



# Research, Mapping and Subsequent Control of Waste in Water Bodies

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**Mini Review**

**Volume 4 Issue 2**

**Received Date:** April 22, 2021

**Published Date:** May 17, 2021

**DOI:** 10.23880/oajwx-16000162

## Abstract

In recent decades, there has been a sharp increase in waste that pollutes the environment. The largest share in them is non-degradable plastic waste. Most of them are located in the water bodies of the continents or in the ocean. Mankind faces the challenge of saving the world or destroying it. Only this year in Bulgaria along the rivers Iskar, Mesta, Danube, Yantra and others was observed accumulation of huge amounts of household and plastic waste. It was even necessary to organize the raking and transportation of these floating masses to the legal landfills. These events prompted the representatives of the Curious Club to propose the creation of a prototype, which on its own floating on water bodies to capture the state of the environment, the presence of unregulated landfills and waste, as well as the discharge of wastewater from illegal sewers. This device will collect and transmit information that club members will map and systematize. We are also proposing the introduction of a method imposed last year in Australia for the use of wastewater netting. We will also use our knowledge after the equipment of the astronomical club both for monitoring space debris and for the growing areas of floating islands of plastic waste in the world's oceans. Technologies that are innovative and have a future to solve these global problems are used. These things can be solved with our enthusiasm and financial support of economic entities interested in the cleanliness of the environment.

**Keywords:** Curious Club; Island; Mapping; Ocean; Plastic; Pollution; Space; Wastewater; Waste; Water Bodies

## Introduction

The topic of the presence of waste, mainly plastic, in water bodies around the world is very relevant because the pollution in the world's oceans and riverbeds is constantly increasing. According to researchers in the Pacific Ocean, there are several islands of plastic and other waste with a total area larger than the area of Bulgaria, for example. Of concern is the fact that the amount of used and non-recycled plastic is increasing every year, and with a significant increase. Pollution of the earth's surface with non-degradable

waste is increasing every year and in Bulgaria this is visible everywhere around us - in settlements, in the mountains and forests, along roads and railways and especially along streams and rivers.

## An Essential Part of Scientific Work

The purpose of our development is to help reduce environmental pollution with this type of waste. Our development aims first to study the pollution, to collect information and map the polluted areas, to take actions to

reduce the pollution and to carry out subsequent control [1,2]. Since the biggest pollution is in the water bodies, we focused on their pollution. In turn, water bodies are divided into water bodies on land on the one hand and seas and oceans on the other. That is why we have divided our project into two parts - the first part will study the waste in streams, rivers, lakes and swamps on the mainland of the Earth, and in the second part we will pay attention to the pollution of the world's oceans. In both parts there are many places polluted by man, but each has its own specifics for monitoring, mapping and taking measures to reduce existing waste [3,4].

To work on this topic we were directed 2 months ago by the pollution on the Iskar River near Svoge and many others that we see traveling around our country. For more than a week, the activities for cleaning the water mirror next to the wall of the Prokopanik HPP in the Iskar River from the accumulated garbage, the area of which was about 12 decares, were carried out. Additional equipment was provided to prevent the process from being interrupted while trucks transported the extracted rubbish to the Kostinbrod regional landfill. The main goal is to prevent some of the garbage from passing through the HPP facilities, so as not to pollute the riverbed to Svoge and further downstream. The torrents of January 11 and 12, which caused floods in the Sofia plain, collected all the waste from the ravines of the Sofia field. Most of the garbage is the result of unconscious human activity. We need to work in several directions, and above all this is the change of consciousness, along with the system of control and sanctions, and no less important factor is the policy of prevention. In the presence of facilities such as hydroelectric power plants, before them, along the river, there should be barrier filters for waste collection.

After the level of the rivers increases, there are always blockages and floods, and after their withdrawal in a normal state, piles of waste, especially plastic, remain on the banks and vegetation. In March, for example, the town halls of several settlements organized the cleaning of the Mesta River from the huge amount of plastic waste and the millions of bags decorated with trees in the riverbed. Under the motto „Let's clean the Mesta River together“, about 300 people responded to the call of the mayor of Belitsa municipality Radoslav Revanski to clean the bed of the Mesta river. At this time of year, the Mesta River and its tributaries are extremely flooded due to melting snow, and for years have carried tons of waste from unregulated landfills near their beds. The idea of the mayor of Belitsa Radoslav Revanski to conduct the action was to clean not only the polluted areas around the reservoir, but also to provoke greater self-awareness in people regarding the cleanliness of the environment. People in the area need to build a sense of responsibility when disposing of waste in unregulated places, such as the Mesta riverbed. Similar initiatives have been organized in

other areas this year. But we can't clean up everything we've polluted the other 364 days of the year in one day. It will be much better if we do not pollute for 364 days, then there will be nothing to clean in this 1 day to clean the river, lake or dam.



**Figure 1:** Waste along the Iskar River, 02.2021.



**Figure 2:** Optads on the branches of the bushes along the Mesta River.

There are many unregulated dumps in riverbeds and thousands of sewers connected to river networks. As a result of the „cleaning“ of the riverbeds, the long-standing trees are cut down and bushes are obtained instead, and thus the condition of the riverbeds deteriorates. As a result, instead of improving the permeability of the water bed after 2-3 years, it is significantly overgrown with shrubby vegetation and when the river level rises, the flow of water masses becomes more difficult. At the same time, the branches of this low and medium vegetation contain a lot of plastic bags and other waste, which people have dumped illegally near the river. After the withdrawal of the rivers, an ugly picture of decorated branches with this type of waste is observed,

which is very difficult to collect and significantly pollutes the environment. At the same time, meteorological elements, such as the wind, carried parts of this waste everywhere, and this pollutes nature even more with this non-degradable household waste. In recent months, we have witnessed many such contaminants, some of which we show in Figures 1,2.

With our project, a prototype of a floating device will be made, which will move autonomously along the riverbed and will photograph and study the terrain of the riverbed and the surrounding area for the presence of waste and canals that flow into the river. The device will record and transmit information to a central point. The information will be collected and a characteristic of the riverbeds will be made along the whole length, on the basis of the collected information maps of the rivers, dumps and waste pipes will be made. This information will be very valuable because the state authorities do not know or do not care about such landfills and there are many waste channels built and entered, which are not regulated, legal and do not have basic treatment facilities. The device will be small in size, which will allow it to pass in small streams, and an all-terrain vehicle function can be offered so that it can pass through fords and when the water level drops. There will also be navigation to manage and track the location to detect if needed and prevent theft. At the same time, it will store and transmit information on the condition of the areas it has inspected. After completing his mission, the operator will remove the collected information from his memory and it will be processed by a team (Figure 3).



**Figure 3:** Prototype of a device for transmitting information.

The European Union has currently recognized a ban on plastics, which will take effect in 2021. Until then, countries must comply with the requirements and stop the production of the described plastic items. But one country takes the

initiative into its own hands. At the same time, we will propose that all drain pipes be equipped with nets to collect the waste contained in them. There are already such developments in Australia. Such networks can also be installed at inflows of streams where large amounts of waste have been found. These networks will be equipped with overflow devices to signal when their capacity is being filled. The waste is then transported, sorted and recycled. In this way, we think we will help limit the spread of waste in the environment around us.

In the summer of 2020, the Australian authorities have installed a new system for water filtration and waste collection. This system is incredibly simple and useful. Both the government and the citizens have already seen the benefits of its use and its effectiveness. It consists of a simple net placed at the outlet of a drainage pipe, which helps to capture large debris and protect the environment from pollution. These pipes release water from residential areas into natural areas, and the waste from these places can be in huge quantities, which is very harmful to the environment. In addition, this debris is usually washed away by heavy tropical rains, which drag it to drainage systems [5] (Figure 4).



**Figure 4:** Plastic waste collection in Australia [6].

The Australian authorities started with the installation of 2 nets and were amazed by the results - their new filtering system managed to collect more than 360 kilograms of garbage in a few weeks. So, it was decided to install these facilities and to minimize pollution of nature and water in particular. Although installation and maintenance cost money, the overall system is quite cost-effective, as the authorities save significant costs on maintaining the state of the environment. For example, they are now saving on the cost of manual labor, which they previously had to pay to people to collect all the waste [6]. Our device will also perform subsequent control to monitor the change in pollution. Thus, the information will be superimposed over a period of time, half or a year, and will analyze and compare the distribution of waste in the studied sites - streams, rivers or lakes. The information

will be passed on to the competent state authorities and they have the power to impose sanctions on violators and to grant or revoke appropriate permits. After a certain period of time, the most neuralgic points can be monitored more often, and even move to continuous monitoring of the situation and the disposal of non-degradable waste.

The reason why this type of waste occupies the largest share is that the material is cheap, easy to shape into various products and at the same time, is very light and relatively durable. However, it is the last factor that makes it extremely harmful to nature. It is recyclable, but not in all its forms (Figure 5). At the same time, when burned, it emits many harmful gases [7,8]. Upon entering the wild, it decomposes as follows:

- Plastic for making straws: about 200 years;
- Plastic plates and cups: about 450 years;
- Diapers made of materials related to the production of plastic materials - between 500 and 800 years;
- Plastic bags - depending on the thickness - from 50 to 200 years;
- Plastic bottles - between 180 and 200 years.



**Figure 5:** Plastic Island.

According to various sources, there are about 150 million tons of plastic waste in the world's oceans, with between 4.8 and 12.7 million tons of plastic waste falling into the seas and oceans each year. According to the European Parliament, more than 730 tonnes of plastic waste fall into the Mediterranean alone each year. The area of the floating islands only in the Pacific Ocean is larger than the territory of a country like Bulgaria. And this is to date, and we can imagine what will happen in 20 or 30 years if adequate measures are not taken. Plastic doesn't just mean uglier beaches, even in untouched places. Marine animals can become entangled in larger floating pieces or become confused and swallow smaller particles. Plastic also attracts toxic substances that enter the digestive system of fish. From there, it can reach people along the food chain. The effect on human health is unknown, at least for now, but it is certain that the damage

is significant.

Waste also brings economic losses to both the sectors and people involved in the sea, but also to producers. Only 5% of the value of plastic packaging is reused in the economy, the rest is simply wasted. The need for more recycling and to prevent more plastic from entering the oceans is obvious. Our university is about to build its own astronomical station. We have the assurance of fellow professors and astronomers from related universities such as Sofia University, VVMU, and Varna Observatory that we will start joint activities of our club with related clubs in the field of astronomy and in particular work on projects and programs of EU, NASA and others. . One of our priorities will be the observation and mapping of both space debris and marine and oceanic waste that cannot be hidden from space observation (Figure 6).



**Figure 6:** Types of waste on European shores.

We came across a system based on artificial intelligence (AI), which has been able to distinguish plastic waste in the engine, analyzing satellite images and concepts. As for the smoke of the scientists behind the technology, this is the first time. The current system is based on an analysis of images collected from the satellites Sentinel-2 of the European Competitive Agency, in order to differentiate between them. This makes possible the gratitude of the perceived and

reflected light from these objects - a self-contained „special signature“, the summons reads.

Based on this logic, researchers from the Limit laboratory in Belarus have developed an algorithm for classifying different populations. The algorithm is used in images of the car around Canada, Scotland, Ghana and Vietnam. The statistical system is able to distinguish between plastics and natural materials such as seawater with 86% accuracy. The team's plan is to improve the technology so that it can more accurately detect floating spots in muddy waters and gullies. The idea is for this method to be combined with the trays, in order to follow the plastic closure and thus to support the cleaning operations. Scientists, however, are categorical that the only way to clean up the cluttered oceans is to reduce the amount of plastic that is produced.

### Conclusion

With this, we briefly presented our views on the fight to reduce plastic waste in water bodies - first on the mainland and then in the ocean. We also presented the possibilities for carrying out specific actions on the basis of the Curious Club at the Vasil Levski National Military University and the development of the astronomy club as a section of this club. The results will not be easy, but we think that we must start step by step to help the development of our planet, because we want to live in a better world!

Our proposal is not revolutionary, but we must not wait for a revolution to save ourselves from the vast amount of non-degradable plastic waste that is all around us. Everyone needs to do something small so that all people can live better and everyone is desirable to limit the use of plastic in their daily lives and thus we will restore the normal state of the environment.

### Acknowledgement

This development belongs to the authors who are part of the „Curious“ club at the National Military University „Vasil Levski“, who invested energy, work and enthusiasm

in its development. With it, they participated in the hacoton „Ecotech“ at the National Military University „Vasil Levski“ and the jury and the audience were very pleased with the idea. The idea is still to be further developed and a prototype of the device for monitoring the presence of waste in the riverbeds to be developed. We sincerely hope that our conceptual development will attract the attention of the interested state institutions and companies and find funding for the completion of the project.

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