Tampere University of Applied Sciences

Refill Cyprus campaign

Can water refill stations reduce plastic pollution in Cyprus?

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ABSTRACT

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The Mediterranean Sea is one of the most polluted seas in the world, with thousands of tons of plastic released into it each year. This poses great risks to the ecosystem of the area, including Cyprus. Studies showed that microplastics have infiltrated turtle nesting sites in Northern Cyprus, confirming plastic pollution as a concrete threat to the island. The objective of this thesis was to examine whether water refill stations are a viable measure against plastic pollution.

The NGO Let's Make Cyprus Green launched the RefillCyprus campaign with the goal being the reduction of single-use plastic water bottles. So far one refill station was successfully installed on the Yermasoyia seafront. A survey was conducted through social media to gather information from residents and frequent tourists of the area about their general knowledge of plastic pollution and their opinion on water refill stations. The goal of the survey was to get feedback on the refill stations and determine their effectiveness.

The results suggest that the groups that use more single-use plastic water bottles and are less aware of the repercussions are more likely to use water refill stations. This may indicate the effectiveness of refill water in the reduction of plastic litter. The respondents believe that raising awareness regarding plastic pollution and stricter regulations and fines against littering would help decrease plastic litter.

Key words: water refill station, plastic pollution, consumer behaviour

CONTENTS

1 INTRODUCTION

Let's Make Cyprus Green is a non-profit organization based in Limassol, Cyprus with a goal to spread awareness to the public about the negative impacts' humans have on the planet, with a focus on waste and plastic use. In October 31st 2020 LMCG launched their first project called "RefillCyprus". The goal of the project is to install water refill stations across the island which offer free filtered drinkable water. The purpose of the station is to motivate people to use reusable water bottles instead of single-use plastic ones and reduce plastic pollution on the island. To date one of said stations is successfully implemented on the Yermasoyia seafront.

The Mediterranean Sea is one of the most polluted seas on the globe, in fact, according to IUCN approximately 229,000 tons of plastic are being released in it each year, equivalent to 500 shipping containers per day (Boucher & Billard 2020).

The aim of this thesis is to analyse whether water refill stations have a measurable impact on the reduction of single-use plastic water bottle litter. Data will be gathered through a survey from people residing or visiting the area where the project is implemented. In addition, similar strategies applied in other parts of the world will be considered and their impact on plastic pollution will be evaluated.

2 PLASTIC POLLUTION IMPACT ON COASTAL ENVIRONMENT

Since the middle of the last century hundreds of millions of plastics have been produced. The most popular types of synthetic plastics are low- and high-density polyethylene (PE), polypropelene (PP), polyvinyl chloride (PVC), plystyrene (PS), and polyethylene terephthalate (PET) that are responsible for approximately 90% of the global production and it is safe to say that coastal environment pollution is mainly composed of these materials. (Ivar do Sul, Costa 2014) Most types of plastics float on water and as a result often end up washing ashore. Apart from macroplastics that are big enough to be seen by the naked eye, microplastics are a big concern in recent years. Microplastics are small fragments of plastics typically smaller than 5 mm and are derived from other larger plastics through UV exposure and corrosion, microbeads from cosmetics, microfibers from clothing and from tyre abrasion. (Duncan et al 2018) These small particles are high in persistent organic pollutants (POPs), picked up from sea water via partitioning. The concentration of POPs in microplastics is several times higher than sea water due to their hydrophobicity. (Andrady 2011) Many marine species confuse these tiny plastic fragments with food and ingest them. Plastic is found in the gastrointestinal tracts of various marine species from deep sea invertebrates to large mammals (Compa et al 2019).

2.1 Plastic pollution in the Mediterranean Sea

The Mediterranean Sea is known to be as one of the most polluted seas worldwide. Each year approximately 229,000 tons of plastic is released into it, consisting 94% of macroplastics and 6% microplastics (Cózar et al 2015).

In total, approximately between 873 and 2,575 tons of plastic debris is floating on the surface of the Mediterranean Sea, posing risk towards marine life. Its home for 4% to 18% of the global marine species with over 600 of them being vertebrates. Overexploitation and pollution are a serious threat to the biodiversity of

the area. It is uncertain to what degree plastic pollution causes harm but through species and location specific surveys its established that it is a threat. It is well known that on a global scale plastic pollution affects various species such as seabirds and sea turtles. (Compa et al 2019)

2.2 Plastic pollution in Cyprus

In Cyprus, during the summers 2016 and 2017 beach clean-up campaigns collected litter from nine Blue Flag beaches (one of the world's most recognised awards for beaches, marinas and boats that meet strict environmental, educational, safety and access-related criteria. One of the environmental criteria is to maintain a beach clean at all times) covering an area of 20,980 m^2 (Blueflag 2021). A total number of 7658 items were collected, broken down into types of items and recorded on the Ocean Conservancy's International Coastal Cleanup Datasheet. The top five items collected are displayed on the pie chart below (FIGURE 1).

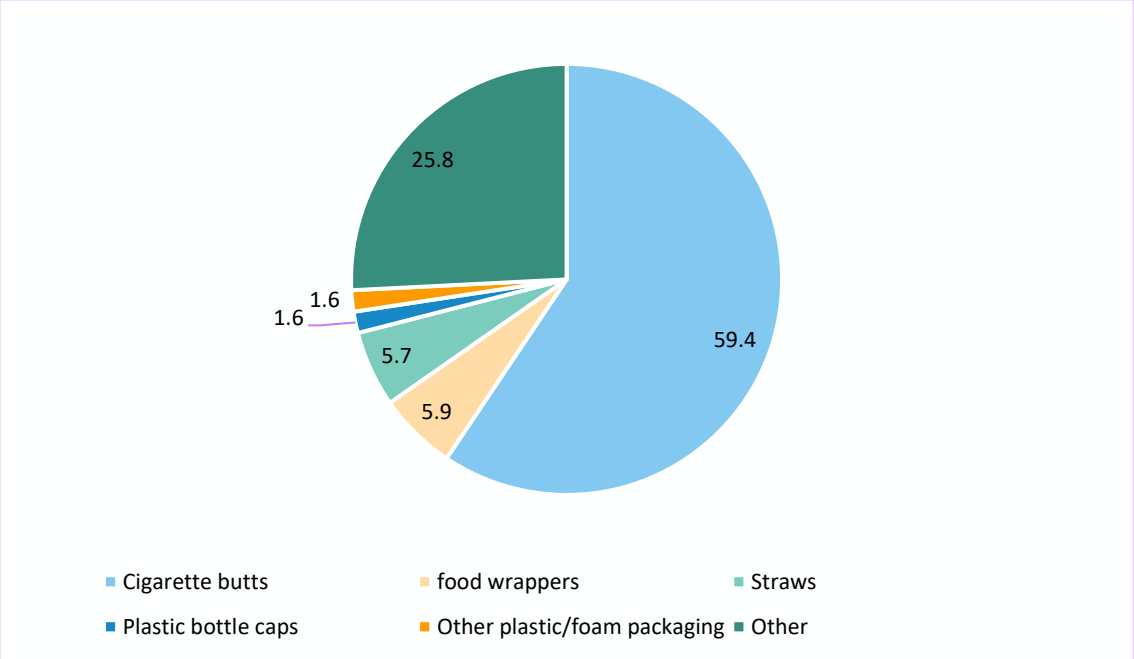

FIGURE 1. Top five items collected

The top ten items collected were cigarette butts, food wrappers, straws, plastic bottle caps, other plastic or foam packaging, beverage cans, metal bottle caps, plastic bags, balloons and plastic cups and plates. Plastic items smaller than 2.5

cm made up 6.4% of the collected litter but were not identifiable. (Loizidou, Loizides, Orthodoxou 2018)

Another more recent clean-up campaign was conducted in the summer of 2019 by AKTI project and research center, in collaboration with local authorities, diving centers, schools and volunteers. The chosen areas that were cleaned were touristic blueflag and non blueflag beaches, with a goal to point out the issue regarding smaller sized litter potentially hiding in the sand. All the beach clean-ups conducted every year are done with the same methods for the possibility to compare the results, draw conclusions and aid worldwide studies.

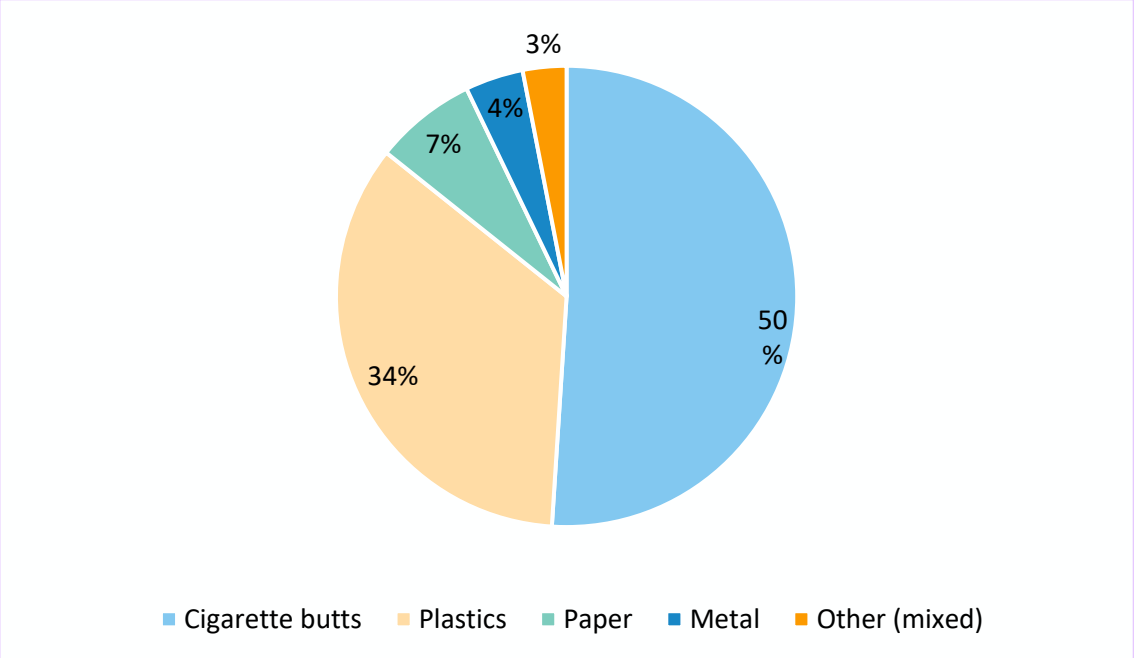

FIGURE 2. Top five items collected (2)

The International Ocean Conservancy Protocol was used for the registration of the litter collected. The total litter collected from the 26 beach clean-ups and 4 ocean floor clean-ups that were carried out was 25.700 pieces of trash weighing over 1130 kg. The top five items collected are displayed in the pie chart above. (AKTI 2019)

3 Impacts of plastics on ecosystems

Over the last two decades microplastics in beach sand has tripled, finding their way onto them from surface waters and get integrated within the sediment. Microplastics have different properties than sand, thus may increase the porosity and permeability of the sediment, resulting in potentially slower warming rates. (Carson, Colbert, Kaylor, McDermid 2011) Another potential outcome is that temperatures increase since plastics have a higher specific heat capacity than sand. Plastic pigment is also a factor; darker coloured plastics absorb more heat than lighter colours. It is still unclear what effect microplastics have on the temperature of the sediment, but since plastic has different properties it most certainly does have an effect. (Duncan et al. 2018) Sand temperature is important for marine turtles, since their nesting success is determined largely on extraneous factors. The sex of the offspring is determined by temperature and could be impacted by the high levels of microplastics in the sand. This can potentially lead to improper ratios of male and female turtles.

3.1 Sea turtles in Northern Cyprus

Northern Cyprus is inhabited by loggerhead (Carettta caretta) and green turtles (Chelonia mydas) and it is considered one of the most important turtle nesting sites in the Mediterranean basin.

In 2016 a study was carried out at 17 beaches across the North-eastern coastlines of Cyprus. The beaches chosen were based upon their spatial distribution and high turtle nesting densities. From 170 turtle nesting sites a total of 1209 sediment samples were collected and examined. The findings of the study suggest that Cyprus's microplastic levels are 5-1000 higher than in other Mediterranean regions that studies were made. These include Malta, Greece and Spain. In fact, the numbers recorded were among the highest ever recorded, trumping the amount of microplastics found in turtle nesting sites in Florida, USA and approaching those in Guangdong, South China in 2015. These findings place Cyprus's microplastic levels in turtle nesting beaches the highest in the Mediterranean and second worldwide. (Duncan et al. 2018)

4 Refill Cyprus campaign

In order to reduce plastic pollution in Cyprus, the NGO LMCG launched the Refill Cyprus campaign that aims to change consumer behaviour regarding single-use plastic water bottle litter. This is achieved through the installation of water refill stations, with free filtered water that will encourage people to carry a reusable water bottle and minimize the use of single-use plastic water bottles. So far one water refill station was installed on the Yermasoyia seafront and five more are scheduled to be installed in Aglantzia Municipality and Paralimni.

PICTURE 1. Water refill station on the Yermasoyia seafront

An estimated 6,000 single-use plastic water bottles were saved in the 5 months the refill station was present. This number is an approximation derived from the amount of water the refill station has provided in the given time period.

The study “The Success of Water Refill Stations Reducing Single-Use Plastic Bottle Litter” was carried out along the Brisbane river in Queensland, Australia and found that plastic water bottle litter decreased post water refill station installation. Furthermore, it suggests that installing water refill stations in areas where single-use water bottles are purchased such as vending machines and kiosks may further decrease litter. (Willis, Hardesty, Vince, Wilcox 2019)

4.1 Consumer behaviour

Consumer behaviour plays an important role in understanding how to prevent and mitigate single-use plastic water bottle pollution. The study “Consumer-based actions to reduce plastic pollution in rivers: A multi-criteria decision analysis approach” conducted in 2020 used multi-criteria decision analysis (MCDA) to determine the effectiveness of alternative consumer-based actions while taking into consideration the environmental, financial and practical aspects in the process. The criteria in which to analyse the alternative consumer-based actions were chosen regarding feasibility, economic impacts, potential environmental impacts and consequences, potential degree of change and evidence of impact for different items taken from other related studies. The weight of each criteria was determined by twelve experts and three authors and scores were assigned from 1 to 5 (higher score represents more positive impact) to each action in regards of their potential environmental impact. In addition, to further analyse the impacts of the actions, SWOT (strengths, weaknesses, opportunities and threats) analysis was used. The results of the study show that reusable water bottles of any type placed second from the 27 consumer-based actions analysed. (Marazzi et al 2020) This indicates that reusable water bottles have the potential to be an effective measure against plastic pollution.

Another study made in Jakarta, Indonesia called “The role of bottled drinking water in achieving SDG 6.1: an analysis of affordability and equity from Jakarta, Indonesia” (Sustainable development goal 6: Ensure availability and sustainable management of water and sanitation for all) concluded that higher income households consume more water form refill stations than lower income households.

The study found that there is a correlation between income level and amount of water used for drinking and cooking from refill stations. Furthermore, the lower income households spend a larger chunk of their monthly income on refilled water, even if the total refill water consumed is lower than higher income households. (Walter, Kooy & Prabaharyaka 2017)

5 METHODS

To gather information regarding how single-use plastic pollution is perceived on the island and people's opinions on water refill stations, surveys were made and shared through LMCG's social media pages (Appendix 1). The survey was comprised of 17 questions of which 6 were regarding personal background information, 8 about plastic pollution and 3 about water refill stations. A total of 108 responses were gathered and analysed.

The background questions were asked in order to compare them with the plastic bottle questions' results and identify possible patterns with groups such as the age of the respondents, their education, occupation etc. The questions regarding plastic pollution were asked to gather information about the respondents' habits when it comes to single-use plastic water bottles, water refill stations and their point of view on the subject.

The first part after the background questions were a series of questions with a goal to comprehend the respondents' general habits and perception about single-use plastic water bottle pollution. These questions comprised of questions such as whether they consume single-use water bottles, how the bottles are disposed when outdoors and their familiarity with the dangers of plastic pollution. Following, a series of questions with the core being water refill stations and the public's view on them were asked. The goal was to understand what the users think about them if they had used them and if they had not used them before they were asked to elaborate further as to what lead them not to.

6 RESULTS

The information gathered from the survey that was published through LMCG's social media was analysed and was used to determine the relationship between the respondents and single-use plastic water bottles. Out of the 108 people that answered 44.4% use single-use plastic bottles, 14.8% don't use single-use plastic bottles and 40.7% reported that they use them sometimes. The information is displayed in a pie chart below (FIGURE 3).

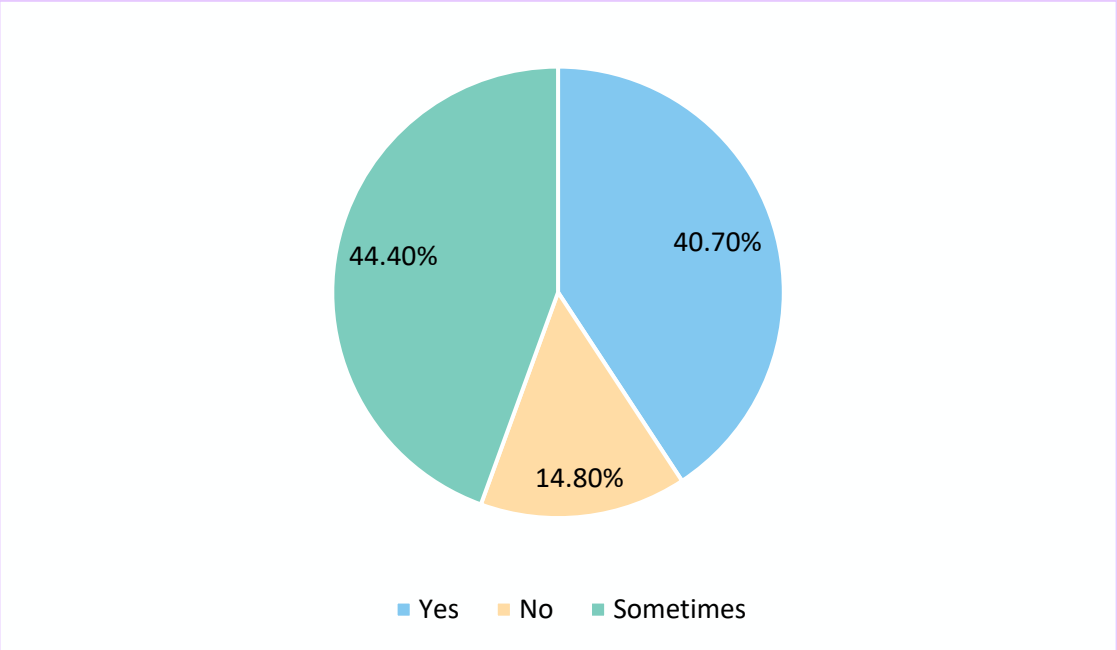

FIGURE 3. Do you use single-use plastic bottles? (designed to be used once and then disposed of)

Higher percentage of frequent tourists use single-use plastic bottles (66.6%) when compared to Cypriot residents (40.2%). According to the data, self-employed and unemployed people are the groups that use the least plastic bottles with 20% and 27.3% respectively, voting no.

When in possession of a single-use plastic bottle while being outdoors, 56.5% of the respondents toss it in a bin, 38.9% aim to recycle it and 0.9% which accounts for one person responded that he/she tosses the bottle on the ground. The rest of the answers (3.7%) were irrelevant.

The information is displayed in the pie chart below (FIGURE 4).

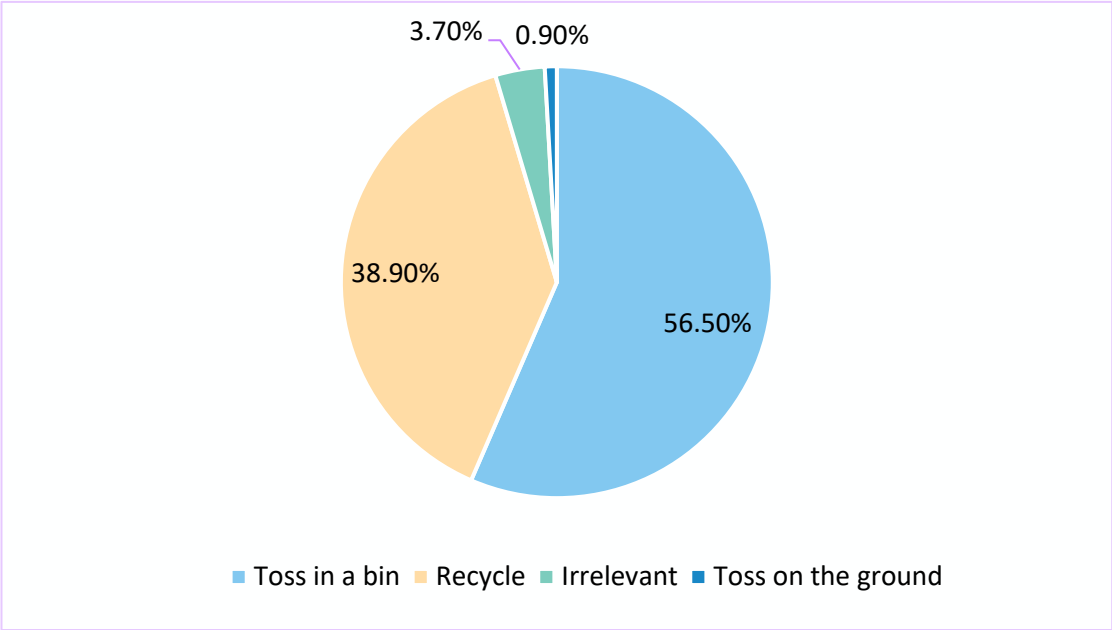

FIGURE 4. How do you dispose of single-use plastic water bottles when outdoors?

When it comes to the familiarity of the respondents with the risks of plastic pollution, they were asked to rate their knowledge from a scale of 1 to 5, 1 being extremely low and 5 being extremely high. The majority believe they possess most of the information about plastic pollution, with a 66.7% rating it a 5, 25.9% a 4 and the remaining 7.4% rated their knowledge with a 3.

The familiarity with plastic pollution of the respondent's can be seen on the column chart below (FIGURE 5).

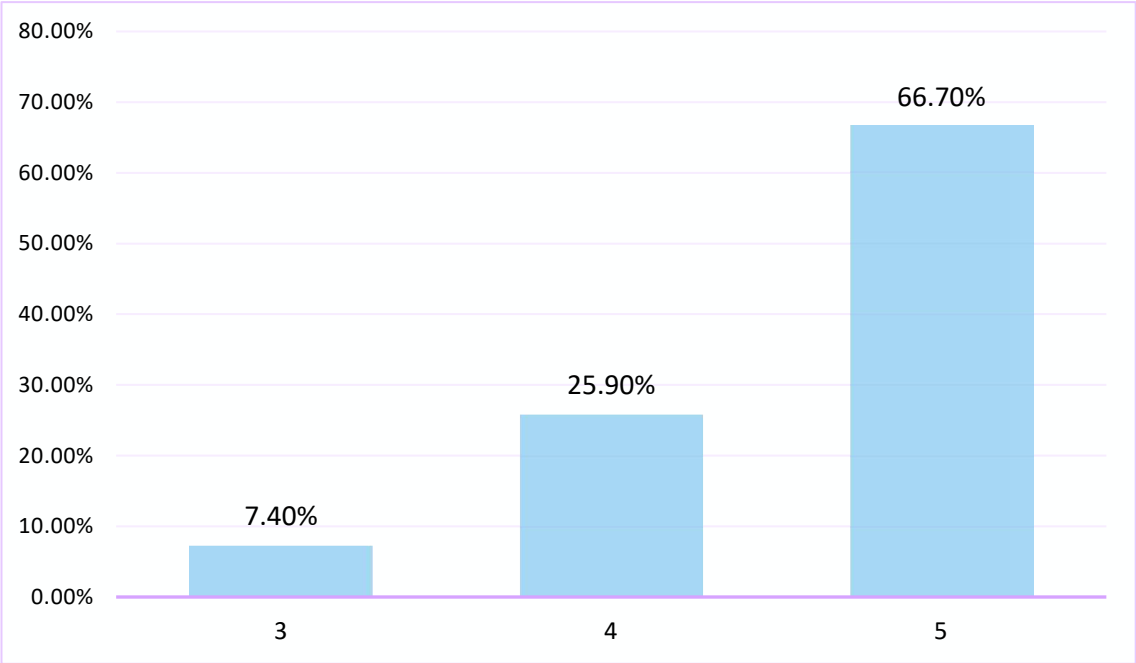

FIGURE 5. Familiarity with plastic pollution

The percentage of students who believe they possess most of the knowledge in plastic pollution is the lowest with 46.7% of them rating it a 5. Self-employed respondents who rated a 5 account for 84.0% making them the group with the highest percentage, followed by unemployed with 81.8%, retired (78.6%) and employed (55.8%). It is worth noting that from the unemployed group none rated a 3 while from the other groups the percentage ranges from 7.0% to 13.3%. None of the groups listed rated their familiarity with plastic pollution with a 1 or 2 on the scale.

According to the data it can be deduced that familiarity with the risks of plastic pollution is inversely linked with the use of single-use plastic bottles. From the respondents who don't use single-use plastic bottles 81.3% rated their familiarity with a 5, 68.2% of the respondents who sometimes use them rated their familiarity with a 5 and only 60.4% of the respondents who do use single-use plastic bottles rated their familiarity with a 5.

When looking at the education of the respondents, 90.9% of the people with vocational school education rated their familiarity with plastic pollution a 5. Respondents with high school education rated 5 the least with 55.0%.

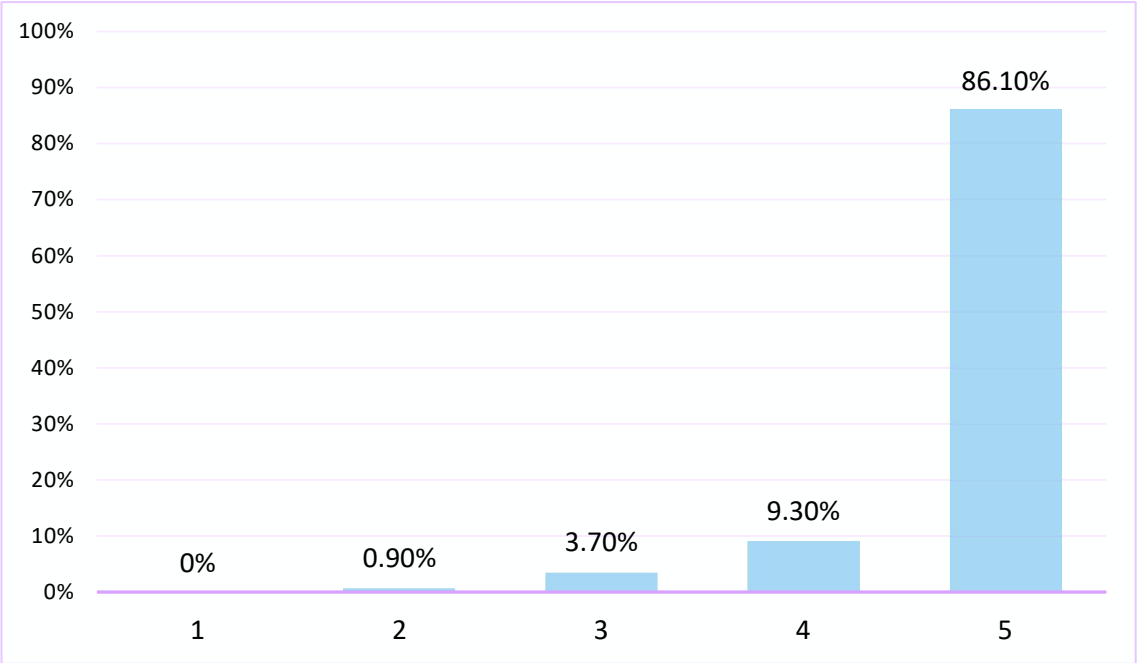

FIGURE 6. How important is it to mitigate plastic pollution?

The percentage of respondents who rated a 5 on how important it is to mitigate plastic pollution is 86.1%, the rating for 4 is 9.3%, for 3 its 3.7% and for 2 only 0.9%. The information is presented in the column chart above (FIGURE 6). When asked “Do you think plastic pollution is a problem in Cyprus?” 98.1% of the answers were yes with only 1.9% being maybe.

The answers to the question “Do you think water refill stations would help reduce plastic pollution” are represented in the pie chart below (FIGURE 9).

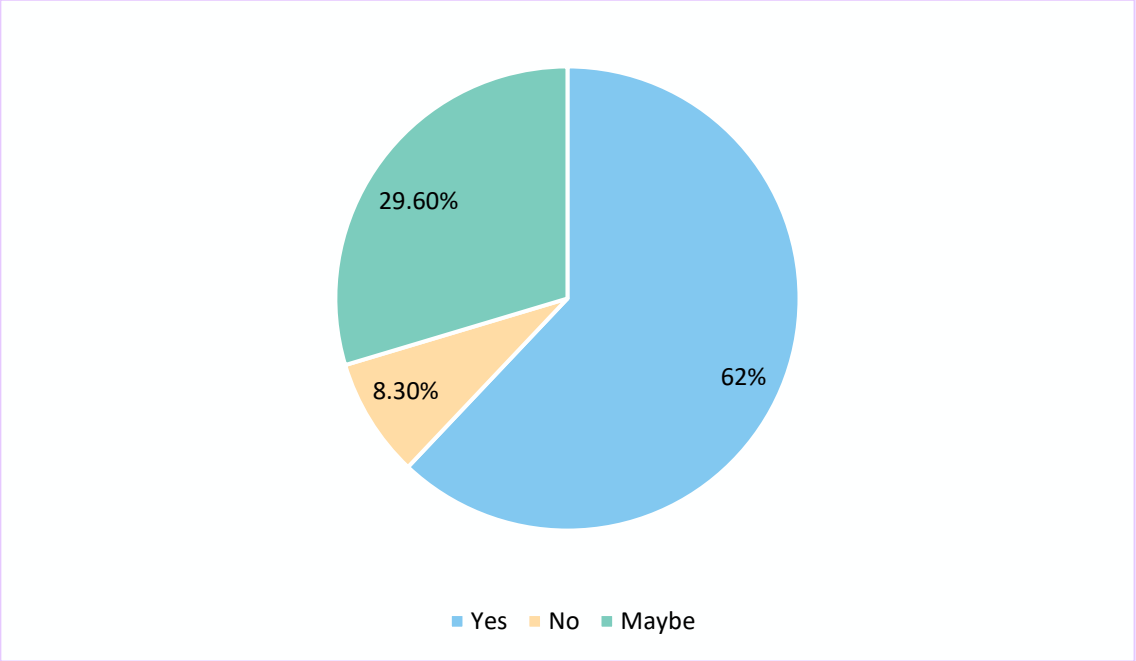

FIGURE 7. Do you think water refill stations would help reduce plastic pollution?

When cross-analysing the results in the figure above (FIGURE 7) with the age of the respondents it can be deduced that ages above 50 believe the least that water refill stations would help reduce plastic pollution. The percentage that thinks it would help accounts for only 46.2%. When compared to ages between 30-50 and below 30, 71.4% and 70.6% respectively, think water refill stations would help reduce plastic pollution. Regarding occupation, only 28.6% of retired people think it would help while at least 64.0% of all the other groups think it’s an effective pollution prevention measure. Students is the occupational group with the highest percentage of votes in favour of the water refill station (73.3%). The vast majority of frequent tourists (73.3%), believe water refill stations are a good idea, while 59.8% of Cypriot residents believe so.

The main reasons the respondents themselves or believe other people toss plastic bottles on the ground were asked. This was achieved through suggesting 4 reasons from which they could rate the efficacy of the suggestion from strongly disagree, somewhat disagree, neither disagree or agree, somewhat agree and strongly agree.

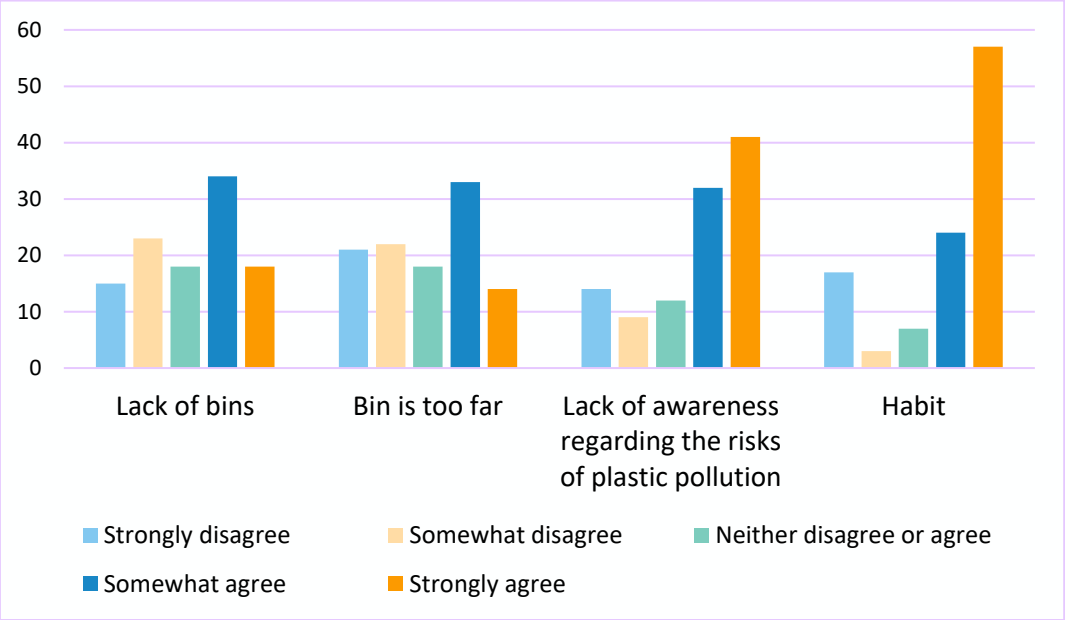

FIGURE 8. The main reasons plastic bottles are tossed on the ground

As we can see from the figure above (FIGURE 8) habit is “strongly agreed” with by the most respondents (57) as the main reason they or other people toss plastic bottles on the ground, followed by “lack of awareness regarding the risks of plastic pollution” with 41 people voting “strongly agree”. As far as the reason with the most “strongly disagree” votes go, “bin is too far” got the most votes.

The people that have used a water refill station before are satisfied and think it is useful. On the other hand, people who have never used water refill stations before can be divided into two categories. First category; people who have never encountered one and second category people who are concerned with the cleanliness and quality of the water.

In the last question of the survey some measures against plastic pollution were suggested and it required the respondents to rate to what extend they agree or disagree with the statements.

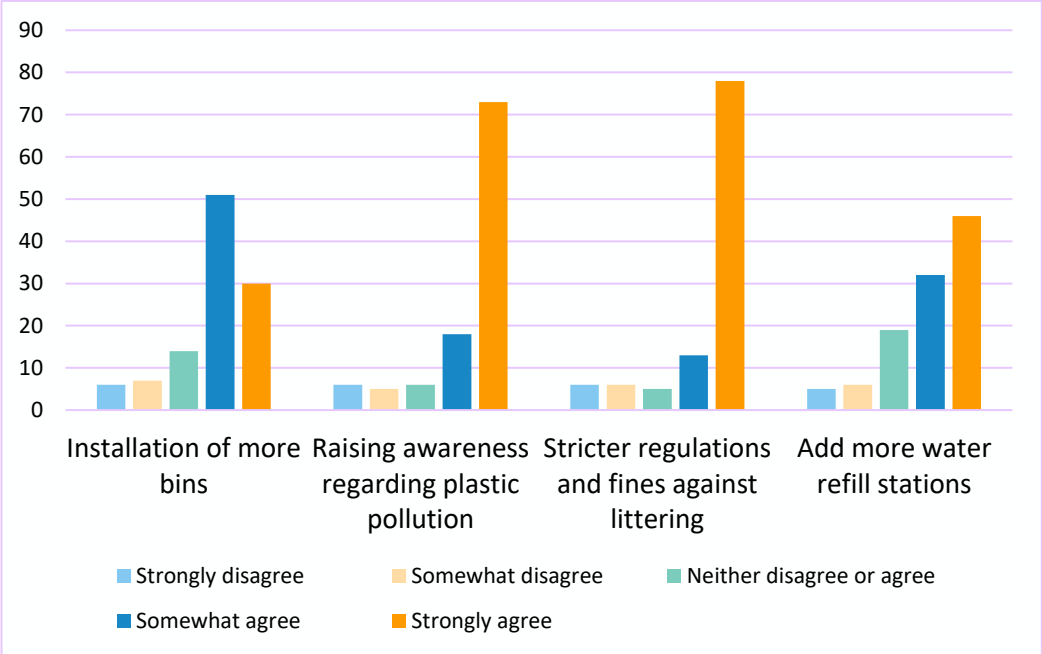

FIGURE 9. Measures against plastic pollution

By looking at the above column chart (FIGURE 9) it can be clearly seen that “stricter regulations and fines against littering” along with “raising awareness regarding plastic pollution” are the most popular measures amongst the four, with 78 and 73 “strongly agree” votes, respectively. There is not any measure that stands out as the most disagreed with since all of them have similar number of “strongly disagree” and “somewhat disagree” votes.

7 CONCLUSION & DISCUSSION

The results of the survey may have been influenced by the fact that the people who the survey was shared with were following LMCG's social media page and were more aware about environmental issues.

According to the results only 14.8% of the respondents claim to never use single-use plastic bottles, therefore there is room for improvement in this sector. The analysis of the data indicates that frequent tourists use more plastic bottles than permanent residents. Also, students appear to be the group with the least familiarity regarding plastic pollution. As awareness is the first step in fighting plastic pollution, the lack of knowledge in students should be addressed. When the results of the question "Do you think water refill stations would help reduce plastic pollution" was studied, frequent tourists and students are the groups that believed the most that water refill stations would be a good idea. As a consequence, installing water refill stations could be effective towards these target groups in reducing plastic bottle litter. Furthermore, the general effectiveness of reusable water bottles was proved by the study "Consumer-based actions to reduce plastic pollution in rivers: A multi-criteria decision analysis approach" by ranking second amongst 27 other consumer-based actions as a measure to reduce plastic pollution, as mentioned in the theory of the thesis. Consequently, water refill stations are a great tool to encourage people to purchase and carry a reusable water bottle. In addition, the other study "The role of bottled drinking water in achieving SDG 6.1: an analysis of affordability and equity from Jakarta, Indonesia" mentioned in the theory suggests that water refill stations are mostly used by higher income households. However, in Jakarta, Indonesia where the study took place refill water is payed. In the case of the RefillCyprus campaign by the NGO Let's Make Cyprus Green in Cyprus, the water provided is completely free of charge, thus people from all income levels have the possibility to access refill water.

The data gathered regarding the reasons as to why people toss plastic bottles on the ground indicates that lack of awareness regarding plastic pollution and habit are the main causes, as discussed in the results and represented in FIGURE 7. These findings track with the answers given to the question "What other

measures against plastic pollution would work best in your opinion", with "Raising awareness regarding plastic pollution" and "Stricter regulations and fines against littering" being the most voted, as seen in FIGURE 8. LMCG is already raising awareness through social media activism and presentation of educational material for various environmental issues in local schools. As far as stricter regulations and fines regarding pollution the Cypriot government is obligated to update their environmental policies in order to maximize the mitigation of littering.

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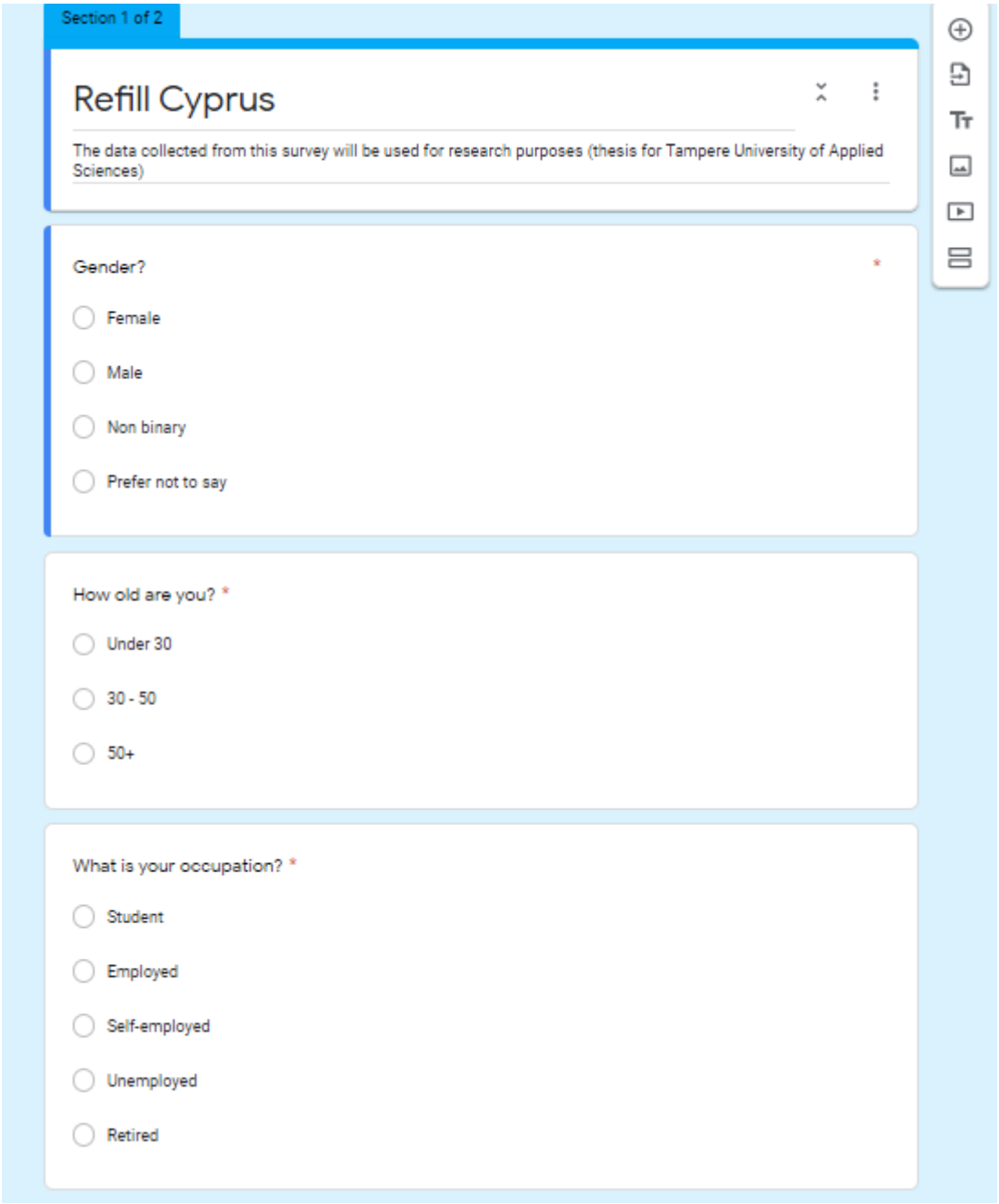
APPENDICES

Appendix 1. Refill Cyprus campaign survey



What is your education? *

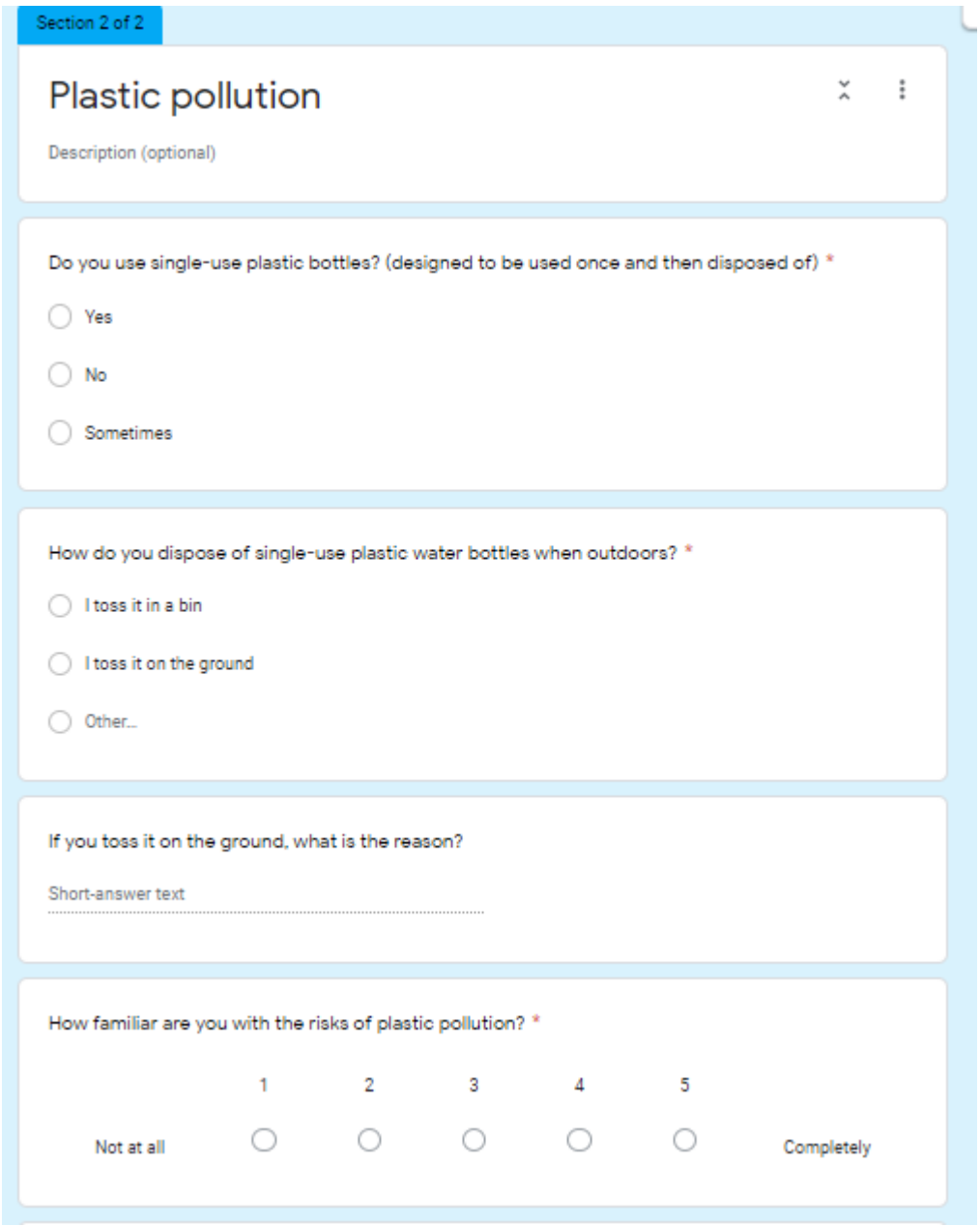
- Elementary
- High school
- Vocational school
- University
- Post graduate
- Other

What is your relationship with Cyprus? *

- I am a Cypriot resident
- I am a frequent tourist
- I have been once to Cyprus
- I have never been to Cyprus

How many months per year do you spend in Cyprus?

- 9 - 12 months
- 3 - 9 months
- Less than 3 months


Section 2 of 2
Plastic pollution
Description (optional)
Do you use single-use plastic bottles? (designed to be used once and then disposed of) *
Yes
No
Sometimes
How do you dispose of single-use plastic water bottles when outdoors? *
I toss it in a bin
I toss it on the ground
Other...
If you toss it on the ground, what is the reason?
Short-answer text
How familiar are you with the risks of plastic pollution? *
1
2
3
4
5
Not at all
Completely

Do you think plastic pollution is a problem in Cyprus? *

- Yes
- No
- Maybe

How important do you think it is to mitigate plastic pollution? *

	1	2	3	4	5	
Not at all						Extremely

What are the main reasons you/others toss plastic bottles to the ground? *

	Strongly disagr...	Somewhat disa...	Neither agree n...	Somewhat agree	Strongly agree
Lack of bins					
Bin is too far					
Lack of awaren...					
Habit					

Do you think water refill stations would help reduce plastic pollution? *

- ◯ Yes
- ◯ No
- ◯ Maybe

If you have used a water refill station before, what do you think about it?

Long-answer text

If you haven't used a water refill station before, why?

Long-answer text

What other measures against plastic pollution would work best in your opinion? *

	Strongly disagr...	Somewhat disa...	Neither disagre...	Somewhat agree	Strongly agree
Installation of ...	○	○	○	○	○
Raising awaren...	○	○	○	○	○
Stricter regulati...	○	○	○	○	○
Add more water...	○	○	○	○	○