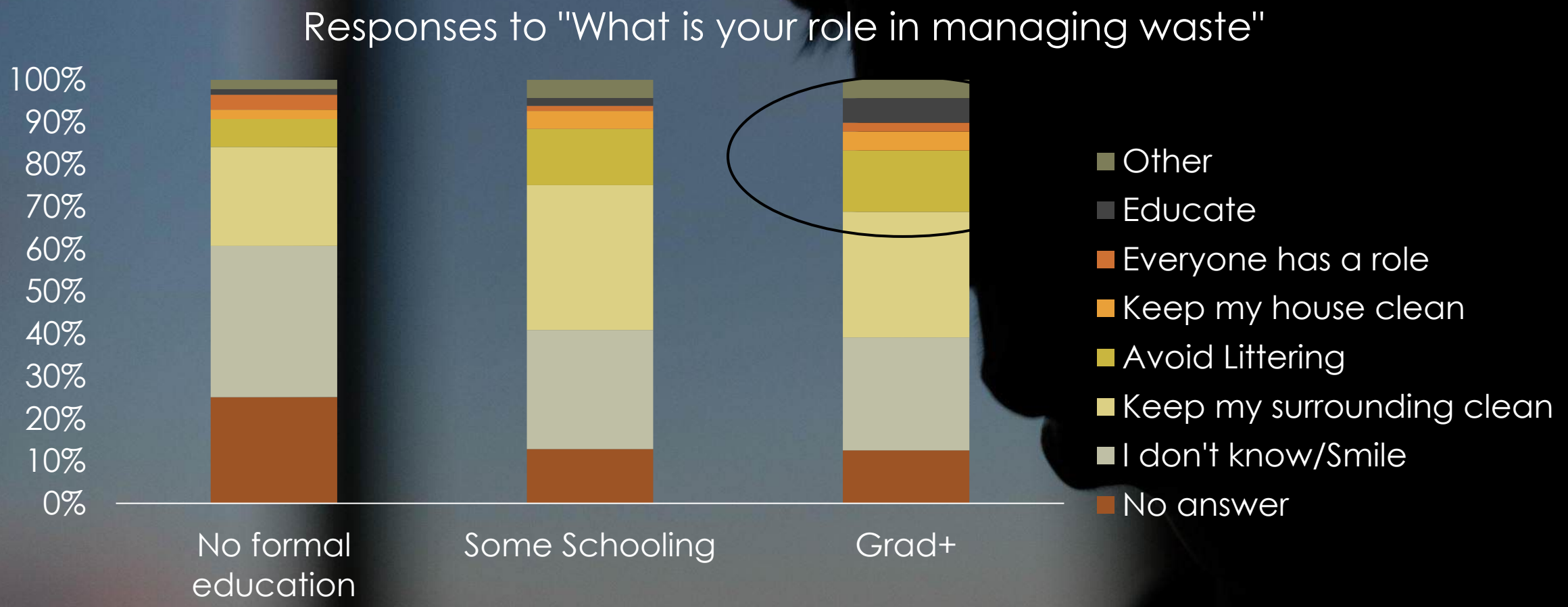

We will be happy
I burn all the waste, don't throw out
Using a dustbin
It is lady's work
I am old what can I do?
I keep my house clean but not able to do anything in the street
Spread awareness

MEN WERE MORE LIKELY TO SAY THEY DID NOT KNOW THEIR ROLE IN MANAGING WASTE. A FEW MEN EVEN SAID THAT THEIR ROLE WAS "MY WIFE KEEPS MY HOUSE VERY CLEAN".



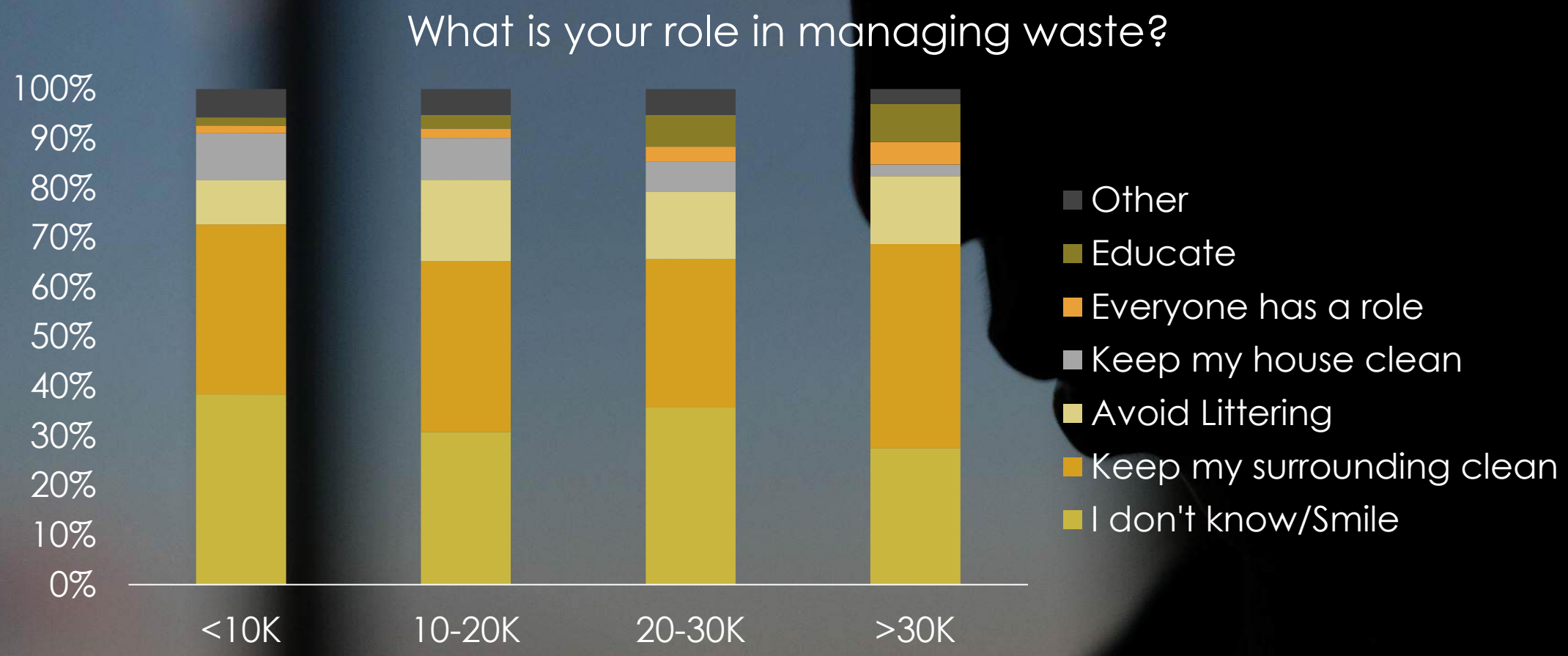
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389

A HIGHER LEVEL OF EDUCATION MAKES RESPONSES LIKE "AVOID LITTERING" OR "EDUCATE" MORE LIKELY.



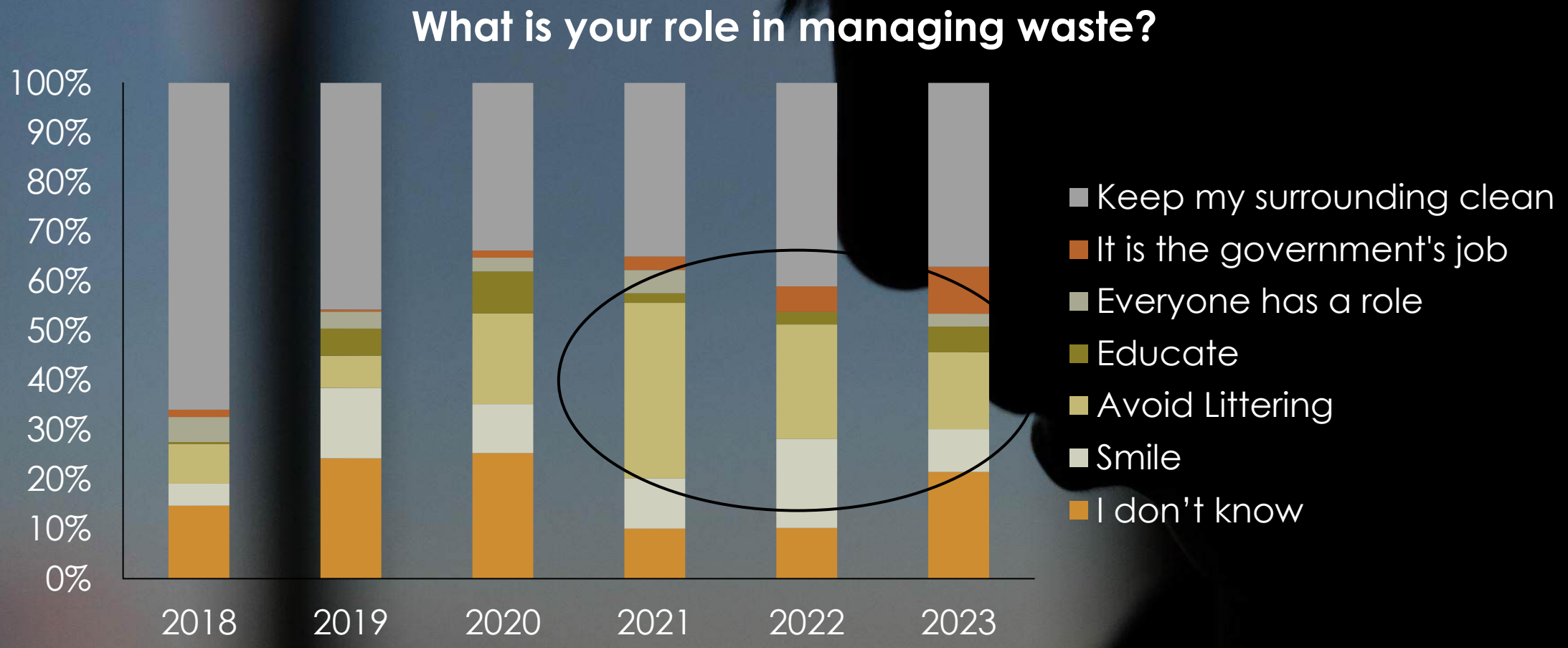
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1389; Responses without specifying an educational level were not considered.

A HIGHER INCOME LEVEL APPEARS TO TRANSLATE TO A HIGHER "CIVIC" SENSE: RESPONSES SUCH AS "KEEP MY SURROUNDINGS CLEAN" AS OPPOSED TO JUST "KEEP MY HOME CLEAN" AND "EDUCATE", "EVERYONE HAS A ROLE" BECOME MORE COMMON.



Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1439; Responses that did not specify an income level and/or did not give a response were not considered.

PERHAPS BECAUSE OF THE EMPHASIS ON EDUCATION IN SWACHH BHARAT, THE RESPONSE "AVOID LITTERING" BECAME MORE COMMON UNTIL 2021.



Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1654; Does not include comments that had NA under the response to this question. It's the government's job has also become more common.

ACROSS EDUCATION AND INCOME LEVELS, SOME BELIEVE THAT THEIR ROLE IN MANAGING WASTE IS TO BURN IT.

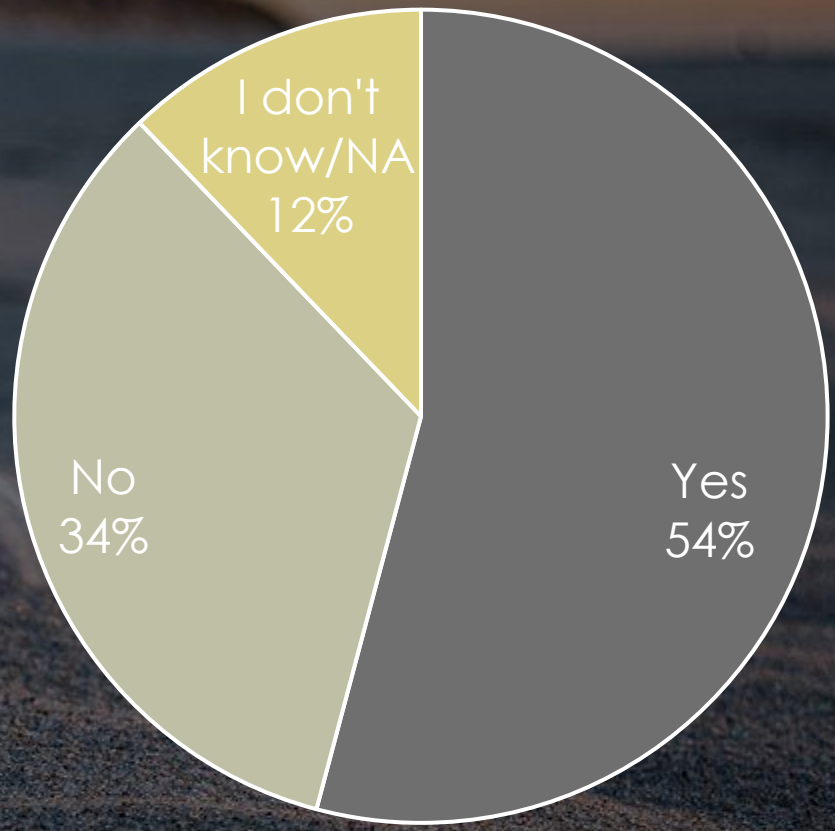
WHY DO PEOPLE BURN THEIR WASTE?

- PROBLEMS WITH COLLECTION
  - IRREGULAR COLLECTION
  - CORPORATION COLLECTS AND THEN BURNS
  - NOT WILLING TO PAY TO FOR WASTE MANAGEMENT
- PROBLEMS WITH PERCEPTION
  - BURNING KILLS MOSQUITOES
  - BURNING IS GOOD
  - BURNING VERY EASY
  - CULTURAL FACTORS (AGNI PURIFIES)

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'.

ABOUT HALF OUR RESPONDENTS FELT THAT THE PLASTIC BAN HAD BEEN EFFECTIVE. THIS TREND REMAINED CONSISTENT ACROSS AGE, SEX, INCOME AND EDUCATION LEVELS.

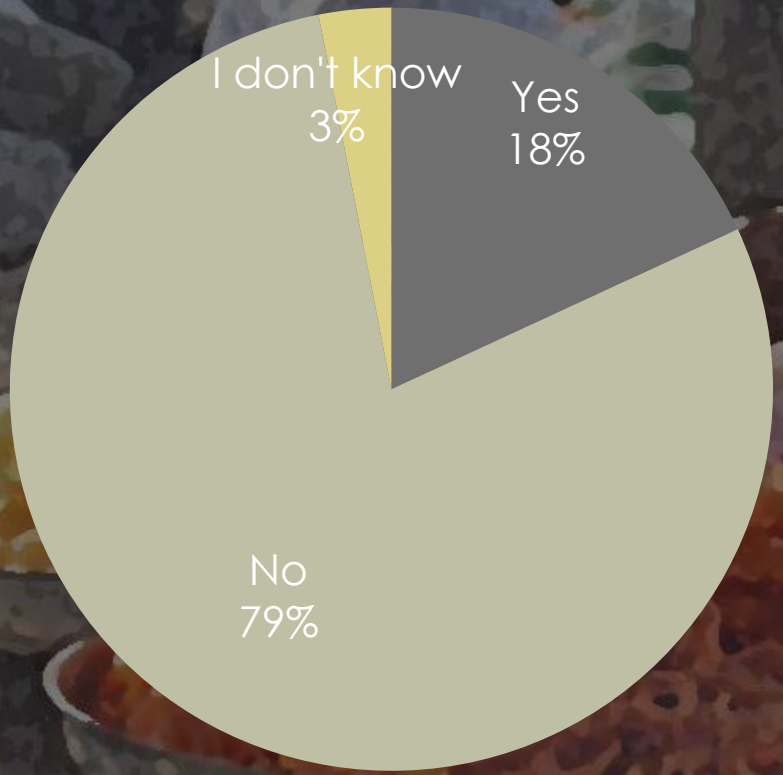
Has the plastic ban been effective?



Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389

HAS THE PLASTIC BAN BEEN EFFECTIVE?

Have you been affected by the plastic ban?

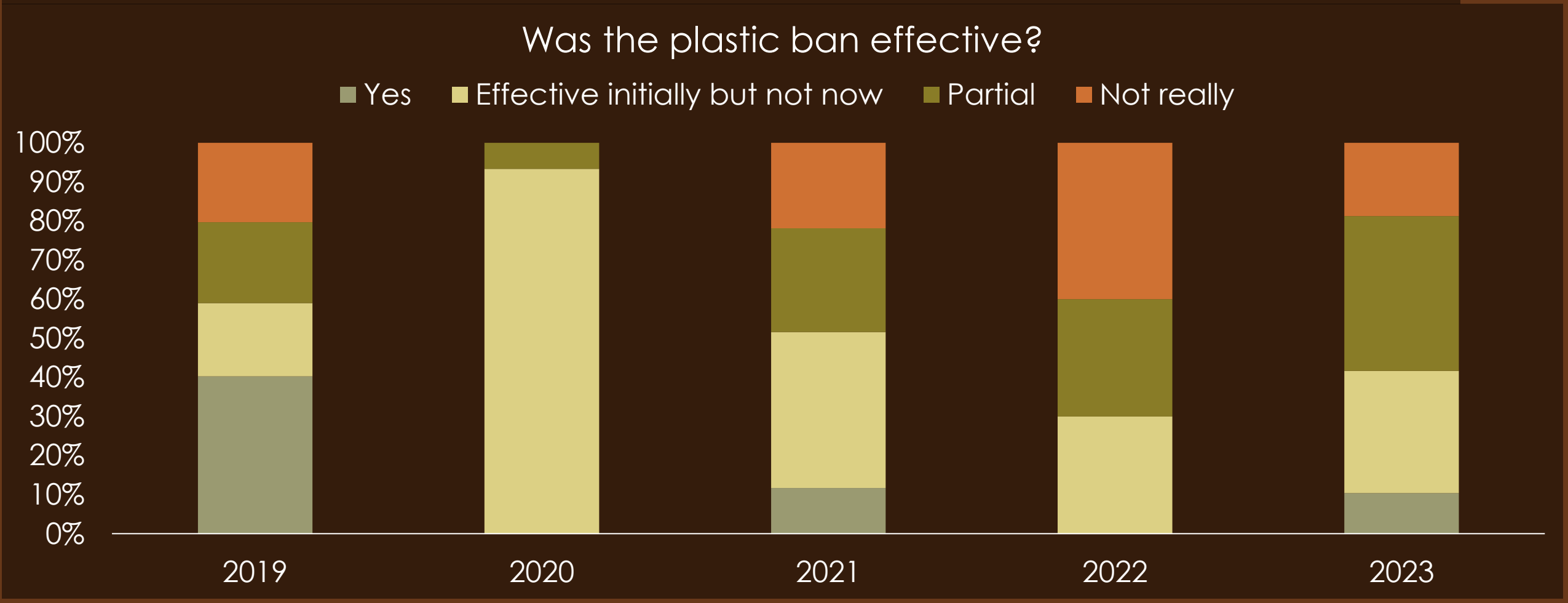


MOST FELT THEY WERE NOT MUCH AFFECTED BY THE PLASTIC BAN – THEY FACED SOME DIFFICULTY INITIALLY, BUT COULD ADAPT. THE HARDEST HIT WERE SMALL VENDORS WHOSE CUSTOMERS DEMANDED PLASTIC BAGS.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1135

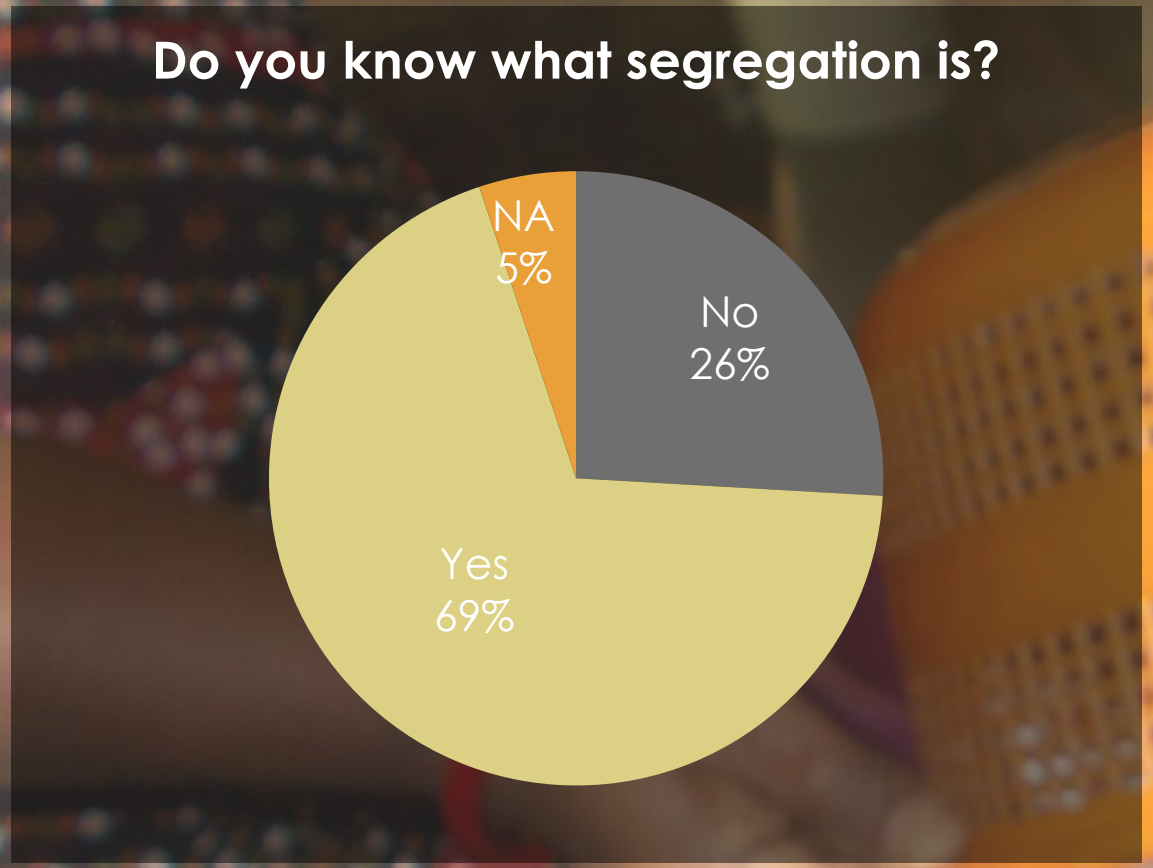
MOST FELT THAT THE BAN WAS GOOD FOR SOCIETY AND SO WERE WILLING TO PUT UP WITH THE INITIAL DISCOMFORT. HOWEVER, MANY SAID THAT THE BAN WAS INCOMPLETE, AND SO FELT IT WAS OK TO CHEAT. MANY SMALL VENDORS REPORTED THAT IT WAS IMPOSSIBLE TO RUN THEIR SHOPS WITHOUT PLASTIC BECAUSE (A) IT WAS CHEAP, AND (B) THEIR CUSTOMERS DEMANDED IT.

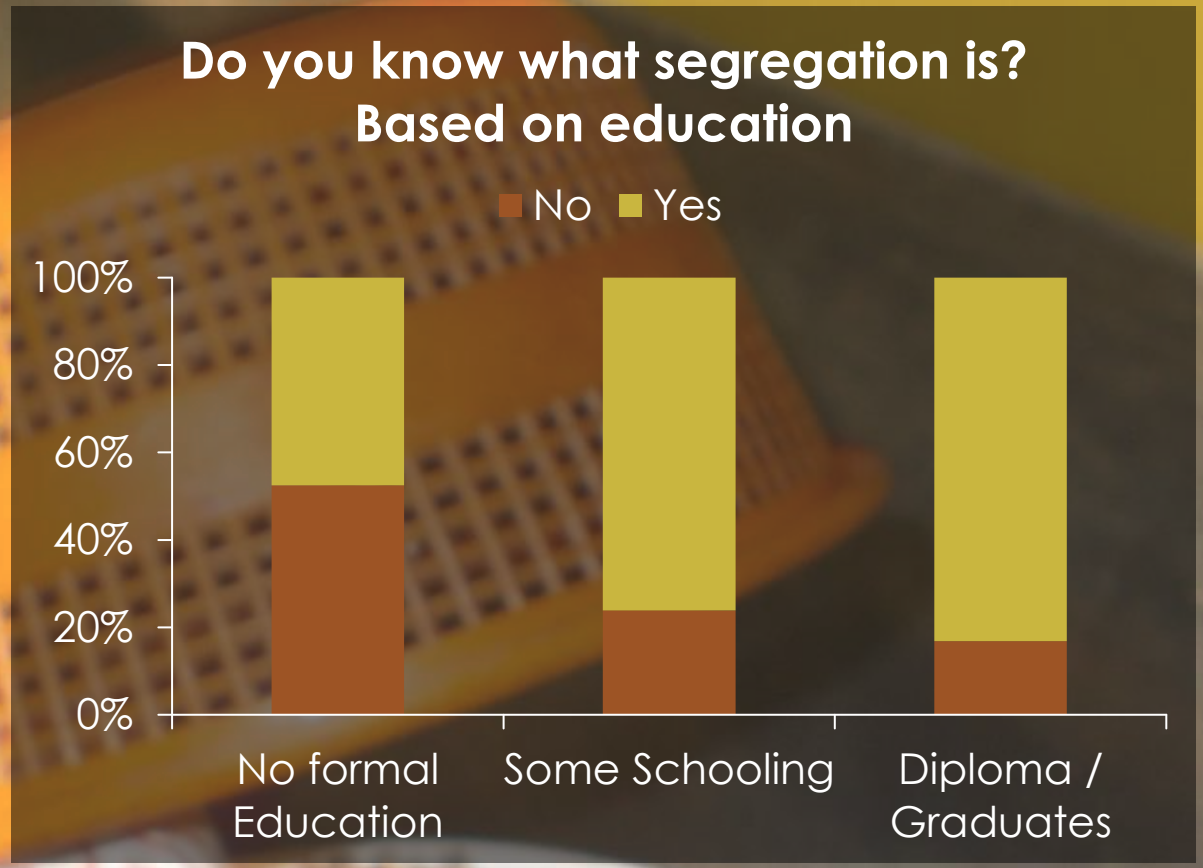
A PARTIAL BAN ON SINGLE USE PLASTIC CAME INTO EFFECT IN JANUARY 2019 IN TAMIL NADU, WITH A LARGER BAN COMING INTO EFFECT IN JULY 2022. BUT COVID 2019 DEALT IT A DEATHBLOW.



Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 467; Does not include responses who said NA/I don't know

MOST RESPONDED THAT THEY KNEW WHAT SEGREGATION WAS, AND THE MORE EDUCATED SOMEONE WAS, THE HIGHER THE LIKELIHOOD THAT THEY SAID THEY KNEW WHAT IT MEANT…

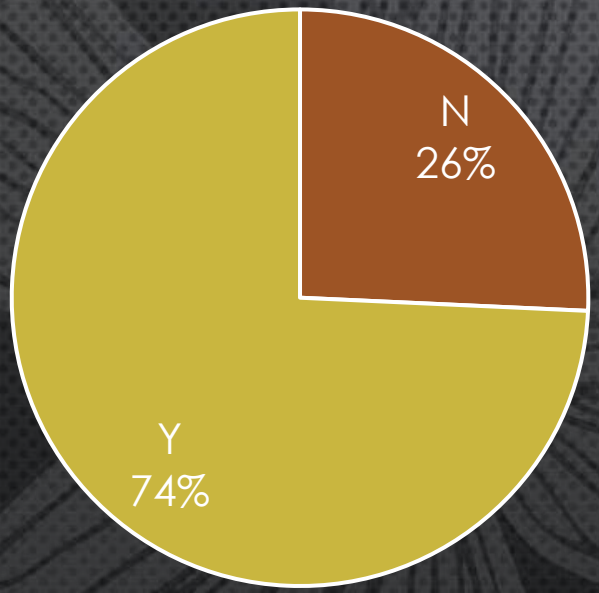




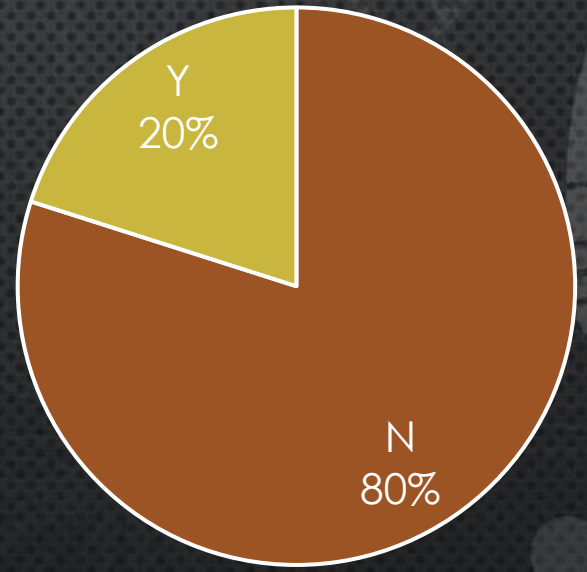
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-[illegible]23'. N = 2389; Education (n=1389); Education data collected only from 2019 onwards.

BUT AMONG THOSE WHO SAID THEY KNEW WHAT SEGREGATION MEANT, FULLY A QUARTER DID NOT KNOW WHY THEY HAD TO SEGREGATE, AND ONLY 20% HAD RECEIVED ANY TRAINING ON THE SUBJECT.

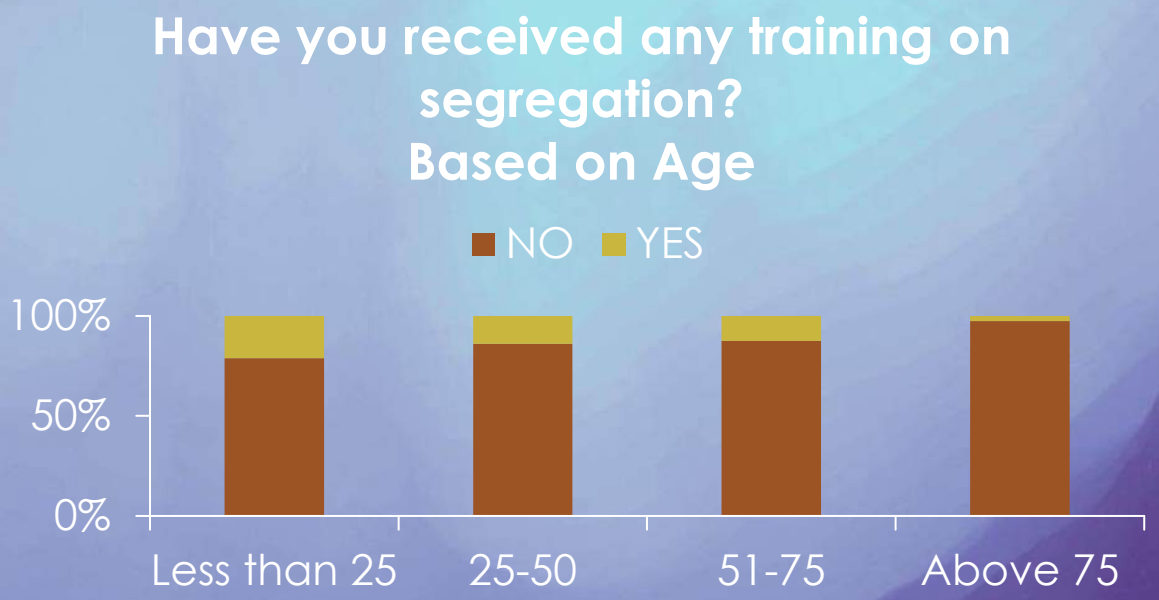
Do you know why you should segregate your waste?



Have you received any training on segregation?



Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1648



THE YOUNGEST AND WEALTHIEST WERE MOST LIKELY TO HAVE RECEIVED TRAINING.

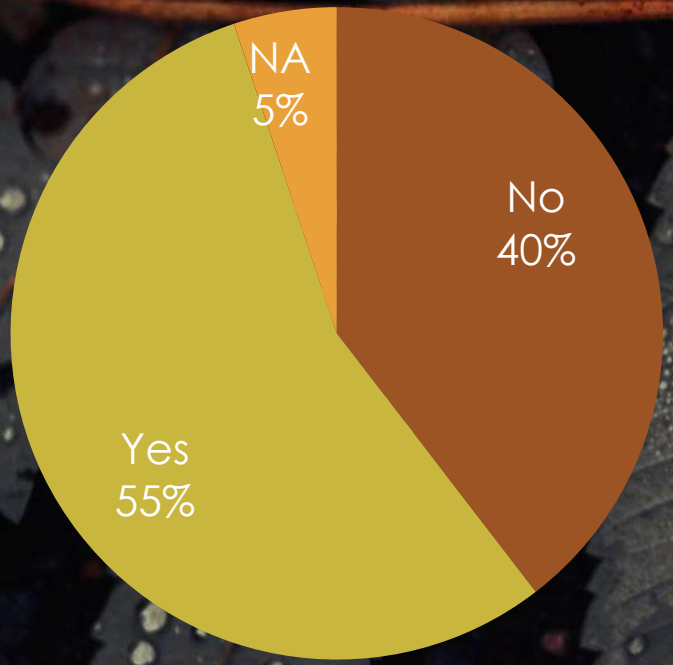
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. (N for Age = 2304; Income = 1918)

ONLY 20 PEOPLE OUT OF THE 2389 WE SPOKE TO MENTIONED SEGREGATING THEIR WASTE AS THEIR ROLE IN MANAGING WASTE.

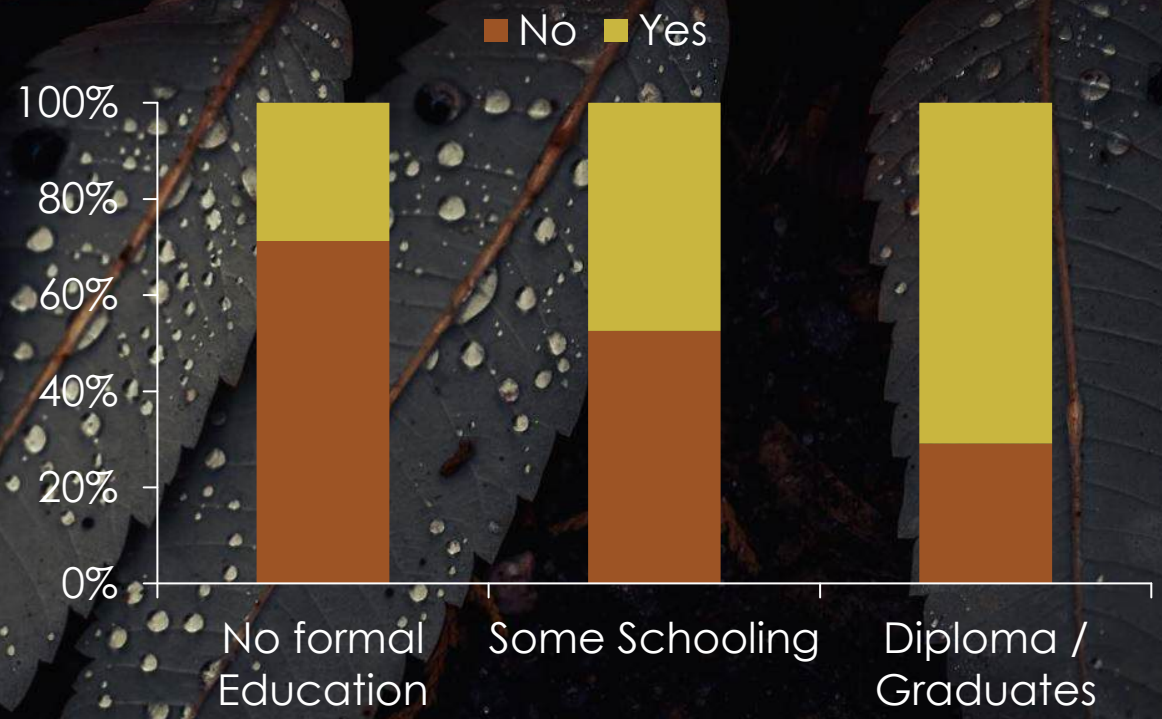
Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389.

ABOUT HALF THE PEOPLE WE SPOKE TO SAID THEY KNEW WHAT COMPOST WAS; STATED KNOWLEDGE OF COMPOSTING CORRELATED WELL WITH EDUCATIONAL ACHIEVEMENT.

Do you know about compost?

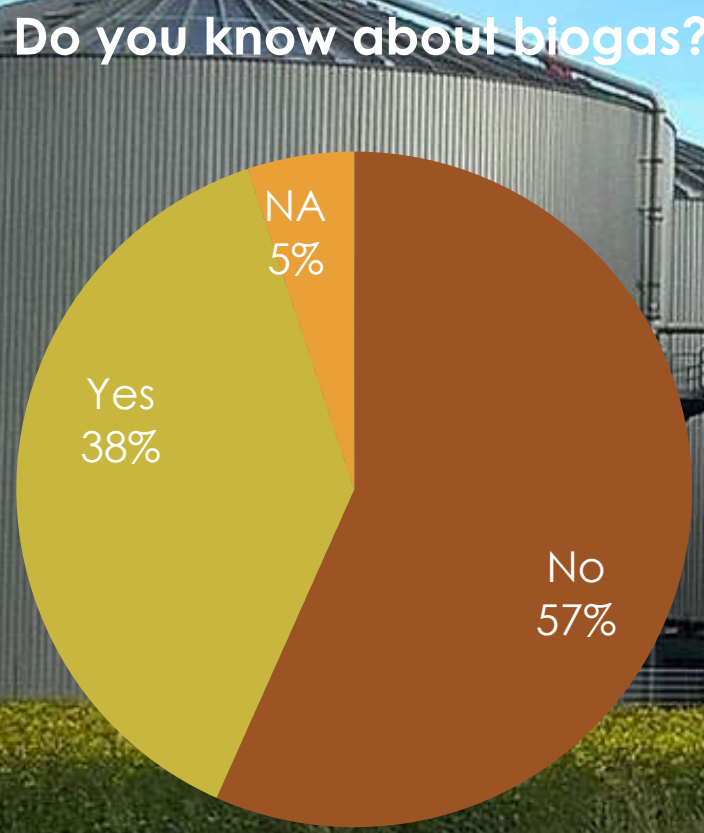


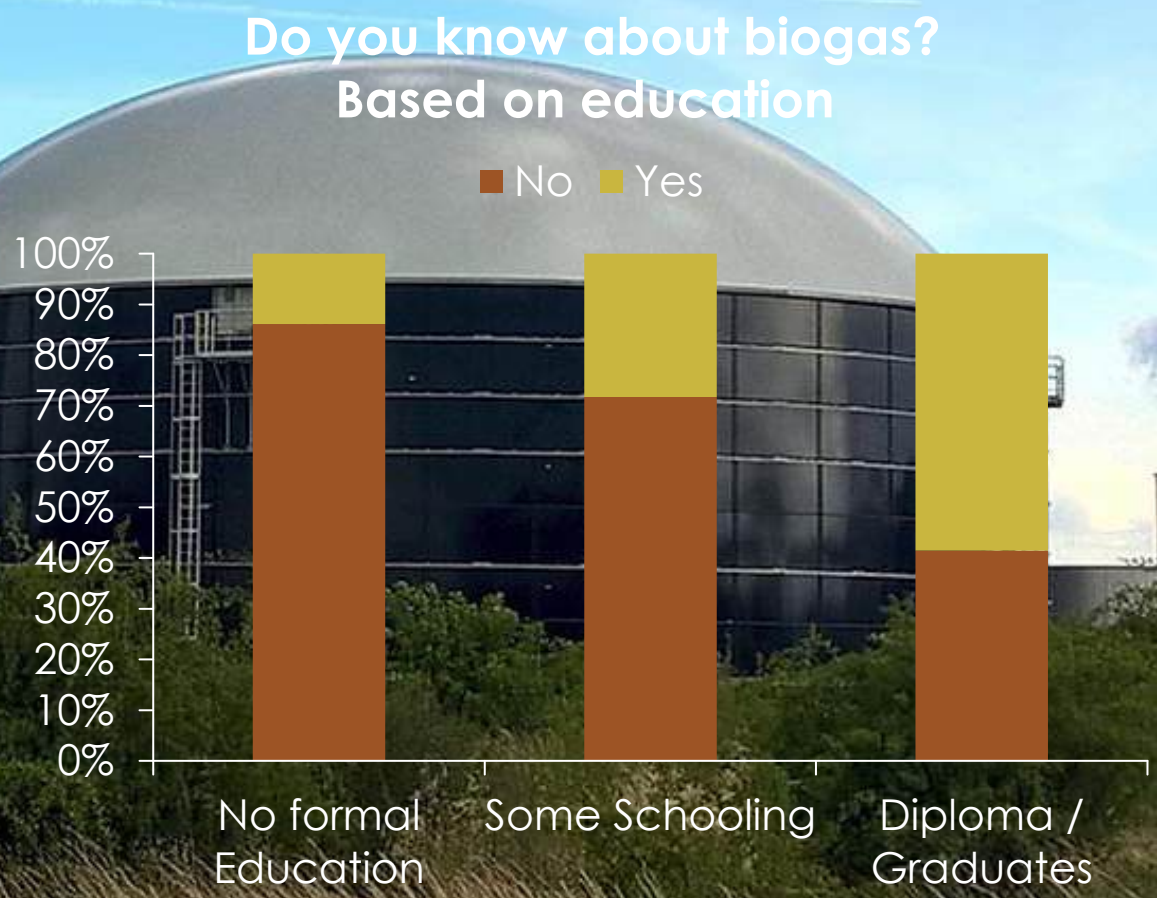
Do you know about compost?
Based on education



Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389 (Education, n = 1267)

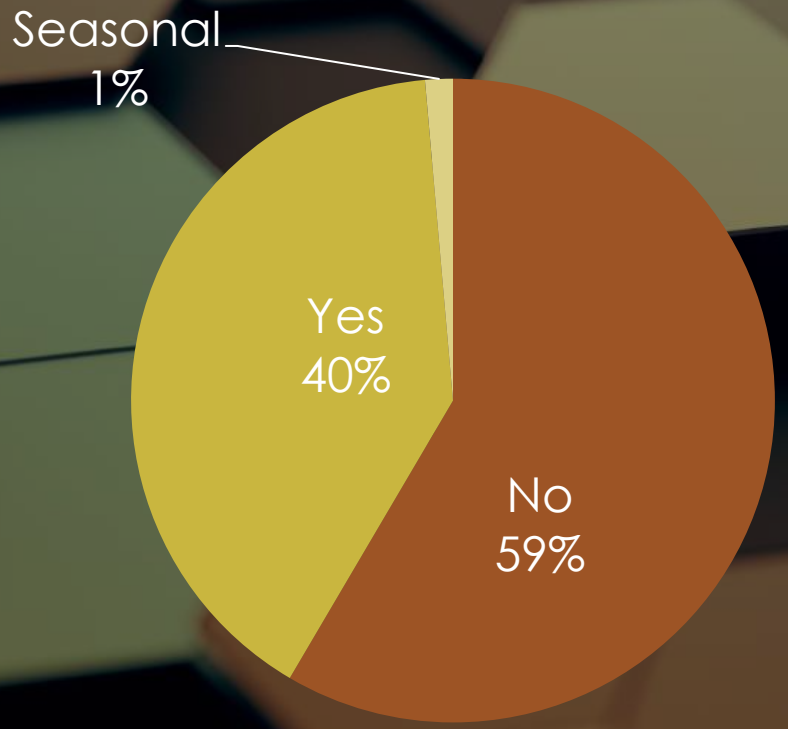
ABOUT A THIRD OF THE PEOPLE SAID THEY KNEW WHAT BIOGAS WAS, AGAIN, STATED KNOWLEDGE OF BIOGAS CORRELATED WITH EDUCATIONAL ACHIEVEMENT.





Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 2389

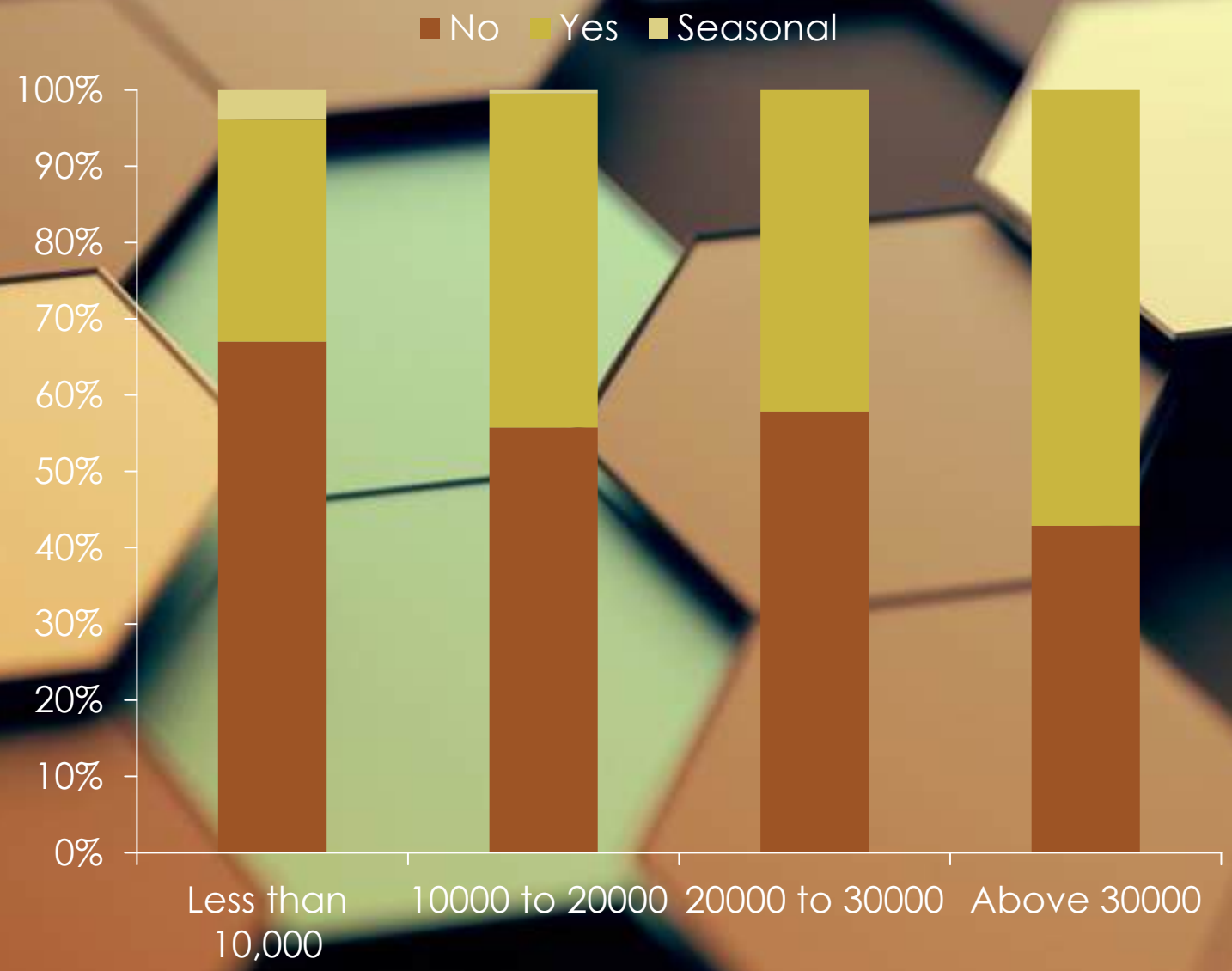
Do you pay for waste-collection services?



40% OF THE SURVEYED PEOPLE TOLD US THEY MAKE PAYMENTS FOR WASTE COLLECTION. BUT THIS CAME IN THE FORM OF INFORMAL PAYMENTS TO THE LOCAL COLLECTOR – EITHER A MONTHLY PAYMENT OF RS. 15-20 OR A LARGER AMOUNT DURING FESTIVALS OR SPECIAL OCCASIONS. ALMOST NO ONE SPOKE ABOUT THE NEED TO PAY FOR MANAGING THEIR WASTE.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1224; Question was included in the survey from 2019 onward. Illegible/ Not known responses were not included.

Do you pay for waste-collection services? Based on monthly income



A GREATER FRACTION OF WEALTHIER HOUSEHOLDS PAID TOKENS FOR WASTE COLLECTION, WHICH MAY EXPLAIN WHY THEIR NEIGHBOURHOODS WERE CLEANER.

Source: Sundaram Climate Institute, 'Waste and Water Study 2018-2023'. N = 1224

REALITIES AND CHANGES

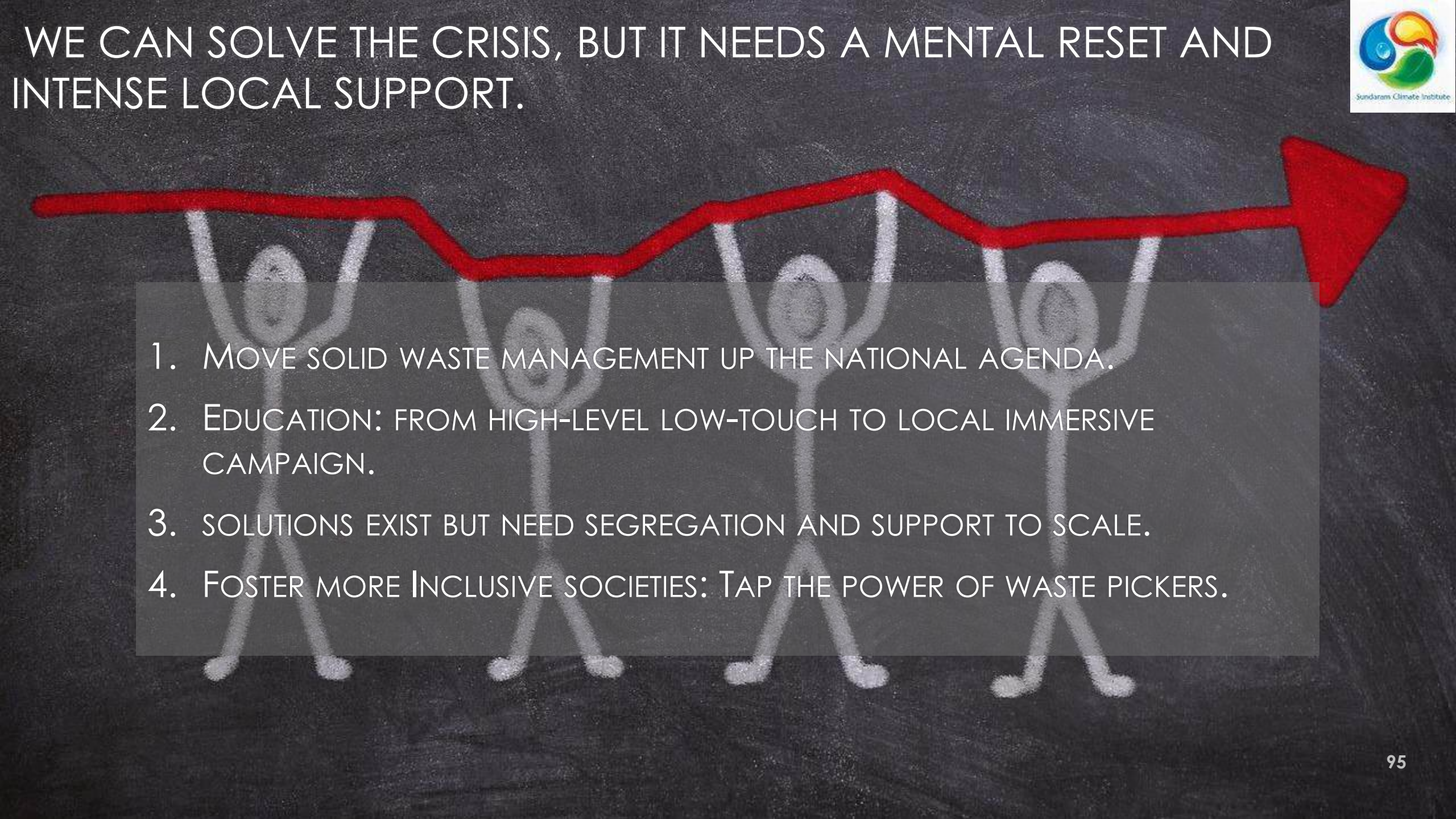
ACROSS INCOME AND EDUCATIONAL LEVELS,

1. A SIGNIFICANT SECTION BELIEVES WASTE DOES NOT BOTHER THEM, DESPITE BEING IMPACTED BY PROBLEMS BROUGHT ABOUT BY MISMANAGED WASTE.
2. MOST ARE UNABLE TO CLEARLY ARTICULATE THEIR ROLE IN MANAGING THEIR WASTE.
3. KNOWLEDGE OF SOLUTIONS LIKE SEGREGATION IS SUPERFICIAL – MOST HAVE NOT RECEIVED TRAINING AND ONLY 1% SAW IT AS THEIR ROLE IN MANAGING WASTE.
4. 60% DO NOT FORMALLY PAY FOR WASTE COLLECTION SERVICES, AND THE REMAINING 40% PAY INFORMAL TOKENS TO THOSE WHO CART AWAY THEIR WASTE. THE MENTAL CONNECTION BETWEEN PAYMENT AND MANAGEMENT WAS NOT OBSERVED.

THIS MUST CHANGE IF INDIA IS TO SOLVE ITS WASTE CRISIS.

CONTENTS

WE CAN SOLVE THE CRISIS, BUT IT NEEDS A MENTAL RESET AND INTENSE LOCAL SUPPORT.



1. MOVE SOLID WASTE MANAGEMENT UP THE NATIONAL AGENDA.
2. EDUCATION: FROM HIGH-LEVEL LOW-TOUCH TO LOCAL IMMERSIVE CAMPAIGN.
3. SOLUTIONS EXIST BUT NEED SEGREGATION AND SUPPORT TO SCALE.
4. FOSTER MORE INCLUSIVE SOCIETIES: TAP THE POWER OF WASTE PICKERS.

1. MOVE WASTE UP THE NATIONAL AGENDA.

Managing waste can help India meet its nationally determined climate contribution by helping to

Reduce carbon emissions.

Build urban resilience.

Reduce geopolitical risk in the transition to electric mobility.

Integral part of Mission Life.

Managing waste creates over a 1-2 million new jobs across the country.

Managing waste well impacts every pillar within sustainable development goals, especially

Sustainable cities

Sustainable consumption

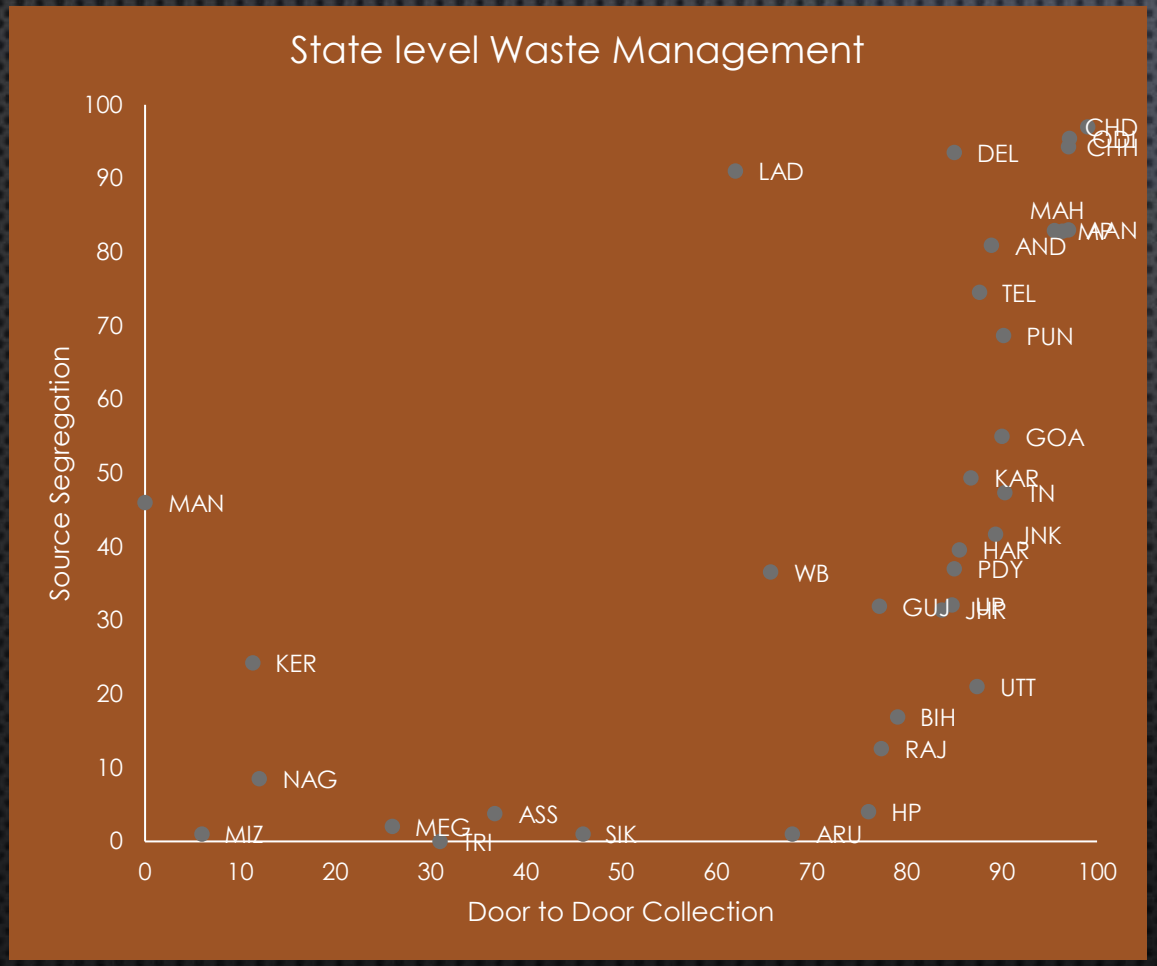
Clean energy, Climate action,

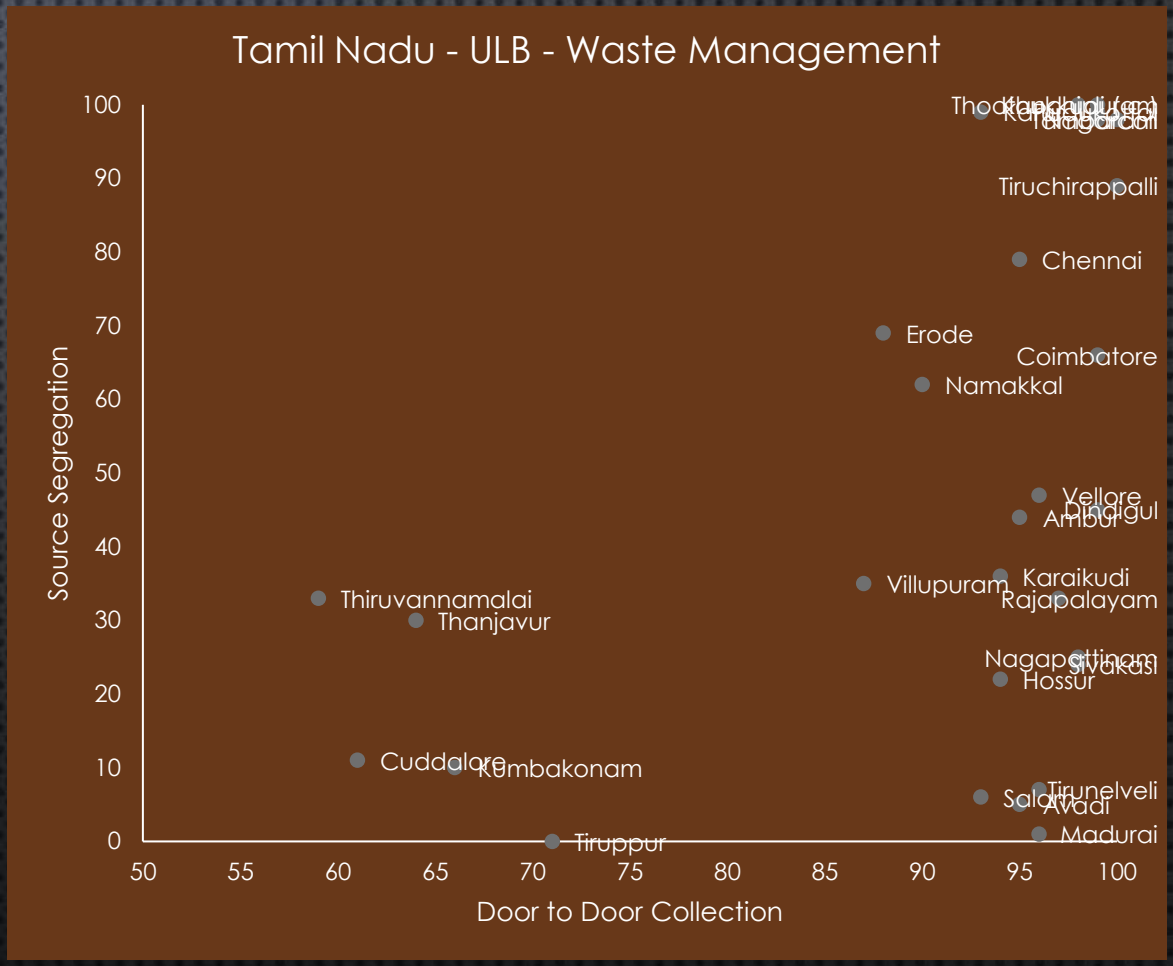
Good health. Zero Hunger

WASTE TO WEALTH NEEDS TO MOVE OFF THE PAGE AND OUT OF OUR DUSTBINS INTO CLIMATE STRATEGY.

- CAN HELP MITIGATE OVER 3% OF EMISSIONS (SOLID WASTE CONTRIBUTED TO 11% OF BENGALURU'S EMISSIONS).
- CAN HELP BUILD URBAN CLIMATE RESILIENCE.
- CONVERSELY, WHEN INDIA KEEPS FEATURING IN GLOBAL HEADLINES FOR URBAN FLOODING, THE CHANCES OF BEING REMOVED FROM GLOBAL SUPPLY CHAINS RISES.
- RECOVERING THE RARE METALS PRESENT IN E-WASTE REDUCES IMPORT DEPENDENCE IN BATTERIES.
- REDUCING FOOD WASTE REDUCES STRESS ON AGRICULTURE WHILE REDUCING HUNGER.
- MANAGING WASTE CAN CREATE 1-2 MILLION JOBS ACROSS THE LENGTH AND BREADTH IN INDIA.

SADLY, TODAY THERE EXISTS A LARGE DISPARITY IN SEGREGATION ACROSS STATES & CITIES. THE ONES THAT MANAGE THEIR WASTE WILL WIN THE BATTLE FOR QUALITY OF LIFE & GET THE JOBS THAT COME WITH IT.





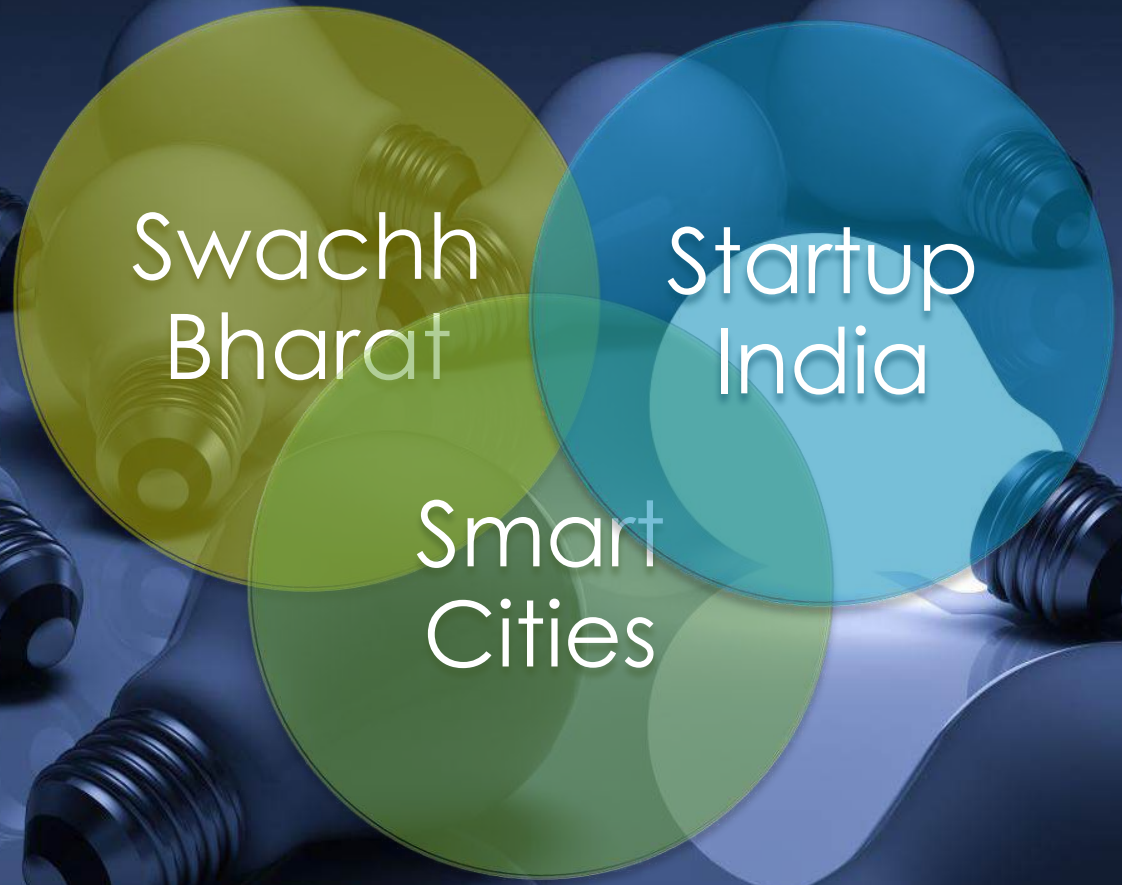
Source: Swachh Survekshan Survey results, 2023.

2. We need more cities on board. For that we need political intent backed by intense local education.

1) Why do it?
    1) For the leadership
        1) Quality of life
        2) Attract high quality talent
        3) Attract investment
        4) Carbon credits – new streams of income
    2) For the people
        1) Health, quality of life
2) What?
    1) Pilots
    2) Experiment with partnership with private entities
    3) Carrot and stick
    4) Repeat, repeat, repeat – in my language, from a person I trust

NOT JUST A HIGH LEVEL CAMPAIGN BUT CONSTANT, LOCAL, ENGAGEMENT WITH A SHOW-AND-TELL HIGHLIGHTING THE GAINS AND HARMS THAT COME FROM MANAGING WASTE WELL, A PERSON'S OWN ROLE IN SEGREGATING & PAYING FOR MANAGEMENT.

3. SOLUTIONS EXIST: PRIVATE ENTITIES (SHGS, STARTUPS, NGOS) CAN SUPPLEMENT MUNICIPAL CORPORATION EFFORTS, CREATING SCALABLE SOLUTIONS TO SOLVE THE PROBLEM. SOLUTIONS CUT ACROSS THREE FLAGSHIP GOVERNMENT INITIATIVES.



PROVEN SOLUTIONS EXIST EVERYWHERE – FROM SEGREGATION (HOUSEHOLD TO CITY-LEVEL), TO MANAGING WET WASTE, TO MANAGING DIFFERENT STREAMS OF DRY WASTE.

CASE STUDY FOR SEGREGATION, PPP, TRAINING, COLLECTION: INDORE.

- When & where: 2015, Indore.
- What worked?
  - Starting small (pilots) and trying different approaches to see what works.
  - focus on high quality service.
  - engaging civil society (800+ self help groups for training and then final segregation).
  - Leveraging every opportunity to create and reinforce awareness and training for all.
  - Adopting a carrot and stick – feeds paid by all, penalties for non-compliance.
  - politically safe space allowed for experimentation.
  - decentralized management for bulk generators.
- Achievement: 100% door to door collection and segregation. Top slot in Swachh survekshan as cleanest city for several years running; Manages 1029 tonnes per day; Earned Rs 7.45 crores from sales of carbon credit in FY22.

> " People were ready to do their part as long as they were assured of regular and reliable garbage collection services "

Source: Atin Biswas, Subhasish Parida et al. 2021, Waste-Wise Cities: Best practices in municipal solid waste management, Centre for Science and Environment and NITI Aayog, New Delhi. Indore Smart City Development Ltd., Annual report 2022.

CASE STUDY FOR SEGREGATION: HOME

Segregation becomes consistent when it is easy to do and there is monitoring

- When & where: 2015, Madurai
- What was hard? Mapping waste flows
- What worked?
  - Focussing on ease (no additional effort to segregate)
  - design to reinforce behaviour (poka yoke, essentially Japanese for mistake proofing) – no yuck factor, dustbins with no lids.
  - Regular Monitoring
  - tech to manage wet waste (compost bins, biogas)
- Achievement: 45 tonnes diverted from landfill in nine years years (17 tonnes avoided food waste by changing behaviour, 28 tonnes managed inhouse, or segregated and sold to Kabbadiwalas)

Source: SCI Analysis

SOLUTIONS TO MANAGE WET WASTE INCLUDE

- Composting.
- Anaerobic digestion to make Biogas.
- Processing by black soldier fly larvae.
- Elimination – stop waste from happening in the first place, including by
  - increasing shelf life.
  - Using alternates for damaged products.
  - Better matching of demand and supply.

COMPOSTING

What?

- Aerobic composting.
- Anaerobic composting.
- Vermicomposting.
- Processing by Black soldier fly larvae.

Why?

- Indian soils have very low organic content.
- Compost is black gold for improving the fertility and water resilience of soils.
- Far lower carbon footprint than landfills.

DONE RIGHT, ANAEROBIC DIGESTION (BIOGAS) CAN BE A POTENT SOLUTION FOR MANAGING FOOD WASTE AND LOWERING FOSSIL FUEL DEPENDENCE.

WHAT?

- WET WASTE WHEN DIGESTED BY BACTERIA IN AN ENVIRONMENT WITHOUT OXYGEN GENERATES BIOGAS (METHANE AND OTHER GASES) WHICH CAN BE THEN REPLACE NATURAL GAS.

WHY?

- DISPLACES FOSSIL FUELS, THEREBY REDUCING CARBON EMISSIONS.
- DOUBLE WIN FOR INDIA:
  - REDUCES CARBON EMISSIONS.
  - IMPROVES ATMANIRBARTA BECAUSE OF IMPORT SUBSTITUTION OF LNG.

CASE STUDY: CARBON MASTERS

- When & where: 2014, Bengaluru
- Why? Need to find scalable solutions for managing wet waste which was available in large quantities post 2012 regulation.
- What was hard? Crack the technology to make it reliable
- What worked?
  - Availability of segregated wet waste
  - Stable, scalable technology
  - Ready market for pressurised biogas
  - equity funding
- Achievement: 14875 tonnes wet waste processed in FY 24, saving 10232 tonnes of CO2-eq

Source: SCI Analysis; multiple conversations with Som Narayan, CEO, Carbon Masters. Photo: © Carbon Masters

BLACK SOLDIER FLY LARVAE

WHAT?

- GROWING BLACK SOLDIER FLY LARVAE ON FOOD WASTE AND THEN PROCESSING THE LARVAE FOR VARIOUS END USES INCLUDING:
  - ANIMAL FEED
  - FERTILIZER
  - OILS
- EXAMPLES: MULTIPLE SMALL PLAYERS (GOVERNMENT, NGO, STARTUPS)

WHY?

- READY MARKETS FOR THE END USES, ESPECIALLY ANIMAL FEED, IMPROVES THE ECONOMICS OF PROCESSING WET WASTE

Source: SCI Analysis

SCALABLE SOLUTIONS TO RECYCLE DRY WASTE

- Eliminate/replace.
  - compostable options.
  - Beware the lure of degradable plastics; beware of microplastic generation.
- Know what you are solving for – trade-offs always exist.
  - Convenience.
  - Cost.
  - Shelf life.
  - Recyclability and environmental sustainability.
- Solutions exist at scale for managing:
  - Paper, plastic (various kinds), Textile waste, E-waste.
  - Hazardous/ medical waste, construction waste, Legacy waste.
- Some types require incineration or co-processing at cement kilns.
- Be wary of greenwashing.

Source: SCI Analysis

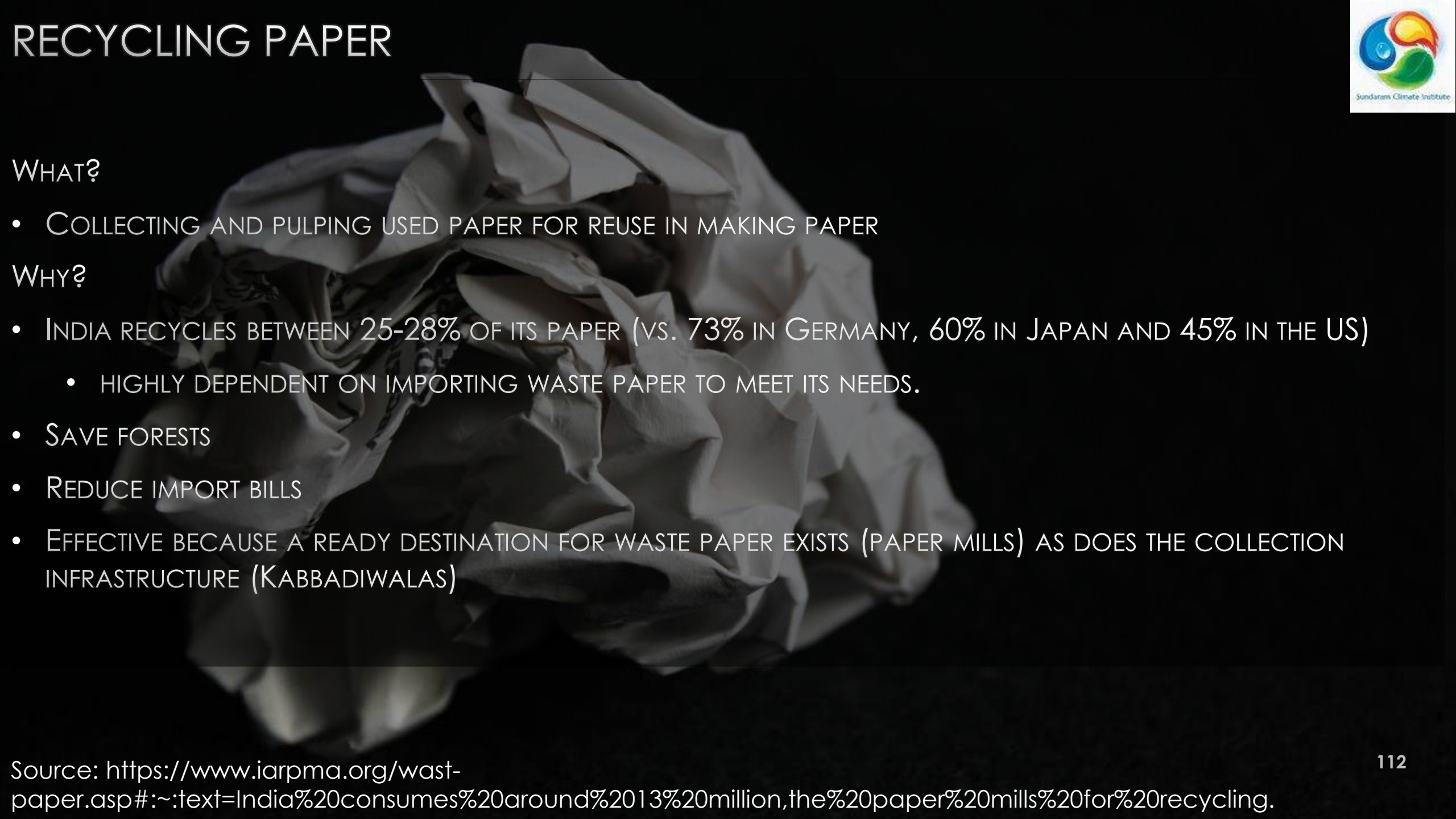
CASE STUDY: PLASTIC ROADS

- When & where: 2019, NHAI (National highway authority of India).
- Why? Need for additional destinations for single use or low value plastics.
- What was hard? Making the technology reliable.
- What worked?
  - Quality of road (long lasting, avoids maintenance costs).
  - Carbon savings.
  - Economic payback (Less maintenance costs, carbon credit possibility).
- Achievement:
  - 72.9 kilometres of road between Tindivanam and Ulundurpet using 500 tonnes of waste plastic.
  - Savings of Rs. 1.6 crore, 1500 tonnes of CO_2 emission avoided. Plastic reused = 500 million plastic bags.
  - Dr Vasudevan awarded Padma shri in 2018.
- Next steps: making paver blocks, granite replacement using plastic packaging.

"Plastic is a wonderful binder – it's up to us to make good use of it" – Dr Vasudevan

Source: Interview with Dr Vasudevan, July 2024; https://www.thehindu.com/news/cities/Madurai/national-highway-goes-the-plastic-way/article8420409.ece

RECYCLING PAPER



WHAT?

- COLLECTING AND PULPING USED PAPER FOR REUSE IN MAKING PAPER

WHY?

- INDIA RECYCLES BETWEEN 25-28% OF ITS PAPER (VS. 73% IN GERMANY, 60% IN JAPAN AND 45% IN THE US)
  - HIGHLY DEPENDENT ON IMPORTING WASTE PAPER TO MEET ITS NEEDS.
- SAVE FORESTS
- REDUCE IMPORT BILLS
- EFFECTIVE BECAUSE A READY DESTINATION FOR WASTE PAPER EXISTS (PAPER MILLS) AS DOES THE COLLECTION INFRASTRUCTURE (KABBADIWALAS)

Source: https://www.iarpma.org/wast-paper.asp#:~:text=India%20consumes%20around%2013%20million,the%20paper%20mills%20for%20recycling.

MANY FORMS OF PLASTIC AND GLASS ARE EASILY RECYCLABLE

WHAT?

- RECYCLE
  - PET EASILY RECYCLED INTO FLAKES AND THEN ONWARDS (THERE HOWEVER, EXISTS THE PROBLEM OF MICROPLASTICS).
  - MANY TYPES OF PLASTIC REGROUND INTO GRANULES/ MADE INTO TEXTILES, ROADS ETC.
  - GLASS CAN BE MELTED AND REMADE INTO GLASS.
- AVOID/ INCINERATE/CO-PROCESS
  - SOME FORMS OF PLASTIC ARE HARDER TO RECYCLE: POLYVINYL CHLORIDE, POLYSTYRENE. MULTILAYER PLASTIC
  - THE ECONOMIC INCENTIVE TO RECYCLE IS LOWER FOR LOW-VALUE PLASTICS

WHY?

- PLASTIC (BECAUSE IT SO DIFFICULT TO BREAK DOWN) IS ENVIRONMENTALLY PROBLEMATIC
- PLASTIC BURNING AND ADDITIVES CAUSE HEALTH PROBLEMS.
- SEGREGATING HAMPERED BY POOR ECONOMICS OF RECYCLING – HARMS OF POORLY MANAGED PLASTIC WASTE NOT CONSIDERED IN PRICING PLASTIC PACKAGING.

Source: SCI Analysis

CASE STUDY: KABBADIWALAS AND RECYKAL

- When & where: Everywhere in India
- Why? Divert waste from landfill.
- What worked?
  - Across the country, there are small Kabbadiwalas who collect dry waste and channel it into different use destinations. This is India's strength in waste management.
  - Recykal tapped into a network of primary Kabbadiwalas (3000+ service providers/aggregators). The EPR (extended producer responsibility) legislation spurred the demand for a verifiable source for recycled plastic. Equity funding helped build scale.
- Achievement: the solid waste ecosystem has a throughput of thousands of tonnes of waste daily. It can scale faster if segregated waste were made available to them given the tightening regulatory environment.

Source: SCI Analysis; Interaction with Srikrishna Balakrishnan, 2024.

TEXTILE WASTE IS HARDER TO RECYCLE, BUT THERE ARE STILL OPTIONS

WHAT?

- AVOIDANCE: PRICING THE TEXTILE RIGHT (INCLUDE ENVIRONMENTAL COSTS) TO AVOID BUY AND TOSS
- UPCYCLING (LESS SCALABLE) AND DONATING AT SCALE (E.G. GOONJ)
- RECYCLING
  - PRE-CONSUMER: MULTIPLE OPTIONS. HIGHLY SCALABLE.
    - HUNDREDS OF OPEN-END SPINNING MILLS RECYCLE HUNDREDS OF TONNES OF TEXTILE SCRAP INTO COLOURED "ECO" YARN DAILY. THIS YARN IS SO CHEAP, THAT IT HAS OUTCOMPETED THE YARN MADE FROM NEW MATERIALS IN SOME CATEGORIES.
  - POST-CONSUMER: FEWER OPTIONS. SEGREGATION & LOGISTICS ARE BOTH BOTTLENECKS.

WHY?

- TEXTILE SECTOR IS A MAJOR CARBON EMITTER AND WATER POLLUTER
- FAST (AND CHEAP) FASHION IS AN ENABLER OF THIS (TOO CHEAP AND IT BECOMES EASY TO WEAR ONCE AND TOSS)

Source: SCI Analysis

CASE STUDY: OPEN END SPINNING UNITS

- When & where: beginning in 2013, Tamil Nadu
- Why? Court regulation against processing (dyeing) resulted in
- What? fabric scraps from garment units being sorted by colour and shred and respun into coloured yarn.
- What worked?
  - Economics; the resultant yarn meets quality for many applications and is so much cheaper than a yarn made from new materials that it has dominated some markets.
- Achievement: hundreds of units employing thousands and creating a stable, profitable ecosystem, that avoids millions of litres of water pollution and new products. In my factories, this past year, we produced over 1500 tonnes of waste, all of which was either reused in our own process, or sold to open end mills like these and other end users. This is entirely because every gram of waste is collected separately. Waste truly becomes wealth, in our case.

Source: SCI Analysis

ELECTRONIC WASTE IS CURRENTLY A HAZARD, BUT MANAGED BETTER CAN BE A SOURCE OF NATIONAL ATMANIRBARTA

- What?
  - The world releases 62 million tonnes of e-waste every year.
  - As prime minister Modi mentioned, that's like tossing 800 laptops every second (he was speaking of 2020 numbers), with 2022 numbers – that becomes 983 laptops – a testament to the speed of growth.
  - India produces 4.1 M tonnes – 65 laptops per second. Rising very fast (up 82% from 2010).
  - Very little of e-waste is recycled: only about 22% globally with most of it through the informal sector with few controls.
  - Burning the plastic cover around wires releases dioxins.
- Why?
  - Rich source of critical minerals: copper, cobalt, nickel, but today only 1% of rare earth material comes from recycled E-waste.
- Examples: Mostly hundreds of small informal units

Source: Cornelis P. Baldé, Ruediger Kuehr, Tales Yamamoto, Rosie McDonald, Elena D'Angelo, Shahana Althaf, Garam Bel, Otmar Deubzer, Elena Fernandez-Cubillo, Vanessa Forti, Vanessa Gray, Sunil Herat, Shunichi Honda, Giulia Iattoni, Deepali S. Khetriwal, Vittoria Luda di Cortemiglia, Yuliya Lobuntsova, Innocent Nnorom, Noémie Pralat, Michelle Wagner (2024). International Telecommunication Union (ITU) and United Nations Institute for Training and Research (UNITAR). 2024. Global E-waste Monitor 2024. Geneva/Bonn; PM India, Mann Ki Baat (https://mib.gov.in/sites/default/files/Mann_ki_baat_January_2023_English.pdf), Accessed 22/7/24

CEMENT CO-PROCESSING

WHAT?

- USING RDF (REFUSE DERIVED FUEL) – ESSENTIALLY HIGH CALORIFIC CONTENT PLASTIC WASTE (HDPE, LDPE, PVC, PP, MLP, SLP) INSTEAD OF COAL IN THE CEMENT MANUFACTURING PROCESS.
- REPLACES FOSSIL FUELS.
- WITH THE CORRECT PROCESS, HARMFUL EMISSIONS CAN BE ABATED.

WHY?

- ALTERNATE DESTINATIONS FOR MLP, SLP LIMITED. THEY CANNOT EASILY BE REMADE INTO OTHER "STUFF".
- HARMFUL EMISSIONS (DIOXINS, PCB, FURANS) CAN BE AVOIDED WITH RIGHT CONTROLS.
- PREVENTS PLASTIC FROM BEING BURNED OR DUMPED INTO THE OCEAN.
- REDUCES GREENHOUSE GAS EMISSIONS OF CEMENT PLANTS.

- EXAMPLE: MOST CEMENT PLANTS.

Source: SCI Analysis

LEGACY WASTE: MANAGING LANDFILLS

WHAT?

- USING GIANT MECHANICAL SIEVES TO SEPARATE PLASTIC, METAL AND TEXTILES FROM INERT MATERIAL IN LANDFILLS.

WHY?

- PUSHBACK AGAINST LANDFILLS FROM SURROUNDING COMMUNITIES.
- RISING LAND VALUE.
- VALUE IN REFUSE-DERIVED FUELS (ESSENTIALLY THE PLASTIC MATERIAL) AND METALS.
- CAUTION: WHILE REMEDIATING LANDFILLS, THE INERT MATERIAL SHOULD NOT BE MARKETED AS COMPOST BECAUSE IT HAS LIKELY BEEN CONTAMINATED.
- EXAMPLES: BIOMINING COMPANIES

Source: SCI Analysis

APART FROM THE POSITIVE IMPACT ON ENVIRONMENTAL AND HUMAN WELLBEING AND THE ENORMOUS VALUE CREATED, MANAGING WASTE IS A POWERFUL JOB-CREATION ENGINE.

- IF WE MANAGE JUST 10% OF THE WASTE THAT IS CURRENTLY BURNED IN INDIA, WE COULD CREATE BETWEEN **100,000-200,000 JOBS**.
- IF WE ELIMINATED WASTE BURNING ALTOGETHER BY MANAGING WASTE, WE WOULD CREATE **1.2 MILLION JOBS**.
- ADDITIONALLY, IF WE MANAGED THE WASTE THAT IS CURRENTLY DUMPED/LANDFILLED, WE WOULD CREATE **AN ADDITIONAL 0.7 MILLION JOBS**.
- THESE ARE JOBS THAT WOULD BE CREATED ACROSS THE LENGTH AND BREADTH OF COUNTRY AND COULD EMPLOY PEOPLE RIGHT AWAY WITH MINIMAL TRAINING.

Source: SCI Analysis and expert opinions. Burning estimates taken from Chaudhary, Pooja, Saryu Garg, Tess George, Muhammed Shabin, Sneha Saha, Subodh Subodh, and Baerbel Sinha. "Underreporting and open burning–the two largest challenges for sustainable waste management in India." Resources, Conservation and Recycling 175 (2021): 105865. Number of jobs calculated as follows: Burned waste quantity multiplied by percentage to get managed quantity: this is divided into categories of waste and then multiplied by the minimum/maximum jobs created per tonne in managing that category of waste. Jobs include logistics, sorting, shredding and processing. The burned quantity estimated by the paper is a highly conservative of several attempts to quantify this inherently large and uncertain number. The informal sector employed more people per tonne of waste processed, but as the sector becomes formalized with a higher technology footprint, the number of jobs will fall.

TO UNLOCK THIS BOUNTY, WE NEED WASTE TO BE SEGREGATED (AT LEAST) INTO WET, DRY AND HAZARDOUS FRACTIONS.

TODAY, THERE ARE SEVERAL BOTTLENECKS TO SEGREGATION.

- SEEN AS BEING DIFFICULT TO DO.
- MOST DON'T QUITE UNDERSTAND WHY ONE MUST SEGREGATE WASTE OR HAVE NOT RECEIVED TRAINING ON HOW EASIEST TO DO SO.
- REQUIRES HIGHER INVESTMENT IN TRAINING, COLLECTION & MONITORING.

AND SO, TODAY, MOST OF INDIA'S RECYCLING RELIES ON WASTE PICKERS WHO WORK UNDER THE MOST APPALLING CONDITIONS. WE FOUND:

- Most recycling today is done by the weakest of the society (45% with no education; 45% with only primary education).
- Most live in a shack with a tin roof, some live on the street, very few with their families; Almost all are dependent on other's support to meet their food needs.
- 75% of the respondents said they chose this job because of a lack of other options, or because their family chucked them out. Surprisingly, 25% said they prefer this line of work. 60% citied community issue for choosing this line of work; Almost all would choose another line of work if they had an option.
- Many of them had been doing this work for 1-2 years, although a couple of women said they had been doing this all their lives.
- Average income Rs. 220 per day (Rs. 100-350 per day).
- Half the waste pickers we spoke to had some protection (gloves and masks), while the other half did not have any protection. One even said she began taking drugs as a form of protection. We observed no children working in our survey area.
- When we asked if they had any infection, 30% refused to answer anything. One had a finger removed because of infection; pain , allergies , asthma were problems. Heart-breakingly, one was pregnant.

Source: SCI Waste Picker Study, 2024, n=22

CASE STUDY: HASIRU DALA

- When & where: 2010, Bengaluru
- What worked?
  - Single overriding objective: Improve the lives of waste pickers.
  - Working with government.
  - Shifting approach from 'fighting fires' to approaching Lok Adalat to secure occupational identity cards and formal recognition of role played by waste pickers (so that they are allowed to freely collect waste).
  - Showing economic contribution of waste pickers: savings of Rs. 84 crore (in collection and transportation) annually in solid waste management by BBMP.
  - Setting up dry waste collection centres (DWCC) to provide a secure, efficient work environment in collaboration with the government.
  - Working with other sister organizations & governments to include waste pickers in solid waste management rules, 2016.
  - Worked with Local governments to facilitate dry waste management in 84 DWCC across Karnataka.
- Achievement: identity cards to over 12000 waste pickers, setting up 84 DWCC; diverted 136,246 tonnes of waste from landfills since inception. Work with 20,000+ children of waste pickers.

Source: Press articles, https://hasirudala.in/about/impact/, Multiple interviews with Nalini Shekar; Photo courtesy: Hasiru Dala

TO PRACTISE EFFECTIVE SEGREGATION AT SCALE TAKES INTENT, STABILITY, PUBLIC-PRIVATE-PARTNERSHIPS (PPP) AND MONEY. MOST MUNICIPALITIES FALTER IN MEETING ONE OR MORE OF THESE REQUIREMENTS.

- Our study stays that people pay, on average , between Rs. 10-20 per month as an informal token to waste collectors. Very few, if any, were aware of the need to pay the corporation for waste collection and management.
- Per Ahluwalia et al and the RBI, many municipalities suffer from financial constraints – Municipal revenue as a share of GDP hovered about 1% for a decade up to 2017-18 (latest data available) in India compared to 6% in south Africa and 7.4% in Brazil. Moreover,
  - 60% of municipal revenue comes from property tax.
  - Own revenue share within overall revenue is only 0.43% (and falling)
- But lack of funding is only part of the story. Per janagraha, the average tenure of a municipal commissioner in India has been less than one year. In Madurai this past year, average tenure has been <6 months.
- Cities with stable leadership and extensive PPP tend to be better in managing their waste (examples include Indore, Mysuru, Pune)
- Households must understand their role – segregate and pay a basic minimum per month to manage not merely collect their waste. This needs constant education and reinforcement.

Source: SCI Waste and Water Study, 2018-2023; n= 399 (only included responses that said they paid and gave a monthly figure for payment made).; Ahluwalia, I. J., Mohanty, P., Mathur, O., Roy, D., Khare, A., & Mangla, S. (2019). Study of Municipal Finances in India, A study prepared for the Fifteenth Finance Commission. Delhi: ICRIER.; Reserve Bank of India, 'Report on Municipal Finances', 2022. Gupta, S & Sachdeva, R., "Revisiting the role of funding: Lessons from expenditure and performance on cleanliness in Indian cities
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WHILE THERE ARE PROMISING SIGNS…

- Strong progressive, regulation, including solid waste management rules, Swachh survekshan, Swachh Bharat investments, Plastic management rules, such as the obligation for use of recycled plastic content (from 30% for category I users in 2025-26 to 60% in 2028-29 onwards), creates a "pull" effect by creating a stable demand for recycled materials.
- Scalable solutions in "how" in both segregation and destinations exist.
- Startup community – entrepreneurs, ecosystem players and investors, are wading in.

BUT A BETTER FUTURE DEPENDS ON IF WE PLAY OUR PART

- UNDERSTAND HOW POORLY MANAGED WASTE HURTS US – SPECIFICALLY, BURNING WASTE IS NOT THE SOLUTION; INDEED, IT MAY BE THE MOST HARMFUL THING WE CAN DO FOR OUR HEALTH.
- ACKNOWLEDGE THE UNACCEPTABLE REALITY OF WASTE PICKERS, AND THE ROLE WE PLAY IN PERPETUATING THIS REALITY.
- REQUIRE PRODUCT AND SERVICE PROVIDERS TO MANAGE THEIR WASTE.
- SEGREGATE AND PAY FOR MANAGEMENT.

“ INTO THAT HEAVEN OF FREEDOM, MY FATHER, LET MY COUNTRY AWAKE

RABINDRANATH TAGORE ”

ACKNOWLEDGEMENTS

In 2018, when we spoke to a woman in a small bye lane of Madurai about her lived water and waste experience, we did not foresee that six years hence, we would be releasing this report. We began our exercise to try and understand what the ground realities of waste and water were in India. Our journey would have not been possible without the encouragement and guidance we received.

This report rests on the tireless efforts of the researchers of Sundaram Climate Institute, led by Malathy Dhivakar and team. They knocked at stranger's doors, braved chases by stray dogs and hooligans, to patiently document the waste and water realities of over two thousand people and gather groundwater depths from thousands more. That's a herculean task, and I thank them. Thanks to Ananth Krishna for his research into the lives of waste pickers and transforming that into art, including the painting that graces the cover of this report. None of us could have done this without our families' unwavering support over the years. We also wish to thank the staff of Southern Roadways Ltd., Sundaram Textiles (P) Ltd. and Dattatreya Textiles (P) Ltd. for their assistance throughout this study.

Our understanding has been deepened by countless interactions with scores of startups, academics, NGOs and social enterprises over the years. I would especially like to thank Prasad Modak, R. Vasudevan, Nalini Shekhar, Som Narayan, Srikrishna Balakrishnan and Bharath krishna sankar for their useful remarks while finalizing the report.

Finally, we extend our heartfelt thanks to the citizens who opened their doors, shared a cup of tea, and allowed us a glimpse into their lives. This report is dedicated to them. Our studies have revealed that there exists a world beyond the well-trodden path, and this world has surprises that hold the key to building India's water resilience.

Mridula Ramesh, Founder, Sundaram Climate Institute, 2024.

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