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Georgetown County Environmental Services Office

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United Nations Youth Corps Internship

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1.1 Introduction

From its beginnings nearly three hundred years ago, Georgetown County and the Waccamaw Neck have always been a region built by the water that surrounds it. The county seat, Georgetown, sits at the confluence of five rivers that comprise Winyah Bay. As the largest delta on the East Coast of the United States and the third-largest watershed basin on the East Coast, Winyah Bay has provided vast natural resources for the region which has, in turn, economically spurred community growth for centuries. However, in the modern era, there are many threats to the valuable ecosystems and environments that have propelled economic and societal growth in this region. Through this study, in partnership with the United Nations Regional Centre of Expertise Youth Corps and the Georgetown County Environmental Services Office, we will examine the current state of anthropogenic pollution within Georgetown County with specific regard to roadside litter and its ramifications. Policy and program recommendations for remediation and mitigation strategies are also discussed based on case studies and literature review.

This report will utilize the United Nations Sustainable Development Goals as a framework for which to apply to Georgetown County to create a better overall community regarding economic, social, and environmental aspects.

The basis for this report will be proprietary research conducted with the Georgetown County Environmental Services Office in partnership with local and state-level Keep America Beautiful Chapters in planning, creating, and executing a countywide litter index. There is a continuous, widespread, and notable litter problem throughout the county to which the litter

index would be utilized to assess the current state of the issue and provide the county with data to inform decisions on solutions and mitigation strategies.

1.2 Overview of Georgetown County in Regard to Litter Index

Georgetown County is unique in regards to its citizenry and diversity of ecosystems and economies. In many reports concerning population groups and their communities within the county, a dichotomy often emerges between the communities along the Waccamaw Neck and the mainland interior of Georgetown County. The Waccamaw Neck, home to the southern beaches of the famous "Grand Strand", is representative of a modern coastal community with a major economy built upon tourism and hospitality revenue. Conversely, the interior communities of Georgetown County are comparable to those of many rural communities across the southeast in that their economies are primarily based in agriculture, forestry, or service-related sectors, and have a relatively low population density.

At first glance, one would expect litter to be directly proportional to population density, and while this is true to some extent, many different factors make this topic of litter distribution immensely complex. Overall, our index results pointed to higher densities of litter and dumpsites in the remote interior regions of the county rather than a population-driven distribution of litter. This is partly to be expected as Georgetown County, like many others, seeks to protect and maintain the tourism economy as it is the major tax revenue generator of the county. However, this distribution of litter raises questions and concerns about environmental and community health in addition to equitable access to resources and aid to those who live away from the Waccamaw Neck. With five major rivers located within Georgetown County, including one of the largest estuaries on the east coast, interior littering and dumping in these watersheds

ultimately affects the health and wellbeing of the entire county, making this issue of litter

distribution crucial for all Georgetown County residents.

1.3 Overview of Planet in Regard to Litter Index

Georgetown County is an exemplary region to study the effects of litter distribution,

cleanup efforts, and proposed management strategies, as it contains such a diversity of

ecosystems as well as communities and cultures. One such aspect is the prevalence of rivers,

wetlands, and a network of watersheds throughout the county. Worldwide, the EPA estimates

that roughly 80% of marine trash and debris is a result of land-borne littering and dumping[1].

Taken into consideration with the Winyah Bay-PeeDee Watershed which drains approximately

20,000 square miles[2], Winyah Bay is a crucial pathway for marine pollution. This allows

Georgetown County and the litter index to be a small-scale study for identification, mitigation,

and remediation strategies for litter and aquatic debris which can eventually be scaled up to use

in regions with larger watersheds, estuaries, and population densities. Unfortunately, adverse

effects to both the community and wildlife from marine and land-based litter can also be

observed in the county. Globally, it is estimated there are between twelve and a half to one

hundred and twenty-five trillion pieces of microplastic in the ocean's waters.[3] These

microplastics are stratified from floating on the surface to suspension in the water column, and to

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[1] "Movement of Aquatic Trash," United States Environmental Protection Agency, accessed March 18, 2021, https://www.epa.gov/trash-free-waters/movement-aquatic-trash.

[2] "Preserving Local Rivers & Their Watersheds," Winyah Rivers Alliance, Winyah Rivers Alliance - Waccamaw Riverkeeper, last modified October 8, 2020, https://winyahrivers.org/winyah-rivers-alliance/.

[3] "Facts and Figures on Marine Pollution," United Nations Educational, Scientific, and Cultural Organization, accessed April 21, 2021, http://www.unesco.org/new/en/natural-sciences/ioc-oceans/focus-areas/rio-20-ocean/blueprint-for-the-future-we-want/marine-pollution/facts-and-figures-on-marine-pollution/#:~:text=Once%20discarded%2C%20plastics%20are%20weathered,more%20than%20100%2C000%20marine%20mammals.

be incorporated and consumed in benthic environments in the deep ocean. The sheer amount of micro and macro plastic pollution in the world's oceans is staggering and accounts for one million seabird deaths annually in addition to nearly one hundred thousand marine mammal deaths.[4] However, the damaging health effects of plastic pollution are not limited to sea life. It is estimated that humans ingest roughly fifty-five thousand particles of microplastic annually as a result of consuming contaminated seafood such as oysters, mussels, and shellfish.[5] Compounded throughout an average lifespan, the routine consumption of microplastic particles can lead to health consequences such as infertility, obesity, cancer, and the alteration of human chromosomes.[6]

1.4 Thesis Paragraph

Through the implementation of a litter index created and executed by the Georgetown County Environmental Services Office, the county will be able to collect litter data, create targeted mitigation and remediation strategies, and track long-term litter trends in response to applied mitigation programs. Additionally, accompanying litter index reports will continue to provide county leaders and local officials with up-to-date statistics and information concerning the effects of litter and their ramifications on human and ecosystem health.

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[4] UNESCO, "Facts and Figures on Marine Pollution".

[5] Evangelos Danopoulos, Jenner C. Lauren, Maureen Twiddy, and Jeanette M. Rotchell, "Microplastic Contamination of Seafood Intended for Human Consumption: A Systematic Review and Meta-Analysis," *Environmental Health Perspectives* 128, no. 12 (2020): https://doi.org/10.1289/EHP7171.

[6] Shivika Sharma and Subhankar Chatterjee, "Microplastic pollution, a threat to marine ecosystem and human health: a short review," *Environmental Science and Pollution Research* 24, (2017): 21530-21547, https://doi.org/10.1007/s11356-017-9910-8.

2.0 Methods

In this report, we define litter as any manifestation of trash, debris, or dumps that are disposed of improperly or illegally on roads, in parking lots, or waterways [7]. Litter can also be referred to as any piece of misplaced solid waste [8]. This broad statement classifies things that are as small as cigarette butts and as large as tractor tires. This improper disposal can be deliberate, such as throwing trash from your car window, or unintentional, as debris being blown away by the wind, or even as a result of hauling loads that are improper and uncovered. The issue of improper hauling of debris is widespread, as a University of Florida study found that even garbage trucks can be a contributor to littering as collected waste can fall off the truck when in transit. [9]

The litter index study was conducted throughout Georgetown County, South Carolina from February to March 2021. Roadside survey points were obtained randomly throughout the county by utilizing GIS open-source data and GPS information. Roadside litter index points were limited to county and local municipality-maintained roads and did not include any state highways or privately owned and maintained drives. The litter index contains 206 individual data points which describe both the quantity of litter and the main litter groups found at each point. The quantity of litter and debris was scored according to guidelines set forth by Keep America

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[7] Wesley P. Schultz, "Littering Behavior in America: Results of a National Study," *Keep America Beautiful*, January 2019.

[8] Scott E. Geller, William Brasted, and Millard Mann "Waste Receptacle Designs and Interventions for Litter Control," *Journal of Environmental Systems* 9, no. 2 (1980): 145-160, http://dx.doi.org/10.2190/5P46-8H2N-41JR-C2EJ.

[9] University of Florida, "UF Study Points To Garbage Recycling Trucks As Source Of Litter," *University of Florida*, February 23, 2000. https://news.ufl.edu/archive/2000/02/uf-study-points-to-garbage-recycling-trucks-as-source-of-litter.html.

Beautiful. Keep America Beautiful scoring protocol rates each site on a scale of one to four with a score of one being minimal to no litter, two being slightly littered but manageable to clean up, three represented a littered site that requires an organized cleanup effort, and four being extremely littered. A score of four could also include illegal dumpsites and large bulk items.

While original plans for this index included 140 roadside points throughout the county, we expanded the number of points to 206 to include many boat landings, beach accesses, and public parks in the county, as these areas are valuable to tourism within the county. Points were also added in densely populated regions such as local municipalities such as the cities of Andrews and Georgetown. In the field, Avenza Maps was used in conjunction with a Google Form to compile data, navigate to each of the data points, and characterize the type and severity of litter observed. Two digital forms were created to record data for the index. The first was used to record the required location and litter information for roadside points, while the second was utilized for parks, boat landings, and beach accesses.

On the roadside points form, the observer recorded the respective site number, street name, site score, type of litter, site-specific comments, and finally, whether this area needed immediate attention by the county. Each form contained categories to indicate which types of litter were observed across the various points. These categories were specific to both the roadside and parks, boat landings, and beach access forms to best describe the common debris observed at each of the respective sites. The litter categories for the roads form were as follows, disposable cups, lids, and straws, drink bottles or cans, paper or cardboard, plastic bags, snack bags, wrappers, takeout containers, full trash bags, construction debris, tires and car parts, furniture or mattresses, and clothing or fabric. For the park forms, beach accesses and boat landings, marine or boat debris, and fishing debris categories were added. Additionally, the number of trash cans

and the distance between trash cans were recorded at all parks, boat landings, and beach access

points to detect a possible correlation between the trash can density and litter intensity.

When conducting the litter index surveys, observers would navigate to their point, and

then walk approximately 100 meters to accurately assess the quantity and categories of litter at

the site. Upon completion, each observer would give their independent score and submit their

litter classification form. Once the scores were submitted, pictures were taken of the site and

additional comments concerning either the severity or type of litter were made. If points were

located on private roads, state roads, or were impossible to access, they would be marked as

"does not exist" or (D.N.E.) and excluded from the dataset. While conducting this survey the

observers watched for illegal dumpsites which were subsequently recorded and marked on our

GIS layer and directed to dumpsite cleanup crews at the Environmental Services Office. Once all

the sites were surveyed this information was compiled to examine trends.

3.0 Results

The litter index achieved a total of 206 data points, which included 152 roadside points

and 54 points located at boat ramps, parks, and beach accesses. Of the 152 roadside points

examined, 61 were classified as one, 36 were marked as two, 42 were scored as three, and 13

points rose to a four on the litter index scale. Percentage wise, the distribution of scores for

roadside points showed that 39% of the sites surveyed were scored as one, 24% received a score

of two, 28% were littered to a score of three, and only 8% earned the designation of a four. This

can be seen in Figure 2. There was a total of 14 roads that did not have any visible litter present

at the time of our survey. Across the eleven categories litter was divided into, drink bottles and

cans were the most prevalent objects of litter with 118 individual sightings across our points.

Disposable cups, lids, straws, and snack bags and wrappers followed closely behind with 109,

and 101 occurrences, respectively. Paper or cardboard was observed at 89 of the sites, plastic

bags were seen across 80 of our locations, takeout containers had 53 occurrences, tires or car

parts were noted at 16 sites, construction debris was found at 9 locations, clothing and fabrics

had 6 occurrences and full trash bags and furniture and mattresses were both noted during 5

surveys. The distribution of litter categories can be seen in Figure 1. There was a total of 11

roads that required immediate attention due to them being categorized as a four or containing an

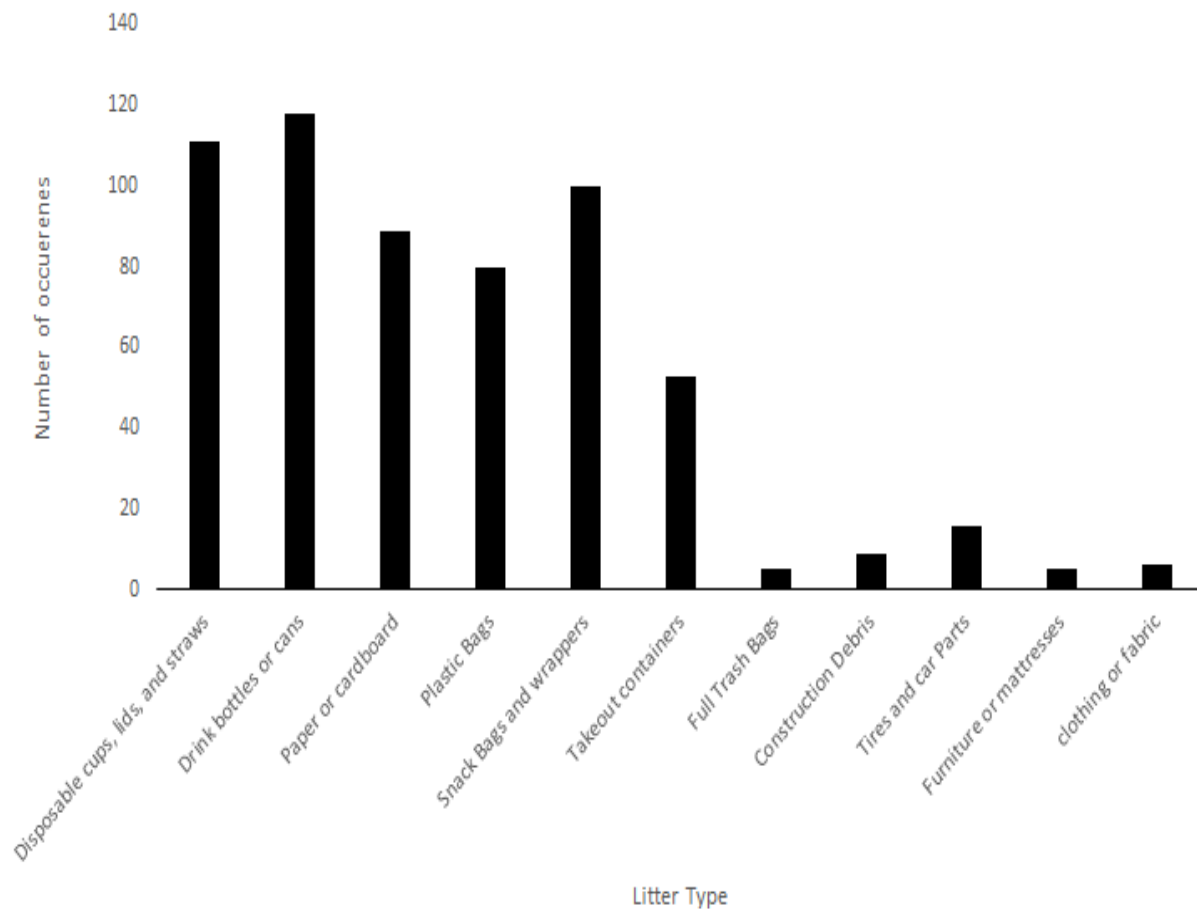illegal dumpsite. Across all the roadside survey points, the average litter index score was 2.04.

Figure 1. The frequency of litter by type category across all roadside points, with aluminum cans

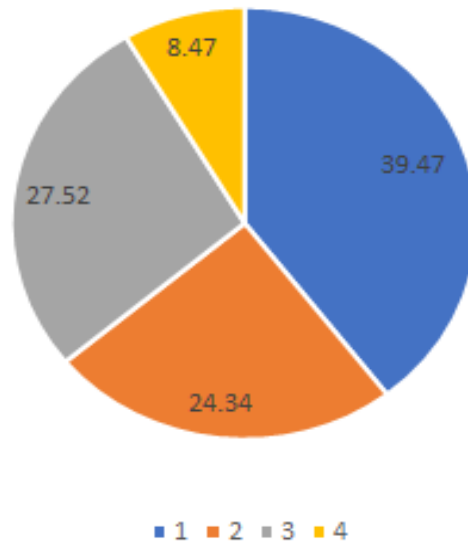and plastic bottles being the most widely reported.

Figure 2. A breakdown of litter index scores across all roadside points surveyed, encouragingly one was the most common.

The 54 boat landings, parks, and beach accesses examined were selected to survey because they are some of the most visited public areas in the county. Our surveys consisted of 16 beach accesses, 22 boat landings, and 16 parks. Of these areas, 31 were marked as 1, 13 were scored as 2, 7 sites receive a score of 3, and 2 were classified as 4. This equated to 57.4% of the total areas examined scoring a one, 25% of the sites earned a 2, 12.6% were 3, and 3.7% were noted as 4 as shown in Figure 4. The type of litter examined at each site was again divided into eleven subcategories with two additional categories added to account for debris prevalent at beach accesses and boat landings. Disposable cups, lids, and straws were found at 40 of the sites, drink bottles and cans were present at 41 of the sites, paper or cardboard occurred at 28 locations, plastic bags were found at 29 sites, snack bags and wrappers was noted at 32 of the points, takeout containers occurred at 10 sites, full trash bags were noted at one site, construction debris and car parts and furniture or mattresses were seen twice among the sites, clothing or

fabrics debris was noted at 3 sites, marine or boat debris was found at 3 sites, and fishing debris occurred at 9 sites. These trends can be further examined in Figure 3. There was a total of six sites that had no litter reported and were predominantly beach accesses with one exception. The only site with no litter that was not a beach access was the North West Regional Facility, a large, well-maintained county park. All 22 boat ramps had some form of litter present. To determine if there was any significance between litter index score and the number of trash cans present, a regression test was utilized and produced an R^2 value of 0.0415. Regression analysis of data relies on a benchmark number of .05 to determine significance. Since the calculated value is below the typical guideline number, it can be concluded that there is a significant relationship. The average score for the boat ramps, parks, and beach accesses was 1.60.
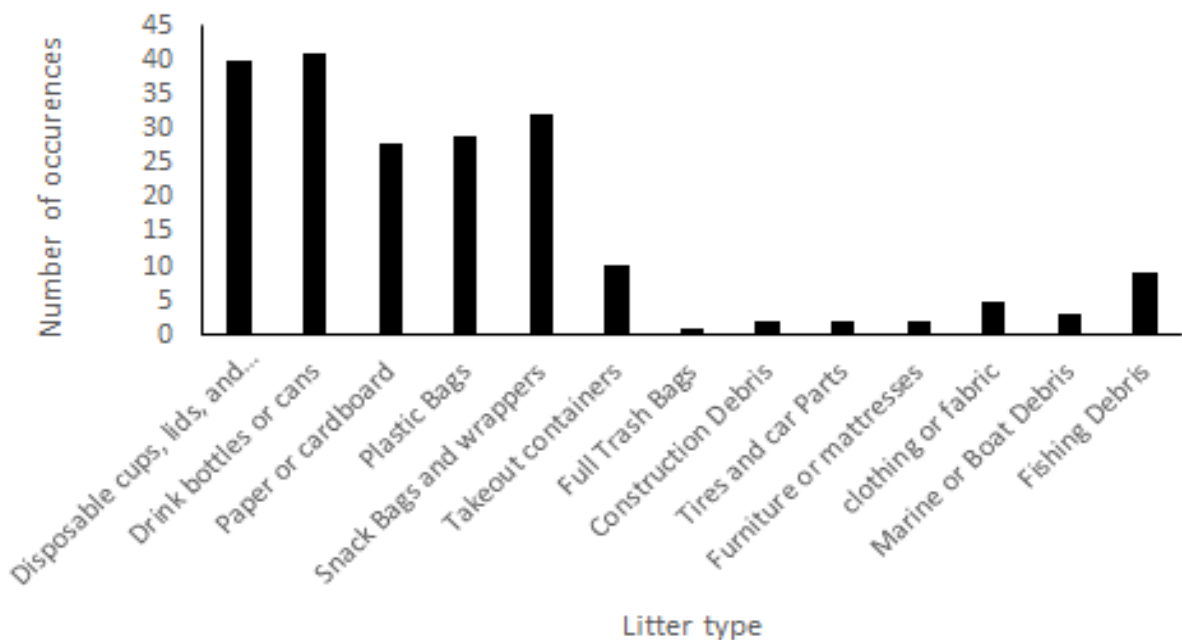

Figure 3. The frequency of litter by category across points located at parks, boat landings, and beach accesses, again with aluminum cans and plastic bottles being the most widely reported.
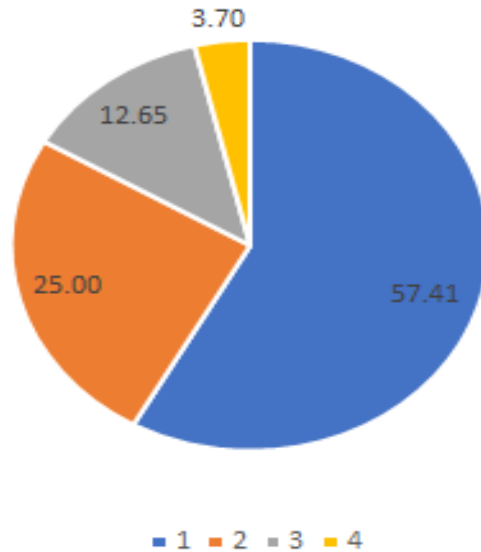
Figure 4. A breakdown of litter index scores across all points located at parks, boat landings, and beach accesses, with a score of one being the most common.

4.0 Analysis - Litter Index

Analysis of our data provides a better understanding of where Georgetown County currently stands among the national, state, and regional averages in terms of their annual litter index scores. Keep America Beautiful reports a national average of 1.67. Compared to our observed score of 2.05 for roadside locations, Georgetown County is more littered than the national average. However, it is important to note that both Keep America Beautiful and its local chapters report litter index scores based upon roadside surveys only. Incorporating our score for public facilities throughout Georgetown county, which was recorded as 1.60, provides a different perspective of litter throughout the county.

Through geospatial analysis of our litter index data, specific trends emerged concerning the concentration and pervasiveness of litter throughout Georgetown County. As seen in Figure 5 a majority of sites surveyed on the interior of the county presented higher litter scores, while

those which were located on the Waccamaw neck were much lower, despite an apparent higher
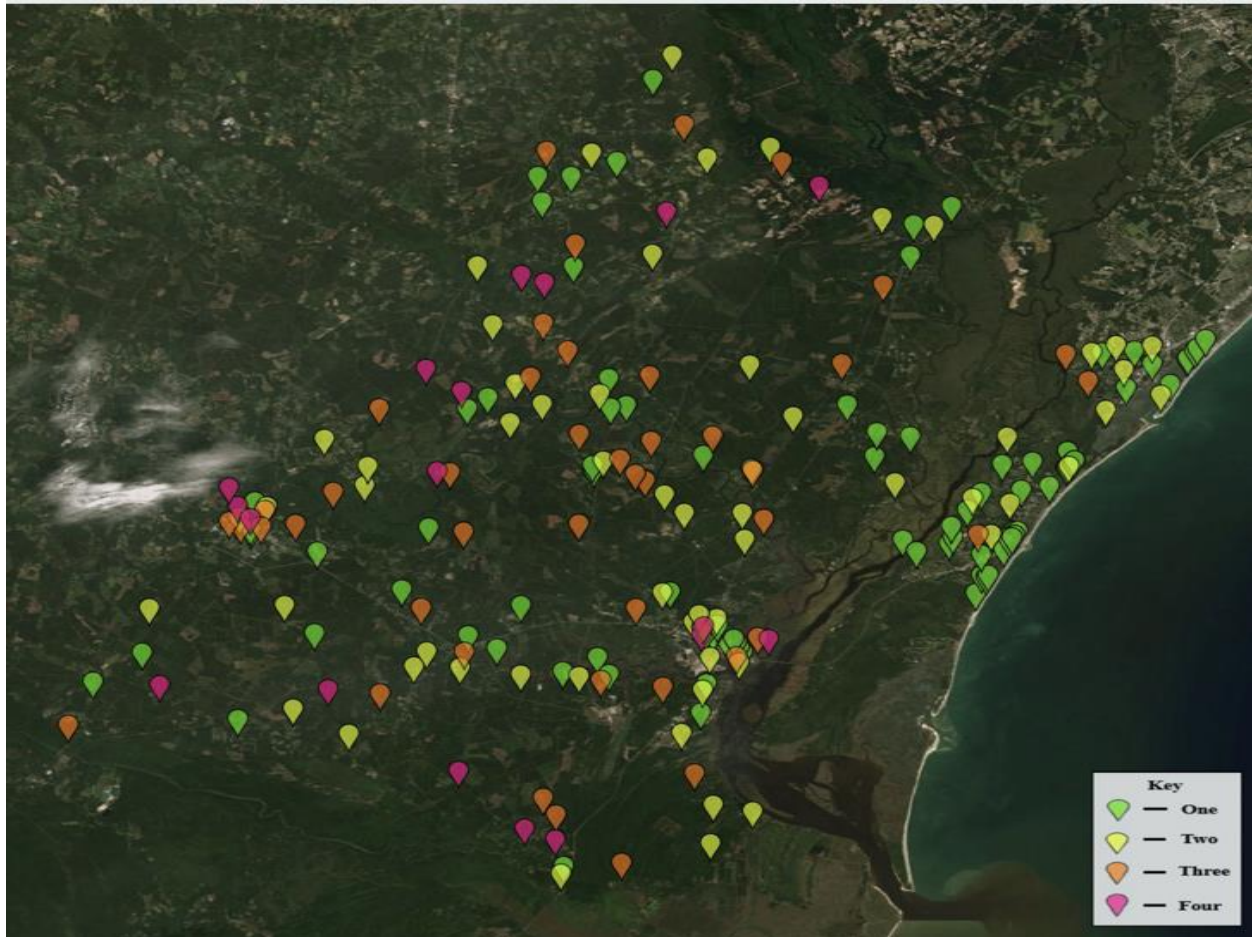
point density on the Waccamaw neck.

Figure 5. This map depicts all 206 data points collected throughout the index. The pins represent

a given index value.

Figure 6 illustrates regions that were recorded to have increased amounts of litter as

"hotspots" throughout interior Georgetown County. The areas of amplified litter were reported to

be the two largest municipalities on the mainland, the city of Georgetown and Andrews, in

addition to the communities of Santee, Browns Ferry, and Sampit. Average values for the four

major municipalities where index data was collected were a score of 1.56 for Murrells Inlet, 1.24

for Pawleys Island, 1.85 for the City of Georgetown, and 2.43 for the City of Andrews. The

averages for these densely populated regions align with the narrative illustrated by the remainder of the dataset, which displays an increasing score value further inland into Georgetown County. Simply put, as distances increased from Georgetown's tourism economy on the Waccamaw Neck, litter intensity and pervasiveness also increased.

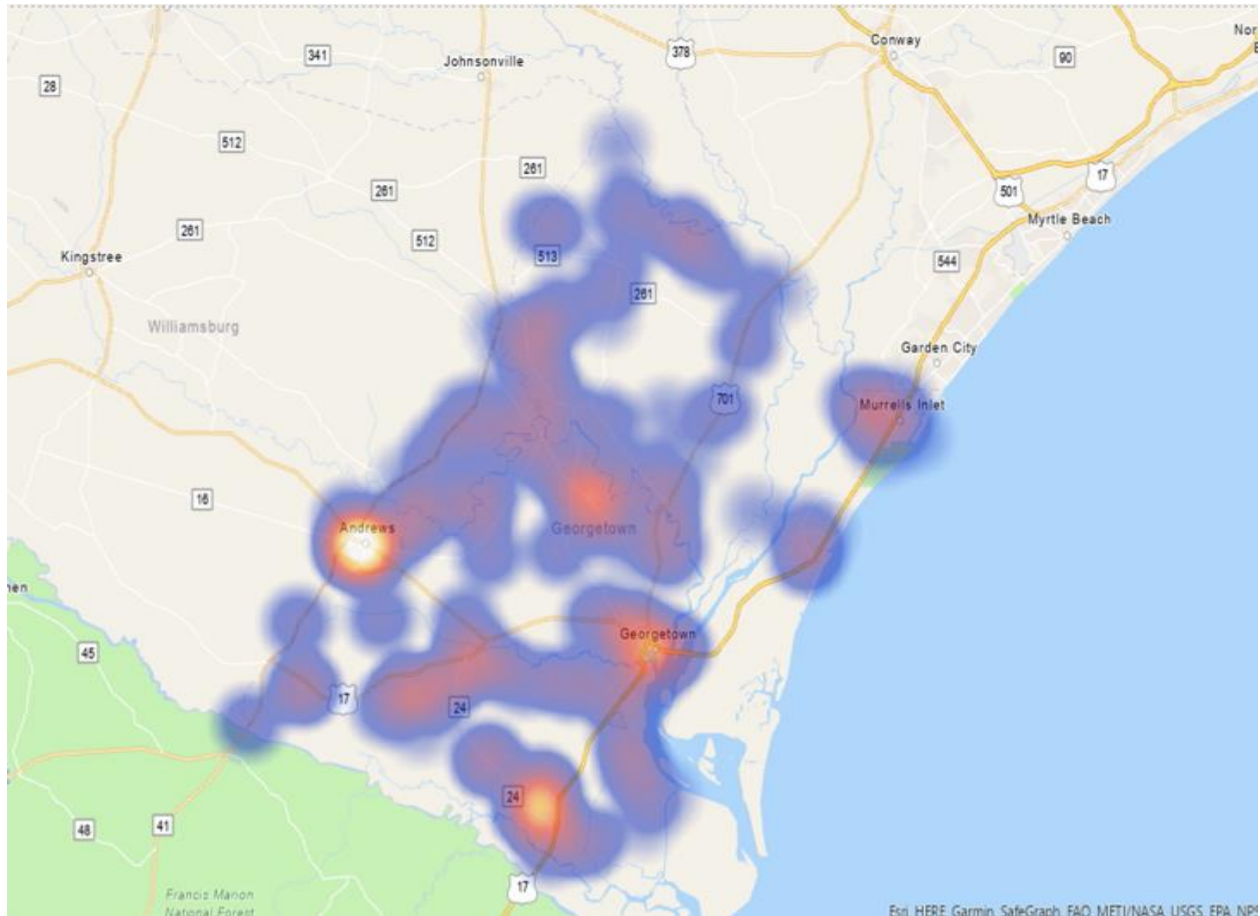**Figure 6.** A heat map distribution of litter throughout Georgetown County, adjusted for point density. Hot spots include the City of Andrews and City of Georgetown, the area near the Santee river, and rural highways.

Unfortunately, these trends are not confined to Georgetown County, an analysis of litter index data reported by South Carolina Keep America Beautiful Chapters in Table 1 reveals similar trends.

Affiliate Name	2019 Score	2020 Score
Keep Dorchester County Beautiful	2.8	Allowed to skip because of COVID-19
Keep Beaufort County Beautiful	1.6	1.8
Keep One Spartanburg Beautiful	2.7	2.9
Keep Wadmalaw Beautiful	1.4	1.2
Keep Florence Beautiful	3	2.2
Keep Aiken County Beautiful	2	1.9
Keep Orangeburg County Beautiful	2.2	2.3
Keep York County Beautiful	1.6	15
Keep Charleston Beautiful	1.6	1.8
Keep Williamsburg Beautiful	1.7	2
Keep Edisto Beautiful	2.1	1.9
Keep Berkeley Beautiful	1.5	1.9

Table 1. Average Litter Index Scores from 2019 and 2020 reporting by South Carolina Keep America Beautiful Chapters

Coastal counties and chapters such as Beaufort, Charleston, Wadmalaw, and Edisto where tourism is the main revenue stream for local government in addition to high property tax values associated with waterfront and coastal property, reported on average a much lower score. The opposite can be observed with counties and chapters such as Florence, Dorchester, and Spartanburg which reported values not only higher than national averages, but higher than state averages as well.

In speaking with a representative from Palmetto Pride, an affiliate of Keep America Beautiful, we discussed that while one may use the national and state averages as comparison metrics, they do not give insight into the current problems of each county and comparing the averages of individual townships and counties doesn't always tell an accurate story.[10] Many of the areas whose scores increased from 2019 to 2020 also expanded their indices to survey more

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[10] Mallory Coffee, "Palmetto Pride and Keep America Beautiful," interview by Shayne Doone and Dean Wrobel, *Zoom*, March 30, 2021.

roads, which means that the conclusion claiming the areas surveyed during the prior year are worse is not always valid. Comparing our litter index scores to others within the state shows us that there is work that needs to be done throughout Georgetown County and South Carolina. However, the annual index surveys and collaborative data between counties and communities within the state are crucial steps towards mitigating and controlling litter.

5.0 Case Studies/Empirical Evidence/Lit. Review

Understanding the psychology behind the motivation for littering is a necessary step to form mitigation plans. A 2009 country-wide report conducted by Keep America Beautiful investigated deeper into the motives for littering. They found that males under the age of 19 are the most likely group to litter,[11] and that males are more likely to litter than females which has been corroborated across multiple studies [12]. This study found that education level, type of residence, or vehicle model were not significant indicators for a tendency to litter. These researchers also found that the majority of 81% of recorded littering instances were done with intent. Individuals littering while in a hurry posed as the most frequent and common motivating factor to litter. The rationale behind this situation is that if there are no trash cans nearby, littering is fine if someone else would be the one to dispose of it.[13] Additionally, areas with a

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[11] Schultz, "Littering Behavior in America, " 42.

[12]Fatin Shukor et al.," LITTER REDUCTION: A REVIEW FOR THE IMPORTANT BEHAVIORAL ANTECEDENT APPROACHES," *Third International Conference on Business and Economic Research*, (2012) https://www.researchgate.net/publication/259470229_LITTER_REDUCTION_A_REVIEW_FOR_THE_IMPORTANT_BEHAVIORAL_ANTECEDENT_APPROACHES

[13] Schultz, "Littering Behavior in America, " 12.

prominent presence of litter influence people to litter and contribute to a positive feedback loop that if someone else already littered here, it will not matter if I do.[14]

Recognizing the relationship between littering and the receptacle allows for positive changes to be made. Increasing the number of trash receptacles decreases the amount of litter in residential areas and along roadsides [15]. A study done by the New Jersey Clean Communities in 2004 found that having more trash receptacles available close to population-dense areas decreased litter in these regions by 40% [16]. Additionally, multiple studies have tested to see if more attractive and eye-catching trash cans motivated people to dispose of their trash correctly. All three of these studies found that painted, or unique bin designs paired with anti-littering slogans motivated people to dispose of the trash properly. Walt Disney World conducted a study to see how far people would carry trash before they lost interest in correctly disposing of it. The study found that people would walk about 30 paces before they would litter with intent. This study became a great example of how providing more trash receptacles can stop the improper disposal of trash and littering. [17]

Signs and prompts can and are used to persuade people not to litter. Studies have found that the presence of signs and verbal prompts reminding people to dispose of trash correctly reduced litter more so than if none were present. Signage tends to work best if they are straight to

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[14] Ruggerro Rangoni and Wander Jager, "Social Dynamics of Littering and Adaptive Strategies Explored Using Agent-Based Modelling," *Journal of Artificial Societies and Social Simulation* 20, no. 2 (March 2017) https://doi.org/10.18564/jasss.3269.

[15] Shukor et al., "LITTER REDUCTION," 5.

[16] Shukor et al., "LITTER REDUCTION," 6.

[17] Keep America Beautiful "Being a Good Neighbor: A Guide To Reducing Litter, Managing Trash, And Encouraging Recycling," *National Association of Convenience Stores and Keep America Beautiful*, 2017. https://kab.org/wp-content/uploads/2017/10/BeingaGoodNeighor_AGuidetoReducingLitterManagingTrashandEncouragingRecycling.pdf.

the point with little room for misinterpretation and a more positive tone. It has been shown that

there is no difference between signage with threatening or cooperative messages, however,

individuals tended to prefer the latter. Verbal reminders also were effective on controlling litter

and worked best when coming from well-respected people of power.[18]

6.0 Recommendations

Our foremost recommendation is that this litter index be conducted annually along the

same points to monitor the litter density and distribution within the county to provide updates on

outreach and mitigation program efficacy as well as monitoring trends in littering.

During the execution of our litter index, we noted several areas for improvement or

modification in future iterations of the county litter index. The first would be to include county

citizens in the study. Creating training programs through the Environmental Services Office and

local Keep America Beautiful Chapters, which follow the Keep America Beautiful survey

protocol, will allow for more roads to be analyzed in a quicker fashion. Due to personnel and

COVID-19 restrictions surveys were conducted on foot. Minimizing the amount of walking that

must be done at each point by driving through the area would certainly speed up survey time in

addition to covering a much greater area. Additionally, monitoring litter movement and

distribution following large storms and floods can give a better idea into how the litter travels

through the county's waterways and into the five rivers of the county. Additional survey

locations are also recommended. New points may be placed near convenience stores and gas

stations as it has been noted that these are areas of high litter density. After speaking with a

representative from Palmetto Pride, creating outreach programs and partnerships with local

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[18] Shukor et al., "LITTER REDUCTION," 9-10.

convenience stores may be a way to motivate people to dispose of the trash properly instead of tossing it out of the window or in the parking lot.[19]

After addressing and studying the current litter problem within the county, government and nationwide programs were analyzed to create specific litter mitigation strategies for Georgetown County. Neighboring Horry County developed a litter control clean-up crew whose purpose is to clean heavily littered and major thoroughfares throughout the county on a 21-day cycle. While many counties create litter management teams in an effort to beautify the county for a tourism benefit, their efforts are also reflected in their litter index scores. After its conception, and the first year of implementation in Horry County the litter control department suppressed the county's litter index score to the lowest it had ever been, a 1.82. Additionally, during their first year, the crew garnered a significant amount of support from the community.[20] This shows that having a clean-up crew can have a significant impact not only with remediation efforts of litter but inspiring the community to be part of the clean-up as well.

Children are our future and investing and educating them will foster good habits that create long-lasting changes. When these changes are paired with innovation, the community's environmental health and well-being will improve. Creating a program that teaches students about the harmful nature of litter will help to stop litter in the future and it will also give them the chance to influence family, friends, and peers. It is proven that educating young people about problems and encouraging them to be part of the change motivates them to influence others

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[19] Mallory Coffee, "Palmetto Pride and Keep America Beautiful," interview by Shayne Doone and Dean Wrobel, *Zoom*, March 30, 2021.
[20] Charles Perry, "Horry County Creates Litter Control Department," *My Horry News*, September 9, 2015. https://www.myhorrynews.com/horry-county-creates-litter-control-department/image_cbae59d2-2ec2-11e4-904f-0017a43b2370.html.

around them [21]. We propose that there should be a program or club for students throughout the county school system that teaches students about the local and global environments and how pollution and anthropogenic challenges affect them. Emphasizing the negative impacts of litter and the increased pollution of microplastics in the local environment along with the community's health will hopefully serve as a motivating factor to help educate their peers, friends, and families. These clubs should also allow them to personally help the community through litter clean-ups, gardening programs, and advocacy. Creating a demonstratable link between the effects of environmental degradation and their connection to the environment is crucial in garnering a true change.

Georgetown County has a citizenry that truly values and respects the many ecosystems which surround them. Georgetown County residents also engage with these environments frequently for employment or recreation in the forms of hunting, fishing, hiking, biking, or kayaking. These cultural values of utilizing the bountifulness of these environments transcend generations and demographics throughout the county and can be used as leverage to garner increased engagement with citizens about litter.

After researching the psychology behind littering and its motivations, we propose that more innovative and eye-catching trash receptacles should be introduced to the county. Knowing that people lose interest in proper disposal after 30 paces and that the preexisting presence of litter are huge contributors to people littering should justify the implementation of more waste receptacles. Cities, towns, and municipalities globally and nationwide have begun to implement

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[21] Institute of Physics (IOP). "Kids teach parents to respect the environment." ScienceDaily.

Accessed April 27, 2021. www.sciencedaily.com/releases/2013/02/130212210042.htm.

innovative and eye-catching ways of disposing of their trash. Such examples include hopscotch paths, mazes, basketball hoops, and overall, more attractive receptacles that are more effective through communities[22]. There is currently one location in the county that has a voting game using cigarette butts, as shown in Figure 5. Installing innovative receptacles in more locations throughout the county could decrease the amount of litter and cigarette butts [23]. Placing more trash receptacles in areas with need as shown by higher index scores, along with positive motivational signs and fun trash receptacles are the necessary changes that are needed throughout Georgetown County.

Figure 7. Examples of fun, interactive ways to dispose of trash that many communities from around the world have implemented.

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[22] Pham, Diane. "Lucerne's Clever Street Decals Make Taking out the Trash Fun." *INHABITAT,* June 24, 2011. https://inhabitat.com/the-city-of-lucerne-turns-taking-out-the-trash-into-a-fun-game/lucerne-trash-games/

[23] Keep America Beautiful "Being a Good Neighbor: A Guide To Reducing Litter, Managing Trash, And Encouraging Recycling," 9.

Figure 8. A "ballot bin" at Georgetown's Carol Ashmore Marine Complex encourages boaters to vote with their cigarette butts whether they prefer fresh or saltwater fishing more in brackish Winyah Bay.

Additionally, given the coastal geography of Georgetown County, there has been traction with implementing "trash sculptures" at public parks and boat ramps. Currently, Georgetown has three of these installations, which consist of aluminum sculptures of coastal wildlife such as fish, shrimp, and seabirds where trash can be placed inside the aluminum frame as an avenue to bring awareness to the interactions litter has with local wildlife. Both these art installations and the "ballot bin" voting game raise awareness to the issue of litter by imparting hyperlocal symbols into the issue, which seems to resonate with the citizens of Georgetown County. The addition of more litter awareness or trash receptacles that engage with the community, epically at avenues to access Georgetown County's natural resources like boat ramps and parks, will certainly curb litter in these areas, or at the least raise awareness of the issue.

Figure 9. An art installation at Georgetown's East Bay Park and Boat Landing signifying the unfortunate link between marine debris and one the Georgetown's historical and cultural identities, shrimp fishing.

Creating campaigns and showcasing commercials that denounce littering and have a call to action will make creating a healthier environment for Georgetown County a popular topic of discussion. Within this campaign, more positive, concise signs that instruct people not to litter will be the most effective. Concise and straight-to-the-point signs that are recognizable, make people look and read. Positive signs have a lasting effect and can persuade people to do the right thing.[24] Signage should also aim to engage all demographics within the county so that the message resonates with a larger and more inclusive audience.

Creating and maintaining partnerships within the community for litter cleanups is vital to the success of our litter mitigation plan. These partners consist of the many groups and organizations that are regularly participating in litter clean-ups throughout the county. These

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[24] Shukor et al., "LITTER REDUCTION," 9.

groups are bringing attention to the serious litter problem which is motivating other groups to get involved. In the last month, there have been four litter cleanups that have worked with the county's Environmental Services Office and have collected a total of 5380 lbs. of trash. Continuing to recognize the great work these organizations and groups are accomplishing will hopefully spur more community engagement while helping the environment and increasing the beauty and tourism aspect of the county.

After researching and crafting our recommendations, we spoke with Michelle LaRocco, the Georgetown County Environmental Services Manager, and Maureen Mulligan, Environmentalist and Training Coordinator, about the current and future litter mitigation plans of the county with regards to the feasibility and efficiency of our proposed solutions. We began by inquiring about current litter mitigation strategies within the county, so we could better understand how our proposed strategies would incorporate with them. The only policy-based framework that the county employs come from the state under Section 16-11-700 which regulates illegal dumping by vehicle, or on private, public or state-owned property. Current county initiatives include creating a cleanup program, where individuals who need to fulfill community service hours by either court mandate or group requirements can volunteer. This initiative would be funded through the accommodations tax (A-tax) grant that was awarded to the department to improve the aesthetics of the county for better tourism and hospitality.

Ms. LaRocco and Ms. Mulligan continued to explain that four key factors will help to combat litter: prevention, enforcement, removal, and elimination. Breaking down each of these elements we were able to outline how success could be measured from both current and proposed mitigation strategies. We gathered that key metrics that would be collected going forward would include recording participation, logging volunteer hours, implementing

prevention through education, and tallying the weight of community cleanups. Using these metrics, the county can strive to curb the litter problem throughout the county, which can then be analyzed through the lens of the annual litter index data. Additionally, through more engagement with community cleanups, the county can become stricter on waste ordinances that relate to ticket-able offenses.

The subject of litter within Georgetown County has always been someone else's problem and the torch was passed around in years past until it has now settled with the Environmental Services Office. Environmental Services is now working with the community to create better avenues for communication that will hopefully lead to more organized cleanups and engagement. We discussed our recommendations for litter mitigation and remediation efforts and, of our proposed ideas it is believed that community outreach and litter education is the most feasible as it will not cost much, and many schools and organizations are interested in learning about and helping the local environment.

The litter control department is something that has potential, but multiple factors would need to be worked out like funding and staffing issues. A proposal of a future study to quantify the economic impact that litter has on Georgetown County's tourism and economic development was well received and could be a potential motivator for local government to fund such remediation crews. We think all these strategies would work well together to create a positive and long-lasting impact on Georgetown County [25].

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[25] LaRocco, Michelle and Maureen Mulligan. "Current and Future Litter Mitigation Plans."

Interview by Dean Wrobel and Shayne Doone. *Zoom*, April 1, 2021.

7.0 Relation of Project and Mitigation Strategies to SDGs

　　While litter index has focused on surveying the current litter problems in Georgetown County, analyzing how this data and our litter mitigation plans relate fit into the United Nations Sustainable Development Goals will allow county officials to ensure sustainable development and progress within the county. The primary sustainable development goals that relate to our work are goals 6, 11, and 12.

　　The sixth United Nations Sustainable Development Goal is to ensure availability and sustainable management of water and sanitation for all. The specific target within this goal that our project focuses on is 6.3.

　　Target 6.3 is aiming to improve water quality by reducing pollution, eliminating, dumping, and minimizing the release of hazardous chemicals and material, in addition to halving the proportion of untreated wastewater and sustainably increasing recycling and safe reuse globally by the year 2030. Our work directly aligns with this target through means of identifying dumpsites and heavily littered areas. Advocating for more education, better trash receptacles, and strict plans that prevent, mitigate, and remove litter will ultimately reduce pollution and the release of hazardous chemicals and materials. All these factors will create healthier water and sanitation for the county by reducing or eliminating the number of plastics that end up in our rivers from storm-water runoff and littering. This effort coincides with getting Georgetown County in line with the U.N. targets by 2030.

　　The United Nations' 11th Sustainable Development Goal is to make cities and human settlements inclusive, safe, resilient, and sustainable. The targets that correspond to the work we have been doing for the litter index are 11.6, 11.7, and 11a.

Target 11.6 aims to reduce the adverse per capita environmental impacts of cities including paying attention to air quality and other waste management. Our work is directly related to this target because we are trying to make Georgetown County more sustainable by bringing current problems to the public's attention, so the community can be involved in reducing waste, and creating a healthier environment. Areas farther inland have reported much worse litter scores and waste management. Our idea for creating a full-time litter patrol team paired with education, advocacy, and clean-ups all work with this target to reduce the adverse environmental effects seen inland compared to the Waccamaw Neck.

Target 11.7 aims to provide universal access to safe, inclusive, and accessible green public spaces. Our survey identified public county facilities that may need litter cleanup work. Mitigation strategies in coordination with outreach and implementation of signs that state to not litter and dispose of trash correctly will work to motivate people to maintain the beauty of these public areas.

Target 11a aims to support positive economic, social and environmental links between urban, pre-urban, and rural areas by strengthening national and regional development planning. The litter index survey throughout the county provided a uniform protocol to accurately represent litter density for the more urban and rural areas. This data paired with our mitigation strategies to decrease the amount of litter will hopefully bring the necessary efforts to clean the more rural areas of the county and keep the more urban areas at a healthy range. Regions such as Andrews, which had the highest municipal score, desperately need additional resources and support from the county. Additionally, with increasing trends of environmental and green tourism in these areas, such as a new state park, healthy environments around these rural areas will have a larger economic value to the communities which reside within them. The

development of the county's tourism economy paired with the clean-up and prevention efforts will, in theory, work to bridge the economic and environmental gap between the two parts of the county.

The United Nations 12th Sustainable Development Goal is to ensure sustainable consumption and production patterns. This goal was foremost related to our litter index and the targets that correspond are 12.2, 12.5, 12.6, 12.7,12.8, and 12.b.

Target 12.2 strives to achieve sustainable management and efficient use of natural resources by the year 2030. This relates directly to our project as the litter index's main objective is to report how the litter is affecting the environment, specifically the plentiful water sources within the county. We aim to use this data to manage the litter, so we can improve the water quality and decrease the amount of litter that is entering our water systems due to irresponsible consumption.

Target 12.5 is intended to substantially reduce waste generation through prevention, reduction, recycling, and reusing. This target encompasses many of our mitigation strategies and we utilize it when proposing our mitigation plans of educating people about the problem while motivating them to be part of the solution. When educating the county's citizenry, emphasizing the importance of prevention, reduction, recycling and reusing will be seen in the programs we plan to do with the area schools. Implementing this education early and often will ideally yield a result of a decreased littering by young people. These mitigation plans will all work together to make sure that this target is achieved.

Target 12.6 is designed to encourage companies to adopt sustainable practices and to integrate sustainability information into their reporting. To achieve this target, we have proposed initiatives to get convenience stores, grocery stores, and gas stations to adopt and enforce litter

campaigns, while supplying these companies with more trash receptacles, effective signs, and information to ensure that litter is reduced significantly.

Target 12.7 promotes public procurement practices that are sustainable, under national policies and priorities. Working with the public to ensure individuals and businesses are held accountable will be the most effective if the public is included in the conversation. Identifying these policies and communicating them to the county while clearly explaining their importance will be the necessary steps to ensure this target is achieved.

Target 12.8 is proposed to ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature. To meet this target our plans include providing quality educational materials which are easily accessible for all. We are proposing this be done by adding more local environmental educational awareness programs to the school curriculum. Additionally, implementing clear and positive signage in public areas and on roadways will help to demonstrate the link between their actions and the harm it has on the environment. Providing this information in a range of formats that is easily digestible by a wide range of audiences will help to make sure the county achieves this target goal.

Target 12.b aims to develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products. This goal contains perhaps the most opportunities for Georgetown County as it continues to develop tourism off of the Waccamaw neck which focuses on the rich culture and history of the county. The litter index will be a useful tool in this development as it can be used to direct cleanup efforts in regions valuable to tourism in addition to monitoring litter levels in those areas.

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