THE IMPACT OF A PLASTIC BAN IMPLEMENTATION SCENARIO ON RESIDENTS OF TIRUCHIRAPPALLI REGION

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Abstract
Plastic was created first for its durability, extended life, and capacity to be moulded into a broad range of items. There are three reasons why plastics are still used in the packaging sector, even though they are harmful to the environment. First, its low economic cost and widespread circulation. The second feature is their capacity to contain air and water while remaining watertight. The third characteristic is its relative inertness. Based on this, respondents were polled to assess their awareness of alternatives and to comprehend the pre- and post-ban situation for plastics. About 370 respondents from different age groups from different sectors from urban and rural dwellers of Trichy were asked about the prohibition of plastic carry bags, its acceptance, the alternatives available and the cost paid. Most respondents were unhappy about the removal of plastic bags and the high cost of cloth or other bags. Due to environmental concerns and their implications, it was revealed that the negative effects of plastics had not entered society sufficiently to allow the people to reject them. However, durability, lightness, flexibility, and low cost still predominate because the consumer requires plastic bags. Strict steps aiming at promoting public knowledge of the damaging consequences of plastics, their negative impact on the environment, and lowering the costs of alternatives should be explored as immediate remedies.

Keywords: SUP's; plastic ban; economic cost; public perception; Trichy; environmental issue; throw away attitude; public awareness campaign; sustainability

1. Introduction

Population explosion, and industrial and urbanization growth at an alarming rate have led to the environmental crisis regarding plastic waste management in a sustainable and environmentally friendly manner. There are two principal kinds of plastic: thermoplastic, which can be moulded repeatedly on heating, such as (high and low density) polyethylene (PE), polyethylene terephthalate (PET), polypropylene (PP), polyvinyl chloride (PVC) and polystyrene (PS) – including 'expanded polystyrene'; and thermoset, which once formed, cannot be heated and remoulded, for example, polyurethane (PUR) and epoxy resins or coatings. (Rhodes, C. J., 2018). Plastic pollution impressive story of Plastic by Pietrelli et.al, states that plastic was considered, erroneously, inert and, therefore, its impact on the environment and on human health was underestimated. In 1965, Plastic

shopping bags technology was patented by Swedish company Celloplast, in 1979, Plastic grocery bags were introduced in the U.S., in 1997, Charles Moore discovered the Great Pacific Garbage Patch, the world's largest collection of floating garbage, when sailing home to Los Angeles., and finally in 2018 - #Beat Plastic Pollution was chosen as the theme of World Environment Day (Pietrelli, Pignatti, and Fossi 2018).

Plastic is now used in every aspect of human life, including domestic and electrical products, medical, agricultural, pipe, and furniture sectors, among others. Plastic is designed to survive indefinitely, however, due to the same chemical composition, it is not biodegradable; it dissolves into smaller fragments and finally termed as microplastics. The widespread access to plastic products made humans' life easier and smarter on one hand and on the other hand led them to encounter long lasting environmental pollution from escalating waste generation due to over production and consumption. most of the used plastic products are discarded after their first use and due to improper management, they find their way in roads, drains, canals, rivers, and roadside open landfills (Hossain et.al 2021).

Use of single-use plastics (think wrappers, straws, and bags) has skyrocketed over the last few decades. But our ability to recycle these plastics at scale remains poor. As a society, we should think holistically about the products we use and their impacts (Mathy Stanislaus 2018). Due to plastics' adaptability, food products including milk, spices, edible oil, bread, rice, snack foods, and numerous sorts of pharmaceuticals may now be packaged in a way that is effective, sanitary, and economical. All consumers, whether wealthy or impoverished, living in metropolitan centres or rural communities, require plastic packaging for a variety of everyday and special-purpose items. Plastic bags are popular with consumers and retailers as they are a functional, lightweight, strong, cheap, and hygienic way to transport food and other products (Madara, Namango, and Wetaka 2016). According to the UNEP report on plastic pollution in 2022, approximately 300 million tonnes of plastic waste are produced every year. However, only 9 per cent is recycled; most of the rest accumulates in landfills or in the natural environment.

Plastic waste (PW) is one of the most rapid-growing waste streams in municipal solid waste all over the world. India has become a global player in the plastic value chain (Hossain et.al 2022). According to a joint analysis by UNEP, CII, and WWF India, India generates 9.46 million tonnes of plastic garbage each year, of which 40% goes uncollected and 43% is used for packaging, the majority of which is single-use. Additionally, the industry association FICCI reports that 43% of the plastics used in India are single-use plastics and are utilized in packaging. As a result, over 80% of India's entire plastic production is wasted. Some of it either gets burned, which pollutes the air, goes to landfills, or clogs sewers (Bansal et.al 2023). Single-use plastic, as the name indicates, is used for a few minutes, and then discarded. The characteristics and subsequent treatment of pre-consumer and post-consumer wastes are different. Pre-consumer plastic wastes are usually free of extraneous impurities, segregated, easily recyclable and distinguished in terms of its physical properties. They are more valuable than post-consumer plastic waste and do not require much processing to convert back to a (recycled) virgin plastic product, whereas post-consumer wastes occur in mixtures of different plastic and non-plastic waste. For recycling, plastic has to be first washed and separated into homogeneous composition. This leads to increase in the recycling costs of post-user waste as compared to pre-user waste (Rafey and Siddiqui 2021).

Plastic bag use – emblematic of a perceived 'throwaway' consumer culture – has become a focus of attention for government, business and community activists striving to find ways in which consumer behaviour can be modified to reduce plastic bag use. Practical evidence

of a 'throwaway' consumer culture which acts as a significant barrier to sustainable consumption in particular and sustainable development in general (Ritch, Brennan, and MacLeod 2009). The implications are likely to go beyond the regulatory level due to the potential positive behavior spillover from socio-environmental interventions that have gained the interest of policymakers as a costeffective and non-intrusive way to change undesired consumer behaviors (Mallick et.al 2021). Compared to many other applications of plastics, e.g., textiles or tyres, bags are less complex and difficult to regulate as they consist of a single type of plastic (usually polyethylene), and alternative carrier bags are widespread (Nielsen et.al 2019). When distributed to customers as ''free," single-use bags appear to be without cost to consumers who do not see the price and thus tend to engage in excessive consumption (Taylor and Villas-Boas 2015).

Fundamentally any product is manufactured to serve its purpose and to be utilized until its period of expiry. The major component of Municipal Solid Waste (MSW) is plastics which is one of the examples of the take-make-dispose economy. The waste composition may also be presented on either as generated or as discarded basis. The former includes all the waste generated in a particular sector, before separation for recycling, composting, or other treatment (Barnes et.al 2009). Plastic is derived and manufactured for material flow in an economy where it should never become waste, but improper disposal and improper segregation of waste have increased its quantum in MSW. Management of plastic waste is a complicated issue and has posed a great challenge to humankind.

The Indian government announced plastic waste management rules 2016 that alter the current regulations and, among other things, impose a national ban on plastic carry bags with a thickness of less than 50 microns. The common cause of the "Use and discard" plastics, which account for half of the plastic pollution, plastic carry bags, were not significantly reduced by this restriction. However, in some states, it has been found that the execution of these rules has been somewhat gloomy, with most of the state legislations leaving only partial bans on single-use bags. Lack of manufacturing facilities to meet the demand of biodegradable single-use products, lack of financial support for developing alternatives of single-use of plastics, lack of government initiatives to promote biodegradable single-use products and high cost for technologies for alternative of single-use of plastics are the most significant barriers in Indian scenario. One of the major reasons is the unavailability options which are economic and ecologically effective. Moreover, the absence of penalties from the government is also a major cause of the widespread use of single-use plastic products (Vimal et.al 2020).

In response to the urgent need to address the SUP's issue, the Government of Tamil Nadu enacted a statewide ban on particular "use once, discard immediately" plastics on June 5th, 2018, taking effect on January 1st, 2019. The Tamil Nadu government has prohibited the manufacture, storage, supply, transportation, sale, or distribution of use and throwaway plastics such as plastic carry bags of any size and thickness, non-woven carry bags, plastic coated paper plates and cups, plastic tumblers, thermocol plates and cups, plastic tea cups, plastic sheet / cling film used for food wrapping, plastic sheet used for spreading on dining table water packets/pouches, plastic straw, and plastic flags. The 'Meendum Manjappai' (Yellow cloth bag) initiative was launched in December 2021 with the goal of eradicating the usage of single-use plastics and encouraging people to employ the age-old method of utilising eco-friendly yellow cloth bags instead. Ultimately, the 'Meendum Manjapai Vizhipunarvu Iyakkam' (Back to Yellow Cloth Bag Awareness Campaign) a promising approach to address plastic waste concerns and promote sustainable practices. However, its success depends on effective implementation, widespread participation,

and addressing any challenges related to convenience, hygiene, and behavioral change.

The manufacturing, import, stocking, distribution, sale, and use of a variety of single-use plastic products, such as straws, stirrers, cutlery, plates, cups, and bags, were prohibited in India beginning in July 2022. The restriction was put in place to decrease plastic pollution in the country. The Plastic Waste Management (Amendment) Rules, 2022, new legislation provide regulating industries and PIBOs more responsibilities to strengthen the EPR (Extended Producer Responsibility) a new committee and online site are also envisaged under the modified rules, both of which would report to the Central Pollution Control Board and develop the circular economy.

2. Objective

The fundamental purpose of this study was to measure the degree of knowledge and comprehension among Tiruchirappalli consumers about the environmental repercussions of using single-use plastic carry bags. The study attempted to assess the extent to which people understood the negative consequences of single use plastic carry bags on the ecosystem, notably in terms of pollution, resource depletion, and long-term environmental deterioration, with an emphasis on environmental education and sustainable consumerism.

Researchers hoped to gain insights that would assist analyse the impact of the plastic ban and identify any gaps in information or areas that needed more attention by conducting this public responder survey. The survey's 370 respondents give a view of the ideas and perceptions of a varied group of people from various age groups and employment sectors. The poll attempted to obtain a complete perspective of public's opinion and understanding about the plastic ban and alternatives by asking people from diverse backgrounds. This survey's findings might give information on the success of the plastic ban, the degree of awareness about plastic alternatives, and any changes in

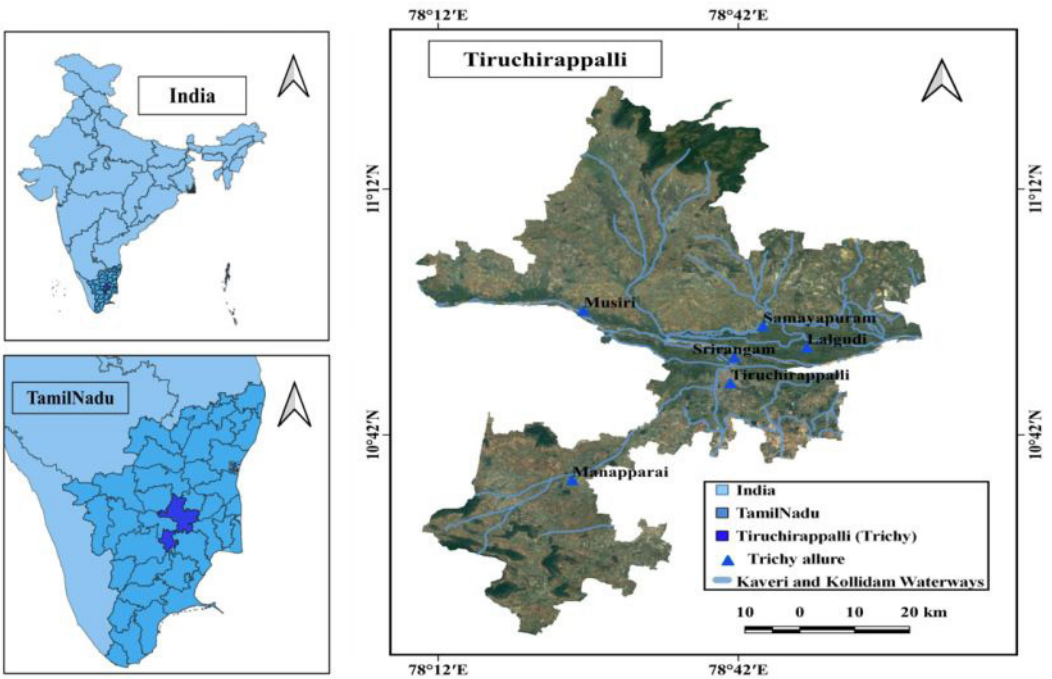

Fig. 1. Study area location map – Trichy, TamilNadu

attitudes or actions before and after the SUP's ban. These findings would be beneficial to politicians, corporations, and groups trying to reduce plastic waste and shift to more sustainable methods.

3. Study Area

The current study area is the fourth-largest city in the Indian state of Tamil Nadu, Tiruchirappalli, popularly known as Trichy, which is located between latitude 10.79N and longitude 78.70E. It covers a region of 4403.83 square kilometers (1700.32sq. mi). The population of Trichy is 9,16,900 according to the preliminary results of the national census of India 2011 and the current population of the metropolitan region of Tiruchirappalli in 2023 is 1,022,518.

There are no dustbins in the residential areas and few dustbins in the city's corporate area due to the door-to-door waste collection system used by the Tiruchirappalli Corporation. However, there are designated dustbins in the suburban and rural areas where trash can be disposed of. A recent monitoring method of waste segregation has also been initiated. Shredded plastics are in progress and it is being used for road laying works.

4. Methodology

A public respondent survey utilising a set of questionnaires was conducted in order to better understand the situation before and after the plastic ban as well as to determine their knowledge with plastic alternatives. Respondents were questioned regarding the plastic ban, with ages ranging from 15 to 67 and working in a various government and private sectors. Data was collected over seven weeks. The survey was designed in Word, and personal interviews were conducted in and around Trichy. A thematic map was analysed and a Chi-square test was performed to statistically estimate the results.

Study area map (Trichy) and the 'Environmental weightage' map was created using QGIS 3.28.7 to test environmental awareness and create a themed map based on environmental weightage (EW). The scale utilised varied from 0 to 10, with 0 representing the least environmental awareness and 10 being the highest. To determine the environmental weightage for each respondent, different parameters were considered, taking into account the specific query and the environmental impact associated with it. These parameters were assigned specific weights. By evaluating the responses and applying the assigned weights, a total environmental weightage was calculated for each respondent.

The location of the respondents was critical in the analysis. The EW values were averaged separately for urban and rural Panchayat residents to highlight the differences in environmental concerns and circumstances between these locations. Finally, a thematic map was created for seventeen aggregated places at the village Panchayat level based on the aggregated EW data. This map most likely represented the environmental weightage across different areas, demonstrating differences in environmental knowledge and concerns.

A Chi-square test was used to evaluate the data and establish the significance of any relationship between plastic bag usage and other factors. The researchers were able to analyse the relationship between plastic bag usage and other variables using the Chi-square test on survey data, providing valuable insights into the patterns and factors associated with plastic bag consumption in the Tiruchirappalli area, to determine whether any observed differences are statistically significant or simply due to chance before and after the implementation of the single use plastic carry bags ban (SUP's).

5. Results and Discussion

Rapid urbanisation and economic progress have resulted in a rise in the global consumption of plastic items. Too far though,

India and the Tamil Nadu state have enacted several rules and regulations to prohibit the use of plastic bags and other plastic objects, but implementation must go much further. In the current study, 370 people in the Tiruchirappalli area were surveyed to determine their understanding of the environmental effects of plastic carry bags as well as their current usage of plastic bags. Prior to the plastic bag ban, plastic bag usage was evaluated using a Chi-square test, and it was shown to be (69.1 percent, Table 1) higher than that of cloth bags.

According to the chi-square test results, men and women use plastic bags in quite different ways. Women use plastic bags at a 65.9 percent rate, while men use plastic bags at a 74.4 percent rate. This difference is statistically significant with a p-value less than 0.05. This suggests that there is a relationship between gender and the usage of plastic bags. Men are more likely than women to use plastic bags. This might be because men are more likely to be the primary grocery shoppers.

Another Chi-square test was undertaken to investigate the usage of alternative materials following the ban on plastic bags, and it was discovered that cloth bags were favoured due to their accessibility. (63 percent, Table 2).

The chi-square test findings show that there is no statistically significant difference in the use of cloth bags by men and women. Females use cloth bags at a rate of 69.2%, while males use them at a rate of 58.5%. This difference is not statistically significant, with a p-value of 0.13. This demonstrates that there is no gender distinction in the usage of cloth bags. Men and women use cloth bags equally. This might be attributed to a number of factors, such as increased awareness of the environmental impact of plastic bags or the availability of reusable bags in shops.

Concerns about the expense of plastic bags before the plastic ban, 291 respondents utilised free plastic bags, whereas 79 paid one to two rupees for each plastic bag. Following the ban on plastics, the cost of cloth bags varied from 5 to 10 rupees per bag at commercial outlets, and there is a slight increase in usage of cloth bags among consumers, as shown in (Figure 2).

Prior to the prohibition, shops frequently distributed plastic bags for free, resulting in extensive customer use. Some businesses, however, levied a modest cost of one to two rupees each plastic bag, which was seen as an additional expenditure for customers. The situation altered with the ban on plastics. Commercial businesses began selling cloth bags as an alternative to plastic bags for 5 to 10 rupees each bag. This pricing disparity between plastic and cotton bags shows a change in consumer behaviour.

Despite the higher expense of cloth bags, their use among customers has grown somewhat. This shows that some people are ready to pay a greater price for cloth bags in order to comply with the plastic prohibition and benefit the environment. The move to cloth bags can be ascribed to a rising knowledge of the negative environmental

Table 1. Use of Single Use Plastic carry bags (SUP's) before the plastic ban in Tamil Nadu

Before plastic Ban			
Use of Plastic Bags $\chi^2 = 0.03$	Female	Male	Total
	65.9%	74.4%	69.1%

Table 2. Use of Cloth bags after the single use plastic ban in Tamil Nadu

After Plastic Ban			
Use of Cloth Bags $\chi^2 = 0.13$	Female	Male	Total
	69.2%	58.5%	63.00%

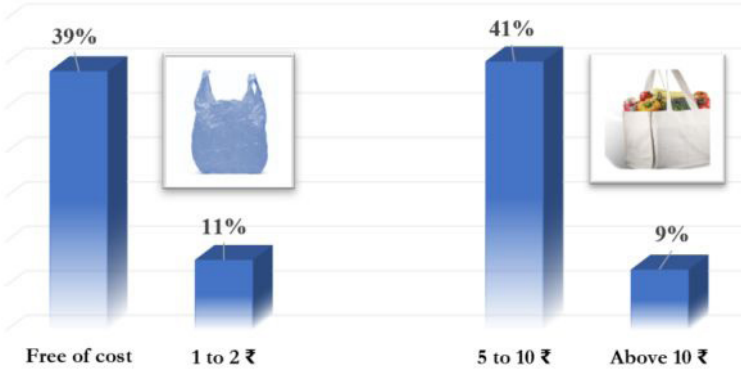

Fig. 2. Cost of bags before and after the plastic ban

consequences of plastic and a desire to embrace more sustainable practises. The slight rise in cloth bag usage reflects a favourable reaction to the ban and a readiness to shift consumer behaviours. Overall, the shift from free or low-cost plastic bags to higher-priced cloth bags indicates a shifting consumer attitude and growing acceptance of alternative choices in the post-plastic ban age.

Although there is a 'Meendum Manjappai' (yellow cloth bag) scheme that was proposed as an alternative to plastic carry bags, only a few respondents were aware of its existence, and many were unaware of the scheme and were much more oriented towards plastic carry bags and cloth bags available at local shops or malls. The project aimed to reduce plastic waste by encouraging people to use cloth bags instead of single-use plastic carry bags, which might contribute to a considerable reduction in plastic pollution and create a more sustainable environment. Reusable cloth bags have the potential to save both consumers and companies money in the long term. Instead of purchasing single-use plastic carry bags, customers may invest in long-lasting and personalised fabric bags that can be reused.

The scheme's success is strongly reliant on the cooperation of both customers and retailers. The scheme's influence on decreasing plastic trash may be limited if it is not broadly adopted or if individuals do not actively engage. The scheme's influence on decreasing plastic trash may be limited if it is not broadly adopted or if individuals do not actively engage. Creating awareness,

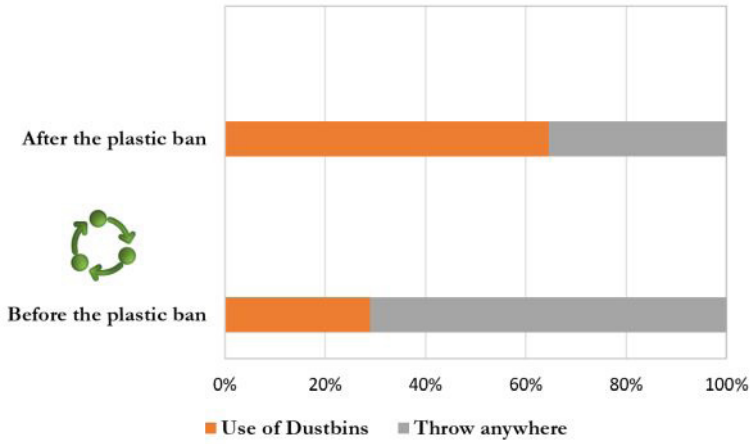

Fig. 3. Methods of disposal of Plastic bag Waste

educating the public, and overcoming resistance to change may take time and effort.

263 of the 370 survey participants disposed their plastic waste informally before the plastic ban. 239 respondents used dustbins to dispose of their plastic garbage following the plastic ban, as demonstrated in (Figure 3).

The fact that 71% of survey respondents disposed of their plastic waste informally prior to the plastic ban indicates a lack of proper waste management practises. Informal disposal techniques might include dumping plastic debris on the streets, in open places, or in waterbodies, causing pollution. This highlights the need for enhanced waste management infrastructure as well as increased knowledge of the negative consequences of inappropriate plastic trash disposal.

Following the plastic ban, 65 percent of respondents used dustbins to dispose of their plastic litter. This demonstrates a good shift in behaviour and an understanding of the need of correct disposal methods. Using dustbins provides for greater waste segregation as well as the potential of recycling or disposing of plastic trash properly. The increased use of dustbins implies that the plastic ban has changed people's attitudes and actions towards the disposal of plastic waste. However, there is still potential for improvement, since a sizable proportion of respondents may still dispose of their plastic garbage informally.

Continued efforts are needed to encourage responsible plastic waste management, such as raising awareness about the necessity of correct disposal, providing accessible waste bins, and creating effective waste management systems. The total impact of the plastic ban may be improved by encouraging more people to utilise waste bins and follow correct disposal practises, resulting in a cleaner and more sustainable environment.

In response to a question on the plastic ban, 65 percent of respondents said they were adjusting to the new laws and restrictions, while 19 percent said they were dissatisfied with the plastic ban because the alternatives it provides are not reasonable or long-lasting (Figure 4).

The fact that 65 percent of respondents said they were adapting to the new legislation shows a favourable response to the plastic ban. It shows that most people are accepting the change and altering their routines to comply with the requirements. This might indicate an increasing understanding and awareness of the environmental effect of single-use plastics, as well as a readiness to support sustainable methods.

The dissatisfaction voiced by 19% of respondents, on the other hand, reveals a concern about the compatibility and durability of the various alternatives to plastic. These people may believe that the alternatives offered, such as reusable bags or containers, are insufficiently practical or long-lasting to replace the convenience

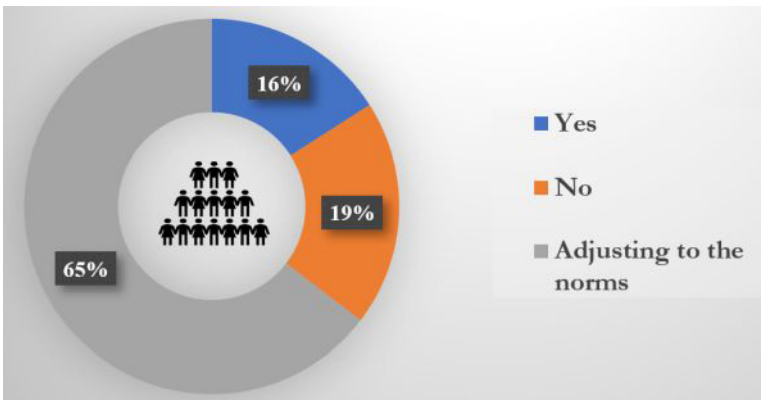

Fig. 4. Percentage rate of accepting the ban on usage of Plastic bags

of single-use plastic goods. It underscores the need for more effective and long-term solutions to the problems highlighted by this portion of the population. To guarantee the effectiveness of a plastic ban, authorities and stakeholders must address the concerns of disappointed respondents. This may be accomplished through investing in Research and development to increase the quality and accessibility of alternative materials, as well as encouraging education and awareness campaigns emphasising the long-term advantages of minimising plastic waste.

Overall, the reaction to the plastic ban appears to be mixed, with some people adapting to the new laws while others express discontent with the available alternatives. It emphasises the need of ongoing attempts to innovate and develop sustainable alternatives that suit consumers' requirements and expectations. The availability of alternatives to single-use plastics can also have an impact on the success of a ban. People are more inclined to utilise reusable bags, affordable steel or bamboo straws and other sustainable goods if they have easy access to them rather than single-use plastics. To solve larger structural concerns, state and federal governments must collaborate with private enterprise. Humanity requires a broader range of effective governmental policies, recycling infrastructure that is appropriately suited for the situation, improved recycling technology, and innovative business models.

With a scale of 0–10, where 0 corresponded to the least environmental awareness and 10 to the greatest, each parameter received a weighting depending on the query and the environmental impact behind the inquiry. Based on the weights assigned to each response, a total environmental weightage was calculated for each respondent. Based on the respondent location, the EW (Environmental Weightage) value was aggregated for urban inhabitants and rural Panchayats. Based on this, a thematic map was created for 17 aggregated locations at the village Panchayat level. The findings revealed

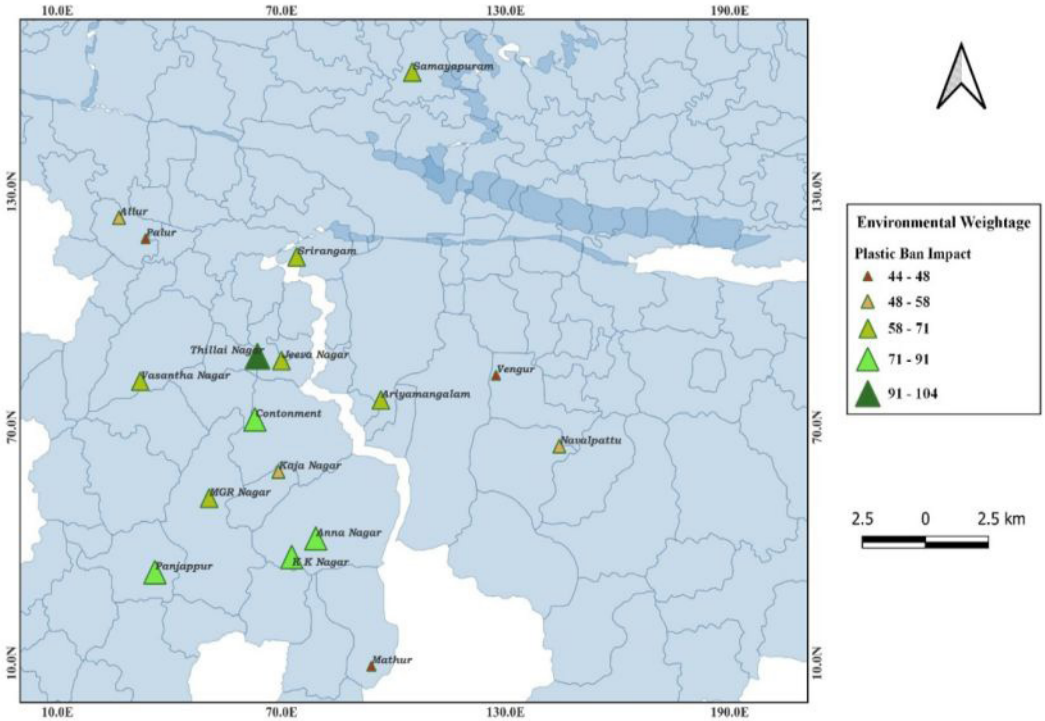

Fig. 5. Weightage driven thematic map to assess the impact of plastic ban in Tiruchirappalli region

that the urban corporation had the highest EW, whereas Mathur, Palur and Vengur which falls under the village panchayat level had the lowest EW (Figure 5). Studying waste collection and awareness patterns revealed that no municipal activities were in place and that local awareness was exclusively dependent on well-wishers, NGOs, and other highly infrequent sources. Although the prohibition on plastic is in place, neither vendors nor users of plastic are subject to any stringent penalties or sanctions.

There are few municipal efforts addressing the issue of single-use plastic carry bags at the local level. The community instead relies on intermittent attempts by well-wishers and non-governmental organisations (NGOs) to raise awareness about the environmental impact of these bags. Such projects, however, are rare and not widely available. This circumstance demonstrates a flaw in the local government structure, since there are no comprehensive laws or regulations addressing the usage of single-use plastic carry bags. There may be inadequate infrastructure, resources, or procedures in place to manage the manufacturing, distribution, and disposal of these bags in the absence of local actions.

The reliance on well-wishers and NGOs for awareness, albeit unusual, demonstrates that there are individuals and organisations that realise the environmental concerns linked with single-use plastic carry bags. However, their absence indicates that attempts to raise awareness and offer alternatives to these bags are neither widespread or consistent.

To solve this issue, local governments must play an active role in adopting programmes to minimise the usage of single-use plastic carry bags. This might involve enacting legislation such as bag bans or fees, promoting reusable alternatives, and establishing recycling programmes. Municipalities can also invest in public awareness programmes to educate the public about the dangers of single-use plastic and to urge behaviour change. By establishing municipal initiatives, local authorities can create a more sustainable waste management system and reduce the reliance on single-use plastic carry bags. Collaborating with well-wishers, NGOs, and other stakeholders can further amplify these efforts, leading to a more environmentally conscious community and a significant reduction in plastic waste.

6. Conclusion

The main reason of using plastic bags is its easy availability. However, Trichy residents were willing to accept the government's plastic prohibition programme. The findings revealed that individuals have a negative attitude about single-use plastics and are looking for readily available alternatives. Though waste management policies have improvised, the mode of penetration of the concept or change among the public is limited especially in rural areas. The replacement of plastic is not as easy as it has already taken so many decades to find alternatives. The purpose of replacing plastic with another non-biodegradable substance such as Styrofoam and an organic replacement has its challenges. Although there is an alternative provided through the 'Meendum Manjappai' (Yellow cloth bag) scheme in the state of Tamil Nadu but the enforcement of the same is limited. There needs to be a strict policy to regulate the use of plastic substitutes, improve recycling and better management of waste segregation. The government should impose severe penalties for creating plastic bags and levy a fee on shopkeepers and customers who use them.

The current difficulty is that the government wants residents to engage in every government initiative and campaign, while society considers it the government's responsibility to maintain the environment clean. However, the idea has not penetrated the public domain that there are some alternatives to plastic and they can only be successful if the common man can accept the alternative and give up plastic usage. Though the best idea is to reduce the consumption of packaging, only when

suggested alternatives are successful, we will be able to attain this. Through this survey, it was revealed that respondents agreed to environmental degradation and threats to humanity posed by the uncontrolled use of plastic bags. Therefore, activities to popularize the change in such zones should be improved. The present survey would lay down a foundation and understanding of the awareness of people about the varied plastic waste segregation techniques and the related cost benefits. The study results could be used for the generalization at a larger scale for effective decision making.

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