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The plastic waste problem- a pledge for volunteer activities

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Abstract: In this explorative study, an overview of up to date data on plastic waste is given. Different methods of handling the plastic waste problem are described. The focus lies on volunteering.
In order to get a picture of the plastic waste problem, a non-exhaustive overview is given of recent scientific and policy reports in paragraph 2. In paragraph 3 the guidelines of the UNEP and ISWA report on Global Waste Management is described. Other sources emphasize the importance of additional measurements. Those are e.g. self-organising volunteer activities in (higher-) education and volunteer cleaning up activities, respectively described in paragraph 4 and 5. In a small sample investigation to the motives for taken part in cleaning-up activities, undertaken in the Netherlands, Europe, two hypotheses were tested 'cleaning-up is a token activity' and 'taking part in cleaning-up activities promotes environmental-friendly behaviour'.
In paragraph 6 the method of the inquiry is described and in paragraph 7 we see from there some evidence for an expanding involvement with pro-environmental behaviour as a result from beach cleaning-up activities. In paragraph 8 we conclude that the need for involvement with the plastic waste problem of all and on all levels, is necessary. The contribution of volunteer activities like self-organizing groups in Universities or cleaning-up projects, seems to be an important factor in behavioural change to tackle the problem of plastic waste.

Keywords: Plastic, Waste, Volunteering**,** Green Offices.

1. INTRODUCTION

The enormity of the plastic waste problem is manifest and urgent for all, politicians, industry, traders, labourers, farmers. We are all inhabitants of the earth, we are 'earthlings'. All social classes are affected, rich as well as poor, people in villages as well as in huge megacities, whether living in dry or wet areas in the world, in sea or land climates.
The visibility of polluted and dirty rivers that take their content to the oceans, has created awareness of the problematic nature of plastic and the disposal thereof.
Pictures of polluted beaches, estuaries and riverbanks, pictures of debris gyres in the ocean, pictures of wounded or killed birds, turtles and fishes by pollution from plastic, are widespread and shared by social media like Facebook and Instagram. There are numerous websites showing places where 'you don't want to be' in a top-10 of the worlds most polluted and or dirtiest rivers beaches and lakes. Without going into detailed theoretical implications of the impact of social media or the power of pictures, we might detect a global growing awareness of the environmental impact of the human lifestyle.
In urban areas in the western world, waste collection and sustainable waste disposal is a serious responsibility and ongoing concern of (health) authorities. Cleanliness of the area, or at least invisibility of waste, is increasingly important in the image of a city and the country. Three recent and still problematic examples are Naples, Beirut and Rio de Janeiro.

- The Naples waste management crisis, where mountains of solid waste lined the streets for months and collectors stopped picking up the waste because all of the region's landfills were full, leading to unprotected disposal [1].
- In Beirut, Lebanon, the 'rubbish crisis' (as stated by the Guardian December 21, 2015) which started autumn 2015, has caused serious problems and hindered the development of the city that has suffered under war activities. "Household waste is pushed to the periphery and piled in hills near the mouth of the city's river. Streets look like rivers of garbage and mounds of waste along the bank reach the height of roadway overpasses [2].".
- In Rio de Janeiro, open water was part of the Summer Olympics 2016. The pollution of the water was extreme and surpassed limits of acceptance for sportsmen and women.

In places where there is not an acute management or political crisis as in the three cities above, but where a proper waste disposal system is lacking, people live with, and often amidst (plastic) waste and they seem not to be able to dispose this. Often (former) landfills are overloaded, there seems to be no way out for plastic waste, but –often open air- burning, resulting in air pollution and direct health problems for those in the neighbourhood of such fires.

Awareness in community members or civilians of the plastic problem seems to grow every year. An example is Clean Up the World, "a community based, environmental campaign that inspires and empowers communities from every corner of the globe to clean up, fix up and conserve their environment. In its 22nd year, Clean Up the World holds in conjunction with the United Nations Environment Programme (UNEP), mobilises an estimated 35 million volunteers from 130 countries

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annually, making it one of the largest community-based environmental campaigns in the world [3].". Social media like Facebook and Instagram contain thousands of volunteering-groups aiming to inspire people to change their lifestyle by e.g. being scrupulous of accepting single use plastics, like plastic straws, shopping bags and water bottles.
This study aims to contribute to the understanding of enormity of the plastic waste problem as such and to contribute to insight in the effects of volunteer activities in cleaning-up and in self-organizing activities in higher education through 'Green Offices', both part of the 17 UN [4] sustainable development goals. These UN goals emphasis the connectedness of education, sustainable consumption and production and the healthiness of the oceans and seas.
To solve the problem of plastic waste, we need, next to industrial and technological solutions, to know more of how to involve as many people in as many social classes of society as possible, since people's behaviour is an important factor in pollution.

2. PLASTIC WASTE CONSIDERED

The vulnerability of our planet earth in terms of climate change has been officially confirmed in the United Nations conference on climate change in Paris, December 2015, 21th Conference of the Parties (COP21) [5].
Parallel to the climate change, the pollution of the oceans, seas and other open water systems like rivers and lakes are a huge and acute problem for marine and fresh water life, and therefore a threat for life on earth in general.

See mammals, fish, shellfish, aquatic plants, corals as well as sea birds are seen entangled and destroyed in plastic rubbish. Even more venomous is the problem of the micro plastics that are affecting all life in the oceans. "There is a ubiquitous presence of plastic in oceans. Plastics are durable, and resistant to biodegradation. Many plastics will fragment in response to UV radiation or influence of movement. Biodegradable plastics doesn't seem to be the solution (…) [6].". Since plastic is almost not bio-degradable, it turns over time into small parts [7]. Small parts [8] can come from a variety of sources, including cosmetics, clothing, and industrial processes. Micro plastics can be found in the bulk of the Great Pacific Garbage Patch [9] the popular name of concentrations of marine debris. Micro plastics are recognized to persist in the environment at high levels, particularly in aquatic and marine ecosystems where they enter [10] the food chain. Charles Moore, founder and research director of Algalita Marine Research and Education, did find a so far unknown gyre of plastic in the South Pacific as announced in July 2017 [11].

The recent report of Eunomia: 'Plastic in the Marine environment' states: "Knowledge of the sources and fate of plastics in the marine environment is far from complete, but what is known is deeply troubling. Increasing awareness of the problems associated with marine plastics is beginning to translate into calls for action (...). Prevention is preferable to cure, and the greatest opportunity to prevent plastic entering the ocean is to take steps to reduce plastic litter on land [12].". Most of the waste in rivers (shores) and on beaches that is not securely disposed of, will enter via fresh water rivers in the oceans, this so-called land-based ocean trash originates on land. This trash can be distinguished from marine-based trash, which refers to trash that is dumped, spilled, or lost while at-sea. Uncontrolled burning of waste in the open air is often an act of despair, since no other solutions to get rid of the waste are at hand.

"Plastic pollution doesn't just dirty beaches—its effects can be felt throughout the ecosystem [11]". Plastic waste inputs from land into the ocean linked worldwide data on solid waste, population density, and economic status, and estimated the mass of land-based plastic waste entering the ocean. Research calculated that 275 million metric tons (MT) (= 275 billion kilogrammes) of plastic waste was generated in 192 coastal countries in 2010, with 4.8 to 12.7 million MT entering the ocean [13].

The urgency of management of (plastic) waste is recognized by the vast majority of political leaders [5]. A flow of reports is produced by researchers all over the world, astonishing figures about the amount of plastic material in our eco-system are communicated via newspapers and digital mass communication media.
A recent unique report of Science Advances, the first report that calculates how much plastic has been made *ever*, states: "We estimate that 8,300 million metric tons (Mt) as of virgin plastics have been produced to date. As of 2015, approximately 6,300 Mt of plastic waste had been generated, around 9% of which had been recycled, 12% was incinerated, and 79% was accumulated in landfills or the natural environment. If current production and waste management trends continue, roughly 12,000 Mt of plastic waste will be in landfills or in the natural environment by 2050 [14].".

3. GLOBAL WASTE MANAGEMENT: GUIDELINES

Based on the impressive work of the United Nations Environment Programme (UNEP, 2015) a report of more than three hundred pages, the International Solid Waste Association (ISWA), made a Global Waste Management Outlook (GWMO) [15] that calls out for (technological) measurements in every sense and on every level. In this report, the costs and benefits of waste management are set against the costs of inaction. Without taking action we will see from the viewpoint of public health, more gastro-intestinal and respiratory infections and blocked drains that aggravate floods and spread infectious diseases. From the viewpoint of environmental impact of open dumping and burning, we will see more severe land, fresh water, groundwater and sea/ocean pollution, as well as (local) air pollution contributing to climate change.
The GWMO [15, p 3] states that "costs to society of inaction exceed the financial costs of proper waste management by a factor of 5-10: in terms of healthcare, lost productivity, flood damage and damage to tourism and businesses".
From this report stems guidelines for four groups of actions to be taken that are intertwined and need to be addressed as far as possible at the same time and not in a chronological order. There is need for action at all directions at the same time. Bottom line is: Bring wastes under control.

Table 1: Simplified guidelines GWMO [16]

Bring wastes under control	
Ensure access for all to basic waste services	Deal with the hazardous substances in wastes
Stop uncontrolled dumping and burning	Bring hazardous wastes under control
Focus on waste prevention	Focus on the 'feedback loops'
Tackle the problem at the source	Close a clean material circle
Move from a linear to a circular economy	

These guidelines appeal on social (e.g. waste prevention), technical (e.g. close a clean material circle) and governance (e.g. ensure access) actions. Executing these guidelines requires 'changing paradigms': "We must also approach our problems with a holistic perception in order to achieve sustainable solutions. We now understand that our world is deeply interconnected through webs of relationships, many in ways which are simply not apparent to us or which we have not evolved to perceive [17].".

Dealing and executing the guidelines of the GWMO, requires change in behaviour and orientation on as much levels as possible.

On the social and economic level, good practices examples are 'Waste to wealth projects' in several countries in Africa (e.g. Ruanda). Technical challenges to clean-up the ocean with cutting edge technology are planned to be executed by the project of Dutch Boyan Slat: The Ocean Clean up [18]. Recently the Norwegian billionaire Kiel Inge Røkke announced to invest in building a research vessel that will collect up to 5 tons of plastics from the water daily [19].

Complimentary volunteer actions on cleaning-up and educational level will be discussed in paragraph 3 and 4. In paragraph 5 a limited investigation in motives for cleaning up activities is discussed.

Complimentary activities focusing on human awareness of waste as threat towards our planet

Huge efforts have to be taken to get the plastic waste problem under control. In addition to and complimentary to the guidelines of the Global Waste Management report, many volunteer activities are carried out. Following are examples of activities to enhance environmental awareness.

Volunteer cleaning up activities (beach, river banks, natural parks, cities) and stewardship

Reports on drivers for volunteering in general [20], or in specific domains like in culture or sports [21] show characteristics of volunteers that have a relatively strong relationship with their work, study or hobby.

The study 'Environmental Volunteering' [22] suggests that the environmental issues addressed in volunteer programmes and the standards of volunteer organisations constitute critical predictors of a volunteer's personal commitment to participation in an organisation. Learning and contact with nature clearly emerged as the most important factors in volunteer motivation for environmental activities. Another recent study on predicting volunteer commitment [23] found that helping the environment and learning about nature were important initial motivations. Other motivations, including social factors and project organization, were found to be significant predictors of volunteer commitment. Volunteers also indicated many significant changes in their environmental outlook and actions during their involvement in stewardship activities.

Cleaning-up

Cleaning is usually considered low class labour [24] and is ranked in the lower paid jobs [25]. It is therefore remarkable that so many people are contributing to cleaning-up activities. For most of them cleaning-up is not their work, nor their study or hobby. However, Clean Up the World estimates "35 million volunteers from 130 countries annually, take part in cleaning-up activities [26]". Clean Up the World claims to be one of the largest community-based, environmental campaigns that inspires and empowers communities from every corner of the globe to clean up, fix up and conserve their environment. Although cleaning-up seems to be an end-of-pipe method, or regarded an approach as fighting a losing battle, cleaning-up activities are advised in the UK Report 'Plastics in the Marine Environment' *'The most practical measure that can be deployed is to focus efforts on regular beach clean-up. By removing beach litter, we are therefore cleaning the oceans* [12] [27] p.4*.'*.

Community building (e.g. via Facebook and other social media)

Social media like Facebook contain thousands of environmental volunteering-and pressure groups [28] aiming to inspire people to change their lifestyle by being scrupulous of accepting single use plastics e.g. 'ban the plastic straw' or 'ban the plastic bottle'. That's is why new steps like refuse (single use plastic) and upcycle instead of recycle are added to the 'old' waste ladder [29]: prevention-reuse-recycle-recovery-disposal, updated in 2010 to reduce-reuse-recycle-energy-incineration.

4. SELF-ORGANISING ACTIVITIES IN HIGHER EDUCATION: GREEN OFFICES

The way universities educate the future intellectual elite in the light of sustainability, can be a part of the problem or a part of the solution. To draw attention to the importance of high quality volunteering activities by students a short discussion of the work of Green Offices [30] follows.

Society increasingly requires universities to address sustainability challenges, such as climate change, social inequality, ecological degradation and the spread of undemocratic ideologies, through their education, research, community engagement, operations and governance [31].

Green Offices are sustainability hubs that empowers students and staff as well as initiates its own activities to advance sustainability at the university and beyond. They integrate existing (sustainability) initiatives, actors, activities, policies and strategies.

A Green Office concerns education, research, community, operations and governance, in line with the UN sustainability goals. A critical issue is the level of awareness of sustainability issues within the organization of the University. To make an inventory thereof the Maastricht University Green Office and rootAbility gUG developed a model with indicators for sustainability assessment and reporting [30]. The movement has by now in Europe 27 Green Offices in 6 countries and 3 partner institutes. The partner in the Netherlands is called 'Studenten voor morgen" (students for tomorrow). They rank Universities (that want to take part) at sustainable criteria. The winner of the year gets an award: the 'Sustainabul' a combination of sustainable and 'bul' (bul= Dutch popular language for diploma).

5. Sample investigation of motives of volunteering in the Dutch Beach-Clean-Up

From 2013 on, in the Netherlands every August a Beach Clean-up is organized by the Foundation for the North Sea (Stichting De Noordzee) sponsored by a large company for dredging and marine activities, working worldwide, Boskalis [32]. This beach clean-up tour covers the complete North Sea coast of the Netherlands, divided into 30 stages, in the first years 30 days on a row, one stage of approximately 6 hours per day in August, later compacted into two weeks, starting at the begin and the end of the coastal line at the same time, meeting each other in the midst.

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Table 2: Results garbage collection by Beach-Clean up in the Netherlands

Year	# participants	garbage collected in kilo	*average persons per stage
2016	2.320	19.203	77
2015	2.015	11.555	67
2014	1.479	20.078	49
2013	563	6.590	19

* The number of persons per stage differs. Stages do differ in attractiveness as some stages are between popular beaches with taverns while others are more 'isolated'. Distances vary from 10 to 16 kilometres. The weather is unpredictable: on cold or rainy days people might choose not to participate or to choose a different day. The organisers introduced a maximum of participants. The amount of waste in kilos varies and the number of participants is increasing. The relationship is not clear, was there more garbage on the beach in 2014 or did the volunteers were more eager in collecting?

The purpose of a small investigation was to learn more of the motives for participation on a beach clean-up. Having in mind the notes on clean-up activities and volunteering, as described in paragraph 3, I was wondering if they experienced this clean-up as a *token* activity. I was triggered by the insight of Oksana Mont that "a behavioural re-bound effect takes place when people feel their small *token* actions (e.g. recycling paper) justify inaction in other areas, e.g. driving a car instead of taking public transport (…). The 'If-Everyone-Slogan' underlines that everyone's contribution is worthwhile significant, and that others are also taking responsibility for their behaviour and making changes. Small changes are vital as people need to start somewhere. They need to feel that they are doing something good and that they're part of a group. However, the biggest misconception is that small individual changes will lead to significant results, since the sum of small individual changes usually only results in small aggregate improvements [33].".

More or less in contrast with this opinion, in a recent study support was found for the hypothesis that "environmental self-identity is related to one's obligation- based intrinsic motivation (that is, feelings of moral obligation) to act pro-environmentally, which in turn affects pro-environmental actions. As expected, the obligation-based intrinsic motivation mediates the relationship between environmental self-identity and environmentally-friendly behaviour [34]".
Their findings suggest that "strengthening environmental self-identity may be a cost-effective way to promote pro-environmental actions, as people with a strong environmental self-identity are likely to act in an environmentally-friendly manner without an external incentive to do so [34].". We saw in paragraph 3 that 'volunteers also indicated many significant changes in their environmental outlook (…) [23].'.

To use both insights, two hypotheses were set up to focus the limited inquiry among volunteers of the Dutch Beach-Clean up. Hypothesis a: 'participants of the beach clean-up realised themselves that their activity was a token activity, a 'make-good' contribution to a cleaner beach and North-Sea, that they carried out to compensate for their otherwise environmental-unfriendly behaviour'. Hypothesis b was 'taking part in clean-up activities strengthen the relationship with nature and by this a broader environmental-friendly behaviour is promoted'.

6. Set up and Results Preliminary inquiry among volunteers of the Dutch Beach-Clean Up in August 2016

Method: At the start of a stage in the Beach Clean-up in 2016, after a short introduction to the volunteers who were assembled at the meeting point explaining the purpose of the inquiry to their reasons for participating, 50 questionnaires were handed out and later 32 filled out questionnaires were received. During the break and afterwards 10 persons were interviewed (average duration of the interview was 30 minutes).
The questionnaire had only one open question next to some identifying questions like age, formal education, and gender. The respondents could give their email or (cell-)phone number if they were willing to go into detail in future research.
The answers on the open question were during processing categorized in seven categories. Some people wrote down various reasons point by point, others made a page-long story, some wrote down just a few words.

Table 3: Reasons mentioned for volunteering in beach clean-up

reasons mentioned	Frequency
1.love for nature / beach	29
2.fun/ having a day out /group activity	17
3. duty /responsibility	7
4. annoyance	6
5. good example / education	5
6. other	3
7. coming into action	1

Discussion of the reasons mentioned in table 3 follows in the next paragraph. To get a picture of the participants, following are categories of age, gender and education.

Table 4 characteristics of participants who took the questionnaire and or took part in the interview

Ages	# persons
<20	2
31-40	10
41-50	7
51-60	6
61-70	2
71-80	2
total	**32**
Gender	# persons
man	12
woman	18
no answer	2
total	**32**
Education	# persons
Foreign	1
secondary level	3
vocational level	3
Un. of applied sciences	13
Master	7
no answer	5
total	**32**
Willingness to continue the contact for further questioning	
Email	And or phone number
23	16

The largest group is between 31 and 40 years. There were no participants in the category of 21 and 30 years, probably due to the age group with small children (the distance was too long for very small children and it is difficult to use buggies on the beach). Two people of 70+ took part. More women than men participated, and their educational level was relatively high (20 out of 32 on university level). The majority was willing to let me contact them by email and or phone for future research. They will be contacted after the 2017 Beach Clean Up for further inquiry.

7. Discussion Results motives for taking part in a beach-clean up activity

All respondents answered the main (open) question: Can you explain as extensively as possible, why you are taken part in a stage of the Beach Clean-up? There were no pre-defined categories, all texts came out of themselves. Their description of their motives contained often more than one reason. Ten persons were willing to express their feelings on beach-littering and cleaning-up in an interview.

The majority (29 out of 32) mentioned an environmental-related reason: love for nature and more specific love for the sea and the beach. Three persons also mentioned explicitly that they are motivated by their religion.

None of the informants expressed the idea of a *token* activity- they spontaneously (meaning: not asked) said, that they did not feel that their participating in this beach clean-up was 'green-washing' for their eventually environmental-unfriendly behaviour. In contrary: they expressed their concern with waste on the beach, and mentioned that they expand their cleaning-up activities to their living environment where they were used to remove littering from others and were keen on avoiding unnecessary plastic wrappings and developed a broader environmental outlook.

Most participants expressed their feeling of contributing to a healthier and cleaner living environment as well as contribute to a healthier North Sea.

Interesting is the high score in category 2: fun/having a day out, taking part in a group-activity.

The 'fun' aspect could be an indicator of a life-style aspect: having a nice day at the beach and doing something good for the environment at the same time. This might be a starting point to a better understanding of motivations for changes in behaviour. Activities generating a 'feel-good' moment for participants are apparently motivating. This might be a similar phenomenon as seen in 'social' festivals where instead of stipulating the severity of the issue at hand, music and other amusement are ingredients to contribute to a positive atmosphere.

In category 6, I stored remarks as: 'My father made me go' and 'My work organised my participation.' The three people who were more or less *send* to the cleaning-up activity and had no intrinsic motivation, explained at the end of the day, that they changed their mind and were convinced of their future participation in cleaning-up activities.

These results seem not to support hypothesis a (cleaning-up is a token activity) and seem to confirm hypothesis b (taking part in cleaning-up activities promotes environmental-friendly behaviour).

8. CONCLUSION

Literature on the problem of plastic waste in the oceans doesn't leave space for doubt: living on earth is in danger since plastic enters all elements of very detailed and refined eco-systems. There is a need for a new holistic paradigm which sustainable producing and consuming. Meanwhile the plastic waste problem has to be handled. Measurements on various levels requires involved people and committed communities.

Volunteer activities play an important role. Setting up Green offices in institutes for higher education mobilises and initiates sustainable education, sustainable institutes and a sustainable future elite. There is evidence [12] that (for the time being) cleaning up activities are practical and effective. The albeit very limited investigation on the motives of Dutch volunteers showed that acting 'environmental-friendly' can be pleasant and stimulating and promotes environmental-friendly behaviour in others areas of life.

How cleaning-up activities are related to encourage pro-environmental behaviour over time and in various areas of life, has to be investigated, preferably over a longer time. For further inquiry, the participants of 2016 will be contacted. In this future research, it might be necessary to dive deeper in the motivational aspect for cleaning-up activities by e.g. using the new ecological paradigm scale (NEP), to provide more insight in moral arguments for pro-environmental behaviour.

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Biography

The author changed her focus of interest after having worked from 2008 to 2014 in the field of Augmented Reality, as Head and founder of the AR-Lab in The Hague (in a consortium of universities and business/museums). Taking part in the first Beach Clean-Up in 2013, she decided to concentrate on sustainability. Being an educator (she studied Pedagogy and Educational Science with a specialization in Organisation and Management at Leiden University) research in learning and motives for behaviour (change) are a perfect match in this new field. Paradigms, moral arguments, based whether on religion, spirituality or pro-environmental insights are part of her research theme.

https://scholar.google.nl/citations?user=b4dKWkUAAAAJ&hl=nl