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INDIA-NORWAY COOPERATION  
PROJECT ON CAPACITY BUILDING FOR  
REDUCING PLASTIC AND CHEMICAL  
POLLUTION IN INDIA (INOPOL)

# REDUCING PLASTIC POLLUTION IN TAMIL NADU, INDIA

## A SCIENCE-BASED STRATEGY



## **INOPOL (2026) Reducing Plastic Pollution in Tamil Nadu, India: A Science-Based Strategy**

This report uses evidence gathered under the INOPOL project to propose a science-based strategy for managing plastic waste and pollution in Tamil Nadu. It provides a synthesis of current knowledge and new monitoring and modelling results, an analysis of key systemic and stakeholder-specific challenges and opportunities, and a practical, phased strategy and implementation roadmap tailored to Tamil Nadu's regulatory and socio-economic context.

### **Acknowledgements**

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The research presented in this report was carried out under the scope of the India-Norway cooperation project on capacity building for reducing plastic and chemical pollution in India (INOPOL), under the Marine Pollution Initiative developed by the two governments and funded through the Norwegian Development Assistance Program to Combat Marine Litter and Microplastics. The INOPOL group would like to thank the project owner, the Royal Norwegian Embassy in New Delhi, and the Norwegian Ministry of Foreign Affairs (MFA) for funding and supporting the project.

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## Foreword

**ANDREAS B. SCHEI**

**COUNSELLOR FOR CLIMATE & ENVIRONMENT,  
ROYAL NORWEGIAN EMBASSY IN NEW DELHI**

I am pleased to present this report titled '*Reducing plastic pollution in Tamil Nadu: A science-based strategy*', developed under the India–Norway Cooperation Project on Capacity Building for Reducing Plastic and Chemical Pollution in India (INOPOL). As the second phase of this partnership concludes, the report highlights the importance of robust, science-based systems for monitoring and reporting to develop management measures to mitigate plastic pollution.

Through the India–Norway Marine Pollution Initiative, our two countries have strengthened collaboration to address marine and plastic pollution. INOPOL is part of the initiative and is significantly contributing for better outcomes through training, programmes, participatory research and good quality reports.

This strategy report demonstrates that strong cooperation between Indian and Norwegian technical institutions can generate scientific knowledge that can lead to practical pathways for action. My best wishes to all the project partners in bringing out this important report.

**Andreas B. Schei**

Counsellor for Climate & Environment, Royal Norwegian Embassy in New Delhi

## Foreword

**THORJØRN LARSEN**

DEPUTY CHIEF EXECUTIVE OFFICER,  
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Plastic pollution is a systemic challenge that cuts across environmental protection, public health, and resource efficiency. It is therefore a pleasure to introduce the report '*Reducing plastic pollution in Tamil Nadu: A science-based strategy*', developed under the INOPOL project.

For NIVA, this report reflects a core institutional priority: strengthening the role of science in guiding environmental policy and practice. Through environmental monitoring, modelling, and system analysis, the INOPOL partnership has generated an evidence base that can support more effective plastic waste and pollution management in Tamil Nadu and beyond.

I would like to express my sincere appreciation to our Indian partners – Mu Gamma Consultants, SRM Institute of Science and Technology, Toxics Link, and CIPET – for their close collaboration, and to the Royal Norwegian Embassy in New Delhi for its consistent support and trust in NIVA's scientific leadership. On behalf of NIVA, I extend my sincere thanks to the Embassy and the Ministry of Foreign Affairs for their trust and commitment to long-term capacity building. I hope this report will serve as a practical reference for policymakers, practitioners, and researchers working to reduce plastic pollution and strengthen sustainable waste-management systems.

**Thorjørn Larsen**

Deputy Chief Executive Officer, Norwegian Institute for Water Research

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## List of ABBREVIATIONS AND ACRONYMS

AMRUT	Atal Mission for Rejuvenation and Urban Transformation		capacity building for reducing plastic and chemical pollution in India
BIS	Bureau of Indian Standards	ISO	International Organization for Standardization
CAG	Civic Action Group	IT	Information Technology
CIPET	Central Institute of Petrochemicals Engineering and Technology	KPIs	Key Performance Indicators
CPCB	Central Pollution Control Board	MFA	Norwegian Ministry of Foreign Affairs
CSR	Corporate Social Responsibility	MGC	Mu Gamma Consultants Private Limited
csv	Comma-separated values	MIS	Management Information System
DoE&CC	Department of Environment and Climate Change	MoEFCC	Ministry of Environment, Forest and Climate Change
DOI	Digital Object Identifier	MPLADS	Member of Parliament Local Area Development Scheme
DRDA	District Rural Development Agency	MRFs	Material Recovery Facilities
E&F	Environment & Forest	MSMEs	Micro, Small and Medium Enterprises
EPR	Extended Producer Responsibility	NAMASTE	National Action for Mechanised Sanitation Ecosystem
FICCI	Federation of Indian Chambers of Commerce and Industry	NGT	National Green Tribunal
GDP	Gross Domestic Product	NIVA	Norwegian Institute for Water Research
GOs	Government Orders	OECD	Organisation for Economic Co-operation and Development
GPS	Global Positioning System	PERSiST	Precipitation, Evapotranspiration and Runoff Simulator for Solute Transport
IEC	Information, Education and Communication	PIB	Press Information Bureau
IIT	Indian Institute of Technology	POPs	Persistent Organic Pollutants
IKHAPP	International Knowledge Hub against Plastic Pollution	PPP	Public-Private Partnerships
INCA	Integrated Catchment Model		
INOPOL	India-Norway cooperation project on		

PWM	Plastic Waste Management	TAPMA	Tamil Nadu Plastic Manufacturers Association
PWMUs	Plastic Waste Management Units	TNGCC	Tamil Nadu Green Climate Company
R&D	Research and Development	TNPCB	Tamil Nadu Pollution Control Board
SBM	Swachh Bharat Mission	TNUIFSL	Tamil Nadu Urban Infrastructure Financial Services Limited
SBM(U)	Swachh Bharat Mission Urban	TPA	Tonnes Per Annum
SHGs	Self-Help Groups	TPD	Tonnes Per Day
SRMIST	SRM Institute of Science & Technology	ULBs	Urban Local Bodies
SUP	Single-use plastic	WtE	Waste-to-Energy
SWM	Solid Waste Management		



## | Preface

This report has been developed under the India-Norway cooperation project on capacity building for reducing plastic and chemical pollution in India (INOPOL). INOPOL is a collaborative initiative between Indian and Norwegian institutions, aimed at strengthening scientific, institutional, and policy-focused capacity to address plastic and chemical pollution from major sources in India. The project is led by the Norwegian Institute for Water Research (NIVA) in partnership with Mu Gamma Consultants Pvt. Ltd. (MGC), the SRM Institute of Science and Technology (SRMIST), Toxics Link, and the Central Institute of Petrochemicals Engineering and Technology (CIPET).

INOPOL Phase I (2019–2022) focused on the industrial regions of Surat and Vapi in Gujarat, where the project examined land-based sources, riverine transport, and the leakage of plastics and persistent organic pollutants (POPs), along with their socio-economic drivers and impacts. Building on this foundation, Phase II has taken a more solution-oriented and integrated approach, with a focus on the states of Tamil Nadu and Uttarakhand. This phase emphasises targeted mitigation measures, strengthened monitoring and modelling, and closer engagement with regulatory bodies, local authorities, industry actors, and communities. Across both phases, INOPOL combines environmental monitoring, socio-economic analysis, and policy assessment to generate science-based evidence that supports decision-making at local, state, and national levels. The project contributes to ongoing policy processes related to plastic waste management, including the implementation of single-use plastic restrictions, Extended Producer Responsibility (EPR), and India's engagement in international negotiations on plastics and chemicals, including the global plastics treaty.

The aim of this report is to develop a comprehensive and actionable strategy based on ground realities for improving plastic waste management in selected Indian states and regions. The report aims to shed light on the systemic challenges to responsible management of plastic waste and elucidate the environmental, health, and socio-economic costs associated with its mismanagement. Specifically, the report assesses the current status of plastic waste management systems, including collection, segregation, recycling, and disposal practices; examines policy and regulatory frameworks governing plastic waste, with particular attention to implementation gaps under the Plastic Waste Management Rules and EPR mechanisms; and draws on scientific evidence and socio-economic insights to support policy development and alignment with national and international commitments on plastics and chemicals. These elements support efforts to strengthen institutional and technical capacity among local authorities, MSMEs, and other key stakeholders, as well as to advance more effective, inclusive, and sustainable approaches to plastic waste management.



# Executive SUMMARY

Plastic pollution is increasing rapidly across the globe, with growing implications for ecosystems, human health, livelihoods, and sustainable development. Across the full lifecycle of plastics, from extraction of fossil and bio-based feedstocks, through production and consumption, to waste management and environmental leakage, plastics generate environmental pressures and socio-economic risks that are unevenly distributed across places and populations. These challenges are becoming more complex in the context of rising production and consumption, international waste trade, and the proliferation of low-value and difficult-to-recycle plastic products.

Tamil Nadu stands at the forefront of this challenge. As one of India's most industrialised and urbanised states, it hosts a large and diverse plastic manufacturing sector and generates the highest volume of plastic waste nationally. Official data indicate that Tamil Nadu generated approximately 7.8 lakh tonnes of plastic waste in financial year 2022–23, accounting for nearly one-fifth of India's total plastic waste generation. While reported collection rates are high, field monitoring and modelling evidence shows that plastic leakage into rivers, settlements and informal dumping sites persists, with significant environmental and social consequences.

This report has been developed under the India-Norway cooperation project on capacity building for reducing plastic and chemical pollution in India (INOPOL). It brings together environmental monitoring, catchment-scale modelling, policy analysis, and socioeconomic insights to propose a science-based strategy for reducing plastic pollution and strengthening plastic waste management in Tamil Nadu. Building on earlier baseline work, it combines new empirical evidence from the Cauvery

River basin with an assessment of regulatory frameworks, implementation challenges and stakeholder roles, translating these insights into a practical, phased strategy and implementation roadmap tailored to the state's institutional and socio-economic context.

A central contribution of the report is the generation of new evidence on macroplastic pollution in the Cauvery River. Field monitoring conducted across multiple sites and seasons shows that plastic pollution is closely linked to urban centres, areas of intense human–river interaction, and high-flow events during monsoon periods. Packaging waste – particularly food packaging, sachets, and thin plastic carrier bags – dominates the observed plastic flows and accumulations, indicating municipal solid waste as a key source of pollution. Despite bans on several single-use plastic items, a substantial share of plastic observed in the river consists of items that are formally prohibited, highlighting persistent challenges related to compliance and enforcement.

Complementing the pollution monitoring, the report provides insights from an integrated catchment model for the Cauvery river basin that enables scenario testing of how changes in population, waste generation, mismanagement rates, and mitigation measures affect plastic transport and retention. The monitoring and modelling results demonstrate that plastic pollution is influenced by a combination of infrastructural gaps, behavioural practices, hydrological dynamics, and institutional constraints, underlining the need for responses that go beyond technical fixes.

Based on this evidence, the report sets out a strategic framework for plastic waste management that prioritises strengthening the implementation of

existing measures, addressing persistent gaps and emerging risks, and steering future action towards reduced plastic use and environmental exposure. The strategy focuses on improving coherence, coordination and effectiveness across the plastic lifecycle. It distinguishes between measures that are already in place, areas where implementation remains uneven, and strategic priorities required to achieve more durable outcomes.

Key strategic directions include consolidating the enforcement of single-use plastic bans, strengthening Extended Producer Responsibility systems to ensure accountability and traceability, upgrading and better integrating Plastic Waste Management Units (PWMUs) with local recycling markets, investing in monitoring and data systems to guide targeted interventions, and embedding behavioural change through sustained

engagement with communities, self-help groups, and informal workers. The strategy adopts a phased implementation approach, supported by a clear timeline, defined milestones, resource planning, and measurable indicators.

Overall, this report provides a science-based, context-sensitive roadmap for reducing plastic pollution in Tamil Nadu. By linking empirical evidence with practical implementation guidance, it aims to assist policymakers, regulators, local authorities, and other stakeholders in translating regulatory ambitions into meaningful and equitable outcomes. While the challenges remain significant, the report shows that targeted investments, coordinated governance and sustained engagement can substantially reduce plastic leakage and contribute to a more circular and inclusive plastics economy.





# CHAPTER 1

## INTRODUCTION

Plastic pollution represents one of the most pressing sustainability challenges of the twenty-first century, with far-reaching implications for ecosystems, human health, livelihoods, and climate change. Global plastic waste generation is projected to nearly triple by 2060, while the accumulation of plastics in rivers, lakes, and oceans is expected to increase even more rapidly (OECD, 2022). These trends reflect not only rising consumption but also systemic failures across the plastics lifecycle, from production and product design to waste management and environmental leakage.

Addressing plastic pollution therefore requires more than isolated interventions. While bans on selected products, recycling initiatives, and clean-up efforts are important, evidence increasingly shows that long-term change depends on coordinated, system-wide approaches that link upstream prevention, midstream waste management, and downstream environmental protection. Such approaches must also recognise the social and economic dimensions of plastic pollution, including its uneven exposure to risks and the central role played by informal and small-scale actors across the value chain.

In India, these challenges are particularly acute. Recent estimates suggest that the country is now the world's largest contributor to plastic waste leakage, generating approximately 9.3 million tonnes of plastic waste annually (Cottom et al., 2024). Tamil Nadu exemplifies both the scale of the problem and the complexity of potential solutions. As one of India's most prominent industrial and urban hubs, the state hosts a large and diverse plastics manufacturing sector, ranging from small-scale enterprises to major industrial units (Business Standard, 2017; The Hindu, 2022c). Industrial centres such as Chennai, Coimbatore, and Madurai have fuelled rapid growth in plastic production, making Tamil Nadu a significant

contributor to India's plastics economy.

At the same time, the scale of waste generation places considerable pressure on existing management systems. According to the Tamil Nadu Pollution Control Board's Annual Report (2022–2023), the state generates an estimated 2,144 tonnes of plastic waste per day, of which around 2,063 tonnes are collected, and 1,930 tonnes are processed (TNPCB, 2023). With 21 Municipal Corporations, 140 Municipalities and 536 Town Panchayats, all Urban Local Bodies operate plastic waste management systems covering collection, segregation, channelisation, and processing. These figures point to important institutional efforts, but they also reveal a structural tension: high reported collection rates coexist with persistent environmental leakage, especially into rivers, settlements, and informal dumping sites.

Tamil Nadu's vulnerability to plastic pollution is further shaped by its diverse geography, which includes extensive wetlands, a long coastline, and monsoon-driven river systems. Evidence from the Cauvery River basin illustrates how plastic pollution is mobilised and redistributed through seasonal flows and interactions between urban activities, practices, and the river. Monitoring shows that plastic leakage is not only a function of infrastructure gaps but also behavioural patterns, institutional constraints, and uneven enforcement. These patterns highlight that strengthening plastic waste management is not only a technical challenge but also a governance and societal one, requiring coordinated action across departments, levels of government, and stakeholder groups.

The report brings together environmental monitoring, catchment-scale modelling, policy analysis, and

socioeconomic insights to provide a robust evidence base for action. It builds on earlier baseline assessments while generating new empirical data on macroplastic pollution in the Cauvery River and situates these findings within a broader analysis of regulatory frameworks, implementation gaps, and stakeholder roles.

The central purpose of the report is to translate this evidence into a science-based and context-sensitive strategy for reducing plastic pollution and strengthening plastic waste management in Tamil Nadu. The strategy focuses on enhancing the effectiveness of existing measures, such as single-use plastic restrictions, Extended Producer Responsibility systems, and decentralised Plastic Waste Management Units, while addressing persistent gaps and emerging risks across the plastic lifecycle.

The report adopts a phased and adaptive approach. It recognises that immediate priorities lie in strengthening enforcement, monitoring, and institutional coordination, while a longer-term

transformation depends on reducing plastic use, improving circularity, and embedding behavioural change across society.

Particular attention is given to the roles of micro-, small-, and medium enterprises, informal workers, and community organisations, whose contributions are essential for translating policy ambition into practice. By linking scientific evidence with strategic planning and implementation guidance, this report positions plastic pollution not only as an environmental issue but also as a systemic governance challenge and an opportunity to advance more inclusive, resilient, and sustainable waste-management systems.

The chapters that follow move from evidence (Chapter 2) to system analysis (Chapter 3) and strategic direction (Chapter 4), before concluding with reflections on institutional learning and pathways forward (Chapter 5). Together, they aim to support policymakers, regulators, and practitioners in advancing coordinated, effective, and socially grounded responses to plastic pollution in Tamil Nadu.





# CHAPTER 2

## EVIDENCE BASE: MACROPLASTIC MONITORING AND MODELLING IN TAMIL NADU

### 2.1 State and catchment plastic waste generation

#### 2.1.1 Municipal Solid Waste

The State of Tamil Nadu is divided into 481 Town Panchayats, 141 Municipalities, and 25 Corporations. In the Financial Year 2024–2025, Tamil Nadu generated an average of 16,563 tonnes of municipal solid waste per day, equivalent to approximately 6.05 million tonnes annually. Of this, around 9,303 tonnes per day were treated, while 7,260 tonnes were disposed of at local dumpsites (TNPCB, 2025). Door-to-door collection for solid waste is carried out in 22 corporations, 140 municipalities, and 466 town panchayats, while the segregation of solid waste is carried out in 7 corporations, 61 municipalities, and 259 town panchayats (Ibid.).

The Greater Chennai Corporation reports collecting 6,150 tonnes of municipal solid waste per day through door-to-door systems (Greater Chennai Corporation, n.d.). With a population of around 6.75 million, the waste generated by the Greater Chennai Corporation corresponds to approximately 0.91 kg per person per day. The above figure places the Greater Chennai Corporation as one of the highest per capita waste generators in India. However, there has been a reduction from the 2015 figure of 1.01 kg/capita/day, which was the highest in India at that point (Dutta & Jinsart, 2020).

#### 2.1.2 Plastic Waste

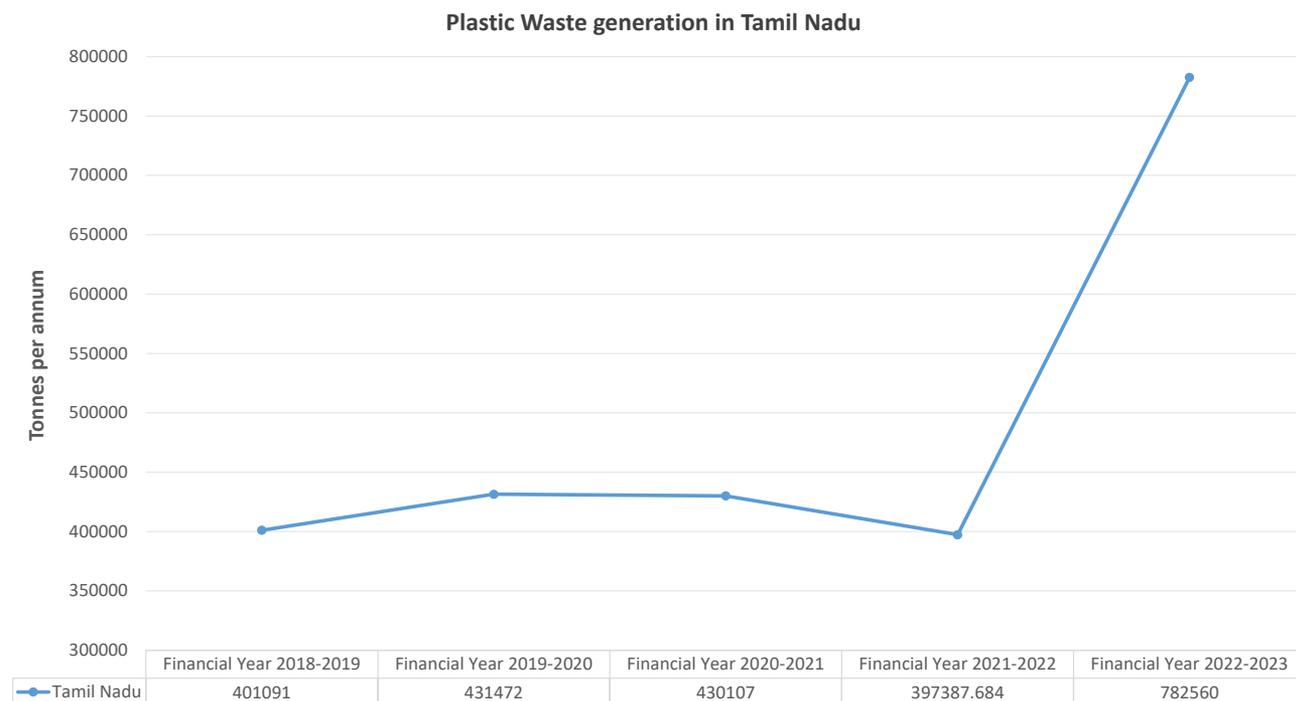
The contribution of Tamil Nadu to India's plastic waste crisis has significantly escalated in the

past five years. The figure below reflects the data submitted by the Tamil Nadu Pollution Control Board (TNPCB) to the Central Pollution Control Board (CPCB) and collated in response to the Indian Parliamentary enquiries regarding India's plastic waste generation. The state generated approximately 7.82 lakh tonnes of plastic waste annually during the Financial Year 2022-2023, which is significantly higher than the previous years. In that year, about 2,144 tonnes of plastic waste were generated daily, 2,063 tonnes were collected, and 1,930 tonnes were processed (TNPCB, 2023). This indicates that 96.22% of the plastic waste is collected, and 90% of it is processed. 96% of this waste is gathered and diverted for recycling and other uses. The state collected 753,633 tonnes of plastic waste, of which about 156,501 tonnes were recycled.

At the national level, India generated between 3.3 and 4.1 million tonnes of plastic waste annually between 2018 and 2023 (MoEFCC, 2024). Over this period, Tamil Nadu consistently accounted for 10-12% of the national plastic waste generation, with its share rising to 19% in the most recent year (2022-23). This trend underscores the state's growing significance in shaping both the scale of India's plastic waste challenge and the effectiveness of national responses.

#### 2.1.3 Cauvery River Basin Plastic waste generation

The Cauvery River, which flows through Tamil Nadu (which has 54% of the basin, including the Karaikkal



**Figure 1.** Tamil Nadu Plastic Waste Generation in the last five years in tonnes per annum (TPA)(Source: MoEFCC, 2024)

region of Puducherry), Karnataka (42%), Kerala (4%), and the Union Territory of Puducherry, is known as a hotspot for pollution and is contaminated by plastic and chemical waste (INOPOL, 2025).

**Nagapattinam district, Tamil Nadu:** This district, which includes the municipality of Nagapattinam, includes the towns of Nagapattinam and Nagore. The average municipal solid waste generated per person per day is 500 grammes. The estimated quantity of waste generated per day in the municipal area is 55 tonnes. Approximately 10% of this total, equating to 5.5 tonnes, consists of plastic waste (Nagapattinam Municipality, n.d.). The Mathirimangalam village panchayat in Nagapattinam district generates 0.17 TPD of waste (INOPOL, 2025). The Plastic Waste Management (PWM) Unit in Mudikandanallur Village was set up in 2020, serving four habitations within the village, catering to 1031 households and a population of 3664. Currently serving about 57 Village Panchayats, the PWM Unit is run by a team of three women. About 110 kg of plastic garbage is

shredded out of the 150 kg of debris that is collected daily. To date, 22 tonnes of plastics have been shredded and sold to road contractors for Rs. 35 each, bringing in a total of Rs. 758,234 (SBM Gramin, 2021).

**Mayiladuthurai district, Tamil Nadu:** Mayiladuthurai has been established as an independent district (bifurcated from Nagapattinam in 2020), which includes 2 municipalities (Mayiladuthurai & Sirkali), 4 town panchayats, and 241 village panchayats (Mayiladuthurai District Administration, n.d.). The Mayiladuthurai Municipality generates an average of 38 tonnes per day of municipal solid waste (Mayiladuthurai Municipality, n.d.), whereas the Sirkali Municipality generates an average of 14 tonnes per day of municipal solid waste (Sirkali Municipality, n.d.). Rajagopalapuram Village in Kuthalam Town Panchayat produces 1.12 TPD of dry waste, with 0.03 TPD being sold to designated vendors and 0.69 TPD of non-recyclable waste being disposed of at regular intervals (INOPOL, 2025).

Dindigul district, Tamil Nadu: The Dindigul City municipal area in 2023 is estimated to generate 114.32 tonnes per day, of which 77.73 tonnes per day is organic waste. The waste generated in 2018 is 103.20 tonnes, out of which 7 tonnes are plastic (6.73%). Therefore, the city's prioritisation of managing organic waste is evident through the establishment of their Centralised Bio Methanization Plant, which has a capacity of 5 tonnes per day, and their microbial compost plant, which can process 57 tonnes per day (Dindigul City Municipal Corporation, 2019).

The Plastic Waste Management Unit was established in Panjampatti village in 2013, generating approximately 250 kg of plastic waste by 2021, with a daily shredding output of 150 kg. As of 2021, around 86,000 kg of plastic has been used for road construction, resulting in a total revenue of Rs. 22 lakh (SBM Gramin, 2021).

Erode district, Tamil Nadu: The generation of municipal solid waste in Erode City Municipal Corporation is approximately 165 tonnes per day, out of which 75 tonnes are biodegradable wet waste, 70.50 tonnes are non-saleable dry waste, 2 tonnes are saleable dry waste, 0.20 tonnes are e-waste, 0.30 tonnes are domestic hazardous waste, 2 tonnes are construction and demolition waste, and the remaining 15 tonnes are inert (NGT, 2020). The Erode City Municipal Corporation has also cleared approximately 80,850 m<sup>3</sup> of the legacy waste dumped at the Vairapalayam dump site on the right bank of the River Cauvery. The Corporation assured the National Green Tribunal that it has cleared approximately half of the 600,000 m<sup>3</sup> of solid waste at the Vendipalayam dump site and will clear the rest by the end of 2021 (NGT, 2021).

Tiruvarur district, Tamil Nadu: The district headquarters, the city of Tiruvarur, produces 22 tonnes of municipal solid waste (Tiruvarur Municipality, 2025). As per the MIS data filled out by cities in the Swachhatam Portal, the urban local

bodies (ULBs) in the district have reported the following amount of waste generated daily in the 11 ULBs: Muthupettai 6.26 tonnes, Thiruthuraiipoondi 7.90 tonnes, Mannargudi 22.00 tonnes, Koothanallur 7.00 tonnes, Needamangalam 2.90 tonnes, Thiruvarur 21.29 tonnes, Nannilam 3.19 tonnes, Peralam 1.97 tonnes, Koradachery 1.81 tonnes, Kodavasal 3.87 tonnes, and Valangaiman 2.39 tonnes (SBM Urban, n.d.).

Salem district, Tamil Nadu: Salem is the fifth largest city in Tamil Nadu. Plastic waste primarily originates from textile shops, which use plastic covers for packaging clothes and garments. The district has 100% door-to-door collections and 90% source segregation, with microcomposting centres and material recovery facilities operating. The municipality generates about 60 tonnes of municipal solid waste per day. (Salem municipality, n.d.)

Namakkal district, Tamil Nadu: Namakkal is a small district in Tamil Nadu, located on the main highway connecting Salem and Dindigul. It was the first Indian municipality to privatise all aspects of solid waste management (SWM). In the Kumarapalayam and Pallipalayam areas of Kumarapalayam Taluk in Namakkal District, a total of 154 unauthorised textile dyeing and bleaching units were identified by the authorities. Of these, 98 are small-scale operations that discharge untreated trade effluent into the municipal drainage system, leading to pollution of the Cauvery River (TNN, 2018). Namakkal Municipality generates 54 tonnes of municipal solid waste per day (Namakkal Municipality, n.d.).

Karur district, Tamil Nadu: Karur district is administratively structured into two divisions – Karur and Kulithalai – encompassing seven circles: Karur, Aravakurichi, Manmangalam, Bukalur, Kulithalai, Krishnarayapuram, and Kadavur, along with 203 revenue villages (Karur District, n.d.). The Kuthithalai municipality has 95% door-to-door garbage collection and generates about 8.9 tonnes of municipal solid

waste per day, out of which dry waste accounts for 3.8 TPD, with 21% of the waste being recyclable (Kuthithalai Municipality, n.d.).

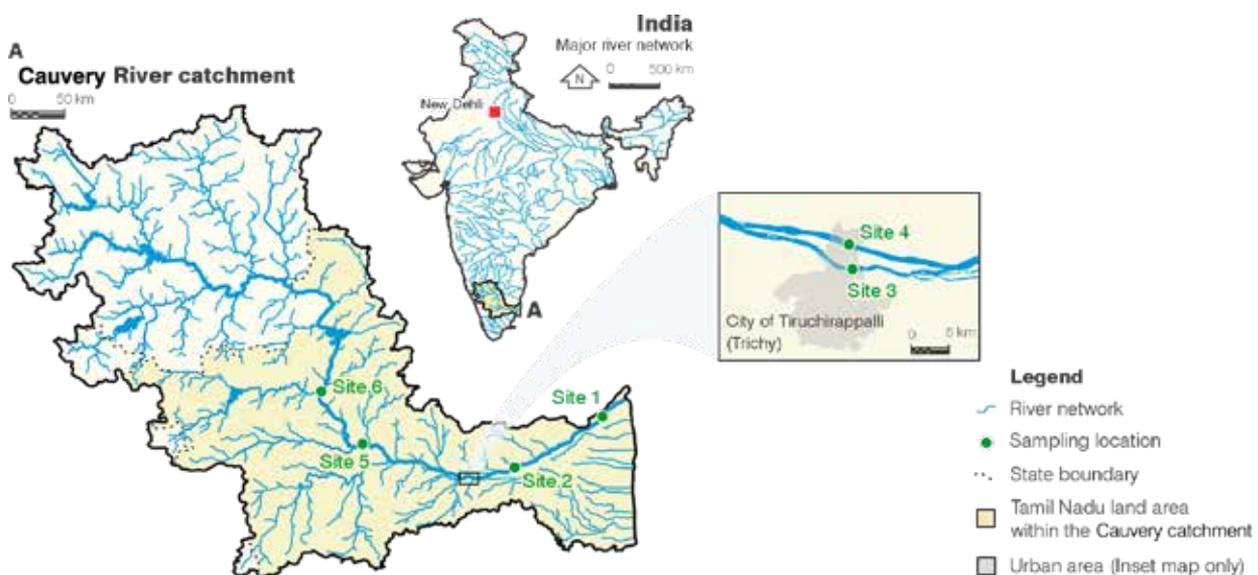
**Trichy/Tiruchirappalli District, Tamil Nadu:** Located in the geographic centre of the state of Tamil Nadu, the city of Trichy/Tiruchirappalli stands on the banks of the River Cauvery. The Cauvery River bisects Tiruchirappalli, a key engineering manufacturing hub in Tamil Nadu. Within Trichy District, the Cauvery River flows through 20 local bodies, including three municipalities and 16 town panchayats (INOPOL, 2025). The municipal solid waste generation in Tiruchirappalli City Municipal Corporation is approximately 60 tonnes per day (TPD) (Tiruchirappalli Municipality, n.d.).

**Thanjavur district, Tamil Nadu:** The Kumbakonam municipality, located in Tamil Nadu's Thanjavur district, is well-known as the temple city. It is recognised for its effective management of both legacy and post-consumer plastic waste; the latter mostly stems from its vibrant food industry. The town hosts a floating population of 25,000 people, generating 72 tonnes of waste daily, with one-third being non-recyclable waste, mainly plastics, totalling

22 tonnes (Down To Earth, 2022). The municipal solid waste generation accounts for about 124 tonnes per day in the city (Thanjavur municipality, n.d.).

## 2.2 Macroplastic monitoring in the Cauvery River

In the INOPOL project, an international team of researchers joined by scientists from the Tamil Nadu Pollution Control Board conducted monitoring of macroplastic pollution at six sites within the Tamil Nadu portion of the Cauvery River (Figure 2) across three different seasons: the northeast monsoon (November 2024) – which affects the lower Cauvery; the dry season (February 2025); and the southwest monsoon (September 2025) – which affects the upper Cauvery, upstream of Tamil Nadu, but leads to an increase in water levels downstream too. Monitoring was performed using a combination of three methods: i) visual observation of floating macroplastic flowing across the entire river width within 15 minutes; ii) use of nets to sample subsurface flows of macroplastic below the field of visibility; and iii) surveys of stranded/accumulated macroplastic in riverbank environments at each site.



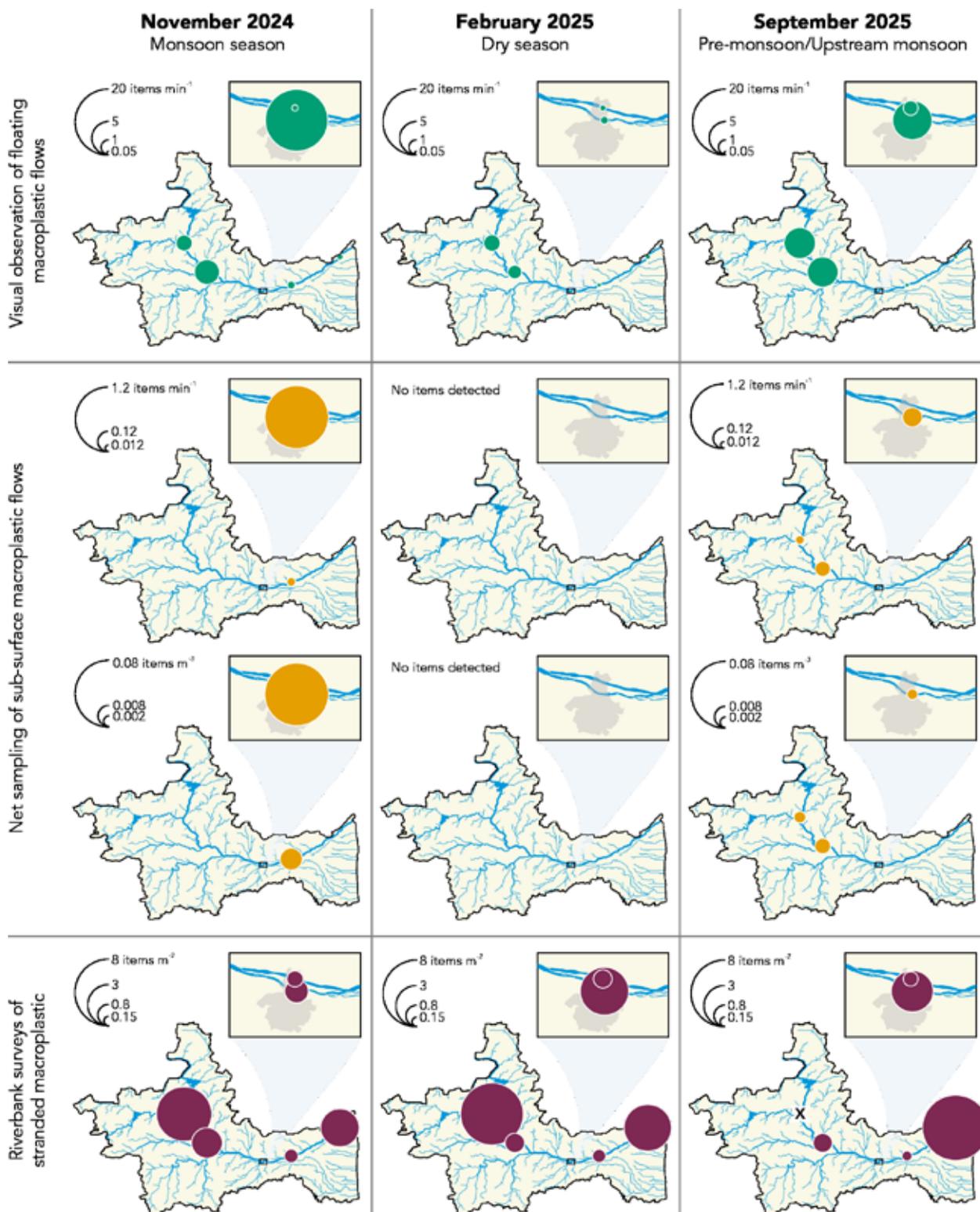
**Figure 2.** Map of the Cauvery River catchment (A) showing the Tamil Nadu portion and the monitoring sites included in this study

Figure 3 displays the observed macroplastic loads across various methodological approaches, sites and seasons. Assessment of the results from visual observations and net sampling indicates that the majority of macroplastic flowing in the river tends to float. This means that for further monitoring of the Cauvery, visual observations of floating macroplastic can be used as a proxy for total macroplastic loads, which represents a simple measurement without the need for equipment and is implementable with minimal training. Macroplastic flows within the river channel were highest at Site 3, which is highly urbanised and located close to the centre of Trichy City. High levels were also observed in the two furthestmost upstream sites (Sites 5 and 6). Macroplastic loads were high during both the northeast and southwest monsoons (November 2024 and September 2025, respectively) and comparatively low during the dry season. This indicates that the volume of water passing through the river at different times of the year mobilises and transports different plastic loads. The northeast monsoon – which directly affects the monitored section – may also increase connectivity with land, washing plastics into the river channel.

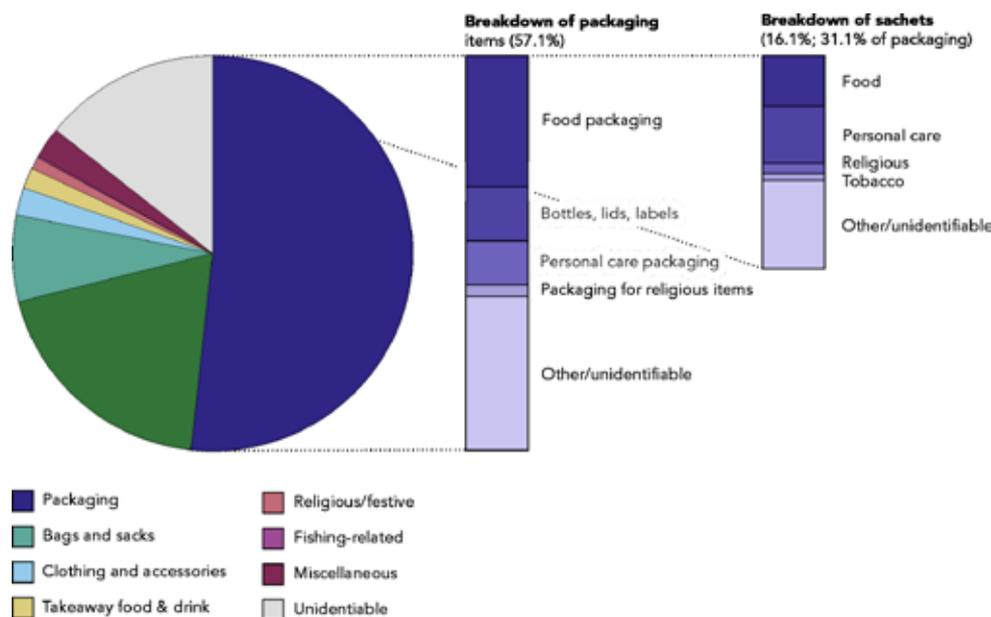
The lowest levels were consistently observed at the two downstream sites (Sites 1 and 2), which represent more rural areas with a lower incidence of potential pollution inputs. The Cauvery River is extensively managed, featuring several large dams throughout the catchment area along with a high density of smaller infrastructure, such as barrages and check dams, along the entire monitored stretch in Tamil Nadu. When in operation, they impede the flow of water and likely also intercept plastic litter, creating a complex pattern of downstream transport and limiting the influence of cities like Trichy in downstream macroplastic loads. The fate and dynamics of this plastic trapping are not yet known, and further investigation is required to understand how they interrupt plastic transport and could potentially function as a capture and clean-up technology.

Densities of macroplastic observed along the riverbanks vary spatially and, to a far lesser extent, temporally. The highest densities were observed at Sites 1, 3, and 6. On one side of the river, at Site 1, there is a vegetable market, as well as a site for religious rituals. Site 3 is a highly urban environment, with evidence of direct dumping of plastics along banks and in the river. Site 6 is located in the town of Bhavani, where there is both direct human interaction with the river (bathing, clothes washing) and active dumpsites along both banks. In the third sampling campaign, the volume of water in the channel at Bhavani had overtopped the banks, meaning that it was not possible to sample them. Submersion in these regions, which are characterised by very high macroplastic densities, likely leads to the remobilisation and transport of many stranded items, resulting in a surge of plastic flows and their redistribution downstream. Further work is needed to investigate the controls on plastic transport in the Cauvery River to better understand the fate of plastic pollution.

Figure 4 shows the breakdown of macroplastic categories across all items observed during the plastic monitoring campaigns. Packaging represents the dominant type of plastic litter observed. Sachets represent the majority (31.1%) within this category, and Figure 4 further breaks them down into sub-categories. The total packaging category has also been divided into sub-categories determining the type of packaging (which includes sachets, e.g., food sachets are within food packaging). The dominant typologies of litter – food packaging, personal care packaging, and plastic bags (often with contents) – indicate that household waste is likely an important source of plastic pollution to the Cauvery. Active dumpsites near the river channel were observed at several sites, and these were present across all three sampling campaigns. Current solid waste management practices for municipal waste are not sufficiently effective in terms of their spatiotemporal scope, accessibility, and efficacy to contain the waste,



**Figure 3.** Observed macroplastic loads across the three sampling campaigns and the three methodological approaches employed in the monitoring programme. Loads are represented by area-proportional circles; note that scales and unit differ between methods



**Figure 4.** Breakdown of observed macroplastic items across different source categories, including further sub-division into source categories and sachets for packaging items.

and this issue likely contributes to the pollution observed in and along the Cauvery.

In addition, during 11.6% of visual observation measurements conducted, people were observed discarding one or more bags of litter from the bridge directly into the river channel. Not included in this count is the discarding of textile bags containing dried flowers, dried fruits, and/or rice as part of a religious ritual. Instead, the 11.6% represents the dumping of plastic bags containing other plastic litter items that were discarded without a blessing being performed. This indicates that there is social acceptance of directly littering into the river, which may have expanded from sociocultural practices that are perceived to have a lower harm on the environment. Monitoring of this behaviour, research into the drivers of this practice, and awareness-raising campaigns specifically addressing this aspect could reduce plastic pollution in the Cauvery River.

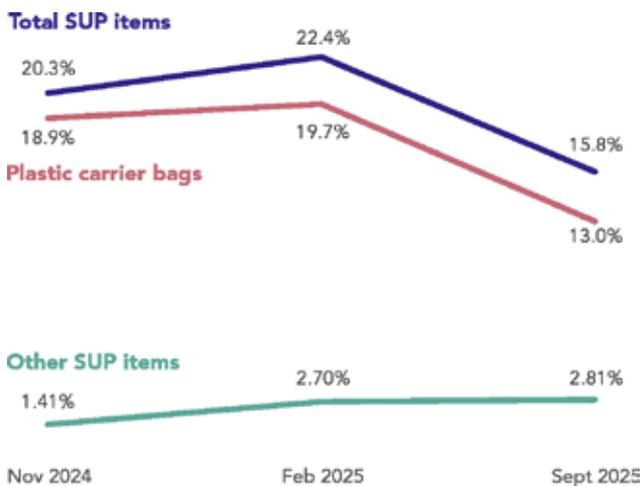
Finally, the increased human interaction with the river specifically, bathing and washing clothes observed at the two upstream sites (Sites 5 and

6) also led to higher pollution levels (Figure 3) and was linked to a shift in the proportion of litter composed of personal care packaging (e.g., shampoo sachets, detergent sachets, and soap packaging). Lack of effective municipal waste management in these upstream areas and practices of directly discarding used plastics in the river likely contribute to the elevated pollution levels at Sites 5 and 6. Implementation of waste collection systems is needed first and foremost to reduce pollution, complemented by monitoring practices related to direct discarding following its introduction to track and elucidate behaviours and perceptions and establish effective solutions to address this source.

Several single use plastic (SUP) items have been banned in India as part of legislation that was first introduced in 2016 and widened to include additional items in 2021 and 2022. Across all three sampling campaigns and methods, the total proportion of macroplastic litter represented by SUP items was 19.3%. However, this figure includes observed occurrences of plastic carrier bags, whose thickness was not measured as part of the monitoring method, and only bags lower than 75  $\mu\text{m}$  (2021) and 120

$\mu\text{m}$  (2022) are covered by the ban. To address this knowledge gap, samples were collected of plastic bags found in the riverbank environment and new plastic bags purchased from drinks stalls during the third sampling campaign. The thickness of the bags was measured using a micrometre. All bag samples had a thickness of less than  $75 \mu\text{m}$ , with most falling within the range of  $5$  to  $20 \mu\text{m}$ . Hence, plastic bags counted as part of the monitoring are likely to be predominantly below the minimum thickness set by the 2021 and 2022 bans. The total proportion of SUP items excluding plastic bags was  $2.4\%$ , indicating relatively satisfactory compliance with the ban for non-carrier bag items.

Figure 5 shows the proportion of SUP-banned items across the three sampling campaigns, which was lowest for the third campaign. Inspection of the different SUP items shows that this trend is driven by plastic carrier bags, whereas other SUP items slightly increase during the monitoring period. This pattern does not necessarily correspond with shifts in ban compliance, as the three campaigns reflect different seasonal conditions that can affect flows and accumulation of plastic in the river. Longer-term spatiotemporal monitoring is needed to follow changes in ban compliance over time. Whilst some of these items may represent a legacy of pollution



**Figure 5.** Proportion of SUP banned items for the three sampling campaigns, divided into carrier bags and non-carrier bag items.

pre-dating the 2016, 2021, and 2022 bans, the relatively long period of time since these bans and the testing of the thickness of new carrier bags in late 2025 suggest that banned SUP items are still in production and/or circulation in southern India. To reduce plastic pollution in the Cauvery River in the future, monitoring ban compliance by producers and retailers is needed. To have a more significant impact on plastic pollution reduction, within the context of SUP bans, some additional items could be added to future iterations of the Plastic Waste Management Regulations, such as other types of sachets and food packaging.

## 2.3 INCA modelling and Cauvery River

For INOPOL, the case study was the Cauvery catchment, in the southeast part of India. To model the transport of macroplastics in the catchment, we used a customised INCA model that considers local parameters.

The INCA (Integrated Catchment Model) is a dynamic, process-based modelling framework designed to simulate the flow of water, nutrients, and pollutants through river catchments. It integrates hydrological, chemical, and biological processes to assess the impact of land use, climate change, and management practices. It uses spatially distributed inputs and allows for scenario testing to support decision-making. The model is modular, enabling customisations for different catchment characteristics. INCA has been widely applied across Europe for water quality assessments. The Integrated Catchment Model (INCA) is a decision-support tool that helps policymakers understand how water, nutrients, and pollutants move through river catchments. It simulates daily changes in water quality and quantity, accounting for land use, climate, and management practices. INCA enables scenario testing to evaluate the effects of agricultural policies, wastewater regulations, and climate adaptation strategies.

In INOPOL, we used a customised INCA model, “INCA-Macroplastic”, adapted for macroplastic dynamics in a catchment and corresponding rivers (Figure 6). Our INCA-Macroplastic model was integrated into our Model Building System (MOBIUS, available on this repository: <https://github.com/NIVANorge/Mobius>), which comprises three modules: the PERSiST module, a mass-balance module (macroplastic in soils) and the river module. The INCA-Macroplastics model covers the two latter ones.

PERSiST (Futter et al., 2014) is a user-friendly hydrological model designed to simulate how water moves through landscapes under different climate and land-use conditions. It helps policymakers understand the impacts of rainfall, temperature, and land management on river flows and water availability. Operating on daily data, PERSiST supports planning for drought resilience, flood mitigation, and sustainable water use. It is particularly useful in regions with limited data, offering reliable insights with modest input

requirements. PERSiST can be linked with water quality models like INCA to assess how changes in hydrology affect nutrient and pollutant transport, as was done for this project.

To set up the PERSiST model for a specific region or catchment, inputs must be integrated into the model. Local data are then needed, such as the daily time series of precipitation (Figure 7), air temperature, reach characteristics (length and width of the streams), and soil parameters (e.g., maximum storage capacity and evapotranspiration thresholds). These data can be collected from online datasets, published literature, and on-site data collections. The PERSiST model was set up for the Cauvery catchment using several sources and the catchment was divided into five reaches, each related to one sub catchment for further modelling, according to the monitoring stations (Figure 8).

Once the PERSiST model was set up for that region, the INCA-Macroplastics model was customised to fit local conditions, e.g., soil conditions, waste generation

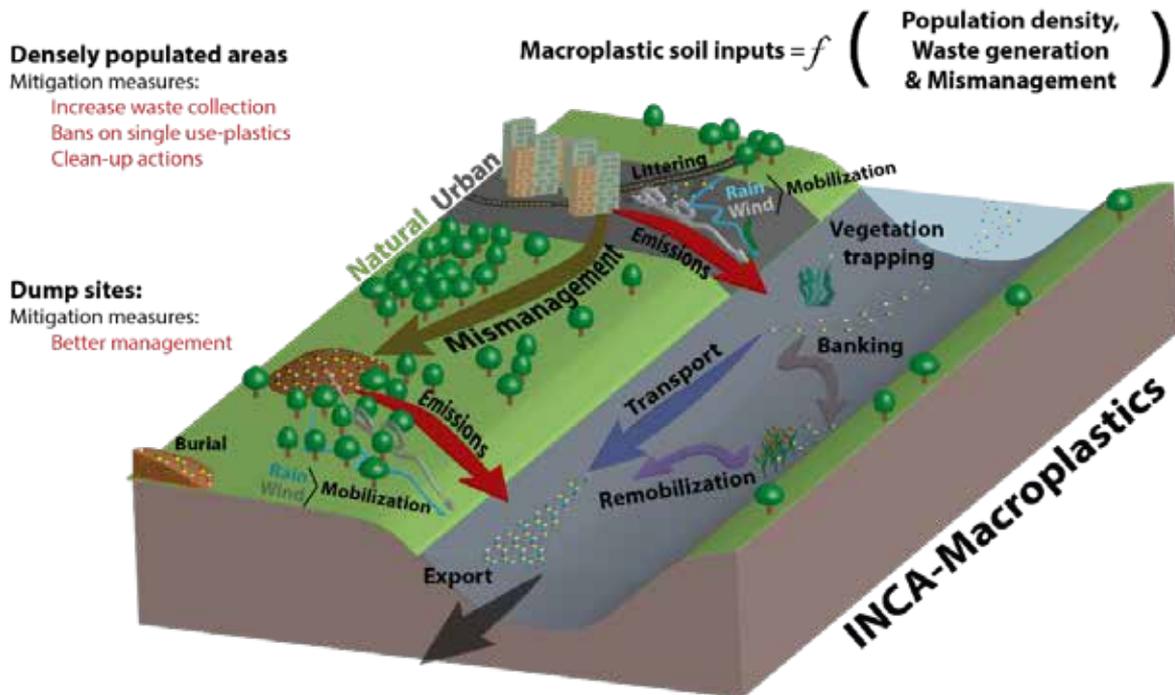
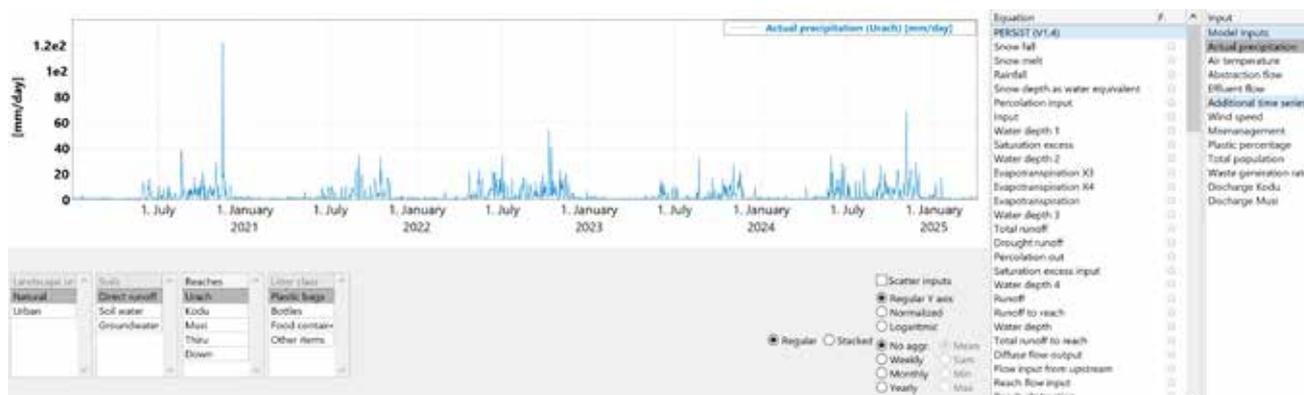


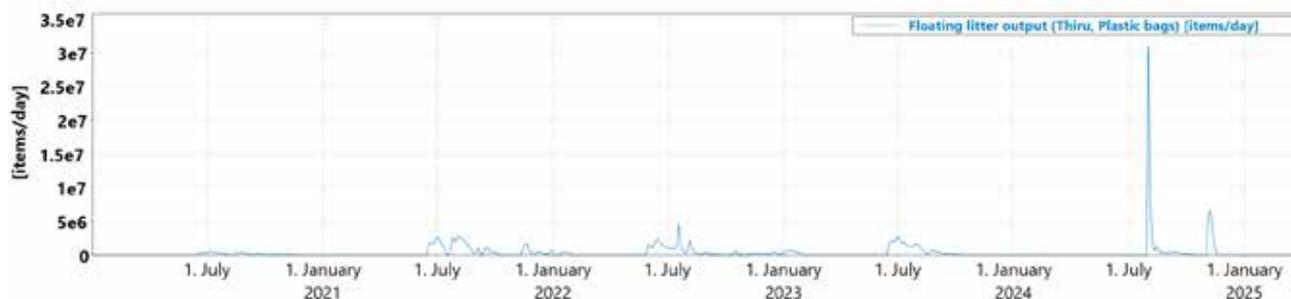
Figure 6. Representation of the INCA-Macroplastic workflow, its parameters and inputs



**Figure 7.** Interface of the MOBIUS model system for the five reaches of the Cauvery catchment. The precipitation (mm/day) of the “Urachikottai” sub-catchment is given as an example



**Figure 8.** The Cauvery catchment and its five sub-catchments that encompass the monitoring stations (red squares)



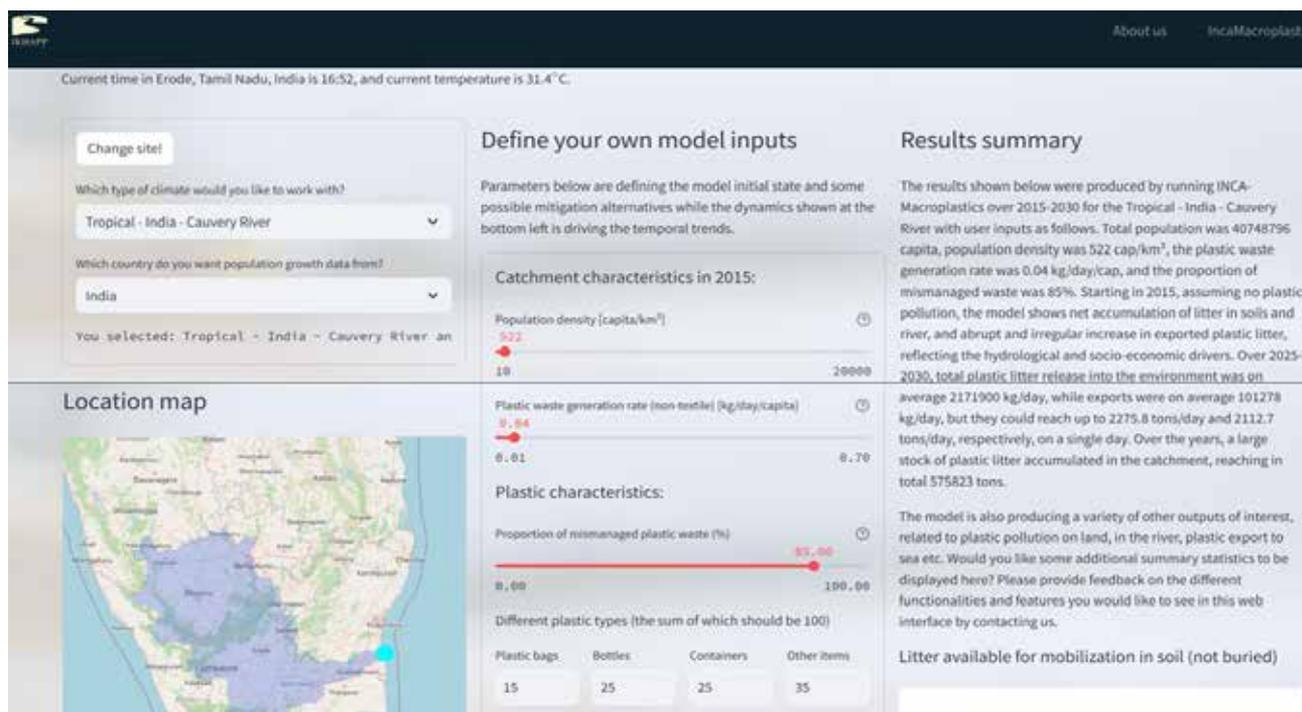
**Figure 9.** Example of outputs provided by the INCA-Macroplastics model in the Thiruchirappalli sub-catchment: floating plastic bags in items/day

rate, river discharge, and run. The model then provides trends and estimations of plastic retention or transport along the catchment and per sub-catchment (for example, floating litter output, Figure 9).

As shown in Figure 9, many parameters can be shown on the graph for each reach and each plastic category (plastic bags, bottles, food containers and other items). From this setup, an online tool was developed that was specific to several regions of the world, including the Cauvery catchment, allowing the

users to visualise the evolution of output parameters according to changes in population density, plastic waste generation rate, proportion of mismanaged plastic waste, and the establishment of mitigation measures (Figure 10).

Once the inputs have been changed, the model can be run again, and the subsequent results will be adapted and displayed through text, values, and graphs. The quantitative output can be exported as a .csv file for further analysis.



**Figure 10.** Print screen of the INCA-Macroplastics tool on IKHAPP website for the Cauvery region and examples of interactive inputs

## 2.4 Future perspectives and recommendations

Tamil Nadu state has, in recent years, become a significant contributor towards total plastic waste generation in India: in the year 2022-2023, Tamil Nadu generated 19% of national plastic waste, despite representing only 6% of the population. Whilst 96% of plastic waste is collected in the state, on average 81 tonnes goes uncollected each day – corresponding with 29 585 tonnes of plastic waste that is not collected over the course of a year. Official statistics indicate that 21% of plastic waste that is collected is recycled, whereas the majority is currently landfilled or incinerated. Mechanisms behind the increase in plastic waste generation in Tamil Nadu are as yet unconstrained and warrant closer attention to track this observed upward trend.

Monitoring of plastic waste – also known as macroplastic – was performed across several sites in the Tamil Nadu portion of the Cauvery River and during different seasons. Plastic flows were measured using visual observation of floating plastic combined with net sampling to quantify submerged plastic flows. Surveys of plastic accumulation along riverbanks were also undertaken. The highest plastic flows were identified close to the urban hub of Trichy, as well as at upstream locations associated with human interaction with the river; namely, bathing, washing, laundry, and fishing. Flows were highest during the monsoon seasons, showing that plastic transport is linked with high flow events. Check dams and barrages interrupt the flow of plastic in the river, likely concentrating plastic in certain areas and limiting the downstream influence of upstream urban locations. Across all sites, 51.7% of the plastic waste observed in the catchment was composed of packaging, with food packaging being the most dominant type. Sachets were also identified as a common type of packaging. The assemblage of waste observed indicates that municipal solid waste is likely to be an important source of plastic to the Cauvery River. Direct dumping of plastic waste from bridges into the rivers was also commonly noted at monitoring locations. 19.3% of plastic observed

across all sites represented banned SUP items, which were predominantly composed of plastic bags below the legal minimum thickness.

A model that simulates hydrology and plastic inputs, retention, and transport was developed for the Cauvery Catchment. The model produces outputs such as estimates of floating plastic items per day, which are also split into four categories (bottles, plastic bags, food containers, and others). This was incorporated into an online interactive tool that allows users to modify parameters, such as population density, waste generation and mismanagement, and mitigation measures, and run scenarios to investigate how plastic pollution could change in the future: <https://ikhapp.org/inca-macroplastics/>.

### 2.4.1 Recommendations to address emerging knowledge gaps

The INOPOL project has established important baseline data on plastic pollution, as well as modelling of plastic transport and retention in the Cauvery River catchment. Whilst this provides a suite of novel insights about the typologies and dynamics of pollution, the data also identify further knowledge gaps that warrant investigation:

- **Assessment of the fate of uncollected (plastic) waste and the barriers hindering 100% collection across the state.** This would help identify and characterise the spatiotemporal pathways through which uncollected plastic waste becomes plastic pollution, as well as highlight opportunities to efficiently and effectively increase waste collection to 100% across the state.
- **Monitoring of state plastic waste generation and investigation of mechanisms underpinning recent increases.** Recent observed increases should be monitored to see how they evolve over time and to determine whether they represent a persistent trend. Understanding the mechanisms that have contributed towards this increase, such as

demographic changes, shifts in industry, awareness, or legislation and/or compliance, would help to identify measures to curb this trend.

- **Extension and expansion of macroplastic monitoring and model development.** Such work would help to understand how spatial and temporal changes vary over longer time scales and how observed trends compare with other rivers in the state, or beyond the state and in other areas of India.
- **Focused monitoring and research to ascertain important fate and transport dynamics for riverine macroplastic.** This would help contextualise the monitoring results and further improve model outputs. This information can also be applied to target clean-up efforts to specific locations that provide the greatest return on investment and have the largest impact in reducing catchment pollution.
- **Research into the socio-cultural and economic factors that lead to direct dumping of litter into river channels or along riverbanks.** This research can identify important mechanisms that can be addressed with awareness-raising campaigns or by expanding waste collection coverage to target priority areas.
- **Monitoring and research on plastic inputs and transport associated with future scenarios, such as climate change-driven extreme weather events, changes in land use, or developments in waste collection and circular economy infrastructure.** This is particularly relevant due to future projections in the magnitude and frequency of extreme weather events, as well as increased urbanisation and population growth. The results of this research could highlight useful mitigation measures, and they could also be incorporated as additional modules in the model to track their impact over time.
- **Work closely with authorities, NGOs, and community groups to validate model assumptions.** This will help to improve model outputs with regard to potential measures to mitigate and reduce plastic pollution, as well as

establish a collaborative and transdisciplinary approach to tailor effective solutions.

## 2.4.2 Recommendations to reduce plastic pollution in Tamil Nadu

The datasets produced in the project also highlight several opportunities to tailor effective solutions that could contribute towards reductions in plastic pollution in the Cauvery catchment and beyond:

- **Improved monitoring of SUP ban compliance,** with a particular focus on plastic bags below the minimum thickness set.
- **Inclusion of additional items into the SUP ban** that represent dominant categories of waste observed in the river, such as sachets or different types of packaging.
- **Awareness-raising campaigns, legislation, and improved waste collection** to limit direct dumping of plastic waste into the river or along riverbanks, with a special focus on areas with higher levels of human interaction in the river or the practice of dumping waste from bridges.
- **Cooperation with authorities responsible for check dams and barrages** to investigate how plastic waste accumulates behind barriers, collect this waste, and determine whether these infrastructures could serve as waste capture technologies to prevent the release of plastics to the ocean. Collection of this waste could be linked to data acquisition to elaborate trends and evaluate the efficiency of new mitigation measures in the region.

The findings from monitoring and modelling highlight several systemic challenges, including the accumulation of banned and problematic plastic packaging and sachets, seasonal mobilisation, incomplete collection coverage, and waste dumping. These patterns point to specific institutional, behavioural, and economic challenges that need to be addressed to make plastic waste management and pollution reduction effective. Chapter 3 further examines these challenges and identifies opportunities towards increasingly sustainable approaches to tackle mismanaged waste and pollution.



## CHAPTER 3

# SYSTEMIC CHALLENGES AND ENABLING CONDITIONS FOR PLASTIC WASTE AND POLLUTION MANAGEMENT

Despite relatively high reported collection rates and ambitious policy measures, plastic pollution persists in Tamil Nadu's rivers, settlements, and rural landscapes. Monitoring and modelling data from the Cauvery basin, combined with baseline assessments and stakeholder consultations, highlights a set of recurring system-level challenges that cut across technical, economic, institutional, and social dimensions (INOPOL, 2025). These challenges resonate with evidence from other parts of India and the Global South, where rapid regulatory developments have been accompanied by uneven implementation, infrastructural deficits, and socio-economic inequalities (Xanthos and Walker 2017; Behuria 2021).

At the same time, the INOPOL project and related initiatives point to important enabling conditions, including strong regulatory frameworks, emerging monitoring capacities, active civil society and informal workers' organisations, and growing recognition of justice concerns in plastic and chemical pollution governance (UN-Habitat and NIVA, 2022; Owens and Conlon, 2021; Orellana, 2021). This chapter synthesises key systemic challenges and enabling conditions before turning to the roles of specific stakeholder groups, such as micro, small, and medium enterprises (MSMEs), as well as opportunities for strengthening the science-policy–society interface.

Tamil Nadu has introduced several regulatory and institutional measures to strengthen plastic waste management, including bans on selected single-use plastics (SUPs), the expansion of Plastic Waste Management Units (PWMUs), and initiatives to promote circular resource use.

Despite these efforts, field evidence from the Cauvery monitoring campaign indicates continued leakage of banned SUPs, including cups, plates, cutlery, straws, sachets, and multilayered packaging. Thin carrier bags, often below the legal thickness requirement, were among the most common items recorded along riverbanks. Similarly, modelling efforts point to ongoing mismanagement, with accumulated plastics mobilised and redistributed during high-flow conditions.

Together, these findings highlight persistent implementation and compliance challenges. They further underline that improving plastic waste management is not only a matter of expanding infrastructure or strengthening regulation but also of addressing the broader institutional, economic, and behavioural dynamics that shape waste generation and disposal. The following section further explores systemic challenges that need to be considered in efforts to reduce plastic pollution.

## 3.1 Systemic challenges and gaps

### 3.1.1 Policy and regulatory implementation gaps

Although the regulatory framework governing plastics has expanded since 2016, implementation remains uneven. Frequent regulatory revisions to the Plastic Waste Management (PWM) Rules and SUP restrictions create uncertainty, especially for small actors with limited administrative capacity to adapt. Weak enforcement and inconsistent compliance

are evident in the continued presence of banned SUPs, particularly thin carrier bags below the legally permitted thickness, as observed during river monitoring campaigns. Challenges with Extended Producer Responsibility (EPR) implementation are widespread. Smaller producers and recyclers often face administrative burdens related to reporting, traceability, and verification requirements (Plastic recyclers challenges in India, n.d.; FICCI, 2024). Local-level enforcement capacity varies significantly across districts, contributing to uneven outcomes in market inspections, data reporting, and follow-up actions. These cross-cutting issues limit the effectiveness of otherwise ambitious policies and highlight the need for sustained enforcement, clearer guidance, and tailored support for smaller market actors.

### 3.1.2 Technical and infrastructural constraints

Infrastructure gaps remain a significant barrier to reducing pollution leakage. Uneven coverage of collection and segregation means that some rural and peri-urban areas largely rely on informal or ad hoc disposal and collection pathways. Limited decentralised sorting, recycling, and processing infrastructure restricts the ability of ULBs and Panchayats to manage increasing waste volumes in an environmentally safe and efficient manner. High operational costs for transport, labour, equipment maintenance, and energy continue to constrain the capacities of public and private waste management actors (TNPCB, 2024). Knowledge gaps persist regarding the environmental fate of plastics and the long-term impacts of proposed technological solutions such as waste-to-energy (WtE) options, pyrolysis, and plastic-modified road construction. Data and monitoring limitations restrict the ability of regulators to identify hotspots, evaluate interventions, or integrate scientific findings in policy decisions. These technical and infrastructural challenges compound systemic weaknesses and contribute to the ongoing leakage of plastics into the environment.

### 3.1.3 Economic and financial barriers

Economic constraints influence both public agencies and private enterprises: ULBs and Panchayats operate with fragmented or uncertain funding streams, limiting their ability to invest in sustained infrastructure upgrades or staffing. MSMEs face difficulties accessing affordable capital, particularly for new equipment or improved processing technologies (Derhab & Elkhwesky, 2022; Mishra et al., 2025). Price volatility in the recycled plastics market creates financial instability for recyclers and processors, limiting investments in higher-quality or more sustainable processing equipment and technologies. Profit margins are particularly low in lower-value waste streams. These economic pressures weaken the system's ability to absorb regulatory changes and implement safe and environmentally sound management practices.

### 3.1.4 Social and behavioural challenges

Even where systems exist, social norms and everyday practices can undermine effective waste management. During INOPOL's monitoring campaigns along the Cauvery River, direct dumping into rivers or riverbanks was frequently observed, both as informal disposal and as part of certain ritual practices (INOPOL, 2025). Limited awareness of health and environmental impacts persists among some communities, enterprises, and small retailers, contributing to continued reliance on low-cost SUPs and inappropriate disposal practices. Gendered and classed inequalities also continue to shape exposure pathways and impacts in the waste sector. Waste picking, sorting, and low-paid recycling roles are often carried out by women, children, and marginalised groups under precarious and unsafe working conditions (Plassnig et al., 2025). Stigma associated with waste work and limited recognition of informal workers restricts opportunities for integration into formal waste systems. Addressing these behavioural and social drivers linked to

pollution requires recognition of the diverse roles people play across the plastics value chain and moving towards increasingly inclusive policy design and implementation.

## 3.2 Micro, small and medium enterprises (MSMEs) as key stakeholders in waste management

Micro Small and Medium Enterprises (MSMEs) remain central to the state's plastic waste economy and recycling ecosystem. Their adaptability and local presence in rural and peri-urban markets enable them to function in areas where formal municipal services are scarce. MSMEs create local employment, provide low-cost recycling services, and support circular-economy innovations. At the same time, MSMEs face several systemic challenges that often arise from a dynamic regulatory environment. These include recurring policy revisions that alter permitted materials and reporting requirements, as well as substantial administrative demands linked to EPR obligations, traceability mechanisms, and compliance documentation. Moreover, many MSMEs have limited technical capacity and rely on outdated technologies, and face barriers to credit, subsidies, and investment in improved recycling or processing equipment. In addition, external factors, such as fluctuating supply and demand for recycled materials and low margins in recycling markets, constrain, cause market instability, and hinder investment in safer and more efficient operations.

Tamil Nadu's MSMEs form a critical part of the state's economic landscape. Nationally, MSMEs account for around 30% of India's Gross Domestic Product (GDP) and nearly 50% of exports (Ministry of MSMEs, 2023). Tamil Nadu is one of the most industrialised states in the country, hosting approximately 15% of India's registered factories (InvestIndia, Government of India). With more than 25 lakh Udyam registrations, Tamil Nadu ranks second nationally (Ministry of MSMEs, n.d.), and notably 26% of registered

entrepreneurs are women, reflecting the state's strong environment towards inclusive enterprise growth (Government of Tamil Nadu, 2025).

This economic relevance positions MSMEs as important actors in plastic waste management, both as generators of plastic waste and as providers of recycling, repair, and processing services. Ensuring that MSMEs can comply with evolving plastic regulations is therefore essential for meeting broader environmental goals and thereby safeguarding their economic viability. Compliance can also support MSMEs in reducing operating costs, improving competitiveness, and accessing emerging markets for sustainable materials and technologies.

### 3.2.1 Regulatory pressures and adaptive capacity

The rules for managing plastic waste have changed many times since 2016, with new requirements and timelines for phasing out certain types of plastics added in 2021 and 2022. Some of these changes have negatively impacted MSMEs that have a limited ability to meet new requirements; for example, through increased operational costs from shifting to alternative materials.

Extended Producer Responsibility (EPR) adds another layer of compliance complexity. Producers, importers, and brand owners (many of which fall within the MSME category) are required to collect and process post-consumer plastic waste equivalent to the materials they place on the market. Many smaller enterprises with limited resources may struggle to meet these obligations, which often require coordination across supply chains and resource-intensive documentation and reporting systems (Plastic recyclers challenges in India, n.d. and FICCI, 2024).

### 3.2.2 Operational and infrastructure

High operational costs further constrain MSMEs' ability to manage plastic waste efficiently (TNPCB,

2024; INOPOL, 2025). The Tamil Nadu Pollution Control Board reports that MSMEs face major challenges related to cost and infrastructure and highlights subsidy schemes targeting equipment and capacity building to ease these burdens.

Managing plastic waste requires resource-intensive collection and segregation processes. Many MSMEs have limited infrastructure and manpower and may rely on external service providers for waste management, at varying costs depending on waste volume and collection frequency.

The absence of adequate infrastructure for waste collection and transportation forces many MSMEs to transport plastic waste over considerable distances to reach recycling or processing centres. This results in higher fuel expenses and logistical challenges, increasing overall operational costs.

Acquiring essential equipment for plastic processing requires significant upfront investment. Despite the existence of some subsidies, the capital requirement continues to pose a significant barrier. Additionally, advanced recycling technologies demand skilled operators, which means labour costs are higher.

These constraints can reinforce dependence on outdated technologies and low-value recycling pathways, reducing both environmental performance and profitability.

### **3.2.3 Broader circular economy and waste management challenges**

Beyond regulatory and operational pressures, MSMEs face a range of structural barriers that limit their ability to participate in sustainable and circular business models. Studies indicate that MSMEs generate diverse waste streams, including plastics, metals, textiles, chemicals, and organics, many of which pose environmental and health risks when improperly managed (Derhab and Elkhwesky 2022). However, their capacity to adopt improved practices is constrained by a combination of economic, infrastructural and information gaps (Mishre et al.,

2025). Financial and investment limitations remain a primary constraint, as many MSMEs struggle to access affordable credit or justify the high upfront costs required for improved recycling, reuse or material-recovery technologies. These challenges are reinforced by inadequate in-house infrastructure, limited availability of advanced tools and equipment, and weak institutional support or incentives for circular-economy adoption. Information and knowledge constraints also play a significant role. Many MSMEs have limited access to technical guidance, reliable market information, or training on circular practices. Low consumer awareness and weak demand for eco-friendly products further reduce incentives for enterprises to innovate or invest in improved waste management systems. In several cases, a limited understanding of the environmental impacts of mismanaged waste contributes to the persistence of harmful disposal practices.

These barriers show that MSMEs are operating within a system that often makes it difficult for them to adopt more circular and sustainable practices. Limited resources, uneven infrastructure, unclear or insufficient support, and weak demand for greener products all shape what is realistically possible for smaller enterprises. As a result, many MSMEs want to do more but lack the financial room, technical guidance, or market incentives to make substantial changes. Addressing these challenges will require coordinated efforts to reduce costs, expand access to practical support, and create clearer pathways for MSMEs to shift towards more sustainable production and waste-management models.

### **3.2.4 Enabling conditions for MSMEs contributions to waste management**

Supporting MSMEs to play a stronger role in plastic waste management will require steady, coordinated efforts from regulators, industry bodies, and financial institutions. Key areas for action include:

- Make it easier for smaller enterprises to understand and meet regulatory requirements by offering practical training on compliance, safer technologies and day-to-day operational improvements, as well as clearer guidance on what is expected under the Plastic Waste Management Rules and the EPR framework.
- Many MSMEs also need financial support to upgrade equipment or shift to alternative materials. Expanding access to affordable credit, subsidies and incentive schemes would help reduce the upfront costs that often prevent smaller firms from investing in better systems.
- More predictable regulatory guidance, including phased timelines and user-friendly compliance tools, can help reduce uncertainty and give MSMEs the confidence to plan ahead.
- Coordination between MSMEs, local governments, recyclers, and industry associations can help stabilise waste supply streams, improve access to shared infrastructure, and open up collaboration opportunities.
- Creating stronger markets for sustainable materials, whether through public procurement, awareness campaigns or support for innovation, can give MSMEs a clearer commercial incentive to adopt more environmentally responsible practices.

These actions can make it easier for MSMEs to comply with regulations, invest in improvements and contribute more fully to Tamil Nadu's wider transition towards better plastic waste management.

### 3.3. Strengthening the science-policy-society interface

Effective plastic pollution management depends not only on technical measures and regulatory frameworks but also on strong links between scientific evidence, policy processes and community

actions. The below sections illustrate how INOPOL's work in Tamil Nadu contributes to strengthen these connections.

#### 3.3.1 Research and baseline knowledge generation

Robust scientific baselines are essential for understanding the scale, distribution, and drivers of plastic pollution. INOPOL's monitoring activities – including environmental sampling, riverine microplastic assessments, and institutional mapping – have identified pollution hotspots, common leakage pathways, and systemic gaps in current waste management practices. These findings support evidence-based decision-making by highlighting where interventions are most needed and where existing measures are not achieving intended results. They also allow policymakers to prioritise investments, adjust regulatory approaches, and tailor programmes to local conditions.

#### 3.3.2 Capacity building for science and policy actors

Improving technical and institutional capacity enhances the state's ability to monitor, report, and respond to the issues of plastic pollution. INOPOL partners have supported training on sampling methods, laboratory analysis, digital data tools, and environmental reporting standards for regulators, scientists, and local authorities. Participatory field visits and collaborative monitoring exercises enhance the practical understanding. These efforts help ensure that environmental data are reliable, comparable, and accessible, which are key prerequisites for effective regulation and cross-agency coordination.

#### 3.3.3 Supporting implementation through evidence

Scientific assessments also provide insight into how existing waste-management and pollution-control policies function in practice. Through fieldwork

and consultations with government officials, waste workers, and communities, INOPOL has identified challenges such as uneven enforcement capacity, administrative bottlenecks, and gaps between state directives and local implementation. Such local-level insights enable more contextually suitable and adaptive governance, where policies reflect local conditions and can be refined over time, while resources can be directed towards actions making the greatest impact.

### **3.3.4 Strengthening societal engagement and awareness**

Community engagement is essential for sustained change. Workshops, stakeholder dialogues, school sessions, and accessible communication materials can contribute to raising awareness of the environmental and health risks of plastic and chemical pollution. Research on the gendered impacts of pollution, such as the disproportionate exposures and risks faced by women engaged in waste and domestic labour, underscores the importance of designing solutions that are inclusive and socially grounded. Broader engagement also helps ensure that proposed interventions are realistic and meaningful for the people most affected.

## **3.4 Concluding reflections**

The challenges outlined in this chapter show that plastic pollution in Tamil Nadu is shaped by a mix of regulatory, technical, economic, and social factors. While the state has taken important steps to strengthen its waste management system, persistent leakage into rivers and settlements, uneven implementation of regulations, resource constraints and social inequalities continue to limit progress. At the same time, there are clear opportunities to build on existing efforts: MSMEs can play a stronger role in recycling and innovation; improved data and monitoring can guide targeted interventions; and stronger engagement with communities and informal workers can help ensure that solutions are both effective and equitable.

These insights form the basis for the strategic directions explored in Chapter 4, which moves from identifying system challenges to outlining concrete options for action. The next chapter considers how Tamil Nadu can build a more coherent, coordinated, and inclusive approach to plastic waste management, one that aligns regulatory ambition with practical implementation, strengthens collaboration across stakeholder groups, and accelerates the transition towards a more circular and less polluting plastics economy.





## CHAPTER 4

# STRATEGIC DIRECTIONS FOR PLASTIC WASTE MANAGEMENT IN TAMIL NADU

This chapter sets out a strategic framework for reducing plastic pollution and strengthening plastic waste management (PWM) in Tamil Nadu. It builds on existing regulations, institutional arrangements, and local initiatives and identifies where greater coordination, prioritisation, and adjustment are needed. The strategy is informed by the evidence presented in previous chapters, including macroplastic monitoring and modelling, baseline assessments of plastic waste flows, and an analysis of systemic challenges related to enforcement, infrastructure, financing, and behaviour. The chapter distinguishes between measures that are already in place, areas where implementation remains uneven, and strategic priorities needed to address persistent leakage, emerging risks, and long-term sustainability challenges. These elements form a phased and adaptive roadmap for advancing plastic waste management in the state.

The strategic approach is guided by three core considerations. First, while Tamil Nadu reports high plastic waste collection rates and has implemented ambitious measures such as bans on selected single-use plastics, evidence shows that plastic leakage into rivers, settlements, and informal dumping sites persists. Second, existing measures are not always implemented consistently across districts and sectors, limiting their overall effectiveness. Third, some downstream solutions may introduce new environmental risks if not carefully assessed. On this basis, the strategy prioritises strengthening the implementation of existing measures, addressing identified gaps and risks, and steering future action towards reductions in plastic use and environmental exposure.

The primary purpose of Tamil Nadu's plastic waste management strategy is to reduce plastic pollution while supporting a transition towards more circular and resource efficient systems. The strategy aligns with national policy frameworks, including the Plastic Waste Management Rules (2016 and subsequent amendments), state-level directives, and broader circular economy principles. (Tamil Nadu Pollution Control Board, 2025).

### 4.1 Strategic focus areas across the plastic lifecycle

#### 4.1.1 Consolidating and strengthening existing measures

Tamil Nadu has already put in place a number of important policy instruments and operational measures for plastic waste management. These include bans on identified single-use plastic items, door-to-door collection systems managed by urban local bodies, decentralised Plastic Waste Management Units (PWMUs), buy-back schemes for low-value plastics, and sustained public awareness campaigns, such as the *Meendum Manjappai* cloth bag campaign (Tamil Nadu Pollution Control Board, 2025; Environment, Climate Change and Forest Department, 2024). Reported collection rates are high, and collaboration with self-help groups and local recyclers has helped strengthen segregation and recovery in many areas. These measures form the backbone of the state's plastic waste management system and remain central to the strategy. Continued enforcement, stable financing,

and institutional support are needed to maintain and improve their performance (Tamil Nadu Pollution Control Board, 2025).

### 4.1.2 Addressing persistent gaps and emerging risks

Despite these efforts, monitoring and modelling evidence indicates that plastic leakage remains a significant challenge. Thin carrier bags, banned items, and multilayered packaging continue to appear in river systems and along banks, particularly during high-flow events. Enforcement capacity and compliance vary across districts, and informal dumping persists where alternatives are limited.

Concerns have also emerged regarding certain recycling and reuse pathways, such as the use of plastics in road construction. While these approaches have helped divert plastics from open dumping, questions remain about long-term environmental performance, potential microplastic release, and the risk of perpetuating plastic dependency. Similarly, Extended Producer Responsibility (EPR) systems face challenges related to traceability, reporting and verification.

Addressing these gaps requires more targeted enforcement, improved monitoring of leakage pathways, and precautionary assessment of proposed solutions to avoid shifting risks elsewhere in the system.

### 4.1.3 Strategic priorities moving forward

Building on existing foundations, the strategy identifies several priorities for the next phase of plastic waste management in Tamil Nadu. These include strengthening EPR implementation through improved registration, auditing, and accountability among producers and brand owners; upgrading and better integrating PWMUs with local recycling markets; and focusing on waste reduction and reuse alongside recycling.

Innovation in recycling technologies is encouraged where supported by life-cycle evidence demonstrating clear environmental and social benefits. Behavioural change is treated as a system lever rather than a stand-alone activity, with targeted interventions aimed at reducing consumption of single-use plastics and preventing littering at source.

## 4.2 Phased implementation roadmap

The strategy is structured in a phased roadmap:

In the short term (0–1 year), priorities include updating regulations, strengthening coordination through a state-level Plastic Waste Task Force, conducting baseline assessments, and expanding training programmes and opportunities for enforcement officers and local actors. Initiatives, infrastructure upgrades, and public information campaigns will be scaled up in selected districts.

In the medium term (2–3 years), efforts focus on consolidation and scale-up. All ULBs are expected to operate functional segregation-to-recycling chains, commission additional recycling capacity, and subject EPR systems to regular audits. Enforcement and performance monitoring will be strengthened to reduce leakage and non-compliance.

In the longer term (4–5 years and beyond), the strategy aims to stabilise plastic waste generation through reduced consumption, increased recycling rates, and a move towards a more closed-loop system. New technologies will be adopted selectively, based on demonstrated environmental performance. Progress will be reviewed regularly and adjusted based on monitoring results.

## 4.3 Governance and monitoring

Effective implementation depends on coordinated action across departments and stakeholder groups. The Department of Environment, Forests & Climate

**Table 4.4.1** Timelines and milestones for PWM strategy implementation

Timeframe	Key Milestones and Actions
Year 1 (2025–26)	<ul style="list-style-type: none"> <li>➤ Complete the state PWM baseline survey; set up State/District Task Forces.</li> <li>➤ Update ULBs' PWM rules (by-laws) and budgets; start segregation bin procurement.</li> <li>➤ Launch large-scale Information, Education, and Communication (IEC) drives, such as rallies and media campaigns, to promote the SUP ban.</li> <li>➤ Commission 100+ new PWMUs using Swachh Bharat Mission (Urban) grants.</li> <li>➤ Strict enforcement of existing bans and the enrolment of all producers in the EPR portal.</li> <li>➤ Initiate a mapping of informal waste workers for integration under NAMASTE and related schemes.</li> </ul>
Years 2–3 (2027–28)	<ul style="list-style-type: none"> <li>➤ 100% of ULBs implement source segregation for plastics.</li> <li>➤ Achieve a &gt;30% recycling rate (through expanded MRFs and PWMUs).</li> <li>➤ Complete pilot roll-out of plastic road projects in all districts (100 km annually).</li> <li>➤ Hold annual stakeholder review conferences; develop mid-term KPI targets.</li> <li>➤ Institutionalise plastic-free events (e.g., schools, temples, offices) statewide.</li> <li>➤ Launch training and skilling programs for sanitation workers and SHG members with gender inclusion targets; promote occupational safety protocols.</li> </ul>
Years 4–5 (2029–30)	<ul style="list-style-type: none"> <li>➤ 50% reduction in SUP items in use (measured by sales/consumption surveys). Establish &gt;500 active PWMUs/state (including rural clusters).</li> <li>➤ Achieve a 40–50% plastic recycling rate; ensure &lt;10% plastic waste to landfill/incineration (the rest used in roads or as fuel).</li> <li>➤ Roll out advanced recycling R&amp;D (partner with IIT/Madras, etc.).</li> <li>➤ Full compliance with national packaging EPR targets; TNPCB reports meet all Form-VI criteria.</li> <li>➤ Formalise labour contracts for waste workers in ULBs and establish grievance and welfare mechanisms.</li> </ul>
Beyond Year 5	<ul style="list-style-type: none"> <li>➤ Integrate the “plastic credits” market under EPR (trading of recycling certificates).</li> <li>➤ Aim for “plastic-neutral” industries (producers offset usage by recovery).</li> <li>➤ Enforce a ban on new polymer industries that violate national regulations, or international regulations if national ones are unavailable (similar to the system followed by BIS for ISO and Indian Standards), and impose a cap on production while limiting the non-essential use of polymers.</li> <li>➤ Consolidate circular systems: increased collection efficiency (near 100%) and continuous public engagement embedded in culture.</li> <li>➤ Institutionalise inclusive waste governance with representation of the informal sector and women-led SHGs in state-level review bodies.</li> </ul>

Change provides overall policy direction, while the Tamil Nadu Pollution Control Board oversees regulation, monitoring, compliance, and capacity building. Urban Local Bodies manage day-to-day waste handling operations, supported by self-help groups, civil society organisations, and recyclers. Detailed institutional responsibilities are outlined in Table 4.3.1 in Annex 1. Clarifying roles and strengthening coordination mechanisms contributes to reducing fragmentation and ensures that responsibilities for enforcement, service delivery, and awareness are complementary rather than overlapping.

Monitoring and learning are integral to the strategy. Progress will be tracked using key indicators related not only to collection and recycling volumes, but also to leakage reduction, compliance, and environmental risks. Annual reviews and mid-term assessments will allow the strategy to adapt to new evidence, emerging challenges and lessons from implementation.

## 4.4 Timeline and milestones

Table 4.4.1 presents a proposed timeline and milestone framework for implementing the strategic actions outlined above. The timeline builds on existing policy initiatives and current implementation trends while introducing sequencing and review points to support coordinated action across departments and levels of government. The milestones are structured to reflect three phases: short-term actions focused on strengthening foundations and closing immediate gaps; medium-term actions aimed at consolidation and scale-up; and longer-term actions orientated towards system transition and circularity. While several of the listed activities are already underway, the timeline clarifies when and how these efforts should be expanded, institutionalised, or adjusted in line with the strategic priorities outlined earlier in this chapter.

Critical milestones include completion of a state-wide baseline assessment (2025), preparation of

plastic waste inventories by all ULBs (2026), and a mid-term policy and performance review (2028). The timeline is aligned with national targets, including the Ministry of Environment, Forest & Climate Change's waste reduction goals for 2013, and will be updated through annual monitoring and review processes.

Recent budget allocations, including the State's 2025–26 commitment of ₹3,450 crore for waste-to-energy facilities in Chennai, underscore the scale of investment in solid waste infrastructure. At the same time, these investments reinforce the importance of prioritising upstream reduction, segregation and recycling to avoid over-reliance on downstream treatment options.

## 4.5 Resource allocation

Implementing the plastic waste management strategy requires substantial investment in infrastructure, human resources, monitoring systems, and institutional capacity. Resource needs span the full waste management chain, from collection and segregation to recycling, enforcement, and public engagement. Capital costs are significant, particularly for decentralised infrastructure such as Plastic Waste Management Units, where a typical rural unit requires an investment of approximately ₹14 lakh (Kuttalingam, 2023). Scaling up to more than 300 units implies infrastructure costs in the range of ₹40–50 crore. Funding will need to be mobilised from multiple sources, including the ULB budget, Swachh Bharat Mission grants, state environmental funds, and EPR contributions.

To reduce pressure on any single funding stream, the strategy emphasises blended financing. Municipal budgets may allocate dedicated plastic management funds, potentially supplemented by modest user fees or levies. EPR contributions collected through the CPCB portal can be channelled back into recycling infrastructure and capacity building, while corporate social responsibility funding and public–private partnerships can support awareness, innovation, and service delivery. State-level entities, such as the

**Table 4.5.1** Resource needs and funding sources for PWM strategy

Resource Category	Requirement / Allocation	Funding Source
Collection & Segregation	Purchase of 5,000+ colour-coded bins, 100 new waste-collection vehicles, and construction of Material Recovery Facilities.	ULB budgets (own/AMRUT funds); SBM(U) grants; Public-Private partnerships.
Recycling Infrastructure	Capital for 300 shredders (~14 lakh each) and bailing units; expansion of small-scale recycling units.	SBM Plastic Waste Management Scheme; State contributions; Industry (EPR) funds; bank loans (TNUIFSL).
Roads & Co-processing	Technical deployment of shredded-plastic road laying in all rural districts; partnership with the Public Works Dept.	Joint funding: Rural Development Department + ULB co-funding + contribution from recycling revenues.
Monitoring & Enforcement	Hiring additional inspectors; mobile enforcement vans; IT systems for tracking (e.g. GPS on vehicles, databases).	State E&F budget; TNPCB revenue (authorisation fees, fines); small cess for manufacturers.
Awareness & Capacity	Media campaigns, training workshops, curriculum development; IEC materials in local languages.	State environment funds; NGO/Civil Society partnerships; voluntary CSR grants; MPLADS (MP Local Area Development Scheme).
Human Resources	Sanitation workers' ( <i>Thoimai Kaavalars</i> ) salary increments; training of volunteers/ambassadors.	Municipal tax revenue; SBM(U) performance grants; PPP engages "Swachhagrahis".
Research & Innovation	Pilot projects for chemical recycling; academic grants for plastic alternatives R&D.	State Innovation Fund; university research grants; industry co-sponsored projects.

Tamil Nadu Green Climate Company (TNGCC), can play a catalytic role in co-financing priority initiatives. Table 4.5.1 outlines major resource categories:

Clear oversight mechanisms are essential to ensure efficient and transparent use of resources. The Tamil Nadu Pollution Control Board will play a central role in auditing fund utilisation and monitoring compliance, while broader financial oversight can be supported by existing state finance and audit institutions.

## 4.6 Monitoring and key performance indicators

Monitoring and performance tracking are central to ensuring accountability and enabling adaptive

management of the strategy. A set of key performance indicators (KPIs) has been defined to track progress across collection, treatment, compliance, and behavioural outcomes (Table 4.6.1). The KPIs are designed to capture operational outputs, such as quantities collected or recycled, as well as system-level outcomes, including reductions in single-use plastic consumption, improvements in segregation, and declines in non-compliance. Baselines reflect the most recent available data, and targets are aligned with state ambitions and national circular economy objectives.

Data for these indicators will be drawn from established sources, including TNPCB annual reports, urban local bodies' records, and EPR compliance

**Table 4.6.1** Key Performance Indicators (KPIs) for Tamil Nadu PWM Strategy

Indicator	Definition / Measurement	Baseline (2022–23)	Target (2030)
Plastic waste collected (tonnes/yr)	Total plastic waste collected by ULBs (per TNPCB report).	753,600 tonnes (96% of generation)	≥95% of actual generation
Recycling rate (%)	(Tonnes recycled ÷ tonnes generated) × 100. Includes recycling, WtE, and roads.	20% (156,500/783,082) (Kuttalingam, 2023)	≥40% of generation
EPR compliance (% registered)	% of required producers/brand owners registered and meeting targets.	80% registered (230 recycling units)	100% EPR compliance
PWMUs operational (number)	Count of active plastic shredding/recycling units (urban + rural).	296 units	≥500 units
Plastic road length laid (km/yr)	Cumulative kilometres of road constructed with waste plastic.	186 km (to early 2024)	≥1000 km cumulative
Source segregation rate (%)	% of households/units following plastic-lagoon (wet/dry) segregation.	60% (estimated)	≥90% of households
SUP ban violations	Number of detected non-compliance incidents (shops/events using banned SUP).	500 (2023 data, TNPCB)	0 (virtual elimination)
Awareness index (qualitative)	% of population aware of PWM rules (via surveys).	(to be assessed)	≥80% awareness

filings. Indicators will be reviewed annually, with the results informing course correction and prioritisation in subsequent implementation cycles.

## 4.7 Summary of strategic priorities

The measures outlined in this chapter point to a clear set of strategic priorities for plastic waste management in Tamil Nadu. These include strengthening enforcement of existing regulations, expanding and upgrading collection, segregation, and recycling infrastructure across urban and rural areas, and ensuring that Extended Producer Responsibility mechanisms translate into tangible improvements on the ground.

Equally important is the need to approach recycling

and reuse options with caution, ensuring that circular economy initiatives reduce overall plastic dependence and do not shift environmental or health risks elsewhere. Sustained engagement with communities, self-help groups, schools, and civil society organisations remains critical for embedding behavioural change and improving segregation at source.

Finally, systematic monitoring and periodic review provide the basis for learning and adaptation. By linking clear milestones, adequate resources, and measurable indicators to its strategic objectives, Tamil Nadu can move from policy ambition to consistent outcomes, reducing plastic pollution while strengthening inclusive and environmentally sound waste management systems.





## CHAPTER 5

# CONCLUSION AND WAY FORWARD

### 5.1 Concluding reflections

Plastic pollution remains a complex and persistent challenge in Tamil Nadu, shaped by rapid industrialisation, changing consumption patterns, and uneven waste management capacity across urban, peri-urban, and rural areas. Despite relatively high reported collection rates and the introduction of ambitious policy measures, evidence presented in this report demonstrates that plastic leakage into rivers, settlements, and surrounding ecosystems continues. Monitoring and modelling results from the Cauvery River basin illustrate how plastic is mobilised through seasonal flows, accumulates behind infrastructure, and enters the environment through a combination of incomplete collection, informal dumping, and everyday practices.

At the same time, Tamil Nadu has established a comparatively strong foundation for addressing plastic waste and pollution. The state has invested in decentralised waste management infrastructure, introduced restrictions on selected single-use plastics, expanded public awareness campaigns, and taken steps to operationalise Extended Producer Responsibility. These measures have contributed to improvements in collection, segregation, and recovery in many areas and provide a solid basis for further action.

The findings of this report suggest that reducing plastic pollution requires more than the expansion of infrastructure or the introduction of new regulatory instruments. Persistent leakage points to systemic challenges that cut across policy implementation, enforcement capacity, economic incentives, social practices, and institutional coordination. Addressing these challenges requires a strategic approach that strengthens existing measures, closes identified

gaps, and aligns downstream waste management with broader efforts to reduce plastic use and environmental exposure.

### 5.2 From evidence to strategy

A key contribution to this report is the integration of environmental monitoring, modelling, and institutional analysis to inform strategic decision-making. Data from macroplastic monitoring in the Cauvery River highlight dominant waste categories, spatial hotspots, and seasonal dynamics that are not fully captured by conventional waste statistics. Modelling results further illustrate how plastics are retained, remobilised, and transported through the catchment, underscoring the importance of considering hydrology, infrastructure, and land–river interactions in pollution management.

These insights underscore the necessity of strategies rooted in empirical evidence and adaptable to changing circumstances. Strengthening monitoring systems, harmonising data collection, and embedding scientific findings into routine planning and review processes can support more targeted interventions and improve accountability. Such an approach enables policymakers and implementing agencies to distinguish between measures that are working as intended and those that require adjustment or additional support.

The analysis of systemic challenges in Chapter 3 further shows that plastic pollution is closely linked to economic and social dynamics. Micro, small, and medium enterprises play a central role in plastic production and recycling but often operate under tight financial and regulatory constraints. Informal waste workers contribute significantly to material recovery while remaining among the most exposed to

environmental and occupational risks. Social norms, affordability considerations, and limited alternatives continue to shape reliance on single-use plastics and disposal practices. These dynamics highlight the importance of strategies that are not only technically sound but also socially grounded and economically viable.

### 5.3 Strategic direction moving forward

The strategic framework set out in Chapter 4 builds on these findings by distinguishing between measures that are already in place, areas where implementation remains uneven, and priorities for future action. Rather than proposing an entirely new system, the strategy emphasises consolidation, coordination, and learning. Strengthening the enforcement of existing regulations, improving the consistency of implementation across districts, and supporting local actors in complying with evolving requirements are central to this approach.

Moving forward, particular attention is needed to ensure that circular economy initiatives contribute to genuine reductions in plastic pollution and do not shift risks elsewhere. Recycling and reuse options can play an important role in diverting plastics from open dumping and littering, but they must be assessed carefully in terms of environmental performance, health impacts, and long-term sustainability. Aligning circular economy efforts with the waste hierarchy, prioritising reduction, reuse, and safer substitution, can contribute to avoiding unintended consequences and lock-in effects.

Extended Producer Responsibility represents another critical lever for change, provided that it translates into tangible improvements on the ground. Strengthening registration, reporting, auditing, and transparency mechanisms can help ensure that EPR obligations support investments in collection, recycling, and waste reduction, rather than remaining largely administrative exercises. Linking EPR more clearly to local infrastructure needs and

monitoring outcomes can enhance its effectiveness and credibility.

### 5.4 Inclusion, behaviour and institutional learning

Reducing plastic pollution also depends on sustained engagement with people and communities. Enforcement alone cannot address behavioural drivers of plastic pollution, such as direct dumping, the continued use of low-cost single-use plastics, and limited segregation at source. Awareness campaigns, community-based initiatives, and locally appropriate incentives remain essential, particularly when coupled with accessible alternatives and reliable waste services.

Ensuring a just and inclusive transition is a cross-cutting consideration. Integrating informal waste workers, recognising gendered dimensions of waste work, and supporting MSMEs to adapt to regulatory changes can improve both environmental outcomes and social equity. These efforts require coordination across departments, clear institutional roles, and long-term commitment, rather than short-term or project-based interventions.

Finally, plastic waste management in Tamil Nadu is shaped by broader national and international developments. Ongoing reforms under India's Plastic Waste Management Rules, evolving EPR frameworks and negotiations towards a global plastics treaty will continue to influence priorities and expectations. Aligning state-level strategies with these processes, while remaining attentive to local conditions and capacities, can help ensure coherence and avoid fragmented responses.

### 5.5 Way forward

The way forward outlined in this report points to a more integrated, evidence-based, and adaptive approach to plastic waste management in Tamil Nadu. Essential components of this transition include strengthening the implementation of existing

measures, investing in monitoring and learning, cautiously advancing circular solutions, and fostering social inclusion. While the challenges are significant, Tamil Nadu's existing institutional capacity, emerging scientific tools, and active engagement by public, private, and civil society actors provide a strong foundation for progress.

By linking strategic ambition with practical implementation and by treating plastic pollution as

a systemic issue rather than a collection of isolated problems, Tamil Nadu can move towards more consistent and lasting reductions in plastic pollution. The experience and lessons generated through this process can also contribute to broader national and international efforts to address plastic pollution in ways that are environmentally effective, socially just, and responsive to local realities.

## References

### Chapter 1

1. Business Standard. (2017). *Tamil Nadu leads South Indian states in plastic manufacturing, consumption*. Retrieved from [https://www.business-standard.com/article/news-ani/tamil-nadu-leads-south-indian-states-in-plastic-manufacturing-consumption-117120900272\\_1.html](https://www.business-standard.com/article/news-ani/tamil-nadu-leads-south-indian-states-in-plastic-manufacturing-consumption-117120900272_1.html)
2. Cottom J., Cook, E., Velis, C.A. (2024) A local-to-global emissions inventory of macroplastic pollution. *Nature*. 633: 101-108. DOI: <https://doi.org/10.1038/s41586-024-07758-6>.
3. OECD (2022) *Global plastic waste set to almost triple by 2060, says OECD*. Organisation for Economic Co-operation and Development. Available from: <https://www.oecd.org/en/about/news/press-releases/2022/06/global-plastic-waste-set-to-almost-triple-by-2060.html>
4. Tamil Nadu Pollution Control Board (2023). *Plastic waste management annual report 2022-23*. [https://tnpcb.gov.in/PDF/Waste\\_Mngt/Plastic\\_Waste/PwmAnnualRpt22-23.pdf](https://tnpcb.gov.in/PDF/Waste_Mngt/Plastic_Waste/PwmAnnualRpt22-23.pdf)
5. The Hindu (2022c). Plastic industry in Tamil Nadu has potential to grow by over 28 per cent: TAPMA. Retrieved from <https://www.thehindubusinessline.com/news/plastic-industry-in-tamil-nadu-has-potential-to-grow-by-over-28-per-cent-tapma/article65501099.ece>
3. Dutta, A., & Jinsart, W. (2020). Waste generation and management status in the fast-expanding Indian cities: A review. *Journal of the Air & Waste Management Association*, 70(5), 491–503. Retrieved from <https://doi.org/10.1080/10962247.2020.1738285> on December 5, 2025.
4. Futter, M.N., Erlandsson, M.A., Butterfield, D., Whitehead, P.G., Oni, S.K., & Wade, A.J. (2014). PERSiST: a flexible rainfall-runoff modelling toolkit for use with the INCA family of models. *Hydrology and Earth System Sciences*, 18, 855-873. doi: 10.5194/hess-18-855-2014
5. Greater Chennai Corporation (n.d.), *Solid Waste Management*, retrieved from <https://chennaicorporation.gov.in/gcc/department/solid-waste-management/> on December 5, 2025.
6. INCA Macroplastics Project. (n.d.). *INCA macroplastics modelling platform*. <https://ikhapp.org/inca-macroplastics/> on November 18, 2025,
7. INOPOL (2025). *Baseline Report on Plastic Waste Management in Tamil Nadu, India: Perspectives and Pathways*
8. Karur District. (n.d.). *District Profile*. Retrieved from <https://karur.nic.in/about-district/district-profile-2/> on December 8, 2025.
9. Kuthithalai Municipality. (n.d.). *Solid Waste Management*. Retrieved from <https://www.tnurbantree.tn.gov.in/kulithalai/solid-waste-management/> on December 8, 2025.

### Chapter 2

1. Dindigul City Municipal Corporation (2019), *City Sanitation Plan*. Retrieved from <https://www.tnurbantree.tn.gov.in/dindigul/wp-content/uploads/sites/30/2019/08/CSP.pdf> on December 8, 2025.
2. Down To Earth. (2022, January 26). *Kumbakonam's plastic waste used as fuel in cement factories | The cleanest cities of India | Ep-6* [Video]. YouTube. <https://www.youtube.com/watch?v=XKYOb7U7FgM>
10. Mayiladuthurai District Administration. (n.d.). *About District*. Retrieved from <https://mayiladuthurai.nic.in/about-district/> on December 8, 2025.
11. Mayiladuthurai Municipality. (n.d.). *Solid waste management*. Retrieved from <https://www.tnurbantree.tn.gov.in/mayiladuthurai/solidwaste-management/> on December 8, 2025.

12. Ministry of Environment, Forest and Climate Change (MoEFCC) (2024), *Lok Sabha Unstarred Question No. 2275*, retrieved from [https://sansad.in/getFile/loksabhaquestions/annex/183/AU2275\\_LoltNG.pdf?source=pqals](https://sansad.in/getFile/loksabhaquestions/annex/183/AU2275_LoltNG.pdf?source=pqals) on December 5, 2025.
13. Nagapattinam Municipality. (n.d.). *Solid waste management*. Retrieved from <https://www.tnurbantree.tn.gov.in/nagapattinam/solid-waste-management/>
14. Namakkal Municipality. (n.d.). *Solid waste management*. Retrieved from <https://www.tnurbantree.tn.gov.in/namakkal/solid-waste-management/> on December 8, 2025.
15. NGT (2020), *Before the National Green Tribunal, Original Application No. 67 of 2020 (SZ)*. Retrieved from [https://www.greentribunal.gov.in/sites/default/files/news\\_updates/6720.pdf](https://www.greentribunal.gov.in/sites/default/files/news_updates/6720.pdf) on December 8, 2025.
16. NGT (2021), *Report of the Tamil Nadu Pollution Control Board in Respect of O.A. NO. 52 & 67 OF 2020*. Retrieved from [https://www.greentribunal.gov.in/sites/default/files/news\\_updates/Report%20filed%20by%20TNPCB%20in%20OA%20No%2052%20of%202020\(SZ\).pdf](https://www.greentribunal.gov.in/sites/default/files/news_updates/Report%20filed%20by%20TNPCB%20in%20OA%20No%2052%20of%202020(SZ).pdf) on December 8, 2025.
17. NIVA Norway. (n.d.). *MOBIUS model repository*. GitHub. <https://github.com/NIVANorge/Mobius>
18. Salem Municipality. (n.d.). *Solid Waste Management*. Retrieved from <https://www.tnurbantree.tn.gov.in/salem/solid-waste-management/> on December 8, 2025.
19. SBM Gramin, (2021, December 1). *Effective PWM systems in villages of Tamil Nadu*. Swachh Bharat Mission (Grameen). Retrieved from <https://sbmgramin.wordpress.com/2021/12/01/effective-pwm-systems-in-villages-of-tamil-nadu/> on December 8, 2025.
20. SBM Urban (n.d.), *City-wise report of Municipal Solid Waste Management* (\* as per the MIS data filled by cities in the Swachhatam Portal). Retrieved from <https://sbmurban.org/storage/app/media/ULBs-SWM-Data.pdf> on December 8, 2025.
21. Sirkali Municipality. (n.d.). *Solid waste management*. Retrieved from <https://www.tnurbantree.tn.gov.in/sirkali/solid-waste-management/> on December 8, 2025.
22. TNN. (2018). *Dyeing units pollute Cauvery with effluents, TNPCB blamed*. Retrieved from <https://timesofindia.indiatimes.com/city/salem/dyeingunits-pollute-cauvery-with-effluents-tnpcbblamed/articleshow/66944961.cms> on December 4, 2025.
23. Tamil Nadu Pollution Control Board (TNPCB) (2023), *Annual Report on the status of Implementation of PWM Rules, 2016 as amended in 2022 for the year 2022-23*, retrieved from [https://tnpcb.gov.in/PDF/Waste\\_Mngt/Plastic\\_Waste/PwmAnnualRpt22-23.pdf](https://tnpcb.gov.in/PDF/Waste_Mngt/Plastic_Waste/PwmAnnualRpt22-23.pdf) on December 5, 2025.
24. Tamil Nadu Pollution Control Board (TNPCB) (2025), *Implementation of Solid Waste Management Rules, 2016 in the State of Tamil Nadu – Annual report for the year 2024-2025*, retrieved from [https://tnpcb.gov.in/PDF/Waste\\_Mngt/Solid-wste/AnnualRptSWM24\\_25.pdf](https://tnpcb.gov.in/PDF/Waste_Mngt/Solid-wste/AnnualRptSWM24_25.pdf) on December 5, 2025.
25. Thanjavur Municipality. (n.d.) *Solid waste management*. Retrieved from <https://www.tnurbantree.tn.gov.in/thanjavur/solid-waste-management/> on December 8, 2025.
26. Tiruvarur Municipality (2025), *Solid Waste Management*. Retrieved from <https://www.tnurbantree.tn.gov.in/thiruvarur/solid-waste-management/> on December 8, 2025.
27. Trichy Municipality. (n.d.). *Solid waste management*. Retrieved from <https://www.tnurbantree.tn.gov.in/trichy/en/solid-waste-management/> on December 8, 2025.

### Chapter 3

1. Behuria, P., 2021. Ban the (plastic) bag? Explaining variation in the implementation of plastic bag bans in Rwanda, Kenya and Uganda. *Environment and Planning C: Politics and Space*. 39: 8. DOI: <https://doi.org/10.1177/2399654421994836>.
2. Derhab, N., & Elkhwesky, Z. (2022). A systematic and critical review of waste management in micro, small and medium-sized enterprises: Future directions for theory and practice. *Environmental Science and Pollution Research International*, 30(6), 13920–13944. <https://doi.org/10.1007/s11356-022-24742-7>
3. Federation of Indian Chambers of Commerce and Industry (FICCI). (2024). Plastic waste management in India: Challenges and opportunities [PDF]. <https://ficci.in/public/storage/SEDocument/20708/wvJXfJlTEGj1Mrh6nMNNORNyY1gf1ZPXOSfOBify.pdf>
4. Government of Tamil Nadu, Micro, Small and Medium Enterprises Department. (2024). *Policy Note 2024-2025*. [https://www.tn.gov.in/rti/msme/msme\\_e\\_pn\\_2024\\_25.pdf](https://www.tn.gov.in/rti/msme/msme_e_pn_2024_25.pdf)
5. Government of Tamil Nadu. (2025). Micro, Small and Medium Enterprises Department: *Policy Note 2024–2025*. Retrieved from [https://www.tn.gov.in/rti/msme/msme\\_e\\_pn\\_2024\\_25.pdf](https://www.tn.gov.in/rti/msme/msme_e_pn_2024_25.pdf)
6. INOPOL. (2025). *Baseline Report on Plastic Waste Management in Tamil Nadu, India: Perspectives and Pathways*. [https://www.niva.no/prosjekter/inopol/\\_/attachment/inline/eb3abfdd-b9c8-4b97-873d-da2d0fc1c3fd:f34733acae3883bf381154b2fe1fbded85b5fd9f/Final-Baseline%20Report%20on%20Plastic%20Waste%20Managment%20in%20Tamil%20Nadu\\_2025\\_INOPOL.pdf](https://www.niva.no/prosjekter/inopol/_/attachment/inline/eb3abfdd-b9c8-4b97-873d-da2d0fc1c3fd:f34733acae3883bf381154b2fe1fbded85b5fd9f/Final-Baseline%20Report%20on%20Plastic%20Waste%20Managment%20in%20Tamil%20Nadu_2025_INOPOL.pdf)
7. Ministry of Micro, Small & Medium Enterprises. (n.d.). *State-wise Udyam registration details*. Udyam MSME Dashboard. [https://dashboard.msme.gov.in/Udyam\\_Statewise.aspx](https://dashboard.msme.gov.in/Udyam_Statewise.aspx)
8. Mishra, S., Sahoo, D., Mohapatra, S. (2025). Barriers to Circular Economy Adoption in MSMEs: A WINGS Analysis of Challenges in Developing Economies. *Circular Economy and Sustainability*. <https://doi.org/10.1007/s43615-025-00668-3>
9. Orellana, M (2021). *The Stages of the Plastics Cycle and Their Impacts on Human Rights – Report of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes*. Available at: <https://www.ohchr.org/en/documents/thematic-reports/a76207-stages-plastics-cycle-and-their-impacts-human-rights-report>
10. Owens, K.A.; Conlon, K. (2021). Mopping up or turning off the tap? Environmental injustice and the ethics of plastic pollution. *Frontiers in Marine Science*. 8. <https://doi.org/10.3389/fmars.2021.713385>
11. Plassnig, S. N., Roy-Basu, A., Grover, S., Krishnan, A., Mosberg, M., & Kvanneid, A. J. (2025). *Gender dimensions of plastic and POPs pollution in India: Tracing impacts across the plastics value chain* (NIVA Report 8136-2025). Norsk institutt for vannforskning (NIVA). [https://www.mugammaconsultants.com/wp-content/uploads/2025/10/Gender\\_dimensions\\_of\\_plastic\\_and-POPs\\_pollution\\_in\\_India.pdf](https://www.mugammaconsultants.com/wp-content/uploads/2025/10/Gender_dimensions_of_plastic_and-POPs_pollution_in_India.pdf)
12. Plastic recyclers challenges in India. (n.d.). *Ministry of Environment, Forest & Climate Change*.
13. Tamil Nadu Pollution Control Board. (2024). *Annual Report 2023–2024*. [https://tnpcb.gov.in/PDF/Information/annualreports/English/AnnualRpt\\_Eng2024.pdf](https://tnpcb.gov.in/PDF/Information/annualreports/English/AnnualRpt_Eng2024.pdf)
14. Tamil Nadu Pollution Control Board. (n.d.). *Plastic waste management*. Retrieved December 5, 2025, from <https://tnpcb.gov.in/plasticWaste.php>

15. UN-Habitat & NIVA. (2022). *Leaving no one behind: How a global instrument to end plastic pollution can enable a just transition*. United Nations Human Settlements Programme & Norwegian Institute for Water Research (NIVA). [https://unhabitat.org/sites/default/files/2022/11/unhabitat\\_niva\\_report\\_leaving\\_no\\_one\\_behind\\_1.pdf](https://unhabitat.org/sites/default/files/2022/11/unhabitat_niva_report_leaving_no_one_behind_1.pdf)
  16. Xanthos, D., Walker, T.R. 2017. International policies to reduce plastic marine pollution from single-use plastics (plastic bags and microbeads): A review. *Marine Pollution Bulletin*. 118 (1-2): 17-26. DOI: <https://doi.org/10.1016/j.marpolbul.2017.02.048>.
- Chapter 4**
1. Environment, Climate Change and Forest Department (2024). Standard operating procedures: Single use plastic free premises. Government of Tamil Nadu. Available from: [https://cms.tngreencompany.com/uploads/SOP\\_TN\\_SUP\\_Secretariat\\_c5a127347d.pdf](https://cms.tngreencompany.com/uploads/SOP_TN_SUP_Secretariat_c5a127347d.pdf)
  2. Kuttalingam, A. (2023). Usage of waste plastic in bituminous road construction [Technical Report]. Available from: [https://swachhbharatmission.ddws.gov.in/sites/default/files/communication-material/TN\\_Kuttulingam-Usage\\_of\\_Waste\\_Plastic\\_in\\_Bituminous\\_RoadConstruction-14.02.2024.pdf](https://swachhbharatmission.ddws.gov.in/sites/default/files/communication-material/TN_Kuttulingam-Usage_of_Waste_Plastic_in_Bituminous_RoadConstruction-14.02.2024.pdf)
  3. Ministry of Environment, Forest and Climate Change. (2021, August 12). Government notifies the Plastic Waste Management Amendment Rules, 2021, prohibiting identified single use plastic items by 2022 [Press release]. Press Information Bureau. Available from: <https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1745433>
  4. Ministry of Environment, Forest and Climate Change. (2025). Parliamentary question: Status of ban on single-use plastic [Press release]. Press Information Bureau. Available from: <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2159298&reg=3&lang=2>
  5. Tamil Nadu Pollution Control Board. (2025). About us. Available from <https://tnpcb.gov.in/about-us.php> [Retrieved October 26, 2025].

# ANNEXURE

**Table 4.3.1.** Stakeholders and their PWM roles in Tamil Nadu <sup>[1][2]</sup>

Institution/Stakeholder	Roles and Responsibilities
State E&F Dept (DoE&CC)	Formulates PWM policy; issues government orders (e.g., on SUP bans); chairs State Task Force; allocates budget; oversees state-wide coordination; liaises with MoEFCC/CPCB; runs IEC campaigns (e.g., <i>Meendum Manjappai</i> ); supports research (via TNGCC) on sustainable alternatives.
TN Pollution Control Board (TNPCB)	Regulatory authority: enforces PWM Rules and state GOs; monitors compliance (inspections, fines, order closures); registers producers/recyclers under EPR; provides technical support/training to ULBs and communities; manages data (annual inventories); facilitates partnerships; and hosts the CPCB EPR Portal link.
Urban Local Bodies (ULBs: Municipal Corporations, Municipalities, Town Panchayats)	Front-line implementers: collect waste (door-to-door segregation); operate or contract PWMUs (including setting up shredders, MRFs); allocate budget for plastic waste within solid waste management; enforce bans locally (e.g., sanctioning stores selling SUP); coordinate with SHGs/sanitary workers; report data to TNPCB.
District Administration (Collectors)	Coordinate district-level task forces; ensure interdepartmental action (Municipal, Police, Revenue); supervise implementation in ULBs and rural panchayats; facilitate training and awareness events; mobilise local resources (e.g., land for collection sites); and review progress in monthly meetings.
Village Panchayats/Gram Panchayats	Implement plastic segregation and composting in rural areas; run PWMUs under Swachh Bharat schemes (with District Rural Development Agency (DRDA) support); manage local plastic collection centres; enforce Gram Sabha resolutions banning plastics; involve SHGs in buying and processing plastic waste.
SHGs/Community Organizations	Operate plastic shredding units and collection centers (as in Panjampatty/Mudikandanallur cases); conduct door-to-door awareness; engage in buy-back schemes (e.g., purchasing at Rs 10/kg); act as local monitors of segregation; promote recycling livelihoods.
Industry/Producers/Brand Owners	Comply with EPR: register with TNPCB/CPCB; fulfil targets for collection/recycling of their packaging; phase out non-recyclable plastics; support innovations (e.g., plastic-to-road projects); contribute to the shared "Plastic Waste Fund" or self-manage recycling programs; adopt eco-friendly design.

<b>Institution/Stakeholder</b>	<b>Roles and Responsibilities</b>
Recycling & Waste Processing sectors	Invest in plastic recycling plants, pyrolysis or waste-to-energy (for non-recyclables); process collected plastics into pellets, fuel or products; work with ULBs/SHGs to utilise segregated waste; share technology (e.g., plastic roads with local bodies); and ensure environmentally sound disposal of rejects.
Central Agencies (MoEFCC/CPCB)	Provide guidelines (Plastic Waste Management Rules and amendments, EPR frameworks); issue technical manuals; allocate central grants (e.g., SBM/U funding); audit state performance; oversee the national EPR registry; facilitate national-level stakeholder workshops; and update norms based on global best practices.
Civil Society/NGOs/ Academia	Conduct independent monitoring; raise public awareness; train local stakeholders; pilot innovative projects (e.g., community recycling microenterprises); advise government on policy; participate in media campaigns; help design indicators; and encourage schools/colleges to adopt waste-free policies.



INOPOL

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