PROMISE
PREVENTION OF MARINE LITTER IN THE LAKSHADWEEP SEA

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POLICY BRIEF (Input Paper): Prevention of Marine Litter in India

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1. Introduction

This document is produced as a part of the project **'Prevention of Marine Litter in the Lakshadweep Sea (PROMISE)'**. The project activities target tourism clusters located along the Lakshadweep shorelines in the Maldives, Sri Lanka and India. The project aims at prevention and leakage of wastes from land-based sources into the Lakshadweep Sea in line with Sustainable Consumption and Production (SCP) approach. This input paper outlines the preliminary findings about the current waste management related policy ecosystem specifically addressing marine litter in India and provides initial recommendations based on desk research. Following engagements with stakeholders such as local authorities managing waste, micro, small and medium enterprises (MSMEs) in the tourism sector, business associations, policy makers etc., this document will be updated incorporating the learnings from these engagements.

2. Background

India is considered a hotspot for marine litter as it is among the largest contributors of marine plastic pollution in the world. This is because of the rapid increase in coastal population and coastal urbanization while systems for plastic waste management are being established more slowly. The recent COVID-19 pandemic has moreover contributed to an increase in plastics use[1]. Of the 10 rivers that carry over 90% of the total plastic debris into the sea globally, three (Indus, Ganga and Brahmaputra) are flowing through India[2]. Worldwide, the Indus carries the second largest amount to the sea while Ganga and Brahmaputra share the sixth place[3].

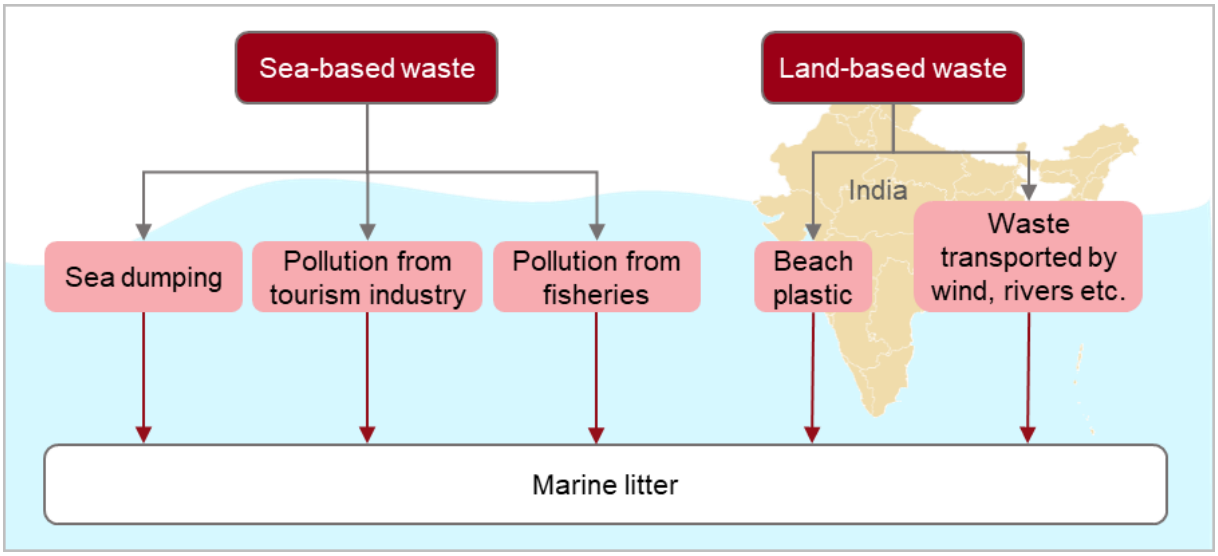
With most of the plastic in oceans originating from land-based sources, the root of the problem lies in current production and consumption patterns of non-recoverable and single-use plastics, according to the United Nations Environment Programme (UNEP)[4]. Densely populated and/or touristic areas and industrial activities impact the generation of marine litter. Also, seasonal episodes such as floods during rainy season increase the chances of mismanaged plastic waste eventually ending up in the ocean. In general, high per capita and total plastic use in regions is not a main indicator for the creation of marine litter, given that plastics can be safely managed after its end-of-life. However, in areas that lack waste collection and management systems, higher total waste produced can be linked to higher risks of plastics entering the sea.

Pathways of marine litter in India are manifold (Figure 1). One source of marine litter is waste which is dumped into the sea such as fishing nets and other waste materials that are either lost or purposely discarded. Secondly,

[1]Brock 2020.
[2]Gray 2018.
[3]Pendharkar 2018.
[4]United Nations Environment Programme 2016.

plastics are littered both intentionally and unintentionally at beaches, with responsible authorities unable to implement clean-up operations effectively. Finally, littering appears particularly often in tourism hotspots where high amounts of single-use plastics (SUP) can be found.

Figure 1: Pathways of Marine Litter



Marine litter is affecting the environment in many ways. It has a strong direct impact on biodiversity, especially affecting marine animals that often get entangled and eventually killed by suffocation or strangulation through plastic debris floating in the sea. Ingestion of plastic waste is also a common phenomenon among mammals, fish, turtles and birds; this subsequently leads to accumulation within humans consuming this seafood. For various species, the surrounding marine environment is endangered furthermore as plastic debris pose a risk to coral reefs. Due to its durability, plastics can travel long distances in water, sometimes transporting marine species which invade other areas at the cost of the native species. Plastic waste can also have secondary impacts, for instance, by litter clogging of stormwater drains, which can result in sanitation problems and floods as demonstrated in Mumbai in 2005[5]. Climate change is another secondary impact of plastic waste. Conventional plastics are based on petrochemicals. Besides the environmental impact associated with its production, plastic waste can cause additional greenhouse gas emissions if incinerated. Even landfilled plastic slowly releases greenhouse gases. Furthermore, the presence of (micro) plastics in the ocean will interfere with the carbon fixation capacity of the ocean.

Not only the environment but also the economy can be affected by the consequences of marine litter. For instance, both the fisheries and shipping industries are affected, since plastic waste can cause considerable damage to ships as plastic debris entangle with propellers and other moving parts. Additionally, the fact that fish populations are decreasing with fish dying from ingestion of or strangulation by plastic waste naturally causes reduced supply to both fishermen, particularly subsistence fishermen, and consumers. Also, tourism suffers with beach and marine litter due to a loss of aesthetic value of shorelines and beaches. Lastly, producers of packaged consumer goods are under pressure to take responsibility for post-consumer waste or find innovative alternatives to plastic packaging, otherwise their business will be threatened if strict legislative measures such as plastics ban come into force.

There are several reasons why plastic waste exists in waterways or beaches. There is a lack of awareness, including a missing sense of urgency to manage waste by plastic consumers, producers and local authorities.

[5]Lamond et al. 2012.

Current infrastructure and treatment facilities are insufficient to handle the growing amounts of municipal solid waste including plastics. Where regulatory measures already exist, they are often not enforced. Efforts of national or state level authorities therefore need to go hand-in-hand with building adequate capacities among local authorities to establish functioning collection systems, at the same time facilitating waste segregation in households and commercial establishments. Moreover, disposal facilities have to be adequately equipped to process a variety of wastes and workers need to be skilled accordingly to effectively operate the facilities.

The prevention of plastics entering the ocean needs to be carried out in locations where such efforts are ecologically most effective, mainly along the shorelines. It is further necessary to focus efforts towards eliminating plastic pollution at the source of the most common plastics used. Polyethylene and polypropylene, which are mainly used in various kinds of packaging, fishing gear, home appliances and toys, are the most common waste plastics recorded on Indian beaches.

Kerala

Kerala represents an interesting case regarding the management of marine litter. This state is situated on the south western coast of the Indian peninsula with an area of about 38,863 square km and a coastline of 588 km spread across 9 districts, forming 10% of India's total coastline. Moreover, Kerala has 44 rivers, 49 reservoirs, 9 fresh water lakes, as well as many ponds and streams[6].

The multitude of water streams presents various economic opportunities for Kerala. For instance, the fishing sector makes up 3% of the state's revenues from exports and 13% of the national marine fish production. Consequently, this sector provides livelihood to around 800,000 people in the 222 fishing villages situated along the coastline of the state6.

Considering the long coastline, marine and beach littering affects Kerala. Tourism, shipping and fishery are the main contributors to the occurrence of marine debris. Experimental fishing along Kerala's coasts has revealed great quantities of trash especially plastics and pieces of nets in nearshore areas[7]. The quantity, composition and seasonal variation of fishing-related debris shows that plastic items, such as fishing gear or nets, are the most dominant type of waste constituting 73.8% by number and 59.9% by weight. In the total debris recorded, 36% were fishing related trash, emphasizing the role of fishing activities in the generation of marine litter[8].

In recent years, seasonal occurrence of plastic waste on beaches of Central Kerala is on a decline. One reason is the initiation of frequent cleaning activities by various initiatives in combination with several awareness programmes[9]. These developments make Kerala an interesting case in the context of marine litter, with potential for further up scaling of measures to a national level.

Lakshadweep

The Lakshadweep sea is a part of the Indian ocean between India, the Maldives and Sri Lanka. The area comprises about 786,000 km² and is named after the Lakshadweep islands, which are a group of 36 small islands, 220-440 km away from the coast of Kerala[10]. Even though the islands' beaches are remote and touristic access to the islands is restricted[10], beach litter is a pressing problem in the area with 45% stemming from fishing activities, 34% being related to tourism and 87% of all litter being comprised of plastics[11].

[6]Kerala Department of Fisheries 2017.

[7]Kripa et al. 2016.

[8]Daniel et al. 2020.

[9]Kripa et al. 2016.

[10]U.T. Administration of Lakshadweep.

[11]Kaviarasan et al. 2020.

3. Important Actors and Initiatives

3.1. Policy Framework

The basis for marine litter regulations was laid out with the **Water (Prevention and Control of Pollution) Act** in 1974. With this Act, India's Central Pollution Control Board (CPCB) was constituted with its main function covering the promotion of cleanliness of water streams in most states as well as advising the Central Government on prevention and control of water pollution[12]. The **Wildlife Protection Act** came into effect in 1972 to "*provide for the protection of wild animals, birds and plants […] and ensuring the ecological and environmental security of the country*"; it also covered marine animals[13] (p.6). The heavy pollution of the river Ganga, followed by the **Ganga Action Plan** in 1986, created momentum for the development of environmental regulations in general as well as specifically targeted at coastal and marine areas. Introduced in 1986, the **Environment Protection Act** was an important break-through for the recognition of nature preservation responsibilities including water streams; this paved the way for a variety of other environmental regulations.

Introduction of the **National Water Policy** in 1987 and the **Coastal Regulatory Zone Notification** in 1991 were the next steps of the policy framework. In 1995, a **National River Conservation Plan** followed. With the first policy already highlighting the need to eliminate water pollution, the second policy specified the prohibition of industrial activities including waste treatment close to certain coastal regions to prevent water pollution[14].

With the turn of the millennium, the impact of human consumption gained more awareness among policy-makers. With the **Guidelines for Recycling of Plastics** and the **Bio-medical Waste Rules**, two waste-related policies were introduced in 1998, complemented by the **Re-cycled Plastics Manufacture and Usage Rules** as well as the **Plastics Manufacture, Sale and Usage Rules** which came into effect the following year. The **Solid Waste Rules** of 2000 marked the end of a wave of waste-related policies during this period. The following years, several policies aimed to facilitate the development of more environmentally friendly products. These included the **National Design Policy** (2007) and **Food Safety and Standards (Packaging and Labelling) Regulations** (2011), both strengthening standardization and the introduction of eco-certification. A framework addressing **Extended Producer Responsibility** (EPR) to complement product design related regulations was recently introduced in 2020.

The **Solid Waste Management Rules** (2011) and **Plastic Waste Management Rules** (2016), including the 2018 amendment, represent another turning point in the development towards the current policy framework. They were accompanied by a variety of guidelines on segregation, collection or disposal of waste as well as by industry reforms to address the issue of waste pollution in India. Since Himachal Pradesh became the first state to ban single-use-plastic (SUP) in 2009, over 25 states in India have followed by introducing similar regulations[15]. The bans represented ground-breaking signals in fighting plastic pollution on a state-level. In 2019, a ban on SUP was even introduced by the Directorate General of Shipping to prohibit SUP on all ships which are in Indian waters as well as on Indian ships[16].

[12]Central Pollution Control Board 1974.

[13]Parliament of India 1972.

[14]Ministry of Environment and Forests 1991.

[15]Radha 2019.

[16]Directorate General of Shipping.

Policy Development in Kerala

An analysis of the beach litter in Kerala indicated that majority of littered materials contains plastic. Accordingly, the prevention of such litter is governed under the National Plastic Waste (Management & Handling) Rules[17]. Since national policies often lack the specificity to be implemented at a local scale in India, Kerala has introduced a variety of state policies such as the **State Policy on Solid Waste Management** of 2018 and the **Integrated Waste Management Strategy** 2020[18]. The policy of 2018 has identified many relevant objectives and four guiding practices: 1) considering waste as a resource 2) 3R principle 3) polluter pays principle and 4) responsibility of citizens over generated waste[19]. It underlines Kerala's frontrunner position, as EPR principles have already been anchored before a National EPR policy has been introduced. Both policy measures build upon the National Plastic and Solid Waste Management Rules of 2016 and were developed by the Local Self Government Department in Kerala with technical support of the Suchitwa Mission. The latter has additionally established the two initiatives, namely the **Green Protocol** and the '**My waste, My responsibility**' which were intended to create a sense of ownership among citizens to reduce and separate waste at the source. In addition, **Master Plans for Cities** are developed by the Town Planning Department for 93 urban local bodies (ULBs)[20].

Kerala has introduced various **Waste Management bye-laws** to complement national laws. The bye-laws for instance require local bodies to collect user fees from households, institutions, street vendors[21]. **Haritha Karma Sena** (or Green Task Force), a support system for managing waste at the field level, collects waste against user fees[22]. The bye-law has moreover raised fines and included provisions for penalties in case of repeated violations. Like other Indian states, Kerala has introduced SUP **bans** with even more particular **restrictions of plastic carry bags** to tackle plastic littering especially in commercial and tourist areas[23]. The **Haritha Keralam** (Green Kerala) initiative was launched in 2016 for enforcing anti-pollution policies. Together with the Suchitwa Mission and the state police, the initiative distributed responsibilities for mapping of litter clusters, awareness raising, warnings and enforcement[24]. An **MSW (Handling & Management) bye-law** was introduced in 2011 by the Centre for Environment and Development. According to these bye-laws, ULBs can declare an area as a sanitation zone or waste free area and/or can prohibit the dumping of any waste in such area[25].

The Public Works Department (PWD) is advocating for the **disposal of plastic waste through road construction**. The Department has published a study on describing the construction of a first test road in Kerala and suggests expanding the approach to a wider scale[26]. However, the concept is perceived with scepticism as it is not considered a long-term solution, while raising concerns of potential toxicity.

Kerala has also introduced their own state-wide **Environment Policy** in 2009 and **State Water Policy** in 2008 addressing among others, the threat to coastal ecosystems through water pollution. However, concerns regarding water resources mostly refer to enabling access to clean drinking water, water for household use or industrial activities rather than specifically targeting the environmental issues connected to marine litter[27,28]. The **Kerala Marine Fishing Regulation Act** of 1980 does not mention the loss of plastic nets, while the revised rule of 2018 only mentions a prohibition of using fishing gear made from plastic in specified areas[29]. Though it suggests

[17]Jayakumar et al. 2019.
[18]Local Self Government Department 2020a.
[19]Local Self Government Department 2018.
[20]Local Self Government Department 2019.
[21]Local Self Government Department 2020b.
[22]Suchitwa Mission 2019.
[23]Environment Department 2019.
[24]Police Headquarters Kerala.
[25]Ministry of Urban Development 2011.
[26]Jeljith and Shuresh Babu 2008.
[27]Department of Environment 2009.
[28]Water Resources Department 2008.
[29]Fisheries and Ports Department 2018.

a general process if fishermen encounter disposed fishing gear, there is no mention of any prohibition, penalties, or an enforcement process to prevent such disposal[29].

3.2. Finance Mechanisms

Various studies have tried to estimate the economic impacts of marine litter[30,]. The economic instruments to tackle marine litter should be targeted at three objectives, namely minimizing the production of marine litter, minimizing the harm caused by marine litter and avoiding unintended consequences from the application of the instrument[30]. Such instruments may then incentivize industries to use less plastic; this may involve using economic disincentives/subsidies (internalizing external cost), targeting waste reduction, implementing a landfill tax for example, or discouraging polluting behaviour by levying a fee for the collection of litter, which for example, is done through a rebate on property taxes given to housing societies separating their own wet and dry waste[31].Moreover, such instruments can be targeted towards particularly problematic areas such as shipping and toxicity related to the litter[30].Overall, economic instruments provide opportunities to compensate for the economic costs associated with plastic debris in marine environments. Such instruments can, for instance, cover EPR fees, deposit refunds, waste collection taxes and recycled product tax rebates[32].An instrument that results in additional costs (tax, fee, etc.) may face initial resistance by some stakeholders; an alternative could be a reward scheme encouraging 'good' behaviour funded by local taxes instead of punishing bad behaviour. Acceptance may change over time, as demonstrated by the example of plastic bans; where plastic bag taxes were introduced early, resistance disappeared once communities saw the benefits. Regarding marine litter, it is unclear if the financing of litter removal follows an approach based on punishing littering or setting financial incentives to collect waste on beaches and in the ocean[30].

Governments across the world, including many states in India, have introduced legislative measures to limit the use of plastic bags. A variety of regulatory instruments have been employed for this purpose. These include the mandatory pricing of plastic bags, explicit levies on each bag, taxes at manufacturing level, discounts on use of own bags, awareness campaigns and, in some cases, a total ban on the use of plastic bags. Consistent monitoring by the enforcement units and strict enforcement of fines when violations are detected are key to ensuring plastic policies, especially bans, are effectively implemented. In Himachal Pradesh, violations even carry fines of up to Rs.100,000 or seven years in jail[7]. In Chennai, carrying a plastic bag carries a penalty of Rs. 100 by the municipal authorities, while shops that provide or sell plastic bags will be charged an even higher fine by having their materials seized or even by being shut down for non-compliance[33]. In contrast, other cities or private sector stakeholders have used an incentivizing method by giving 1% discount to customers who bring their own bags[34,35].

Finance Mechanisms in Kerala

Kerala has introduced some finance tools for reducing plastic waste litter while at the same time distributing financial responsibility for waste creation. There is a **user charge** for solid waste management collection[36]. As per this rule, homes, institutions, street vendors, and public event organizers are charged monthly fees depending

[30]Newman et al. 2015.
[31]Times of India 2019.
[32]Liu et al. 2013.
[33]Sukanya Das 2014.
[34]Kapinga and Chung 2020.
[35]Gupta 2011.
[36]Suchitwa Mission 2019.

on the amount of waste. The fees for homes could range from INR 20 to 200 per month. Its enforcement is the responsibility of local authorities who are in charge of penalizing violations such as disposal in public places with fines[37]. Little is known however, about the level of enforcement, the effectiveness and consequences of these charges.

The city of Kochi has been a frontrunner in Kerala where ULBs have collaborated with the state agency Kudumbashree to organize the collection of household waste[38]. The solid waste charge of 2% of the property tax is collected along with the property tax. Additional user charges are collected at the rate of INR 30 per household. For commercial establishments it would be in the range of INR 60-80 per month**Error! Bookmark not defined.**. To further reduce production and usage of SUP products, the plastic ban in combination with according fines for violations are added measures.

At the same time, incentivizing measures have also been put in place to promote the emergence of innovative products and services which support the anti-litter transition. According to the Kerala Industrial and Commercial Policy, an **Entrepreneur Support Scheme** (ESS) shall be introduced for micro-, small- and medium-size enterprises (MSMEs) engaging in plastic waste recycling, bio-degradable plastics. For this purpose, loans at affordable interest rates will be made available from Kerala Financial Corporation[39]. In line with the ESS, one of the 4 guiding principles of the states Integrated Waste Management strategy is to develop suitable funding and devolution mechanisms for solid waste management projects. It suggests that the government should facilitate access to external sources of funds, especially grant funds, to construct larger projects, create mechanisms for easy access to funding for multiyear projects and also support Local Self Governments[40].

3.3. Stakeholders and Initiatives

Efforts required for preventing marine litter and a transition to Circular Economy (CE) are driven collaboratively across national, state and local governments, industry, civil organisations and non-governmental organizations (NGOs) as well as the civil society. The Ministry of Environment, Forests and Climate Change (MoEF&CC) plays an important role in establishing and strengthening the national policy framework surrounding marine litter. It is engaged, for instance, in multiple projects for aquatic conservation such as the National River Conservation Directorate, National Plan for Conservation of Aquatic Eco-systems (NCPA), National Lake Conservation Plan (NLCP) and National Wetlands Conservation Program (NWCP). With regard to policy-making and ocean governance, various other Indian ministries are also involved. These include the Ministry of Earth Sciences, the Ministry of External Affairs, the Ministry of Agriculture (Department of Fisheries), the Ministry of Defence (the Indian Coast Guard and the Indian Navy) as well as the Ministry of New and Renewable Energy. In addition, the Central Ground Water Board (CGWB) under the Ministry of Jal Shakti, Department of Water Resources, River Development and Ganga Rejuvenation develops technologies and monitors and implements national policies to sustainably manage India's ground water resources, including their protection from pollution[41]. Law enforcement is carried out by the Indian Coast Guard as well as State Coastal Zone Management Authorities (SCZMA). Moreover, the CPCB and State Pollution Control Boards (SPCBs) are a crucial intersection of governmental activities on national and state level, ULBs and the private sector concerning pollution prevention as they provide various technical services including monitoring.

Various institutions such as the National Institute of Ocean Technology of the Department of Ocean Development, the Indian National Centre for Ocean Information Services (INCOIS), National Centre for Earth

[37]Suresh 2018.

[38]Gesellschaft für Internationale Zusammenarbeit 2012.

[39]Government of Kerala.

[40]Local Self Government Department 2020a.

[41]Central Ground Water Board 2021.

Science Studies, the Central Marine Fisheries Research Institute (CMFRI) and the National Institute of Oceanography are contributing to the prevention of marine litter with their research and provision of information. These institutions also engage with international organisations such as the MARPOL International Convention for the Prevention of Pollution from Ships and the Marine Satellite Remote Sensing Service (MARSIS).

With their community work and regional projects, national initiatives by the Swachh Bharat Mission and NGOs such as Mangroves for the Future and World Wildlife Fund (WWF) India raise awareness about marine litter prevention. Clean Seas launched by UNEP is another noteworthy international initiative which aims to engage governments, the general public and the private sector in the fight against marine plastic pollution. India joined the global initiative in 2018, to jointly address the root-cause of marine litter by targeting the production and consumption of non-recoverable and single-use plastic[42].

International organizations and their initiatives also play a role in moving towards global sustainability goals regarding marine litter. MARPOL, the International Convention for the Prevention of Pollution from Ships, addresses pollution from ships including plastic pollution[43]. The UN has initiated several programmes such as (a) the Global Partnership on Marine Litter, which follows a voluntary multi-stakeholder coordination mechanism to bring together policymakers, civil society actors, the scientific community and the private sector, (b) the Counter MEASURE programme, which developed a region-based model for monitoring and assessment of pollution reduction and offers webinars on counter measures in various countries including India[44], (c) the Honolulu Strategy, a planning framework for the prevention and management of marine litter and an effort to reduce the ecological, human health, and economic impacts of marine litter globally[45]. The Honolulu Strategy aims to reduce the amount and impact of (a) land-based litter and solid waste introduced into the marine environment, (b) sea-based sources of marine debris including solid waste, lost cargo, abandoned, lost or discarded fishing gears and abandoned vessels and (c) accumulated marine debris on shorelines, in benthic habitats, and in pelagic waters[46]. Finally, the India-Norway Marine Pollution Initiative of 2019 aims to exchange experiences and competence, to collaborate on efforts to develop clean and healthy oceans, sustainable use of ocean resources and growth in the blue economy. In addition to supporting local governments in implementing sustainable waste management practices, this initiative proposes to engage in beach clean-ups, awareness raising campaigns and a pilot project using plastic waste as fuel substitution for coal in cement production besides developing frameworks for deposit schemes[47].

In the plastics system, both consumer and producer activities have a strong influence on its downstream processing. Besides households and plastics products manufacturers, many other private stakeholders have a major effect on marine litter. These include, for instance, fisheries, the shipping industry and the tourism industry which is especially economically affected by marine litter. The private sector has therefore engaged in a variety of national initiatives. Local fisheries have for example started to haul back to land all the plastic that they find while they're out at sea, following a call by the Fishing Community of Kerala.

Stakeholders and Initiatives in Kerala

Kerala has implemented a range of local initiatives and invested in creating a network of governmental institutions, research institutes and NGOs to fight marine litter in this coastal state. The Kerala State Pollution Control Board (KSPCB) plays a central role in this regard[48]. The KSPCB advises the state government of Kerala on

[42]Clean Seas 2021.

[43]International Maritime Organization 2005.

[44]Mishra 2020.

[45]United Nations Environment Programme 2016.

[46]UN Environment 2019.

[47]Press Information Bureau 2019.

[48]Kerala State Pollution Control Board 2021.

the prevention of water pollution, collects and disseminates information on water pollution and monitors effluents. Another important governmental body supporting Kerala's efforts to protect the oceans and prevent marine litter is the Department of Fisheries which enables the local fisheries sector to implement more sustainable practices[49]. In 2017, the Chief Minister of Kerala further launched the Responsible Tourism Mission comprising economic, social and environmental responsibilities[50]. Initiatives such as the development of a "Green Protocol" certifying waste free tourism destinations helped decreasing the effect that the tourism industry has on marine litter and pollution[51]. Recognising the importance of solid waste management to address the problem of marine litter, the government of Kerala established the Suchitwa Mission as a Technical Support Group (TSG) in the waste management sector and the Haritha Keralam Mission with a focus on hygienic waste management, agricultural development and organic farming under the Local Self Government Department[52,53]. State policies passed by governmental bodies are locally implemented by the roughly 1200 panchayats and municipalities[54].

Next to governmental bodies, research institutes are important stakeholders to develop more sustainable practices and innovations that tackle the problem of marine litter at its root cause. One such institute is the Kerala State Council for Science, Technology and Environment (KSCSTE) with its Centre for Water Resources Development & Management (CWRDM). The CWRDM conducts research in all spheres of water management including ground water development and management, water quality, climate change & environment, and transfer of technology[55]. The University of Kerala hosts a Department of Aquatic Biology and Fisheries which is one of the oldest departments of the university, enjoying a range of different grants for its outstanding performance[56].The National Institute for Interdisciplinary Science and Technology (CSIR-NIIST) at Thiruvananthapuram is involved in development of comprehensive solid waste management schemes for Kerala as well as research on bio-plastics[57].

The state-owned Kerala State Coastal Area Development Corporation Limited (KSCADC) is bridging the efforts of the state government, research institutes and the private sector. The company pools financial resources to support integrated development activities in Kerala's coastal areas[58]. The fishing community of Kerala is engaged in collecting plastics from the ocean while fishing and represents another stakeholder group from the private sector. By involving government agencies, they have set up a recycling centre in the region, to clean, sort, and process all the sea-tossed plastic that they fish out and have collected 65 metric tonnes of plastic waste so far[59]. Private sector support was also signalled by five Kerala IT and hospitality companies, which held an underwater conference to raise awareness about the risks and consequences of marine pollution[60]. The sanitation campaign, Suchitwa Sagaram, launched by Kerala's state government in 2017, trains fishermen to bring plastic back to shore and at the same time raises awareness about the dangers of polluting the ocean[61]. This campaign, however, has been facing various challenges due to lack of funds[62].

[49]Department of Fisheries 2021.
[50]Kerala Tourism 2021a.
[51]Kerala Tourism 2021b.
[52]Suchitwa Mission 2021.
[53]Haritha Keralam 2021.
[54]Local Self Government Department 2015.
[55]Kerala State Council for Science, Technology and Environment 2021.
[56]University of Kerala 2021.
[57]National Institute for Interdisciplinary Science & Technology 2019.
[58]Kerala State Coastal Area Development Corporation 2021.
[59]The Energy and Resources Institute 2017.
[60]Bobins 2018.
[61]UNEP 2018.
[62]Sudhish 2020.

4. Problem Analysis

Many of the marine litter policies and interventions previously mentioned have understated challenges related to infrastructure, effectiveness and enforceability of policy implementations as well as lack of cooperation and stakeholder engagement. The following are some of the key limitations.

The most pressing issue concerning marine litter is the lack of established infrastructure for its collection and adequate treatment. Open dumping is common and there are few incentives to stop this practice; instead, many obstacles exist to properly treat waste. Collection is a challenge with lack of space in many urban areas to set-up community bins covering 100-200 households.

The availability of disposal facilities is generally insufficient and shortage of funds is a reason for lack of infrastructure. Low value materials, such as single-use plastics or multi-layered, metalized packaging products, are often ignored by the already weak waste collection systems that exist currently. These systems rely highly on informal waste workers who are mostly unregistered and are difficult to organize on a required scale. On a higher scale, there is no uniform approach and supporting framework for the integration of the informal sector.

The operating waste treatment plants are poorly equipped to deal with different types of waste. Moreover, though there are one-off examples as in the city of Kochi, the current waste system misses the opportunity to promote waste segregation and establish door-to-door collection schemes at the household level.

There are few structured programmes to create awareness and build capacity on compliance with solid waste management/plastic waste management rules.

Responsible authorities are currently not able to clearly distribute roles and responsibilities to enable ULBs to break down national and state policies (e.g. on EPR) to the local level. Consequently, there is limited expertise, technical knowhow and capacity for infrastructure development and waste management among ULBs. Moreover, regarding a variety of policies such as concerning plastic bans, there is no uniform approach across states. As a result, ULBs lack guidance on the implementation of plastic prevention policies and both monitoring and enforcement of existing policies is generally low. Finally, in the absence of economically attractive operational models, ULBs lack the financial capacity to establish and operate the necessary infrastructure.

Many of the policies are also developed without adequately engaging various stakeholder groups and identifying alternatives. For example, plastic bans impact plastic producers; thus, the introduction of such a policy often means dropping out of business unless a viable alternative is provided.

Research institutes and the private sector are likewise not incentivised enough to develop viable alternatives to plastic products, which are less harmful to the environment and especially to the marine ecosystem. Moreover, innovative policy approaches including circularity goals are not yet well implemented in the regulatory framework surrounding the manufacturing of plastic products. As EPR rules are being adopted and enforced slowly, private sector actors are not yet made accountable to a level that they engage in establishing waste collection and treatment systems which allows recirculation of the manufactured plastic material towards the producer.

Problem Analysis for Kerala

In comparison to many other Indian states, Kerala has been able to partly establish the necessary infrastructure to collect waste at the household level. However, open dumping is still practiced even in water streams and littering is still common especially in tourist areas such as beaches. Being a state with a long shoreline, both tourism on beaches and fishery are among the main sources of trash reaching water streams and the sea.

Treatments plants in Kerala are mostly well equipped to deal with the formally and informally collected waste. According to the CPCB, 60% of Kerala's ULBs have material recovery facilities and a total of 214 plastic waste

recyclers are registered in the state[63]. A waste treatment plant nearby Kochi has the capacity to process 200 tonnes of mixed waste via mechanical composting and 50 tonnes of organic waste via vermicomposting daily[64]. However, the long-term effect of previously used landfills close to water streams has irreversibly polluted two of the city's rivers. In addition, local self governments (LSGs) such as panchayats face difficulties when it comes to identifying suitable land for new recycling facilities and implementing the appropriate infrastructure for plastic waste management. Residents moreover often protest against the implementation of treatment facilities close to their homes[65]. Human capacity needs add to this problem as many LSGs have very limited technical expertise in engineering and accounting[66].

State-wide segregation programmes and kitchen bins, pipe composting units, and biogas plants process up to 80% of waste within some neighbourhoods. Yet, up to almost 40% of Kerala's non-biodegradable and mixed recyclable waste is still collected by the informal sector, making it difficult to monitor waste streams and implement effective recycling[67].

Being one of the most decentralised states in India, Kerala's ULBs have a high degree of discretionary power as well as accountability towards citizens[68]. This is largely due to the state's efforts to transfer powers to LSGs as well as the Kerala Municipality Act which entrusts municipalities with a list of functions[69]. Still, administrative accountability and financial management of the ULBs are limited[70] because institutions are not able to execute their functions effectively as the state government still has overruling powers over LSGs[65].

While there is a comparably advanced strategy in Kerala for the collection of household waste on land, the policy framework as well as stakeholder engagement of relevant actors on sea remains weak. The development and enforcement of effective policies that address some of the main sources of marine litter, namely fisheries, shipping and tourism industry is currently low. In line with a focus towards a land-based issue, environmental policies of 2008 and 2009 in the state have not yet addressed recent research findings such as the long-term effects of microplastics and the extent of marine litter for the global environment to a sufficient extent. Paradoxically, environmental policies are highly concerned about protecting fisheries although they have been identified as major contributors to marine litter, which prevents a stricter course of action against such interest groups[71].

5. Recommendations

Based on this problem analysis, the project PROMISE suggests the following potential areas of intervention to improve the implementation and compliance of marine litter policies.

- Future initiatives to build infrastructure for collection, reduction and segregation of waste at the source should focus on beaches. Especially MSMEs and the informal sector should be integrated in this process. Treatment plants need to be equipped for recycling of different types of plastics and wastes.
    - **Kerala:** Local governments must offer sufficient financial compensation for formal waste pickers to integrate informal waste pickers into formal systems. The storage, release and transport of marine plastic debris needs a standardised and regulated process.

[63]Central Pollution Control Board 2019.
[64]Gesellschaft für Internationale Zusammenarbeit 2012.
[65]Arunachalam and Ashalakshmi 2010.
[66]National Institute of Urban Affairs 2015.
[67]Suchitwa Mission 2020.
[68]Venugopal and Yilmaz 2009.
[69]Centre for Public Policy Research 2017.
[70]Gesellschaft für Internationale Zusammenarbeit 2012.
[71]Department of Environment 2009.

- Responsible authorities need to develop long-term strategies and targets as well as clearly distribute roles and responsibilities that allow breaking down national and state policies to the local level and provide guidance on enforcement and implementation. Capacity building programmes need to be established.
    - **Kerala:** Further capacity building is necessary to translate political objectives into action and strengthen enforcement of policies addressing both littering on land and on sea.

- Governmental bodies need to create regional and international cooperation with the private sector including plastic manufacturers, producers of fast-moving goods as well as stakeholders from the shipping and tourism industry and fisheries. It is crucial to engage private stakeholders as well as the informal sector and NGOs in the policy development process.
    - **Kerala:** Especially small local entrepreneurs in the hospitality sector need to be supported by formal structures enabling them to become profitable. Dialogues with the fishing, shipping and tourism industry will be crucial for joining efforts towards minimizing marine litter.

- Policy makers can enable the transition by realigning incentives, facilitating secondary markets, defining standards and stimulating innovation. This incentivizes research institutions and private stakeholders to find alternatives to current plastic products which are less harmful for the marine environment. Environmental policies further need to address new scientific insights such as the effects of microplastics.
    - **Kerala:** Research and innovation needs to be promoted in Kerala and ideally emerge collaboratively with the tourism and fishery industry.

- Public funding for marine litter prevention initiatives should be increased. Viable business models need to be created for ULBs to finance improved collection systems based on, for example, household fees or taxes and private stakeholders to utilize the potential from recovering the value of plastic for further reprocessing. Governmental bodies should therefore create a policy instrument that combines motivation through rewards and penalties and engages in segregation or recycling measures.
    - **Kerala:** Policies encouraging collection, segregation and recycling of waste should be developed locally and adapted to the specific conditions in Kerala. In addition, state governments are in a strategic position when it comes to supporting MSMEs with innovative business models in their area.

- In an EPR scheme, funds may be collected from producers to cover the costs of collection, processing and safe disposal of waste. These private stakeholders should be included in the policy development process to ensure that they will adequately take on their responsibilities in an EPR scheme.
    - **Kerala:** Although a collection system based on household fees has been established, the private sector and other stakeholders are not yet held financially accountable in a holistic EPR system. Local governmental bodies should support private stakeholders that are subject to such policies.
- Since marine litter is never just a national challenge, cooperation with global organizations and initiatives as well as among different projects to fight marine litter should be strengthened.
    - **Kerala:** Local initiatives should be supported in scaling-up, collaborate among each other and lay the ground for making a difference in fighting marine litter across India's coastlines.

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Publication bibliography

Arunachalam, P.; Ashalakshmi, K. S. (2010): Solid Waste Management: A Case Study of Arppukara Grama Panchayat of Kottayam District, Kerala (India). Available online at https://dyuthi.cusat.ac.in/xmlui/handle/purl/4300, checked on 5/16/2021.

Bobins, Abraham (2018): CEOs Hold Underwater Meet at Kerala Beach to Raise Awareness About Marine Pollution & Global Warming. India Times. Available online at https://www.indiatimes.com/news/india/ceos-hold-underwater-meet-at-kerala-beach-to-raise-awareness-about-marine-pollution-global-warming-275350.html, checked on 5/16/2021.

Brock, Joe (2020): The Plastic Pandemic. Reuters. Available online at https://www.reuters.com/investigates/special-report/health-coronavirus-plastic-recycling/, checked on 5/16/2021.

Central Pollution Control Board (1974): The Water Prevention and Control of Pollution Act. Available online at https://pcbassam.org/rules/WaterAct.pdf, checked on 5/16/2021.

Central Ground Water Board (2021): Central Ground Water Board - Homepage. Available online at Central Ground Water Board (CGWB), checked on 5/16/2021..

Central Pollution Control Board (2019): Status Report. Available online at https://greentribunal.gov.in/sites/default/files/news_updates/REPORT%20IN%20EA%20NO.%2013%20of%202019%20IN%20OA%20NO.%20247%20of%202017%20(Central%20Pollution%20Control%20Board%20Vs.%20State%20of%20Andaman%20&%20Nicobar%20&%20Ors.).pdf, checked on 5/16/2021.

Centre for Public Policy Research (2017): Defending Decentralisation in Kerala: Probing the Autonomy of Kerala's Urban Local Bodies - Centre for Public Policy Research (CPPR). Available online at https://www.cppr.in/centre-for-comparative-studies/defending-decentralisation-in-kerala-probing-the-autonomy-of-keralas-urban-local-bodies, updated on 4/18/2019, checked on 5/16/2021.

Clean Seas (2021): Clean Seas Homepage. Available online at https://www.cleanseas.org/, checked on 5/16/2021.

Daniel, Damaris Benny; Thomas, Saly N.; Thomson, K. T. (2020): Assessment of fishing-related plastic debris along the beaches in Kerala Coast, India. In *Marine pollution bulletin* 150, p. 110696. DOI: 10.1016/j.marpolbul.2019.110696.

Department of Environment (2009): Kerala State Environment Policy. Available online at http://www.keralabiodiversity.org/images/pdf/environmentpolicyenglish.pdf, checked on 5/16/2021.

Department of Fisheries (2021): Department of Fisheries. Available online at https://www.fisheries.kerala.gov.in/, checked on 5/16/2021.

Directorate General of Shipping: Prohibition on use of Sinqle Use Plastic. In : Gazette of India. Available online at https://dgshipping.gov.in/writereaddata/ShippingNotices/20191017054502089464 1DGS_Order_05of2019.pdf, checked on 5/16/2021.

Environment Department (2019): Blanket Ban on Single Use Plastic. Available online at http://sanitation.kerala.gov.in/wp-content/uploads/2019/12/output.pdf, checked on 5/16/2021.

Fisheries and Ports Department (2018): Kerala Marine Fishing Regulation Rules. Kerala Gazette. Available online at http://extwprlegs1.fao.org/docs/pdf/ind188623.pdf, checked on 5/16/2021.

Gesellschaft für Internationale Zusammenarbeit (2012): City Sanitation Plan for Kochi. Available online at http://mohua.gov.in/upload/uploadfiles/files/CSP_Brochure_Kochi.pdf, checked on 5/16/2021.

Government of Kerala: Entrepreneur Support Scheme. Available online at https://kerala.gov.in/documents/10180/9aef66b2-78c9-416b-bf11-6615329aab80, checked on 5/16/2021.

Gray, Alex (2018): 90% of plastic polluting our oceans comes from just 10 rivers. World Economic Forum. Available online at https://www.weforum.org/agenda/2018/06/90-of-plastic-polluting-our-oceans-comes-from-just-10-rivers/, checked on 5/16/2021.

Gupta, Kanupriya (2011): Consumer Responses to Incentive to Reduce Plastic Bag Use: Evidence from a Field Experiment in Urban India. In *Working papers* (65). Available online at https://ideas.repec.org/p/snd/wpaper/65.html, checked on 5/16/2021.

Haritha Keralam (2021): MISSION – HARITHA KERALAM. Available online at http://haritham.kerala.gov.in/haritha-keralam/, checked on 5/16/2021.

International Maritime Organization (2005): International Convention for the Prevention of Pollution from Ships (MARPOL). Available online at https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx, checked on 5/16/2021.

Jayakumar, C.; Shibu, K. N.; Raju, S. (2019): A Study on Plastic Litter along Kerala Coast. Thanal. Available online at http://thanal.co.in/uploads/resource/document/plastic-litter-study-final-report-73616175.pdf, checked on 5/16/2021.

Jeljith, P.; Shuresh Babu, C. K. (2008): Disposal of Plastic Waste Through Road Construction. Available online at http://keralapwd.gov.in/keralapwd/eknowledge/Upload/documents/5178.pdf, checked on 5/16/2021.

Kapinga, Chrispin Petro; Chung, Shing Hin (2020): Plastic Pollution in South Asia. United Nations ESCAP. Available online at https://www.unescap.org/sites/default/files/SSWA%20Development_Paper20-02_Marine%20Plastic%20Pollution%20in%20South%20Asia.pdf, checked on 5/16/2021.

Kaviarasan, T.; Naik, Subrat; Sivadas, S. K.; Dhineka, K.; Sambandam, M.; Sivyer, David et al. (2020): Assessment of Litter in the Remote Beaches of Lakshadweep Islands, Arabian Sea. In *Marine pollution bulletin* 161 (Pt B), p. 111760. DOI: 10.1016/j.marpolbul.2020.111760.

Kerala Department of Fisheries (2017): Marine fisheries. Available online at http://www.fisheries.kerala.gov.in/marine-fisheries, checked on 5/16/2021.

Kerala State Coastal Area Development Corporation (2021): Profile. Available online at https://www.keralacoast.org/profile.php, checked on 5/16/2021.

Kerala State Council for Science, Technology and Environment (2021): Centre for Water Resources Development and Management. Available online at https://kscste.kerala.gov.in/2019/05/25/centre-for-water-resources-development-and-management-cwrdm/, checked on 5/16/2021.

Kerala State Pollution Control Board (2021): Hompage of the Kerala State Pollution Control Board. Available online at https://www.keralapcb.nic.in/, checked on 5/16/2021.

Kerala Tourism (2021a): Responsible Tourism Mission. Available online at https://www.keralatourism.org/responsible-tourism/, checked on 5/16/2021.

Kerala Tourism (2021b): Waste Free Tourist Destinations / Implementation of Green Protocol. Available online at https://www.keralatourism.org/responsible-tourism/waste-free-tourist-destinations/81, checked on 5/16/2021.

Kripa, V.; Prema, D.; Kaladharan, P.; Jeyabaskaran, R.; Ambrose, T. (2016): A National Marine Debris Management Strategy to Conserve Marine Ecosystems (228). Available online at https://www.researchgate.net/publication/320331017_A_national_marine_debris_management_strategy_to_conserve_marine_ecosystems.

Lamond, J.; Bhattacharya, N.; Bloch, R. (2012): The Role of Solid Waste Management as a Response to Urban Flood Risk in Developing Countries, a Case Study Analysis. In *FRIAR 2012* 159, pp. 193–204. DOI: 10.2495/FRIAR120161.

Liu, Ta-Kang; Wang, Meng-Wei; Chen, Ping (2013): Influence of Waste Management Policy on the Characteristics of Beach Litter in Kaohsiung, Taiwan. In *Marine pollution bulletin* 72 (1), pp. 99–106. DOI: 10.1016/j.marpolbul.2013.04.015.

Local Self Government Department (2015): Local Bodies. Available online at http://lsgkerala.gov.in/en/lsgd/localbody-list, checked on 5/16/2021.

Local Self Government Department (2018): Kerala State Policy on Solid Waste Management. In : Kerala Gazette. Available online at http://sanitation.kerala.gov.in/wp-content/uploads/2018/09/go-65.2018-13.09.18-_-State-policy-on-SWM.pdf, checked on 5/16/2021.

Local Self Government Department (2019): Solid Waste Management Initiatives -Kerala. Available online at http://sanitation.kerala.gov.in/wp-content/uploads/2019/01/NGT-Regional-Monitoring-Committee-review-kochi-25.01.19.pdf, checked on 5/16/2021.

Local Self Government Department (2020a): Integrated Solid Waste Management. Available online at http://sanitation.kerala.gov.in/wp-content/uploads/2019/11/combinepdf.pdf, checked on 5/16/2021.

Local Self Government Department (2020b): PWM Bye-law. Available online at http://lsgkerala.gov.in/system/files/2020-09/PWM-By-law-1.pdf, checked on 5/16/2021.

Ministry of Environment and Forests (1991): The Coastal Regulation Zone Notifications. In : Gazette of India. Available online at https://www.forests.tn.gov.in/tnforest/app/webroot/img/document/legislations/01_Coastal%20Regulation%20Zone%20Notifications.pdf, checked on 5/16/2021.

Ministry of Urban Development (2011): Solid Waste and Waste Water Management. Available online at http://cedindia.org/wp-content/uploads/2013/08/Municipal-Solid-Waste-Handling-Management-Bye-law.pdf, checked on 5/16/2021.

Mishra, Pravakar (2020): Counter Measures for Riverine and Marine Plastic Litter in India. Available online at https://www.npcindia.gov.in/NPC/Uploads/file%20upload/3_Dr%20Pravakar%20Mishra%20_MoES_NCCR_Mishra_p_12May2028487.pdf, checked on 5/16/2021.

National Institure of Urban Affairs (2015): A Study to Qualitatively Assess the Capacity Building Needs of Urban Local Bodies(ULBs). Available online at https://niti.gov.in/writereaddata/files/document_publication/report-ULB_0.pdf, checked on 5/16/2021.

National Institute for Interdisciplinary Science & Technology (2019): Annual Report. Available online at https://www.niist.res.in/english/wp-content/files/annualreport_201819.pdf, checked on 5/16/2021.

Newman, Stephanie; Watkins, Emma; Farmer, Andrew; Brink, Patrick ten; Schweitzer, Jean-Pierre (2015): The Economics of Marine Litter. In Melanie Bergmann, Lars Gutow, Michael Klages (Eds.): Marine Anthropogenic Litter. Place of publication not identified: Springer International Publishing, pp. 367–394.

Parliament of India (1972): The Wildlife Protection Act. In : Gazette of India. Available online at https://legislative.gov.in/sites/default/files/A1972-53_0.pdf, checked on 5/16/2021.

Pendharkar, Vrushal (2018): Indus, Brahmaputra and Ganga among the top 10 plastic waste carrying rivers. Available online at https://india.mongabay.com/2018/01/indus-brahmaputra-and-ganga-among-the-top-10-plastic-waste-carrying-rivers/, checked on 5/16/2021.

Police Headquarters Kerala: Waste Dumping and Polluting Air and Water Bodies. Available online at http://sanitation.kerala.gov.in/wp-content/uploads/2018/01/Executive-Directive-No.9.2016-DGP.pdf, checked on 5/16/2021.

Press Information Bureau (2019): India and Norway Launch Initiative to Combat Marine Pollution. Available online at https://pib.gov.in/Pressreleaseshare.aspx?PRID=1563932, checked on 5/16/2021.

Radha, R. (2019): Plastic Pollution and Plastic Ban: Will Tamil Nadu Stand a Chance? Available online at https://www.researchgate.net/publication/335082929_PLASTIC_POLLUTION_AND_PLASTIC_BAN_WILL_TAMIL_NADU_STAND_A_CHANCE, checked on 5/16/2021.

Suchitwa Mission (2019): Haritha Karma Sena Spreading Awareness on Decentralised Waste Management. Available online at http://sanitation.kerala.gov.in/wp-content/uploads/2019/03/sbm-coffee-table.pdf, checked on 5/16/2021.

Suchitwa Mission (2020): Introduction and Strategic Environmental Assessment of Waste Management Sector in Kerala. World Bank. Available online at http://sanitation.kerala.gov.in/wp-content/uploads/2019/11/1_KSWMP_Vol-I-IntroSEAFin3_10Jy20.pdf, checked on 5/16/2021.

Suchitwa Mission (2021): Homepage of the Suchitwa Mission. Available online at http://sanitation.kerala.gov.in/profile/, checked on 5/16/2021.

Sudhish, Navamy (2020): Suchitwa Sagaram runs out of steam. Available online at https://www.thehindu.com/news/national/kerala/suchitwa-sagaram-runs-out-of-steam/article30452603.ece, checked on 5/16/2021.

Sukanya Das (2014): An Initiative Towards Curbing the Usage of Plastic Bags in Supermarkets: A Case Study in Chennai, India. In : Handbook of Waste Management. Available online at https://www.researchgate.net/publication/262002388_An_Initiative_Towards_Curbing_the_Usage_of_Plastic_Bags_in_Supermarkets_A_Case_Study_in_Chennai_India, checked on 5/16/2021.

Suresh, Meera (2018): Kerala Government to Levy User Fees for Failure to Dispose of Solid Waste at Source. New Indian Express. Available online at https://www.newindianexpress.com/cities/kochi/2018/sep/19/kerala-government-to-levy-user-fees-for-failure-to-dispose-of-solid-waste-at-source-1873818.html, checked on 5/16/2021.

The Energy and Resources Institute (2017): Strategy for Fostering Resource Efficiency and Circular Economy in Goa. Available online at https://www.teriin.org/sites/default/files/files/strategy-fostering-RE-CE-Goa.pdf, checked on 5/16/2021.

Times of India (2019): Mumbai: 15% Tax Rebate for Housing Societies that Process Waste, Water. Available online at https://timesofindia.indiatimes.com/city/mumbai/15-tax-rebate-for-hsg-socs-that-process-waste-water/articleshow/70720094.cms, checked on 5/16/2021.

U.T. Administration of Lakshadweep: About Lakshadweep. Available online at https://lakshadweep.gov.in/, checked on 5/17/2021.

UN Environment (2019): Promotion of Countermeasures Against Marine Plastic Litter in Southeast Asia and India. Available online at https://gicait.maps.arcgis.com/apps/Cascade/index.html?appid=430700ada8ee48fa936b66b9d096bf8e, checked on 5/16/2021.

UNEP (2018): Fishing for Plastic From the Sea. Available online at https://www.unenvironment.org/news-and-stories/story/fishing-plastic-sea, checked on 5/16/2021.

United Nations Environment Programme (2016): The Honolulu Strategy: A Global Framework for Prevention and Management of Marine Debris. With assistance of Ecosystems Division. Available online at https://wedocs.unep.org/handle/20.500.11822/10670.

University of Kerala (2021): University Departments. Available online at https://www.keralauniversity.ac.in/dept/d-list, checked on 5/16/2021.

Venugopal, Varsha; Yilmaz, Serdar (2009): Decentralization in Kerala: Panchayat Government Discretion and Accountability. In *Public Admin. Dev.* 29 (4), pp. 316–329. DOI: 10.1002/pad.541.

Water Resources Department (2008): Water Policy. Available online at https://kerala.gov.in/documents/10180/46696/Water%20policy, checked on 5/16/2021.