

An assessment of the innovative ways of stimulating societal engagement in the combat of marine pollution-The case of ‘plastic punch’ organization

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Abstract

The marine plastic menace continues to remain a big problem in Ghana as most waste management strategies and facilities appear woefully inadequate in handling the levels of plastic waste generated. The growing concerns and the problems they pose have attracted the interest of international partners, civil society organizations and ordinary citizens who today view the role of collaboration with the government as key to ending the menace. One such civil society organization is the Plastic Punch Non-governmental Organization which seeks to improve the marine environment through enhanced societal engagement with a citizen science approach.

Focusing on ridden sea turtle nesting areas in Ghana of marine plastic pollution to enhance effective breeding seasons of the endangered sea turtle species like, Plastic Punch considers voluntary participation of the community as vital to its beach clean-up efforts. This strategy is compared with current strategies implemented by the government of Ghana towards stimulating societal engagement.

The study assesses the impact of marine plastic along Ghana’s coast; identifies and investigates current governmental measures focused on societal engagement in comparison to Plastic Punch’s works; and collects data to evaluate the outcomes of Plastic Punch’s operation. The study finds the government organizes clean-up campaigns or exercises once in a while which have not sustainable as a result of changes in political leaderships. Awareness creation mainly by radio announcement and public broadcast which appear ineffective as volunteers are solely constituted by the police and allied security forces, local government staff, the Zoomlion staff and partisan supporters of the ruling Government.

However, PP implements awareness creation mechanisms that include public outreaches such as visitations to schools, churches and community centers; community clean-up events at market squares; online broadcast of theatre series; animated jungles; and the use of gaming app. Of the level of volunteer participation at Plastic Punch events, the study finds an average of over 60 per cent regular attendances of new volunteers at each event across the years of operation, with a retention rate of 15.80%, 11.06%, 38.27% and 48.87% for periods in 2018, 2019, 2020 and 2021 respectively. The highest attendance recorded was 500 volunteers in the year 2019 with mean average weighted waste collected estimated at 4000 kg. PP continues to evolve in its operations and recently launched sea turtle data collection app. The study concludes recommending further cooperation and the scalability of its operations.

Keywords: Marine plastic menace, Environmental pollution in Gulf of Guinea, Citizen science against marine plastic, Societal engagement for environmental sustenance in Ghana.

Accepted on 17th November, 2021

Introduction

According to Ayittah, the past few years has demonstrated with a growing body of evidence that plastics are a common contaminant on beaches and within coastal waters of Europe and Africa. The IUCN, International Union for

Conservation of Nature affirms this assertion claiming plastics have been detected on shorelines of all continents, near popular tourist destinations and in densely populated areas —thus, more than 300 million tons of plastic are produced annually of which half go into the design of

single use items such as shopping bags, cups and straws. According to Ayittah and IUCN, plastics are synthetic organic substances that are the outcome of chemical reactions resulting from petroleum. Due to plastic's lightweight, strong and malleable nature for modification into other artifacts at such a cheap cost, Ghana—a developing nation enjoined with developed nations around the world, finds this single commodity economically empowering as waste generated from plastic amounts to 1,980 tons out of the 11000 tons of waste produced. In Ghana, the management of plastic waste continues to remain a major national concern as plastic bags and other plastic products show up everywhere, including the oceans. The issue continues to draw international concern as is evident in the collaboration between Germany and Ecuador to host this year's International Ministerial Conference—seeking to address marine litter and plastic pollution scheduled for September. It is unclear if Ghana as a country has a strategic policy dealing with the plastic menace. And if it does, is the implementation centralised or decentralised, how involved are the citizenry. Rhetorically, these and many more questions continue to linger [1-4].

As the Ghanaian society expands, many well-meaning Ghanaians and non-Ghanaians alike, institutions and groups, have taken it upon themselves to join the plastic waste management battle across the length and breadth of the nation. Notable among them in this effort along Ghana's oceanfront is the continuous work of the Plastic Punch organisation. Plastic Punch, a science driven energetic non-profit organization launched in January of 2018 in Accra, Ghana, harnesses its 'youthemism' and 'youthenize' energies with the ultimate aim of protecting the coastal environment against plastic waste accumulation. Plastic Punch does so by providing sustainable waste management solutions, and raising awareness of the harms of single use plastics. In the view of Plastic Punch, rather than having most people especially, people living along the coast use the beaches as dumping sites for all forms of refuse including plastic, there is the need to churn this waste which is a menace into a blessing by applying scientific reasoning, resource and technology. Plastic Punch has seen major progress towards its vision in terms of public outreach, funding, and international and local conference appearances. In pursuing the concept of citizen scientist, Plastic Punch focuses on turtle nesting ecologies of Ghana [5-7].

To what extent is the growth of Plastic Punch becoming a model scalable for wider coverage across the entire coast of Ghana and possibly the West African region? This inquiry herewith drives the aim of the study seeking to examine the effectiveness of the overall vision of Plastic Punch, thus "protecting the coastal environment against plastic waste accumulation, through the provision of sustainable waste management solutions, and awareness

creation of the harms of single use plastics." The study intends to achieve this goal by; Assessing the impact of marine plastics along the Ghanaian coast; identifying and investigating the various strategies operationalized in comparison with that implemented by Plastic Punch; Collecting various data to evaluate the outcomes of Plastic Punch strategic operation. The study will also review best practices and proceed to make recommendations towards ensuring environmental sustenance becomes a household concept for the citizenry. A successful outcome of this study will promote best practices towards dealing with plastic waste management, while identifying and filling the gap between citizen interest and stakeholder engagements. Finally, it will attempt to advance the citizen science concept of solving major societal challenges in Ghana.

Literature

Overview of marine plastic pollution in Ghana and impact

It has been asserted that the economic well-being and nutritional security to billions of people is provided by marine and estuarine fishing. However, ubiquitous in marine environments is plastic debris constituted by micro plastics and microfibers. According to IUCN, a minimum of 8 million tons of plastic per year end up in the world's oceans, which they pre suggest is reason floating plastic debris currently remain the most abundant marine litter. Ayittah notes that all of the sea areas investigated so far have been in the vicinity of possible coastal industrial sources, near major shipping lanes, or, in the case of the Sargasso Sea, subject to conditions more likely to retain and accumulate floating material than to disperse it due to the particular water circulation patterns. Hence, ocean based plastic is said to mainly originate from the nautical activities, fishing industry and aquaculture [8,1,2].

According to the Ocean Portal Team (OPT) and Jambeck, Ayittah and IUCN, plastic can be found all around our surroundings today, which buttresses the fact; plastic remains a necessary commodity in today's world as its use is also found in packaging, household and sports equipment, vehicles, electronics and agriculture, face washes and fabrics, building and construction. It is further estimated that 30% of these synthetic organic polymers may reach landfill sites while 70% tend to end up in drains deliberately, beside other open spaces. It is hence asserted that the main sources of marine plastic are land based resulting from events of inadequate waste disposal and management, urban and storm runoff, holiday beach makers, sewer overflows, industrial activities, construction and illegal dumping. In other words, it is expected that those plastic waste deposited in open spaces become subjected to runoffs and finally find its way into larger water bodies where they tend to be harmful to aquatic life. Globally, IUCN notes that these plastic waste—forming

part of 80 per cent surface water marine debris, ends up in deep sea sediments. This is due to the single fact that it takes more than hundred years for plastic to decompose [9,1,2,10, 11].

Again, the impact of plastics has been determined to have visible and invisible forms. According to IUCN, the most visible disturbing impacts of marine plastics are the concerns of ingestion, suffocation and entanglement suffered by hundreds of marine species which come in contact with them in one form or another. It is observed, marine wildlife such as seabirds, whales, fishes and turtles in seeking for food, ordinarily mistake floating plastic waste for prey, resulting in their death due to starvation from plastic filled stomachs. They may also suffer from reduced ability to swim, lacerations, infections, and internal injuries. As a force of disruption in the ecosystem, it is also asserted that floating plastics contribute to the general spread of invasive marine organisms and bacteria [2].

As alluded to by Savoca et al., Bergmann et al., Cózar et al., GESAMP and IUCN, the concern for invisible plastic (also known as microplastics) was detected in water samples collected from the world's oceans which included the Arctic as well as tap water, beer, and salt. The IUCN further asserts, the production of plastic materials rely on several chemicals classified as carcinogenic, capable of interfering with the body's endocrine system. The effect may include reproductive, developmental, neurological and immune disorders for both human and wildlife consumers. There is also the concern of toxic contaminants accumulating on the surface of plastic debris over a prolonged exposure within seawater. As marine organisms continue to ingest plastic debris, the contaminants succeed in entering their digestive systems, while accumulating along the food web over time. Thus, the assertion of the effect of persistent organic pollutants is correlated by evidence from field studies that suggests plastic debris can effectively contaminate fish tissues over time. This therefore, incites a potential transfer of contaminants between marine species and humans upon seafood consumption. The seafood phenomena is currently identified as a health hazard, however, there is the need for more research into the concept. This is the major concern, buttressed by Savoca et al., Reiterating the findings of Markic et al., which listed at least 100 fish species destined for human consumption to have potential for ingested plastic debris [8,11-15].

Another identified invisible impact of plastic from a petroleum product source, is the concern of its contribution to the global warming menace. The increasing carbon emission is a by effect of the incineration of plastic waste, upon the release of carbon dioxide into the atmosphere. Other noteworthy impacts from plastic waste encompass the damage of the aesthetic values of the various tourist

destinations sites. This negative changes leads to decreased tourism, incomes and high costs of cleaning and maintenance of the sites. The concerns of marine plastic in our environments today, are well documented, however, the plastic pollutant which continues to degrade the natural environment despite the numerous efforts directed at various solutions, still remains a major concern across the world's oceans. Therefore, we examine some of the current efforts in place [2].

Current efforts at tackling marine plastic pollution

Globally, the concerns for impact of plastic on the marine environment are on a surge with public awareness campaign in parallel. At the international level, various efforts have been undertaken to fight the marine plastic waste challenge globally. It is reported that during the 2015 G7 summit in Bavaria, Germany, the world leaders in the 'Leaders' Declaration' acknowledged the risks of microplastics. Such efforts are crowned with operational definitions, policy regulations, plans and strategies such as SDG 14. On a related concern, the United Nations Environment Program (UNEP) also emphasised that one of the main emerging environmental issues of our time is the presence of marine plastic debris and thus their ability to transport harmful substances. The UNEP examined some efforts of the national legally binding instruments such as taxes and levies, bans and restrictions, and enhanced waste management measures during disposal, encouraging reuse and recycling, and promote alternatives to plastic products, as to encompass the main legal efforts made at the international and national levels. According to UNEP, international regulations on sea based sources of marine pollution are more advanced compared to land based regulations [2,16].

The 1972 Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter (also referred to as the London Convention), the 1978 Protocol to the International Convention for the Prevention of Pollution from Ships (MARPOL), and subsequently the 1996 Protocol to the London Convention (the London Protocol), remains the most important of all legal conventions. Due to limited financial resources to ensuring enforcement, compliance to these regulations still remains woefully inadequate. The IUCN, therefore suggests the need to further explore existing international legally binding instruments addressing plastic pollution. The suggestion is in agreement with the UNEP call to create a new legally binding international framework that encourages global actions across these key pillars. Policies and strategies such as the recycling and reuse of plastic materials is described as the most effective approach available to reducing environmental impacts of domestic waste management via open landfills and the practise of open air burning. The UNICRI affirmed these assertion insisting –the improvement of waste management

should be accompanied with international efforts focused primarily on reduction and stricter regulation on primary production of plastics. The UNICRI note further that the 2015 Paris Climate Accord could be a model for any newer international policy framework that attempt at incorporating more level playing field between nation states and thus, helping mobilize international financing support. UNICRI assumes this is needed considering the notable flaws in current international legal framework of United Nation Convention of Law of the Sea, UNCLOS 82 – offering a broader margin of discretion within which states regulate land based sources resulting marine plastic pollution. The Convention in Article 194 of UNCLOS 1982, as an example require states to "prevent, reduce and control pollution of the marine environment from any source. Whereas the convention in Article 207, 4 and 211, 1 of UNCLOS; aligning the responsibilities of the states utilized the wording "shall endeavour" in establishing the global rules on land based sources, the wording on sea based sources was "shall establish" –the later suggesting a binding and immediate enforcement enshrined in its principle. UNICRI iterated that presently, states are reluctant in giving up national sovereignty on land based sources. The reason being that it relates with national economic policy. They emphasised however that this is not the case of international regulations on sea based sources of marine pollution such as MARPOL Treaty and the London Protocol. Therefore, according to UNICRI, a new international framework must demonstrate greater ambition by imposing specific additional measures at the international level –with its political and economic implications relevantly situated. One such measure is a cap primary global plastics production from 100% fossil fuel sources and the consistent banning or restriction (on a global scale) for use and production of harmful single use plastic, chemical additives and micro plastics as suggested by UN Environment for a more affordable and environmentally sound alternatives. There are also regional conventions implemented in this regard according to Tickell,. Such conventions include the AU, African Union's 1994 Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (Bamako Convention) similar to the Basel convention, the Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention) designed to protect the marine environment of the North East Atlantic Ocean; the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention); the Framework Convention for the Protection of the Marine Environment of the Caspian Sea (Tehran Convention) aimed at "the protection of the Caspian environment from all sources of pollution including the protection, preservation, restoration and sustainable and rational use of the biological resources of

the Caspian Sea" (Article 2.). Others are the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention); the Kuwait Protocol also known as the 1990 Protocol for the Protection of the Marine Environment Against Pollution from Land Based Sources; the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention); and the Convention for the Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan Convention) of 1981. Efforts will ultimately require extra funding [2,16-18].

The suggestion of initiating a global fund to support the implementation of all these actions particularly within developing countries like Africa can be described as fundamental and may serve as a boost to the works of all marine plastic warring stakeholders [17].

Marine plastic warring stakeholders and approach to societal engagement

With the current state of marine plastic pollution at a crisis level, the fight remains a challenging huddle for environmentalists, governments, and international organizations at large. Therefore, any efforts at tackling the menace should incorporate multifaceted approach. Thus, beside the legal frameworks espoused, other measures are required to drive home behavioural change. These measures are discussed under the following section [19,17].

Drivers of behavioral change towards fighting marine plastic pollution: Force of change is said to be a management tool at achieving sweeping changes within organisations. Change as many see it, is inevitable in any human society or dwelling, however, people generally tend to resist such changes due to numerous uncertainties driven by fear, perceptions and so forth. The principle effectively relates with following [20].

Concepts on motivation: While motivation according to Robbins and Coulter (n. d.), "refers to the process by which a person's efforts are energized, directed, and sustained toward attaining a goal," it will require appreciable efforts when it comes to managing the current challenges of marine plastic litter found in our aquatic environments, particularly in Ghana. Robbins and Coulter's (n. d.) definition relates to three key elements, namely: Energy, direction, and persistence. According to them, the energy element refers to "a measure of intensity, drive, and vigour." Thus, in light of efforts at minimizing or eliminating marine plastic pollution, the energy element measuring of intensity, drive, and vigour thus aligns with levels of enthusiasm amongst individual citizens, organisations, and government authorities that directly reflect in actions taking at any point in time. The Ghanaian government have over the years attempted to

drive such motivation by implementing community labour days for special environmental clean-up sessions. The declaration of the National Sanitation Day as a response to the outbreak of cholera in 2014 is one such example of motivated efforts by the government – driven by a necessity. The clean-up event was expected to be a day event every month. In other words, Robbins and Coulter's (n. d.) suggest that these motivated persons, organisations, and government authorities; “puts forth effort and works hard” at achieving their goal. To them, such efforts are to be qualified in terms of quality and intensity though they recognise high levels of effort do not necessarily translate to favourable job performance. However, unless the efforts are channeled in a direction that benefits the organization. Robbins and Coulter's (n. d.) further assert that “the effort directed toward, and consistent with, organizational goals” should be the kind of effort desired from employees if the motivation is to ensure persistence aligned with efforts to achieve those goals. The government of Ghana also relies on sanitation officers to ensure sanitation compliance within communities—serving as a deterrent measure [21,22].

Organizational behavior: In management practice, organisational behaviour remains a concept of interest to researchers. The essence of the concept is integral in changing the dynamics of efforts in overcoming the marine plastic pollution menace. The various schools of thought highlight human behaviour within the organisation. Thus building on Fred Luthans definition that organizational behaviour is simply the capability of “understanding, predicting and controlling human behaviour at work”, whereas Stephen Robbins explained it as the “field of study that investigates the impact that individuals, groups, and structure have on behaviour in organizations for the purpose of applying such knowledge towards improving an organization's effectiveness” [20]. The unending debate establishes the link between individual behaviour and the need for that to align with a collective behaviour of a group. How can the effort sort against marine plastic be translated into a collective effort from individuals, a group, or a nation?

Corporate social responsibility: Given that organisations are influenced and also influence the environment they are located in, their relationship with the community is described as essential to their growth. Hence, corporate social responsibility (CSR) today appears to be the ethical hallmark of every industry across the world today—one that seem to becoming subconsciously demanded or expected of organizations within and around the environment where they operate. This organizational subculture inherently, is heavily imbibed by both the traditional and non-traditional multinational companies and corporations (MNCs). According to Soundarya, the World Bank and the World

Business Council on Sustainable Development (WBCSD) define CSR as “the commitment of business to contribute to sustainable economic development – working with employees, their families, the local community and society at large to improve their quality of life, in ways that are both good for business and good for development” (Soundarya 2014 pp 40). According to Lok Yiu Chan, “many multinational companies have established well developed CSR programs and adhere to their code of conduct to do businesses ethically, help the economy grow, create larger job markets, protect the environment, raise public attention on certain issues, and more areas to bring social goods to the world”. These definitions specify CSR to cover the needs of the community such as environment. These environment concerns include marine plastic pollution. Therefore, during 1970, Prof Davies also defined CSR as “the firm's consideration of and response to issues beyond the narrow economic, technical, and legal requirements of the firm” [23-25].

Citizen science: Concepts and Potential Benefits: The National Park Service US Department of Interior (NPS, 2021) explained that citizen science describes the situation of the public voluntarily helping in the conduct of scientific research. According to them, the citizen scientists may design experiments, collect data, analyse the results, and solve problems investigated. From another perspective, Vohland K. et al., also espoused that the term citizen science broadly refers to “the active engagement of the general public in scientific research tasks”. They alluded that it has become a growing practice of collaboration between scientists and citizens resulting in the production of new scientific knowledge for the society. Further to this, they suggested the practice has been around for centuries, though the term citizen science was coined in the 1990s and only gaining popularity thereafter. The National Geographic Society also espoused that the concept citizen science refers to the “practice of public participation and collaboration in scientific research to increase scientific knowledge. Through citizen science, people share and contribute to data monitoring and collection programs. Usually this participation is done as an unpaid volunteer.” Vohland K. et al., therefore, affirmed that the practice has become a growing field of science, policy, and education and is far reaching in the wider society. It seeds as a field of research and a field of practice, thus, increasing the “need for overarching insights, standards, vocabulary, and guidelines” according to Vohland K. et al., According to Haklay et al., this need has led the European Citizen Science Association (ECSA) to characterised citizen science practice under the ECSA 10 Principles of Citizen Science for good practice. The principles address the questions of power relations, data ownership, and political impact, aimed at acknowledging citizen science as a broadly practiced approach in science among universities,

research institutes, and civil society organisations. While these guidelines are subjective in its practice, the concept remains broadly explorative and continues to serve varying purposes for the scientific community. The practice is exemplified in the US national parks, where most citizen scientists appear to collect data with tools provided by project directors according. They indicated that while the data helps professional scientists and resource managers answer scientific questions in solving important problems, the activity also helps participants build meaningful connections to science and its practice [26,27].

Current state of national stakeholder commitment: The section examines current state stakeholder commitments at national and sub national levels. That is, government, organisations and individual citizenry commitments aimed at resolving the menace, are discussed in subsections below.

Government led approach towards mitigating plastic pollution: The UNEP notes that 127 representing about 66% of nations have adopted some form of legislation regulating the use of plastic bags in line with UNCLOS Article 145 towards the protection of the marine environment. Since the early 2000s saw the first regulatory measures specifically targeting plastic bags, the decade has seen a gradual increase –many of these countries doing so within the last couple of years. According to UNEP, as many as 27 countries currently have legislation banning specific plastic materials such as polystyrene, plastic products such as straws, plates, cups, packaging, or mandated reduced production levels of these items. They assert further that similarly 27 countries have instituted taxes directed at manufacturing and production of plastic bags, whereas 30 have implemented charges described as consumer's fees for plastic bags at the national level [2].

UNEP also found that 43 countries had legislations with elements or characteristics of extended producer responsibility for plastic bags. On another breath, 63 countries instituted extended producer responsibility mandates for single use plastics. This strategic mandate includes product take back, deposit refunds, and recycling targets. However, 8 (Canada, France, Italy, Republic of Korea, New Zealand, Sweden, the United Kingdom of Great Britain and Northern Ireland, and the United States of America) out of 192 countries worldwide representing 4% of nations have bans focused at microbeads based on national laws or regulations. Therefore, the WWF Policy Paper affirmed that much is done at national level across the world focused at preventing leakage of plastic into nature, and promoting clean up. The primary focus for many countries especially in developing countries is to increase the collection rates of plastic and improving waste management, via infrastructure upgrade. According

to UNICRI, considering over two billion people worldwide have no access to solid waste collection, particularly in developing countries, thus suggesting basic waste management facilities in these countries remain to pollution prevention. Some countries have introduced measures aimed at phasing out the most problematic types of plastic products [2,19,17].

The need for adequate litter and recycling bins have been proposed for cities, and on coastal beaches whereas Governments, research institutions as well as industries are called to work collaboratively to reduce microplastics (from pellets, synthetic textiles and tyres) by redesigning products, and rethinking usage and disposal. There will also be the need for research and innovation to be supported to help with gathering scientific evidence needed to spearhead appropriate technological, behavioural and policy solutions. The effort should also accelerate conceptualisation of newer technology, materials or products to replace plastics [2].

UNICRI further suggested, states set and maintain more ambitious binding regional (or global) reduction targets of achieving zero discharge into marine environment of plastic litter and micro plastics in the long term. Essentially, these targets should aid in the gradual reduction of marine plastics. This would mean an establishment of national action plans aimed at national reduction targets with concrete measures. Thus such action plans must prevent plastic litters getting into marine environment through more commitment to waste prevention and improved waste management, which relates to UN SDG 12 [17].

Organizational corporate social responsibility towards mitigating plastic pollution: UK Essays, (2018) CSR of business organisations includes: A focus ensuring that the private sector does not contribute to the violations of human rights, promotes the respect of these rights, the respect of core labour standards, and ensure local communities benefit from large companies' operations especially in developing countries like Ghana. Others include responsible management of environmental impacts of a company's operations, such as emissions, waste and use of sustainable resources, avoidance of corruption and the increase in business practice transparency, and incorporation of social and environmental criteria in procurement decisions. For companies into the use of plastic, CSR require they produce environmentally friendly products, or implement strategies that ensure their products do not end up in water bodies. To what extent are efforts under CSR realized in this regard?

Efforts of NGOs, academia, and the citizen engagement: The UNICRI noted that with quantification, the vague reduction target will become meaningful, and will not merely add up to the numerous general and occluded

provisions within existing international legal frameworks. This notable assertion affirms UNCLOS 82 Article 165 on legal and technical requirement. Similarly, the need to assess the impact of such environmental deterioration based on sound scientific principles is stipulated in Article 204. Though data collection of marine plastic remains a major huddle for all stakeholders, GESAMP also recommended a technical guideline for monitoring and assessing marine litters which literally serves academia, NGOs, industrial researchers and environmental scientist in private and public practise across the world. Thus, with growing literature on the concerns of marine plastic churned out each year, there is relatively undocumented level of consensus leading to the rise in public awareness and the consequential public engagement amongst citizens, and groups beside government agencies. In Ghana such consensus have led to stakeholder collaborations and deliberations that saw various Government Agencies, NGOs (including environmentalist and citizen scientist) and international dignitaries in attendance. Herein, the works of citizen scientist and the Plastic Punch Organization were deemed crucial to overcoming the marine plastic litter concerns of Ghana [17,12,3].

Materials and Methods

The method used is the case study approach, which combines qualitative and quantitative data gathering and analysis technique for examining the varying data sets with regards to: Community engagement for clean-up operations of Plastic Waste within sea turtle nesting sites in Ghana. The study's scope and area of interest was selected based on the biological importance and relevance of the work of the Plastic Punch Organization to ecological sustenance therewith. The study area is described below.

Study Area

Though all sea turtle nesting sites remain the centre of focus for various beach clean-up events organized by various groups, Plastic Punch focuses its main beach clean-up activities within three selected locations noted as sea turtle nesting grounds along the easting coastline of Ghana. These locations are identified as Nesting site (1) New Ningo-Prampram, (2) Regional Maritime University (RMU) of Sakumono-Nungua, and (3) Koklobite beach (figure 1).

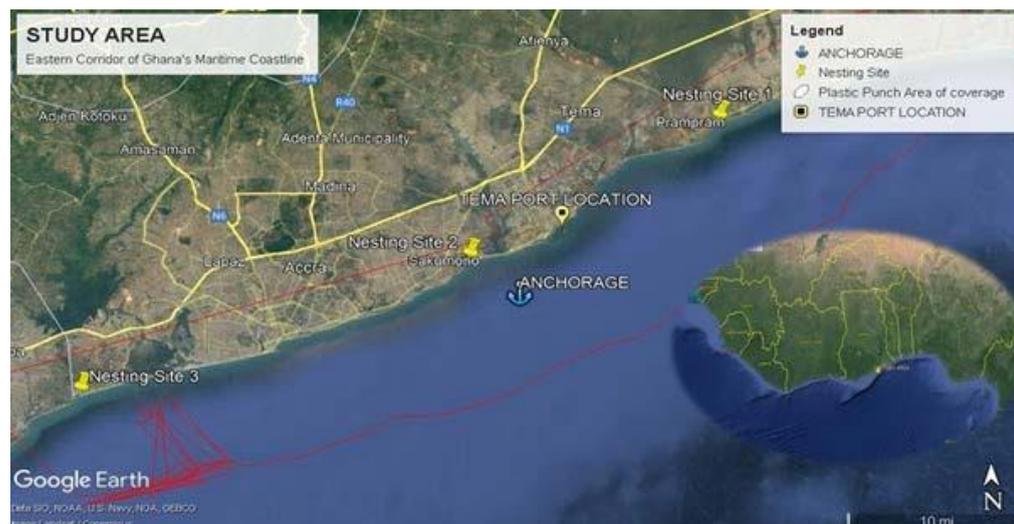


Figure 1. Ghana's East Coastline encompassing Turtle Nesting Sites hosting Activities of Plastic Punch

Based on these identified locations as seen in Figure 1, the study was designed to cover all beach clean-up activities led by Plastic Punch in these areas. As a tropical environment, weather patterns year in year out alternate between wet and dry seasons, whereas met ocean characteristic project a generalised pattern across the entire Gulf of Guinea as alluded to by Sackey. The coastline to these locations have a mixed rocky and sandy landscape that is currently subjected to various levels of coastal erosion [28,29].

Data gathering

For primary data gathering, the study makes use of review of verifiable internal data from the Plastic Punch organisation that encompasses: Sorting of Waste for Categorization, Workshops, Infuse of Recreational activities, Recycling of

plastics, and other wastes to Landfill. Site attendance and observations particularly focused on workshops, clean-ups, and exhibitions. Qualitative and quantitative data on public calls for organized activities as well as education were sampled through the review of the Organization's online presence, radio and television talk shows. Direct and indirect interviews were also conducted occasionally. Material tools deployed in the data collection process included the use of camera, google forms and internet surfing.

Secondary data obtained and utilized in this study constituted the previous literature on the various issues in the study largely obtained from Google search engine and the research gate platform. These literatures included

online articles, electronic files, news report etc.

Data analysis

The data analysis in this study is carried out to measure various parameters identified as essential to evaluating the organizations performance. It is believed that cumulative outcome will yield a clear picture of interpreting the efforts and the impact Plastic Punch is making in improving marine environmental sustenance in Ghana. The following factors will be examined over time:

I. Average Turn ups of Volunteers year-on-year beach clean-up event record of volunteer attendance examined should help project the trend of impact of awareness creation and the various strategies implemented to encourage societal engagement.

II. Retention rate of Returning Volunteers – knowledge of the average number of volunteers who continuously participate in beach clean-ups also project the level of understanding of influence being made. Thus, it is evaluated by dividing number of returning volunteers with total volunteers for the single event and multiplying by 100 per cent.

III. Weighted plastic waste collected at each location against other forms of debris – the regular waste collection at beach clean-ups against spanning a year helps evaluate the environmental impact of Plastic Punch's effort. Each collected waste is weighed on a weighing scale to determine its nominal weight after clean-up events. How does this correspond with volunteer turn-up?

IV. Records of sea turtle save this examine direct efforts by plastic punch geared towards relieving animals in distress such as those entangled in plastic waste and are unable to return to the sea from shore.

It is expected that the analysis will be situated in the most appropriate context while highlighting the essence for continuous improvement.

Results and Discussion

The results presented here reflect records, observations and perceptions of various beach clean-up attendances and operations carried out by Plastic Punch between the year 2018 and 2021 over turtle nesting sites in Ghana.

Awareness creation mechanisms

According to Plastic Punch, they follow a centralised approach and continue to implement various awareness creation mechanisms that take into account modern trends of technology, as well as the changing societal interest. They assert that education is key to behavioural change, however, according to them, education with evidential display of reality, thus, speaks more volumes than simple speeches. Therefore, some of the efforts towards awareness creation have focused on the production of theatre series

in collaboration with Village Minds films production as an educational tool for society wide. Traditionally, visitations are made to schools, churches, market centres and community gatherings where public education is carried out. Awareness creation are also achieved through community clean-up events geared towards sensitizing natives of need for regular clean-up exercises in their neighbourhoods and market spaces to prevent plastic from ending up in the ocean and at the beach. Other non-traditional means of raising awareness implemented include public education given through regular radio and television news reports and interviews (<https://fb.watch/8ywIDQQAeZ/>, <https://fb.watch/8ywx5RWe4/>, <https://www.facebook.com/plasticpunch/videos/1806815419480884/>), efforts directed at generating social media buzz or trends with videos, images and articles (<https://youtu.be/f6K8liSYLkg>, <https://www.facebook.com/plasticpunch/videos/291263882692484/>, https://m.facebook.com/watch/?v=399311847461252&_rdr). Other outreach tools include the broadcast of animated jungles, and the launch of the game App (found on google play store <https://play.google.com/store/apps/details?id=com.PlasticPunch.PlasticPunch&hl=en&gl=US>) directed towards gaming audience in the community. Again, making the study of science relevant to ordinary citizens through the citizen science approach has led Plastic Punch to launch of Sea Turtle Data App (<https://m.apkpure.com/plastic-punch-sea-turtle-data-app/org.plasticpunch.seaturtles>). The tool is expected to help shape data gathering on sea turtle along the coast by engaging ordinary citizens and creational beach personnel as observers. It is important to note here that all these measures are implemented simultaneously and therefore successes are not measured against each but on the collective effort that ensures an enhanced volunteer turn up, growing interest of society to engage the challenge to reduce the marine plastic menace. In comparison, the decentralised strategy relied on by the government to raise awareness and encourage volunteerism in clean-up events have focused on discretionary powers under the law by which the local government authorities such as the District, Municipal and Metropolitan assemblies operate. They do so in collaboration with the administration at the regional ministry level. Despite public announcement through the information service department for participation of environmental clean-up, volunteerism amongst locals are relatively non-existent, as such events are mostly patronised by the active duty persons in the security forces and local government. Occasionally, some private sector workers are encouraged to participate. Since, most of these events appear to be politically motivated, partisan supporters within the citizenry most likely turn up for which they are compensated for by the political party administration to create the appearance of a successful event [30].

PlasticPunch&hl=en&gl=US) directed towards gaming audience in the community. Again, making the study of science relevant to ordinary citizens through the citizen science approach has led Plastic Punch to launch of Sea Turtle Data App (<https://m.apkpure.com/plastic-punch-sea-turtle-data-app/org.plasticpunch.seaturtles>). The tool is expected to help shape data gathering on sea turtle along the coast by engaging ordinary citizens and creational beach personnel as observers. It is important to note here that all these measures are implemented simultaneously and therefore successes are not measured against each but on the collective effort that ensures an enhanced volunteer turn up, growing interest of society to engage the challenge to reduce the marine plastic menace. In comparison, the decentralised strategy relied on by the government to raise awareness and encourage volunteerism in clean-up events have focused on discretionary powers under the law by which the local government authorities such as the District, Municipal and Metropolitan assemblies operate. They do so in collaboration with the administration at the regional ministry level. Despite public announcement through the information service department for participation of environmental clean-up, volunteerism amongst locals are relatively non-existent, as such events are mostly patronised by the active duty persons in the security forces and local government. Occasionally, some private sector workers are encouraged to participate. Since, most of these events appear to be politically motivated, partisan supporters within the citizenry most likely turn up for which they are compensated for by the political party administration to create the appearance of a successful event [30].

Community engagement at beach clean-up events

Though much is talked about today of the need for community engagement in tackling various forms of environmental challenges in the 21st century world, Plastic Punch per its mission implements strategic plans to ensure they engage these individuals in communities all year round with the purpose of getting rid of plastic waste in Ghana’s marine environment –herewith, focusing on specific sea turtle nesting sites (see Figure 1).

Level of voluntary participation and attendances: Ordinarily, community engagement is hard to measure and is best evaluated against participation of individuals in community led events. Therefore, for beach clean-up events organized by PP over the last quarter of 2018, the entire year of 2019 and 2020; Figure 2 shows the average numbers of volunteers who willingly participated (Figure 2).

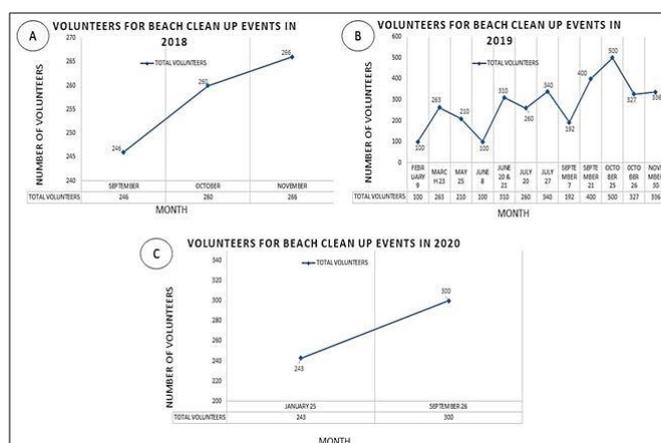


Figure 2. Volunteer Turn-up for Plastic Punch's Beach Clean-up events between 2018 and 2021. (A) The year 2018 marked the beginning of plastic punch’s beach clean-up activity to create awareness on marine pollution in Ghana. Three (3) beach clean-up events were held in September, October and November at Ningo-Prampam. (B) In 2019, Plastic punch resumed operations with 12 beach clean-up events organized over the year – constituting volunteers of RMU students, GIZ, Governance programs GH, Ghana flour mill staff and Jamestown Gbekebii and Decathlon school kids. The events occurred on major holidays in Ghana and Africa including the AU Day and UN day. (C) the first and last beach clean-up under review occurred on 25th January, and 26th September 2020 at the regional maritime university with volunteers constituted by students and pupils from Lincoln community school, East airport international school, Interact club EAIS, parents, teachers of the various schools and Jamestown Gbekebii (children) were present. Decathlon Ghana also supported greatly with the beach clean-up action.

From Figure 2 (A) which represents beach clean-up events in the last quarter of the year 2018 marking the commencement of Plastic Punch’s operation, the three clean-up events saw a progressive steady rise in the number of volunteers from 246 to 260 and 266 in September, October and November respectively. However, across the

year 2019 which saw a flood of beach clean-up events, the number of volunteer participation commencing in January rose steadily to March before dipping concurrently in May and June (see Figure 2 (B)). After the June 8th dip, there was a sharp rise recorded on the June 21st where 310 volunteers were in attendance. Between June 21st and November 30th, the average was as high as 344.17 volunteer attendances. The year 2020 as seen in Figure 2 (C) on the other hand, marked a period that saw the onset of the Covid-19 pandemic and the various restrictive interventions. Plastic Punch commenced its beach clean-up event on January 25, which saw the attendance of 243 volunteers –marking a rising momentum for community engagement for the year. However, due to the state of emergency declaration in March following the global health crises that ushered in various regulations and protocols including the localized lockdowns, travel restrictions and the public order act banning mass gatherings across Ghana, especially in Covid-19 hotspot areas such as Accra –so determined by the Ghana Health Service, PP was forced to terminate and postpone all plans for beach clean-up events scheduled for the year till further notice. Therefore, as restriction eased up in Ghana relatively in September, the second beach clean-up event was held on September 26th to mark the EU celebration, of which 300 volunteers were in attendance. The turn-up at these events shows a growing interest among citizens who find the need to ensure they are contributing to improving their native environment.

Retention rate of voluntary participations: The study further assessed among volunteers which participants were in attendance as returnees. The findings are as presented in Figure 3. You can display the graphs and place the tables in annex. (Figure 3)

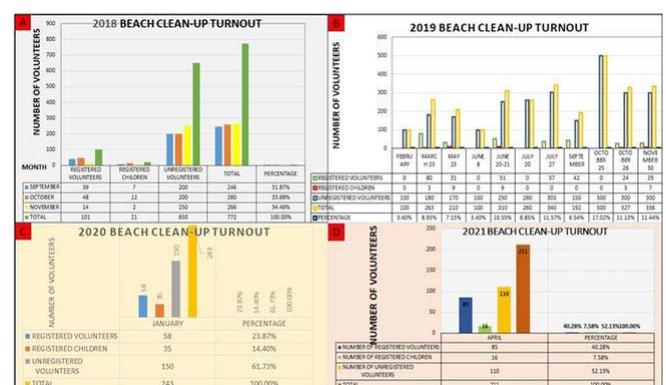


Figure 3. Analysis of volunteer participation of various demographic groups. Registered and Unregistered volunteers are further examined to distinguish between returning volunteers and individuals with renewed interest in actions against environmental pollution. Data compiled is the breakdown of the initial data computed in the time series analysis showing the trend of volunteer participation between 2018 and 2020. The results here also accounts for a clean-up event for the first quarter in the year 2021.

In Figure 3 (A) of 2018, an average of 256 attendances as per median value to a mean of 257—representing 31.87%, 33.68% and 34.46% respectively, were evaluate for each month observed. These volunteers included children from schools and churches within the Ningo Prampram. The rate of retention the same period is estimated at 15.80% at a mean value of 40.66. In 2019 as shown in Figure 3 (B), the highest volunteer turn up occurred on the United Nations (UN) day where 500 volunteers gathered on October 25, to celebrate the achievements of the UN. With a minimum volunteer turn up of 100, and the last of 11 beach clean-up events occurring on November 30, at Prampram beach, the overall mean value was 245 to a median of 300 volunteers—representing 8.33% of regular attendance of beach clean-up events over the year. The volunteer retention rate is estimated at 11.06% at a mean value of 29.55. In 2020 as shown in Figure 3 (C), unregistered volunteers constituted 61.73 per cent of attendees in January. Volunteer retention rate is computed for the month of January, given that the March 11 declaration by the World Health Organization (WHO) of the coronavirus pandemic of which Ghana, subsequently recorded her first positive coronavirus in the same month, led to various governmental interventions restricting activities of PP. These interventions which included over the three months long lockdown of capital city, Accra, interrupted beach clean-up schedules prepared for the year by PP. Therefore, volunteer retention rate for January 2020 was 38.27%, with 400 volunteer turn up on September 26 of the same year post lockdown of the Greater Accra region. The first beach clean-up of the year 2021 (seen in Figure 3(D)), also recorded a volunteer retention rate of 47.87% showing a steady rise from the last quarter estimated value of 2020 [28].

Plastic waste management after beach clean-up events

Plastic waste management remains one of PP’s focus, as PP believes the lack, inefficient or inadequate waste management facility, resulted in the various environmental pollution challenges seen along the Ghanaian coast. Therefore, for the period of 2019 which witnessed 10 beach clean-up events over a year, figure 4 shows the amount of waste collected at the various sea turtle nesting sites. (Figure 4)

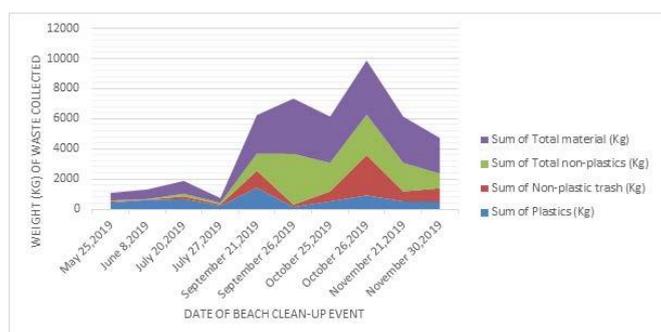


Figure 4. Estimated Weight of WASTE materials Gather during

Beach Clean-up organized by Plastic Punch in 2019

As seen in figure 4, the larger bulk of plastic material collected over the year 2019 occurred between September and November with average of over 4000 kg. The period of highest collected waste also appear to coincide with the period of highest volunteer turn up of the year 2019 (see Figures 2 and 3). While it is imperative to understand that the waste collected along Ghana’s eastern coast are not constituted only by plastic, the various items sorted and quantified, provides an understanding of the environmental situation. Between July 20th and November 30th 2019, seven beach clean-up events occurred for which various sets of items were collected as shown in (Figure 5).

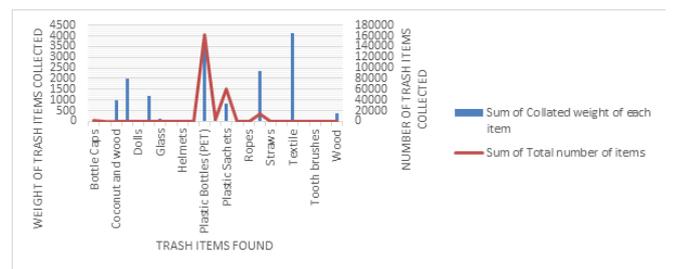


Figure 5. Nature of Trash items found on the beach During Sea Turtle Nesting Beach Clean-up in 2019

From Figure 5, plastic bottles (PET) and textile was the leading waste product found on the sea turtle nesting beaches examined. This finding is in agreement with the notion that waste generated after creational beach activities were not properly disposed of. Other products of fibre like coconut husk among others also supported these assertions. The chart further shows various material such as dolls, wood, straws and plastic water sachets, collected during beach clean-up events thus, suggesting much of Ghana’s marine plastic debris originated from landward areas.

Sea turtle along the coastline of Ghana continue to face the threat of plastic pollution. Though, so many of these endangered animals have been saved directly and indirectly by the works of Plastic Punch during beach clean-ups and turtle monitoring sessions, not all these events have been recorded and hence, statistics in this regard are lacking.

This notwithstanding, Plastic Punch continues to make progress in improving the marine environment of Ghana. Their efforts continue to receive international recognition and support. As a recipient of the EU grant in 2019, Plastic Punch also participated in the Ocean Sciences Meeting in San Diego, USA the same year. Again, due to the growing impact of Plastic Punch’s citizen science strategy, the UN has recognised its role as one of Ghana’s leading institutions for attaining SDG 14. These recognitions have led to the PP organization partnering with the Ghana Statistical service and the EPA for the collation of marine plastic data along Ghana’s coastline. Plastic Punch continues to make

effort in community engagement using various tools and services based on sound scientific principles. The latest amongst their effort include the 'Let's Go Green Challenge' in Ghana, seeking to empower the youth with innovative ideas at improving the environment. While Plastic Punch has successfully identified sea turtle nesting sites along the east coastline of Ghana, the organization is yet to track population trend and seasonality of their occurrence at the Ghanaian coast. These efforts are financial and capital intensive [31].

Conclusion

The study examined the impact Plastic Punch is making as a frontier to the current challenges facing Ghana's effort directed at improving marine environmental sustenance across its coastline –though mainly focusing on sea turtle nesting sites. A comparison of the organization's strategy to governmental strategies seeking to whip societal involvement in addressing the challenge, so deemed vital was examined against sustainable volunteer participation on a regular basis. An understanding of Plastic Punch's centralised citizen science approach showed greater value in terms of purposefulness and effective organisation of beach clean-up events. The strategy also appears to enhance behavioural change for environmental cleanliness through education, art and science. The import of the effect is the enthusiasm drive amongst volunteers who see their noble actions as a direct response to distress calls from various organism along the beach. While Plastic Punch continue to organize clean-up events regularly –successfully, reaching out to all segments of society for volunteers, the government's politically motivated programs on the other hand, fails to drive home effective behavioural change, and do not encourage unionism amongst the various political segments of society in efforts directed at environmental sustenance. The government continue to outsource environmental clean-ups to commercial entities such as Zoomlion Ghana ltd, as it is unable to fully engage with the general public. The Plastic Punch citizen science strategy also ensures citizens are better equipped with right tools and knowledge. Though the National Sanitation Day appear to have ended with change in government in 2016, environmental pollution continues.

Community engagement remain a priority in Plastic Punch's strategic operations, as such beach clean-up activities are a vital part of getting ordinary Ghanaians to participate in solving the current environmental problems. Though, PP does not view beach clean-up events as an end in itself, the efforts appears to draw ordinary volunteers closer to the problem. Therefore, equipping these volunteers with the right tools and knowledge is a step towards behavioural change. The idea is to make a scientist out of every citizen who may come to learn of the problem. Plastic Punch hence, have made available various technological app tools such as the video game and the sea turtle data collection

apps, which is currently being piloted. PP continues to carry out public awareness creation through visitations and community clean-up events. Volunteer attendances have also been commensurate with the level of efforts made by the PP organization. While Plastic Punch's activities lean into Corporate Social Responsibility (CSR) of various organizations, their success continue to hinge on efforts that put the responsibility over the environment in the hands of individuals who feel the overwhelming need to see the best of their surrounding environment. Thus, suggesting cooperation amongst likeminded individuals, institutions and groups. The model therefore, appear effective and remain scalable for enhance sustainable marine environmental development across West Africa.

Acknowledgement

We wish to acknowledge the support from family and friends. We also Thank Plastic Punch organisation for the granting access to aid in this study.

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