

Environmental Impact of Plastic Alternatives in Zamboanga City: an Assessment



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ABSTRACT: The escalating environmental impact of plastic pollution has compelled policymakers and researchers to explore sustainable alternatives. This study examines the environmental impact of various plastic alternatives employed in Zamboanga City, analyzing their effectiveness and potential drawbacks. This study investigates the ecological consequences of substituting traditional plastics with alternative materials in Zamboanga City, Philippines. The study combines quantitative data analysis of waste production with qualitative interviews involving city stakeholders using a mixed-methods approach. Initial findings indicate a reduction in single-use plastic consumption following the adoption of plastic alternatives, but data reveal the challenges related to the recyclability and biodegradability of these materials. Stakeholder perceptions vary on the benefits and limitations of different alternatives, emphasizing the necessity of a multifaceted approach to plastic waste management. The study underscores the intricate balance between environmental sustainability and practical considerations in implementing plastic alternatives. Insightful discussions with residents, environmental experts, and policymakers illuminate the complexities surrounding the transition away from conventional plastics. The study offers recommendations for sustainable waste management practices to guide decision-making processes for policymakers and businesses in Zamboanga City, ultimately aiming to foster informed and ecologically conscious choices in mitigating plastic pollution.

KEYWORDS: Environmental Impact, Plastic Alternatives, Waste Management, Ecology

I. INTRODUCTION

Plastic pollution is one of the biggest environmental issues of the modern world that has attracted a lot of attention from scholars, officials, and society. Research has also documented the effects of plastic waste on aquatic environment, animals, and people stressing the importance of finding solutions to the challenge of plastic pollution. The annual figure of plastic waste that finds its way into the oceans at eight million metric tons and this is a major challenge to the world's species and ecosystems. The issue concerning the increasing amount of plastic waste in the environment has cheered the use and production of various plastic substitutes as safer options to conventional plastic products. New biodegradable materials like PLA that is polylactic acid and PHA that is polyhydroxyalkanoates, are also being used which can break down naturally into natural environment thus reducing the problem of plastic waste disposal in the future. Scientists have analyzed the biodegradability and environmental effects of bioplastics compared to conventional plastics, which means that there is a need for a critical evaluation and regulation of bioplastics. In addition, the analysis of the life cycle assessment (LCA) of the plastic substitute has been carried out to determine the overall environmental impact and the possible reduction in greenhouse gas emissions, energy consumption, and resource depletion. It is very crucial to assess all the environmental impacts and effects of a product throughout its life cycle from the raw material extraction all the way to the disposal.

Zamboanga City has not invested in significant research regarding the effect of plastic alternatives and their effectiveness in managing the city's plastic waste problems. Nevertheless, measures that have been taken such as the city's ban on the use of plastic items in public places, encouragement of the use of reusable bags and containers have seen some positive impact in minimizing on the generation of plastic waste and enhancing the awareness on the conservation of resources among the public. Moreover, there is still a gap in the literature as to the effectiveness and the longevity of the plastic alternatives in Zamboanga City. This research study aims at addressing this research gap by carrying out an extensive investigation of the effects of plastic alternatives on the environment, social aspects, and policy recommendations in the city and based on the current literature on plastic pollution and sustainable materials management.

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Plastic pollution is a major and widely-discussed problem of the modern world that has noticeable negative impacts on the environment. As a result, most cities have started using plastic substitutes with a view of decreasing the adverse effects they have on the environment. One of such cities is Zamboanga City in the Philippines that has been researching on different types of plastics in a bid to reduce on the negative impacts of plastics. This research work seeks to assess the suitability and feasibility of the above-mentioned alternatives in combating plastic pollution in the city.

Due to globalization and increased human activities, plastic pollution has become a menace to the aquatic lives, environment and human beings. The use of plastic materials in manufacturing goods, and their disposal has culminated to plastic waste being dumped in landfills, rivers, seas, and other natural habitats. The problem of plastic waste management is especially acute in Zamboanga City, being a coastal city and largely dependent on the products of the sea to support population's needs. Hence, there is a significant necessity to evaluate the effectiveness of plastic alternatives in the reduction of plastic pollution within the city. Plastics became possible to create highly efficient and popular materials due to such characteristics as durability, low weight, and low price. Plastic waste, if not properly disposed of, has been reported to pollute the environment in a very dangerous way affecting aquatic life, wildlife, and human beings. This is especially true with the highly urbanized coastal cities that lack appropriate waste management infrastructures; for instance, Zamboanga City. Many discussions have been held on biodegradable alternatives for the conventional plastics produced using fossil resources feed and feedstocks but little is still known on the LCA of the various environmental and health impacts. This study assesses available market plastic substitutes in Zamboanga City, Philippines, to determine their LCA and compare it with the conventional types.

The study aims at assessing various forms of plastic substitutes that are already in the market or in practice in Zamboanga City. These may include the use of biodegradable plastics, paper bags, reusable containers and other merchandise that are environmentally friendly to replace the single use plastics. Therefore, based on the identified alternatives, this study seeks to assess their efficiency in the reduction of plastic waste generation, prevention of environmental pollution, and encouragement of sustainable consumption practices among the residents and companies in the city. Moreover, this study also looks into the social, economic and policy ramification of using plastic substitutes in Zamboanga City. This involves determining the feasibility of the various materials such as their cost, availability, and implementability and the legal framework under which they can be used. Thus, taking into account these complex factors, the work will help identify the potential and applicability of plastic substitutes as sustainable solutions to the problem of city plastic waste.

To arrive at evidence-based policy, business, and civil society recommendations, this study employs survey and interview data, waste audit data, and environmental impact assessments in Zamboanga City. The research hopes to provide useful information to decision makers, planners, and the public to lessen the problem of plastic pollution and encourage an eco-friendly culture in Zamboanga City. This study is timely and relevant since it tackles with a significant environmental problem that demands immediate action. Thus, based on the given criteria of effectiveness, sustainability and implications, the study seeks to provide insights into the possibilities of plastic alternatives for Zamboanga City and propose strategies towards the fight against plastic pollution and for the creation of a sustainable future.

II. METHOD

The research design utilized in this study was mixed method, where both quantitative and qualitative data were collected in order to obtain rich and detailed information about plastic alternatives in Zamboanga City. Thus, the study used surveys interviews, waste audit and environmental impact assessments in order to ensure that all aspects related to the use of plastic alternatives in the reduction of plastic pollution were explored from all sides. To obtain data, a survey questionnaire with structured questions was provided to residents, businesses, and other stakeholders in Zamboanga City to understand the consumers' perception of plastic alternatives, perception on the issue of plastic pollution, and sustainability in consumption. Focus group discussion and interviews were held with stakeholders such as local government officials, waste management agencies, environmentalists, and plastic industries to get a further understanding of the situation and prospects of employing the alternatives to plastics in the city. Waste assessment was also conducted on various sites within Zamboanga City to determine the quantities and kinds of solid wastes particularly plastics with the aim of determining the patterns of consumption of plastics and the effectiveness of the existing systems of waste management. The environmental impact of the plastic alternatives was analyzed using the life cycle assessments (LCAs) that compared the ecosystem load of various materials, manufacturing energy efficiency, greenhouse gas emissions, and resource exhaustion parameters.

This study employed stratified random sampling to ensure that the participants came from different age groups, occupations, and regions of Zamboanga City. The study comprised of households, businesses, learning institutions, and public entities to ensure that the data collected are diverse on the plastic substitutes and their effects on the environment. Both quantitative and qualitative analyses were applied on the data collected from surveys, interviews, waste audits and

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environmental impact assessments. Description and correlation analysis of the collected data were used to determine and illustrate different patterns and tendencies, while qualitative data was analyzed thematically and with content analysis in order to determine the most important themes and messages.

III. RESULTS

The results are categorized into usage patterns, environmental performance, stakeholder perceptions and economic impact.

Table I. Usage Patterns

Users	Usage Patterns
1. Supermarkets	- Predominantly used biodegradable bags and paper bags. - Some stores offered incentives for customers using reusable bags.
2. Local Markets	- A mix of traditional plastic bags and biodegradable alternatives. - Limited adoption of reusable containers due to convenience issues.
3. Restaurants	- Increased use of compostable containers and utensils. - Higher-end establishments more likely to adopt fully biodegradable products.
4. Households	- Transition to reusable shopping bags. - Slow adoption of compostable kitchen waste bags due to cost and availability.

A. Usage Patterns

The table below shows how supermarkets, local markets, restaurants, and households use plastic bags and alternative biodegradable bags. The study found varied usage patterns of plastic alternatives across different sectors. Biodegradable bags were predominantly used in supermarkets, while reusable containers were common in restaurants.

B. Environmental Performance

The table below shows the effects of alternative plastics or bags on the environment. The Life Cycle Assessment (LCA) revealed that biodegradable alternatives substantially reduced carbon footprints compared to traditional plastics. However, the production and disposal of certain bioplastics presented challenges, such as higher water usage and limited composting facilities.

Table II. Environmental Performance

Alternative Bags	Environmental Performance
1. Biodegradable Bags	- Reduced carbon footprint by approximately 30% compared to traditional plastic bags. - Concerns about complete degradation in environments lacking industrial composting facilities.
2. Paper Bags	- Significant reduction in plastic waste. - Higher water and energy usage in production, raising concerns over overall sustainability.
3. Reusable Bags	- Substantial long-term reduction in plastic waste. - Environmental benefits directly correlated with frequency of reuse (minimum 50 uses to offset production impact).
4. Compostable Containers	- Effective in waste reduction when properly composted. - Challenges with composting infrastructure leading to mixed waste streams and reduced composting efficiency.

C. Stakeholders' Perceptions

The table below shows the perceptions of stakeholders towards alternative plastics. Consumers generally viewed plastic alternatives positively, citing environmental benefits. However, cost and convenience were significant barriers to widespread adoption.

Table III. Stakeholders' Perception

Stakeholders	Perceptions
1. Consumers	- Positive attitudes towards plastic alternatives due to environmental benefits. - Resistance due to higher costs and lack of convenience. - Preference for reusable over single-use alternatives when economically feasible.
2. Businesses	- Initial cost concerns for procuring alternative materials.

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	<ul style="list-style-type: none"> - Long-term benefits noted in terms of waste management cost reduction and enhanced customer satisfaction. - Need for clear guidelines and support from local government for smoother transition.
3. Environmental Activists	<ul style="list-style-type: none"> - Supportive of the shift to alternatives but highlighted the necessity of comprehensive environmental education. - Emphasized the importance of proper waste segregation and infrastructure development for the full realization of benefits.

D. Economic Impact

The table below shows the economic impact of the use of alternative plastics in terms of initial costs, long term savings, and government support. While some businesses reported initial costs in transitioning to alternatives, long-term financial benefits were noted due to reduced waste disposal fees and increased customer satisfaction.

Table IV. Economic Impact of the use of alternative plastics

Variables	Economic Impact
1.Initial Costs	<ul style="list-style-type: none"> - Businesses reported an average initial increase in costs by 15%-20% due to procurement of biodegradable and reusable alternatives. - Small and medium-sized enterprises faced more significant financial strain compared to larger corporations.
2. Long Term Savings	<ul style="list-style-type: none"> - Reduced waste disposal fees by approximately 10%-15% over a year. - Customer loyalty and increased business reported by establishments actively promoting sustainable practices.
3.Government Support	<ul style="list-style-type: none"> - Need for subsidies or financial incentives to support businesses transitioning to sustainable alternatives. - Potential for job creation in sectors related to the production and processing of biodegradable materials.

E. Additional Observations

The table below shows the additional observations of the study.

Table V. Additional observations

Items	Observations
1.Infrastructure Gaps	<ul style="list-style-type: none"> - Limited composting and recycling facilities hindering effective use and disposal of alternatives. - Local government initiatives focused on improving waste management infrastructure critical to the success of these alternatives.
2.Public Awareness	<ul style="list-style-type: none"> - Educational campaigns increased awareness but highlighted the need for continued efforts in public education regarding the benefits and proper use of alternatives.

IV. DISCUSSION

The research reveals that even though the plastic replacements have positive environmental implications, their usefulness depends on the appropriate consumption and disposal manners. Other measures that have to be made at the local level include providing more compost bins and raising the awareness of the public. Thus, the research provides a more complex view of the environmental effects of the plastic alternatives in Zamboanga City. Although there are numerous benefits like cutting down on carbon emissions and minimizing on the use of plastics, there are several issues that need to be dealt with to fully harness them.

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A. Environmental Feasibility

This shows that carbon footprint is lowered when using biodegradable bags as opposed to the conventional plastics. However, there is no sufficient industrial composting facilities in Zamboanga City to properly decompose these items. Unfortunately, paper bags, which are a better option than plastic bags, are produced using a lot of water and energy, thus posing a challenge in sustainability.

B. Behavior Shifts and Public Perception

This work established that there was a positive attitude towards the plastic alternatives and this was because of the awareness on conservation of the environment. However, high costs and inconvenience are the factors that hinder the widespread application of the approach. This shows that even though the consumers are aware, the economic and practical factors have a great influence on their purchase decisions. Reusable bags were cheaper in the long run, hence they became popular; however, to generate the intended environmental impact, they must be used repeatedly.

C. Economic Considerations

The first costs of investment for companies, which decided to switch to other materials, were rather significant, and affected mainly small and medium-sized companies. The long-term advantages that include the reduced cost of waste disposal fees and the enhanced customers' satisfaction may in the long run counterbalance the costs. But it is equally important to have supportive policies and possibly subsidies from the local government for the economic pressure during the transformation process.

D. Infrastructure and Policy Gaps

This work identifies several major problems of infrastructure, mainly concerning composting and recycling facilities. Hence, the use of biodegradable and compostable materials does not equal to effective waste management if there are no proper disposal mechanisms in place. Therefore, the local government has a central part in the enhancement of these infrastructure capacities.

V. RECOMMENDATIONS

Based on the findings, several policy and practical recommendations emerge:

1. Implement targeted subsidies and incentives to support businesses transitioning to sustainable materials. This could include tax breaks, grants, or direct financial aid.
2. Prioritize the development of composting and recycling facilities to manage biodegradable and compostable waste effectively.
3. Continue and expand public awareness campaigns to emphasize the environmental benefits of plastic alternatives and proper disposal methods.
4. Conduct longitudinal studies to assess the long-term environmental, economic, and social impacts of adopting plastic alternatives.
5. Compare the effectiveness of different types of biodegradable materials and reusable products in various settings (urban vs. rural) to design tailored approaches for different contexts.
6. Investigate emerging technologies in biodegradable and compostable materials that could offer better environmental and economic efficiency.
7. Evaluate the effectiveness of existing policies and regulations in promoting sustainable practices and identify areas for improvement.

VI. CONCLUSION

The shift to the use of plastic alternatives in Zamboanga City has positive environmental implications with possibilities of long-term economic returns. Yet, to reap these benefits, it is crucial to tackle issues of cost, infrastructure, and people's conduct. Strategic policy interventions, infrastructure developments, and the continuous awareness campaigns are necessary to improve on the sustainability of the urban environment. This study provides useful findings that can help local and national initiatives that aim at reducing the problem of plastic pollution and encouraging the use of better materials. Further research should be made on the basis of these findings to find out new strategies and its long-term effects to enhance the environmental sustainability in Zamboanga City and other related places. Thus, the research findings demonstrate that there is no one perfect substitute for conventional plastics that could meet the multiple requirements in different sectors of Zamboanga City. To optimize environmental advantages, we should employ all three strategies: By limiting the use of plastic through bans and reuse programs, it helps the material to have a higher chance of being recycled and properly managed especially for flexible packaging because of its weight, and gradually replace some of the virgin plastic types as the negative consequences of their disposal decrease. In the final analysis, the success of such policies depended on the consumer and intersectoral cooperation policy support.

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