



State of Plastic Pollution in Pondicherry, India: A Case Study of Auroville Beach

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

Prime Minister Modi started the Swachh Bharat Mission as a mass movement in 2014. The mission subsequently received a massive response from the people's side. Swachh Bharat Mission aimed to improve the cleanliness of the Indian cities and villages. Under the Clean India Mission Urban, Puducherry started working for a clean city. As the district Puducherry is home to various beaches and tourist activities, the waste management of such places is essential. Eden Beach of Puducherry has the blue flag, whereas Auroville Beach (AB) comes under the least governed beaches in terms of its waste management. The following study aims to evaluate the people's attitudes towards plastic pollution in the beach areas. The research is based on the forty-two responses of the participants who visited the AB at least once in recent times. All the participants are students of Pondicherry University. The purpose of the research centred around policy suggestions regarding the plastic and sanitation management of AB. The available literature demonstrates that plastic usage has a massive impact on the livelihood of the local population and

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the tourist's preferences. The beach of Auroville has the potential to attract more tourists with the sustainable use of consumer products. Lack of reliable data about the state of pollution causes maladministration, which in turn hampers tourist preferences.

Keywords: Puducherry; plastic; pollution; sanitation; beaches; tourists.

1. INTRODUCTION

The Puducherry Union Territory (UT) is divided into four distinct coastal districts: Puducherry, Karaikal, Yanam, and Mahe. Coastal communities in all four regions rely on coastal resources for their economic development and livelihoods. The Puducherry region is closely connected to Tamil Nadu along the Bay of Bengal coast. Previously known as Pondicherry, the UT was renamed to Puducherry to reflect popular demand for a decolonized term. The areas of Puducherry are located along the shore, making them particularly vulnerable to the impacts of climate change and coastal disasters (Murali et al., 2013). The AB, situated roughly in the middle of Puducherry, is relatively isolated from the main city (known as White Town). The area surrounding AB is largely associated with the *Auroville Society* and the *Auroville Foundation*.

Beach areas are primarily affected by plastic pollution and various recreational activities. Plastic waste along the shore is a common issue. The Puducherry coastline is rich in beautiful beaches, aquatic diversity, and blue economy potential. However, poor maintenance of these beach areas poses a threat to the natural ecosystem, which in turn impacts the socio-economic well-being of the local population (Hemalatha & Sujatha, 2019). It is essential to raise awareness about beach management within the local community. Although Pondicherry's Eden Beach has received a 'Blue Flag' designation, indicating it is one of the cleanest in the world, other popular tourist spots along the coastline do not maintain the same standard of cleanliness.

The Government of India launched the Swachh Bharat Mission (Clean India Mission) in 2014 to rank cities and states based on their performance in sanitation efforts. On October 2, 2014, the Prime Minister urged citizens to pursue Mahatma Gandhi's vision of cleanliness and hygiene with the slogan "Na gandagi karenge, Na karne denge" (We will not create filth, nor will we allow it). The mission is divided into two categories: rural and urban sanitation initiatives. Puducherry falls under the urban category. The

beach management systems at Eden and Rock Beach, overseen by the Puducherry administration, operate with notable efficiency, successfully drawing in a significant number of tourists. These well-maintained facilities offer a variety of amenities and activities that enhance the visitor experience. In contrast, the situation in Auroville is becoming increasingly concerning, with environmental and infrastructural conditions worsening each day. This decline not only affects the local community but also poses challenges for attracting visitors to the area.

This research aims to analyse pollution levels in beach areas and propose alternatives for more effective management of these sensitive environments. The Auroville area is particularly significant due to its spiritual connection to Shri Aurobindo. The entire Union Territory of Pondicherry stretches along the coastline and features numerous beaches; however, only one beach has received the Blue Flag certification, highlighting gaps in effective administration. The need for this study is underscored by the rising pollution levels at AB. The findings will include suggestions to reduce plastic pollution, which could also enhance tourist attractions.

Existing literature suggests a significant impact of people's attitudes and perceptions on the pollution level of an area (Al-Shidi et al., 2021). While there have been studies of other prominent beaches of India, but beach of Auroville is hardly discussed in any of such studies. This indicates that there is a clear gap in the literature on the management of the AB. The beach of Auroville is largely neglected throughout the literature; despite having a large number of visitors regularly, the Beach lacks any comprehensive study about its efficient management. Plastic pollution control on the beaches is a humongous task which requires substantial data and evidence for policy formulation. This paper will help the decision makers to efficiently formulate rules and regulations regarding the beach areas of Auroville. The paper has the following objectives:

- To analyse the peoples' attitudes towards plastic waste management and their usage in the beach areas.

- To discover the current state of sanitary facilities on these beaches.
- To find out the general plastic pollution awareness among tourists and local populations.
- To determine the tourists' preferences regarding clean beaches.
- To showcase the interest of the people regarding costly plastic alternatives

The following research will contribute new knowledge to society as the basic objective of the study is to improve awareness and management of the beach area. The single-use plastic acts as a cheap alternative to other material products. The local tourism and blue economy largely depended upon cheap packaging for its profit margin. The research has four hypotheses: H1 Tourists prefer clean beaches compared to littered beaches. H2 Awareness about the environment and marine ecology prevents people from polluting the beach surroundings. H3 Expensive plastic alternatives encourage people to purchase cheap plastic products. H4 Plastic products are still crucial in beach areas since there is a need for more inexpensive alternatives.

The coastal pollution is deteriorating such a historical and cultural site. This study aims to suggest some fundamental infrastructural and policy changes to cure this ill-treated area of the Auroville coast. The study analyses the plastic pollution and its relation to the tourist attraction. The unplanned and unregulated plastic usage and waste management threaten the region's environment and socio-economic set-up. The socio-economic impact of such pollution also encroaches upon the livelihood of the local population. The plastic alternative and their cost are also discussed in the paper. Data is collected from the forty-two residential students of Pondicherry University who visited the AB at least once.

2. REVIEW OF LITERATURE

Coastal pollution and beach management are widely discussed matters in the academic arena. The pollution of beaches and coastal areas threatens aquatic and human health. The sewage pollution of bathing beaches poses a possible danger of spreading enteric and other diseases. Currently, there's a lack of reliable data on the severity and extent of infections spread through polluted bathing beaches (Beach Pollution, 1954). To effectively tackle the issues

related to coastal maladministration, it is crucial to implement comprehensive policies tailored for effective beach management. According to Williams & Rangel-Buitrago (2019), There are five preliminary steps towards a clean marine space, which are *Knowledge, Prevention, Mitigation, Removal and Behavioural Change*, where they specifically emphasise behavioural changes as the significant aspect of marine litter. In his paper titled *Surfers, Sewage and the New Politics of Pollution*, Ward (1996) assesses the coastal water pollution through the sewages of Britain and the environmental politics of reflexivity in terms of cognitive and aesthetics.

The COVID-19 pandemic, marked by heightened concerns about safety and sanitation, led to a notable rise in the use of single-use plastics, while simultaneously sparking debate about the environmental implications of this surge and the necessity for sustainable alternatives (Kantai, 2020). The active engagement of local authorities, communities, and industries is crucial for driving effective mitigation efforts. For effective waste management, it is essential to focus on reducing consumption, promoting recycling efforts, and fostering public education and awareness about the importance of these practices (Liu et al., 2013). Clean beaches attract more number of tourists as blue flag beaches were in preference in comparison with non-blue flag beaches in the study conducted by Saayman & Saayman (2017). The study in Portugal and Wales found that users' perspectives on beach management, policies and strategies are major determinants of tourist preference for beach destinations (Vaz et al., 2009).

Marine plastic pollution is a critical environmental issue, as plastic materials can take longer to decompose in ocean waters than on land, where factors such as cooler temperatures, varying salinity, and less microbial activity hinder the breakdown process, leading to the accumulation of debris that threatens marine life, disrupts ecosystems, and poses significant risks to human health and biodiversity (G et al., 2003). Plastic debris along the coastline poses a serious threat to the delicate ecological balance of the marine ecosystem, endangering wildlife, disrupting habitats, and harming the overall health of ocean environments (Sridhar et al., 2007).

Environmental awareness at the community level is required for behavioural changes regarding the usage of plastic bags (Suleman et al., 2022).

Changing people's attitudes toward pollution is not something that can be accomplished through short-term campaigns alone; it requires long-term education and consistent efforts over time to effectively raise awareness and promote sustainable practices (Stachowitsch, 2019). Awareness programs and interventions should focus on the responsible use of plastic and its reduction (Patil et al., 2019). A study by Oh et al. (2009) revealed that information about tourists' preference for beach management can enhance the facilities and programs executed by authorities. A work titled Plastic Bans in India – Addressing the Socio-economic and Environmental Complexities suggests that the mere ban on Single-Use Plastic Products would be less effective unless we take into consideration the environmental, social, and economic sides of such measures (Nøklebye et al., 2023). The prevalence of inefficient and unregulated recycling practices, along with a significant lack of ecological awareness among individuals and organizations, is exacerbating the current environmental crisis and leading to further degradation of our natural resources and ecosystems (Powrie et al., 2021). According to a survey, plastic items are the most common form of anthropogenic litter, often constituting over 85% of the total litter. (McGlade, 2021).

3. MATERIALS AND METHODS

The research is conducted as an exploratory case study due to the limited existing literature on the subject. It aims to quantitatively analyse the current situation at AB, focusing on various aspects of plastic pollution in the area. The study utilises percentage values to present the findings obtained from an online questionnaire completed by forty-two participants. The primary data collected forms the foundation of the study, while secondary sources, including books, research articles, and internet resources, were also consulted to provide a comprehensive analysis. In order to provide a holistic idea about plastic pollution, the study provides a table to demarcate the various positive uses of plastic products. The paper also includes pie charts related to people's attitudes towards beach pollution and other aspects of the objectives.

4. RESULTS

The data was collected through a structured questionnaire survey with close-ended questions. The participants were from Pondicherry

University and were familiar with the Auroville area. The data set was generated through Google Forms and comprised 42 participants. More than 90% of participants had visited AB, making the study population extremely relevant to current research.

- >90 per cent of people were positive that clean beaches attract more tourists.
- Only 54.8 per cent of people were adequately aware of the marine ecology and plastic pollution in the beach areas.
- >85 per cent of people use plastic products in beach areas, either frequently or occasionally.
- <10 per cent of visitors came across any awareness sign boards in AB
- <30 per cent in the survey agreed upon the availability of alternative plastic products on the beach premises.
- A small fragment of people, <15 per cent, are unwilling to purchase expensive plastic alternatives compared to plastic products.
- Plastic alternative products are expensive and that's the reason people turn to plastic products; as the survey suggests, <20 per cent of people expressed that these alternatives are not expensive.

5. DISCUSSION

Beach pollution in Auroville is a significant factor contributing to the declining number of tourists. This paper began with four hypotheses, and the data presented reveals the current situation in Auroville Beach (AB). The first hypothesis has been confirmed, as most visitors expressed that clean beaches are a major attraction for tourists. It is important to note that awareness levels among visitors are low, and the absence of signboards addressing pollution exacerbates the situation. These two factors contribute significantly to the high usage of plastic products in beach areas, which stands at approximately 85 per cent. Additionally, the survey indicates that individuals who are knowledgeable about marine pollution tend to avoid using plastic products in these areas. Therefore, the second hypothesis has been confirmed. Less than fifteen percent of the study population indicated a reluctance to purchase expensive alternative plastic products in beach areas. This finding suggests that the third hypothesis concerning individuals' motivation to buy cheaper products is incorrect, while the alternative hypothesis holds true. Additionally, the majority of respondents acknowledge a significant shortage of plastic

alternatives, as well as their higher costs. the continued use of plastic products in beach
 Consequently, the fourth hypothesis regarding areas is validated.

List 1. Some common types of plastic and their usage in daily life

Type of Plastic	Common Uses
Polyethylene Terephthalate	Beverage bottles, food containers, fabric
High-Density Polyethylene	Milk jugs, detergent bottles, grocery bags, water pipes
Polyvinyl Chloride	Plumbing pipes, cable insulation, flooring, medical devices
Low-Density Polyethylene	Plastic bags, shrink wrap, squeezable bottles
Polypropylene	Food containers, automotive parts, textiles, laboratory equipment
Polystyrene	Disposable coffee cups, plastic food boxes, cutlery, CD and DVD cases
Polycarbonate	Eyeglass lenses, compact discs, safety helmets, bullet-resistant glass
Acrylonitrile Butadiene Styrene	LEGO bricks, electronic housings, automotive body parts
Polyurethane	Foam seating, insulation panels, synthetic fibres, wheels and tyres
Polyamide (Nylon)	Textiles, automotive parts, mechanical gears, kitchen utensils

Source: Made by Microsoft Copilot

List 2. Some of the common plastic products used by tourists in their visit to any beach

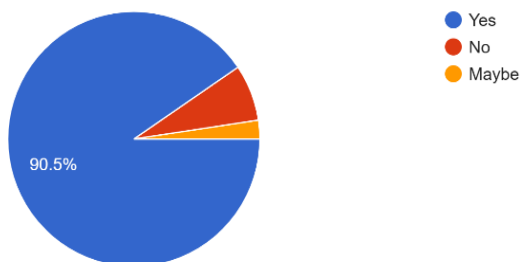
Plastic Product	Common Uses
Plastic Bottles	Beverage containers, water bottles
Plastic Straws	Drinking straws for beverages
Plastic Bags	Carrying groceries, packing beach items
Food Containers	Storing and transporting food
Plastic Cutlery	Disposable forks, knives, and spoons
Plastic Cups	Drinking cups for cold beverages
Plastic Wrappers	Packaging for snacks, candy, and other food items
Beach Toys	Buckets, shovels, frisbees, and other toys
Plastic Flip-Flops	Casual beach footwear
Sunglasses	Eye protection against sun glare
Cooler Boxes	Storing and keeping food and drinks cool
Plastic Chairs	Beach chairs for sitting

Source: Prepared by Microsoft Copilot

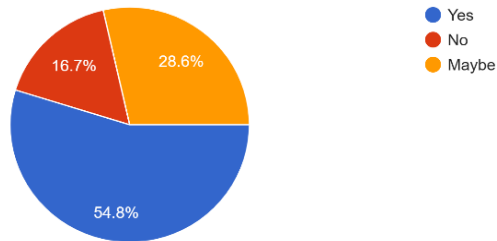
Based on the responses of participants, the following results are revealed

Do you think that clean beaches attract visitors?

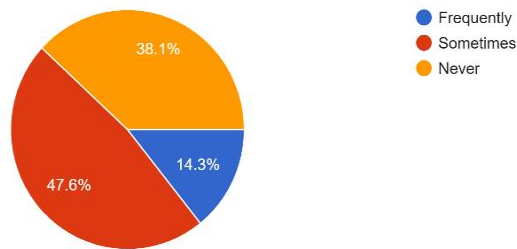
42 responses



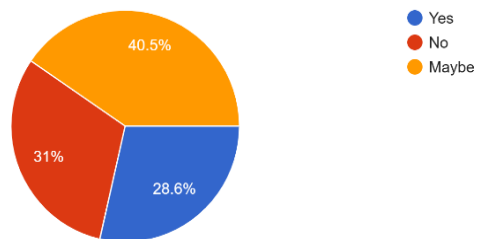
You are fully aware about marine ecology and pollution
42 responses



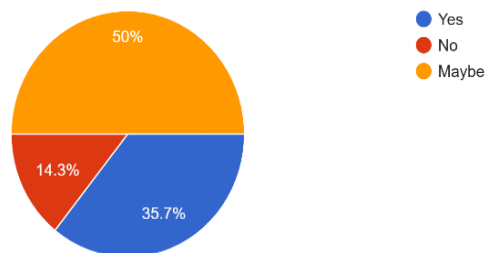
How often you use plastic products on beaches
42 responses



Are there any alternative products available for single use plastic or recyclable plastic in beach areas?
42 responses



If you're provided with alternative products for plastic, will you purchase it even if its expensive?
42 responses



Do you think Plastic alternatives are expensive?
42 responses

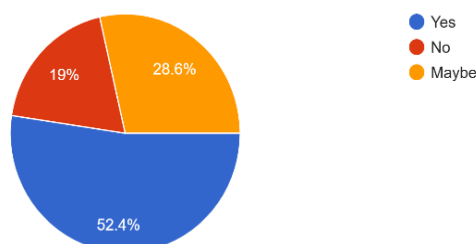


Fig. 1. Pie chart showing different responses for different parameters

6. CONCLUSION AND RECOMMENDATION

Auroville and its beaches are highly significant due to their association with Aurobindo and the practice of meditation. Marine pollution poses serious risks to both human health and aquatic ecosystems. This paper examines various dimensions of beach pollution and proposes potential solutions. It highlights the importance of behavioural changes in order to maintain clean beaches and protect marine ecology. While other beaches in Puducherry are well cared for, AB is receiving insufficient attention. The paper demonstrates that pristine beaches attract more tourists than those that are littered. By implementing some fundamental changes to tackle plastic pollution and transforming tourist behaviour, AB has the potential to evolve into a vibrant tourist destination. Three hypotheses of the paper proved to be correct. The third hypothesis of the paper turned out to be the opposite when compared with the data. While people are ready to purchase expensive plastic alternatives, they are forced to buy plastic products in the absence of such products. The study aimed to evaluate those aspects of AB that local authorities can improve without any big interventions from higher levels of government. Compliance with these suggestions can effectively boost the tourism industry and preserve the marine ecology alongside the beaches. The grassroots-level environmental preservation steps are essential for a safer and sustainable earth.

The plastic pollution of AB is getting worse due to its maladministration and lack of proper awareness among tourists about the right conduct in these areas. The beaches are often used as a space for recreational activities and

vacation spots. While beaches are prone to getting littered and polluted due to such activities, proper maintenance can cure the beaches of these negative effects of tourism. Based on my study, I came to the following suggestions to curb the plastic pollution around AB.

- Local authorities conduct periodic surveys and investigations to assess the cleanliness of beach areas.
- Regular awareness and sensitisation programmes for local people residing in these areas.
- Administration should make sign boards and announcements about proper conduct on the beach.
- The government should work towards reducing plastic and replacing it with alternative products that can be available in such areas.
- The expense of plastic alternatives should be reduced to encourage their use.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology.

Details of the AI usage are given below:

Two tables of the study, which are of general category, have been generated by the Copilot

- COPILOT, 1.1.8.0, Microsoft Copilot, "Draw a table about types of plastic and their usage"

2. COPILOT, 1.1.8.0, Microsoft Copilot, "Plastic products used in beach areas in a table"

COMPETING INTERESTS

Author has declared that no competing interests exist.

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