Interreg
Euregio Meuse-Rhine
LIVE litter free rivers and streams
EUROPEAN UNION
European Regional Development Fund

Final Report

Monitoring of plastics in the Meuse

Report

Version 1.0

2bprojects
Asset Informatiemanagement

Colophon

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Reporting

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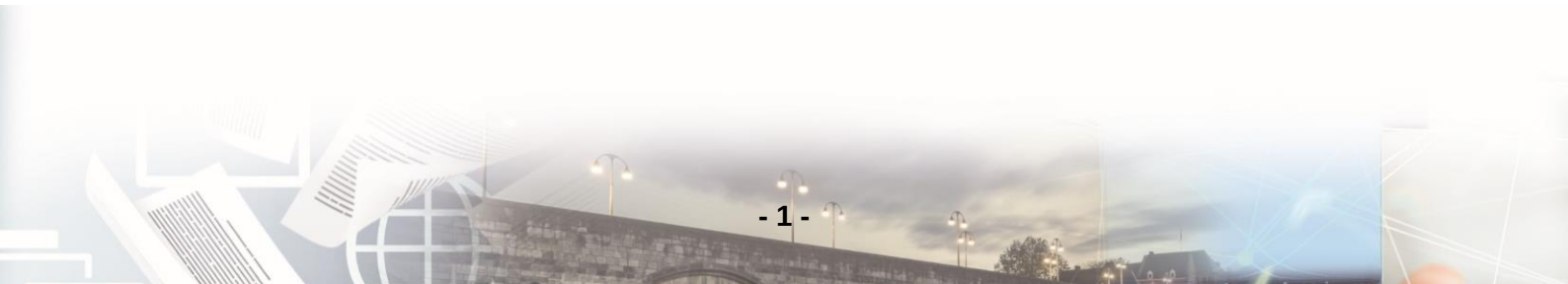
Title	**Final report**
Topic	**Monitoring plastics in the Meuse.**
Status	**FINAL v1.0**
Date	**23 December 2021**

This project is supported by the Interreg V-A Euregio Meuse-Rhine program. The Lives project is being carried out within the context of Interreg V-A Euregio Meuse-Rhine, with 735.300 euro from the European Regional Development Fund.



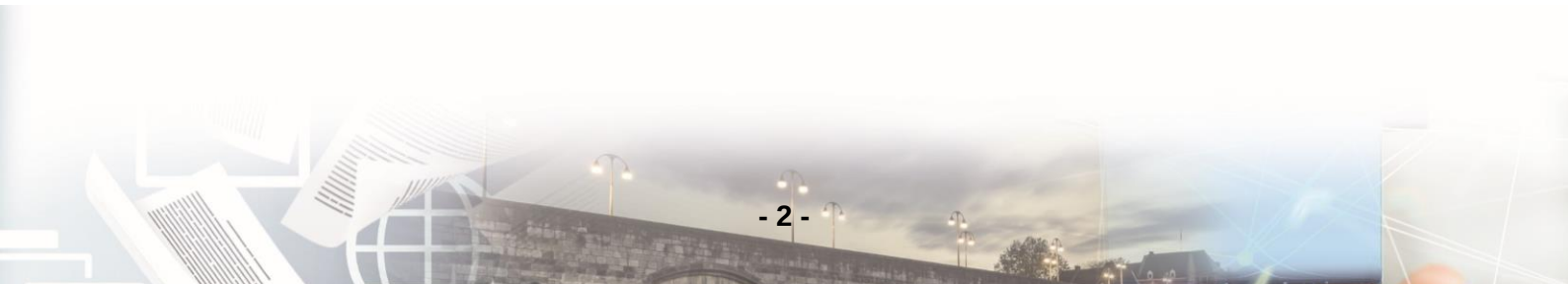
Foreword

Before you lies the report " Monitoring of plastics in the Meuse ". The research into testing of a sampling technique in the water column of the Meuse and the generation of a representative dataset was carried out in the context of work package 1 of the LIVES project.

This research took place in the period from November 2021 to December 2021.

Quinten Buil

Maastricht, 23 December 2021



Summary

Introduction

Work package 1 of the LIVES project aims to be able to monitor litter in the Meuse river basin for the Euregio Meuse-Rhine by means of the inventory and sharing of data. Part of this work package is the testing of a sampling technique in the water column of the Meuse and the generation of a representative dataset. Currently, there is no sampling technique available, so there is limited knowledge about litter in the water column. Testing a sampling technique and generating representative dataset is a first step towards obtaining this knowledge.

Pilot

In this pilot, net measurements were carried out as a proof of concept for the monitoring of litter in the water column of the Meuse. A dataset was generated from these network measurements. The generated data serves as input for an Open Access Data System[1], which has been realized in the context of LIVES work package 1.

Scope

By means of a meeting with the stakeholders, starting points were collected for the pilot.

3 measurements were carried out at 3 different locations on the Dutch part of the Meuse within the Euregio Meuse-Rhine. The locations are shown in Bovenmaas and Grensmaas and are shown below successively with the flow direction (south to north) of the Meuse.

A. Bovenmaas, near measuring pontoon RWS Eijsden, on 24-11-2021;

B. Bovenmaas, for the ball line of weir Borgharen,on 25-11-2021;

C. Grensmaas, for the ball line of weir Linne, on 26-11-2021;

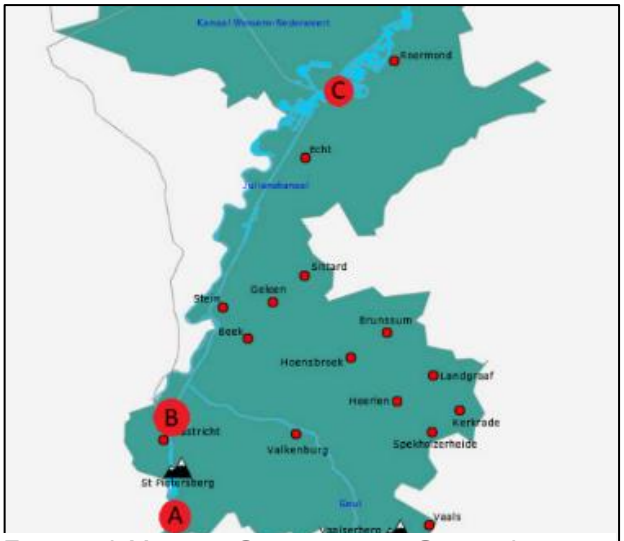


FIGURE 1:MAP OF CENTRAL AND SOUTH LIMBURG SHOWING THE MEASURING LOCATIONS.

Sampling technique

The technique used for sampling is a technique that has previously been applied to the Rhine, the Waal and the IJssel. A set-up has been used with, where possible, 3 nets on top of each other per set-up. The nets are placed next to/behind the boat in the water. The nets are attached to a vertical line with carabiners and are located respectively at the water bottom, in the middle of the water column and just below the water surface. This set-up is used to get insight of the entire water column.

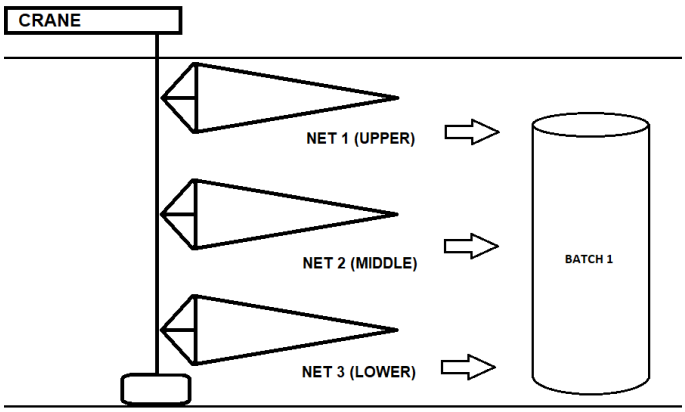


FIGURE 2: NET SETUP + THE CONSTRUCTION OF BATCHES

Deliverables

[1] 2bprojects B.V. (2021, December). LIVES Open Access Data System - LOADS.

With the help of the implementation of this pilot, two deliverables have been realized:

1. A representative and qualitative dataset for macro- and mesoplastics.[2]
2. A sampling and analysis protocol for the monitoring of stray plastics in the water column for macro- and mesoplastics.

Representative dataset

In order to create and generate a representative dataset, it is important to know when a dataset is 'representative'. A representative dataset meets the following requirements:

- Provides the desired information;
- Is uniform and consistent;
- Data is easy to interpret;
- Data is easy to share.

A representative dataset is on the one hand about the content of the dataset (information demand) and on the other hand about the form of the dataset for the purpose of end use (interpreting and sharing data). The information demand is recorded at the initial stage of the pilot. During the pilot, during the execution of the net measurements and the analyses, a part of this information demand is realized each time.

By establishing functional specifications (see Annex 13) in advance for data to be delivered and for the implementation process, the implementation can provide a uniform and consistent dataset. This means that the data is complete, that 'the same language' is spoken in the field of data and that everyone adheres to the same 'rules of the game' when it comes to entering and processing data. The process in which the data was created is recorded, so that the data can always be interpreted and reproduced correctly. Speaking the same language is necessary for sharing and combining data with multiple parties and organizations.

By setting requirements for how data must be filled, it is also possible to test whether this has actually happened. For each value in a dataset, it was assessed whether it meets the functional frameworks[3]. By having insight into the quality of data, it is clear how reliable and complete the data is. The results from quality testing provide input for analyses. This results in a quality score for reliability and completeness of the data. Below are the scores of the data from this pilot in terms of reliability (to what extent do the values correspond to the functional specifications) and completeness (to what extent are the fields that are mandatory filled).

Reliability: 95%
Completeness: 100%

Sampling and analysis protocol

In this pilot, a sampling and analysis technique was tested using the 'try and test' method. This means that an assumption is tested to find out whether the concept or idea is feasible. These techniques have been translated into a sampling protocol (annexes 3 to 5) and an analysis protocol (annexes 6 to 8). These protocols contain a step-by-step plan, a process sheet and a photo report. With the sample and analysis protocol it is possible to reproduce the measurements and the required data.

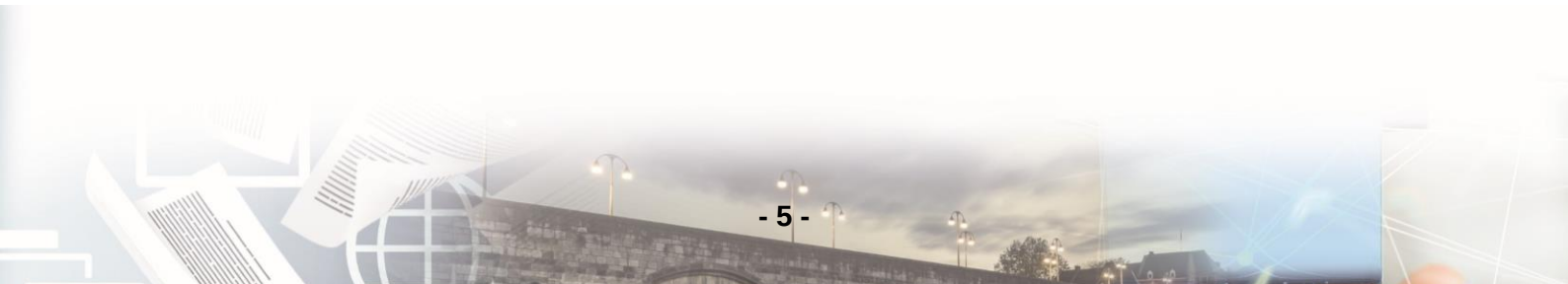
There have been 9 measurements of each 1 hour[4]. The results of this pilot can be found in Annex 13. The sampling process has been tested and is positive, workable and safe. As a result, no people have to enter the water unauthorized. In addition, the crane vessel on the deck immediately provides workspace and at low temperatures it is possible to sit warm in the cabin when the nets are in the water. A crane vessel is also safe to use at higher discharges from the Meuse (up to 700 m^3/s).
With the help of additional samples of measurements on the Meuse of ATKB, the analysis process was simulated. These samples have been used to enlarge the entire set of batches which makes the test

[2] Macroplastics are plastics larger than 5 cm. Mesoplastics are plastics with a size between 5 mm and 5 cm.
[3] Detailed explanation of how this is calculated can be found in Annex 9.
[4] This is a starting point that has been taken to carry out every measurement the same. It has not been investigated which measurement duration is most suitable.

results of the analysis process more representative. The analysis process is experienced as workable. The lab at Zuyd Hogeschool in Heerlen offers a large space where you can work. In addition, the school has several tools that have been used in the process such as sieves, ovens, trays and large tables.

Conclusion

In this pilot, an information process has been integrated into the tested sampling technique and analysis technique. The information process is, regardless of the measurement method carried out, the core for providing insight into the litter problem. The inventory and sharing of data between multiple parties is only possible if agreements are made about how data is handled and the processes in which the data is created. These agreements must be made by organizations that want to gain insight into and mitigate the litter problem in a cross-border collaboration. The tested sampling and analysis technique are both efficient and workable processes, in which the information demand is well safeguarded. These techniques can possibly be applied in a multi-year monitoring strategy and further developed on the basis of the lessons learned.



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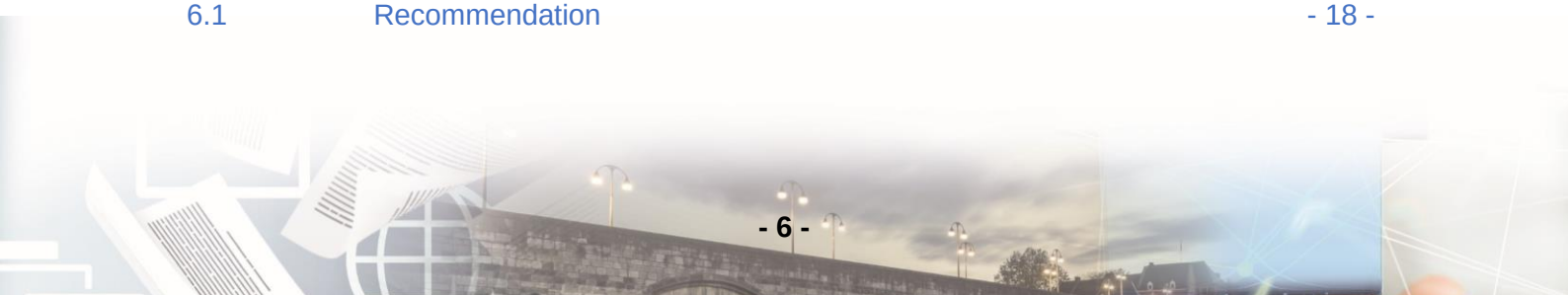


1 Introduction

1.1 Litter pollution – How did we get here?

The past 70 years have seen a worldwide exponential increase in the production and consumption of products.[5] New materials such as plastic revolutionized our way of living. However, this leap forward also has a shadow side to it: a large portion of these products have ended up in the environment through improper waste disposal and littering. This so called litter pollution is now everywhere: large amounts of plastics have accumulated in our oceans (also known as the 'plastic soup'), in our rivers, and on land. We even find microplastics, which mainly stem from litter that is broken down in the environment, in the food we consume and the water we drink.

1.2 Litter in rivers – A serious problem

Litter pollution is produced on land through mismanagement of waste and littering. Only a small fraction of litter pollution ends up in the famous 'plastic soup' in seas and oceans. Most litter is (temporarily) retained in rivers.[6] Here it has a range of negative effects on nature and fauna, it can increase flood risk due to blockage of drainage systems, and cause economic damage.[7] Due to the longevity of the materials in our waste streams, the ubiquity and large volume of it, litter pollution has become one of the most significant and challenging environmental problems of our times.

Key knowledge required to effectively tackle the litter problem is currently lacking. For example, very little is known about the sources of litter pollution, how much litter is exactly in our rivers, and where hotspots of litter can be found. Such knowledge is key for the design of effective litter reduction, mitigation, and removal strategies. This knowledge can only be gained through effective monitoring of litter in our rivers.

Rivers run cross-border, litter pollution therefore is a cross-border problem as well which requires international cooperation to solve. Monitoring is one of the areas where international cooperation is needed the most. International standardized methods to monitor riverine litter are currently lacking. This leads to data gathered by different countries to often be incomparable with each other, hindering the design of effective solutions to the litter problem.

1.3 The LIVES project – Cross border cooperation to reduce litter pollution

The Litter Free Rivers and Streams (LIVES) project is a cross-border initiative with the aim of reducing the presence of litter in the catchment of the Meuse river through international cooperation. This project unites governments, water managers, and scientists from Germany, Belgium, and the Netherlands to jointly tackle the litter pollution. This is done on three fronts: 1) creating a shared understanding of the litter pollution problem through cross-border monitoring and data sharing, 2) implementation of measures aimed at reducing litter, and 3) creating institutional arrangements to anchor these changes in future policy.

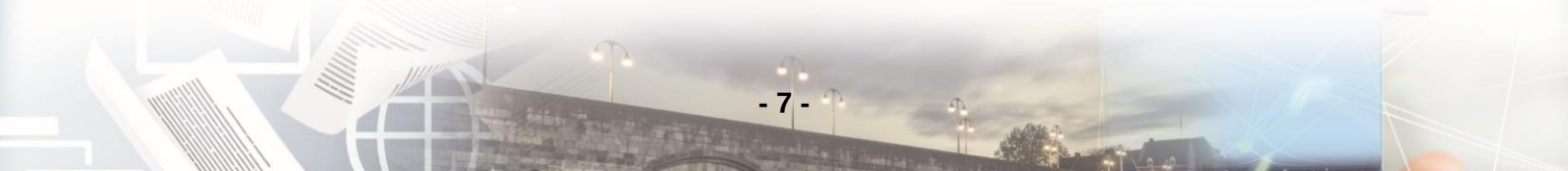
1.4 Reading guide

The first chapter describes the general information of the pilot. The second chapter explains how to generate a representative dataset. Chapter 3 explains the sampling technique. In chapter 4 the analysis technique. Finally, there is a conclusion with recommendations.

[5] For example, plastic production increased from 2 to 381 million tons worldwide per year over this period of time, Geyer et al., 2017

[6] Stored for example on riverbanks, Meijer et al., 2021

[7] van Emmerik & Schwarz, 2020; Deloitte – The price tag of plastic pollution



2 Pilot - Litter monitoring on the Meuse

Work package 1 of the LIVES project aims to be able to monitor litter in the Meuse river basin for the Euregion Meuse-Rhine by means of the inventory and sharing of data. Part of this work package is the testing of a sampling technique in the water column of the Meuse and the generation of a representative dataset. Currently, there is no sampling technique available, so there is limited knowledge about litter in the water column. Testing a sampling technique and generating representative dataset is a first step towards obtaining this knowledge. The assignment was carried out in a collaboration of four parties: 2bprojects, Idverde, Rijkswaterstaat and Zuyd Hogeschool (see Annex 1).

2.1 Scope

This pilot was carried out in the Dutch part of the Meuse within the Euregion Meuse-Rhine. Within this area, measurements were carried out at three locations, in 3 periods, in the period from November – December 2021.

In this pilot, the following issues were investigated:

1. How can the chosen sampling technique be carried out efficiently, workably and safely?
2. How can the chosen analysis technique be carried out efficiently and workably?
3. What is a representative dataset and how can it be realised?
4. How can a dataset be tested for quality?
5. What lessons can be learned from the process?

In addition to these two deliverables, the pilot includes:

1. A representative and qualitative dataset for macro- and mesoplastics;
2. A measurement and analysis protocol for the monitoring of stray plastics in the water column for macro- and mesoplastics;
    a. Sampling and analysis protocols serve as proof of concept for the monitoring[8] of stray plastics in the water column.

2.2 Principles

Through a meeting with the stakeholders, starting points were collected for the pilot. The starting points are recorded in a spreadsheet.

The following principles have been established:

Number of locations:	3
Number of measurements per location:	3
Measurement time:	1 hour
Sampling method:	Net measurement from ATKB.
Number of nets:	3
Net diameter:	1 m
Mesh size of net:	1 mm
Execution method:	Crane vessel

[8] One Proof or Concept (Poc) is a method of determining the practical feasibility of a concept, theory, technology, idea or functionality. A PoC is applied in the initial stages of product development, the method is used to assess whether the idea can be realized. It is a 'try and test' method. In fact, an assumption is tested to find out whether the concept or idea is feasible.

The measurements were carried out at the following locations (downstream, south to north in main stream of the Meuse):

A. Bovenmaas, near measuring pontoon RWS Eijsden, on 24-11-2021;

B. Bovenmaas, for the ball line of weir Borgharen,on 25-11-2021;

C. Grensmaas, for the ball line of weir Linne, on 26-11-2021;

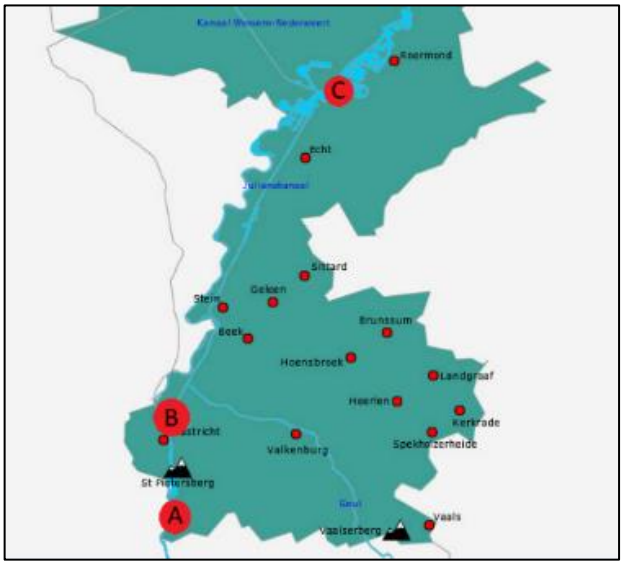


FIGURE 3: MAP OF CENTRAL AND SOUTH LIMBURG SHOWING THE MEASURING LOCATIONS.

3 Representative dataset

Part of this pilot is the generation of a representative dataset. A representative dataset and important to be able to share and compare data in a (cross-border) collaboration between multiple parties. This provides a cross-border insight into the problem of littering. In order to determine whether a dataset is representative, it is necessary to define what is meant by 'representative'.

A representative dataset meets the following specifications:

- Provides the desired information;
- Is uniform and consistent;
- Data is easy to interpret;
- Data is easy to share.

The data from this pilot will be used as input for the Open Access Data System.[9] The paragraphs below describe how the above specifications were answered in this pilot.

3.1 Terminology

- **Uniform**
  The term 'uniform' is used to indicate that all data has been recorded in the same way, but has also been collected uniform way.

  An example:
  Suppose that information has to be recorded about bottles. One person writes: 'Bottle'. Another person writes down 'PET bottle' and yet another person writes down 'Btl'. Three different values arise that mean the same thing. By agreeing in advance that a bottle will be noted as 'Bottle', this will result in uniform data.

- **Consistent data**
  The term 'consistent data' refers to data that is filled in a uniform manner. Consistent data therefore contains data that is unambiguous and complete.

  An example:
  Suppose there is a large Excel sheet with data. There should be no empty cells in this. Empty cells cause a lack of information, resulting in inaccurate analyses. In addition, the values must be uniform as explained in the previous example. So if data is not uniform and not complete, we speak of 'inconsistent data'.

3.2 Safeguarding the information demand

Regardless of how a pilot is carried out, there is a certain demand for information. This demand for information stems from a need to want to know something. This is also called the 'information demand'. The information demand was recorded in the initial phase of the pilot.

In the elaboration of the processes in this pilot, the data is always centrally positioned in every process. For each process step of the sampling and/or analysis, it is recorded which part of the information demand is added to the dataset. In this way, when following all processes, the information demand is realized simultaneously. This can be seen in the process sheets in Annexes 6 and 9.

The information demand of this pilot is laid down in a registration form, attached in Annex 12. The information demand contains general information per measurement (for example: time, measurement duration, etc.) and results of the analysis (for example: total weight and the categorization of litter).

[9] 2bprojects B.V. (2021, December). LIVES Open Access Data System - LOADS.

3.3 Preconditions for interpreting and sharing data

In a general sense, generating data is a fairly unambiguous process. However, interpreting data is a bit more complex. Especially if the period in which the data was generated is a while ago. Without corresponding interpretations, it is possible that data no longer be interpreted in the same way over a longer period of time. To ensure that the data in this pilot can be interpreted, the process in which the data was created has been recorded. As a result, it is always possible to reproduce what the preconditions and starting points were at the time that the data was generated. Data can therefore always be collected in the same way.

By setting requirements for the way in which data must be recorded, a dataset can be structured uniformly and consistently (as described in the example of section 3.1). The requirements for the data from this pilot can be found in Annex 10. This in turn helps with data sharing. Sharing data is above all: making agreements. First, it must be described together which data there is. And then, what data is needed in certain situations. The data that will be shared must be standardized. Together, it is determined what a piece of information exactly means (and what it doesn't) and how the content is described. Only then is it possible to share and combine data.

This is important in order to be able to share and compare data in a (cross-border-)collaboration between multiple parties. This provides a cross-border insight into the litter problem, so that action can be taken more effectively in mitigating litter in the Meuse.

3.4 Qualitative assessment of data

By setting requirements (Annex 10) for how a dataset must be filled, it is also possible to test whether this has actually happened. For example, it can be assessed per value in a dataset whether it meets the set specifications.

Insight into data quality ensures that the owner of the data has a grip on his information process. Having a grip on an information process means that:

- It is known what is in the content of the dataset;
- It is known what the quality of the data in the dataset is;
- It will be possible to set quality requirements to keep the dataset 'clean'.

By having a grip on the information process, it is clear how reliable the data is. Insight into data quality provides insight into the reliability of data used in analyses. Reliable analyses result in more effective measures, which for LIVES partners contributes to the common goal: Monitoring and mitigating litter in the Meuse river basin.

3.4.1 Quality check in this pilot

Part of this pilot is the generation of a representative dataset. In order to determine whether a dataset is representative, it is necessary to define what is meant by 'representative'. This chapter has described how a dataset can be made representative. With the quality check carried out, a dataset can also be kept representative. This was carried out in this pilot with the quality check tool Elyzee.

Annex 10 describes how requirements are set for the data and how this translates into a data test. Annex 11 sets out the quality criteria used. The data test was carried out with Elyzee. Elyzee is a data quality check tool that tests the data for quality on the basis of criteria. The criteria arise from the set functional specifications. With Elyzee it becomes clear what the reliability (to what extent do the values correspond to the functional specifications) and the completeness (to what extent are the values that are mandatory filled) of a dataset. A quality report can then be run from the data test. This quality report of the data has been added in Annex 14. The data generated in this pilot has the following scores:

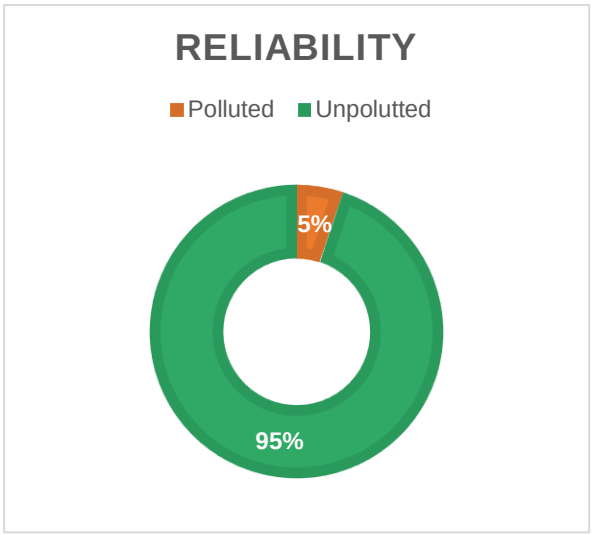


FIGURE 4: RELIABILITY SCORE OF THE CHECKED DATASET.

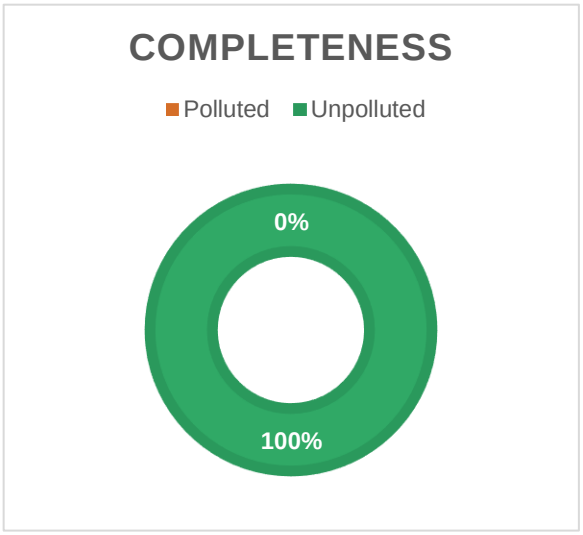


FIGURE 5: COMPLETENESS SCORE OF THE CHECKED DATASET.

4 Sampling protocol

4.1 Sampling technique

The technique used for sampling is a technique that has previously been applied to the Rhine, the Waal and the IJssel. The same set-up was used as previously carried out in an ATKB study[10]; i.e. where possible 3 nets on top of each other per set-up. This is a sampling technique with hoop-shaped larvae nets (see Annex 5) that settle in the water flow like a windage in the wind. The nets are placed next to/behind the boat in the water. The nets are attached to a vertical line with carabiners and are located respectively at the water bottom, in the middle of the water column and just below the water surface. This way it is possible to get insight of the entire water column.

The detailed explanation of the approach is described in Annex 3.2.

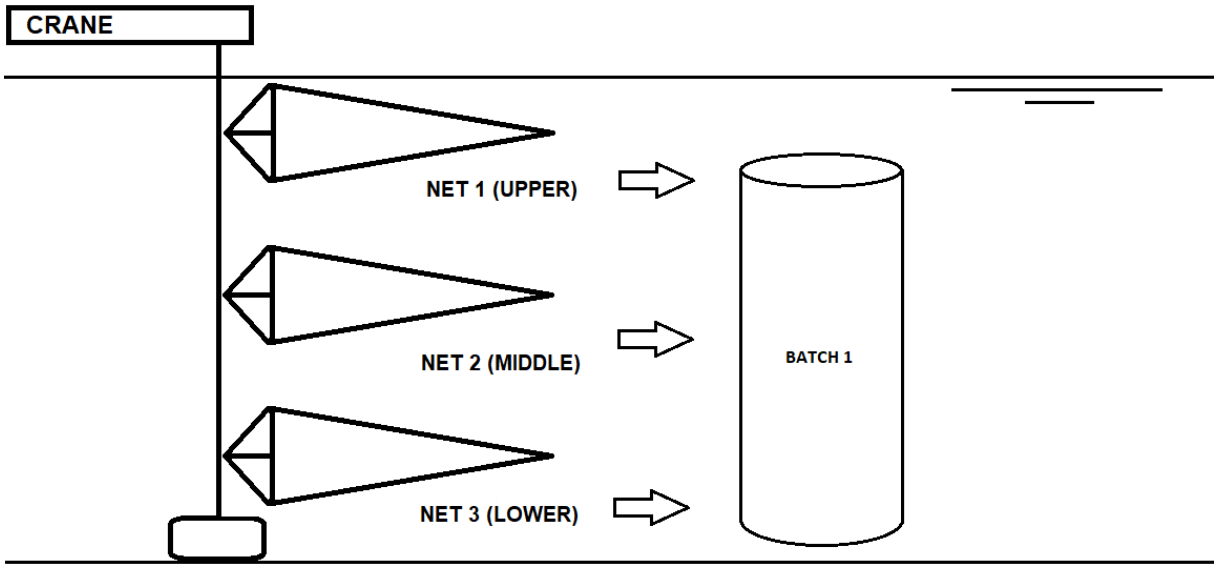


FIGURE 6: THE MEASUREMENT SET-UP AND THE CONSTRUCTION OF (SUB-)BATCHES OF ONE MEASUREMENT.

4.2 Execution

The measurements was carried out using a skipper with a crane vessel. This was chosen because in this way can be measured safely on the Meuse and this means that no people have to enter the water unauthorized. A crane vessel can use spud poles positioning itself firmly in the water, so that work can also be done safely at higher discharges of the Meuse (up to 700 m^3/s). In addition, the crane vessel provides workspace on the deck and at low temperatures it is possible to sit warm in the cabin when the nets are in the water.

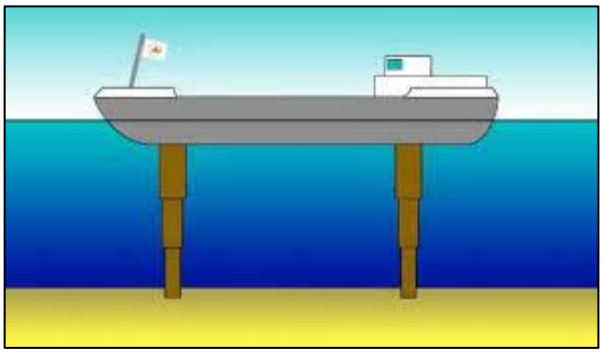


FIGURE 7: A SHIP THAT POSITIONS ITSELF FIRMLY ON THE BOTTOM BY MEANS OF SPUD POLES.

The extended implementation is described in the roadmap in Annex 3.2 and the process sheet in Annex 4. A photo report can be found in Annex 5.

[10] ATKB. (2020, December). Meetplan monitoring Plastics.

4.3 Results

There have been 9 measurements of 1 hour[11] each, spread over 3 locations. The table below shows some of the results collected during sampling.[12]

LOCATION	DATE	MOMENT	MEASUREMENT DURATION	DEPTH	NET SETUP	FLOW-SPEED
Measuring pontoon Eijsden Hotels	24-11-2021	09:26	01:00	4,00	3 nets (B, M, O)	0,25
Weir borgharen	25-11-2021	08:36	01:00	6,85	3 nets (B, M, O)	0,21
Weir Linne	26-11-2021	10:52	01:00	8,20	3 nets (B, M, O)	0,13

TABLE 1 PART OF THE RESULTS OF SAMPLING BY MEASUREMENT LOCATION.

4.4 Conclusion

In this part of the assignment, it was investigated whether the sampling technique could be carried out efficiently, workable and safely. Based on the principles described in section 2.2, a draft sampling protocol has been written. Using a 'try and test' method, the feasibility of this protocol was tested.

The process that has been completed in Annex 3.2 has been experienced as feasible by the executing party (Idverde) as well as the coordinating party (2bprojects). Working on a crane vessel offers sufficient space to work safely and efficiently. The maintenance contractor of the area is directly authorized under the performance contract to carry out work on the Meuse. The measurements went well and all the necessary data that has been predetermined in the information demand has been collected.

With the help of the sampling protocol, monitoring was carried out in the same way at different locations. The data from the sampling can be compared with each other in this way. In order to map the effects of the chosen starting points and measurement conditions, monitoring should be carried out in the same way more often. In Annex 3.3 all lessons learned are bundled. These lessons learned contain optimizations and advice that can be built on in a possible follow-up process.

4.5 What does this mean for LIVES?

The sampling technique performed is defined as a workable technique. In the context of monitoring, it is important to carry out multiple measurements using the same technique to gain insight into the litter problem in the Euregion Meuse-Rhine. The sampling protocol developed in this pilot can be used in follow-up pilots or monitoring programs to provide this insight. In addition, this report can be used for the further development of this sampling technique.

[11] This is a starting point that has been taken to carry out every measurement the same. It has not been investigated which measurement duration is most suitable.

[12] The data in this table concerns a part of the entire dataset. The data shown in the table is for information to show what such a set of data looks like. This says nothing about what was actually caught. Catch data is fed in the analysis phase.

The entire dataset can be found in Annex 13.

5 Analysis protocol

5.1 Analysis technique

After sampling, the measurements were analysed. Zuyd Hogeschool has made a laboratory available to carry out these analyses. This location has ovens, with which the plastics are dried and large tables where counts have taken place. The analysis of all batches of samples was carried out on one day in week 49.

The plastics should be categorized depending on the type of plastics. Macroplastics (>5cm) and mesopastics (5mm-5cm) are weighed separately. All plastics must be dried before weighing. As a result, no water is weighed with it. Mircoplastics (<5mm) are not in the scope of this assignment.

Macroplastics (>5cm)
The counting of macroplastics was done on the basis of the OSPAR[13] list, as it is used in the Clean Rivers project. After counting, the whole of the macroplastics is weighed.

Mesoplastics (5mm-5cm)
The counting of mesoplastics was done on the basis of the OSPAR list, as it is used in the Clean Rivers project. After counting, the whole of the mesoplastics is weighed.

5.2 Execution

In order to simulate the analysis process, additional samples of measurements on the Meuse of ATKB were also analysed. These samples have been used to enlarge the entire set of batches, which makes the test results of the analysis process more representative.

ATKB is a party that also carries out net measurements in the Netherlands. They also carried out measurements on the Meuse during the same period using the same technique. The execution technique of ATKB differs in different areas compared to the execution technique as applied in this pilot. This does not matter for simulating the analysis process. The final results (Annex 13) also indicate that the sampling of the additional samples was carried out by another organisation.

All samples are placed on a sieve and rinsed out. For each batch, all pieces of litter that could be found on the eye were placed separately on a tray. This tray is placed in the oven to dry the litter. In the end, all pieces of litter were peated on the basis of the OSPAR list and weighed. The OSPAR[14] list is an internationally recognized list in which litter can be categorized.

The detailed implementation is described in the roadmap in Annex 6.2 and the process sheet in Annex 7. A photo report can be found in Annex 8.

5.3 Result

After analysing, the pieces of litter were peated and weighed. The following are the types of litter (in accordance with the OSPAR list) that were mainly found during monitoring:

- Indefinable plastic pieces 0 - 2.5 cm (hard plastic);
- Plastic films or pieces of it 0 - 2.5 cm (soft plastic);
- Plastic films or pieces of it 2.5 - 50cm (soft plastic);
- Other rubber.

[13] This list can be found in Annex 13.

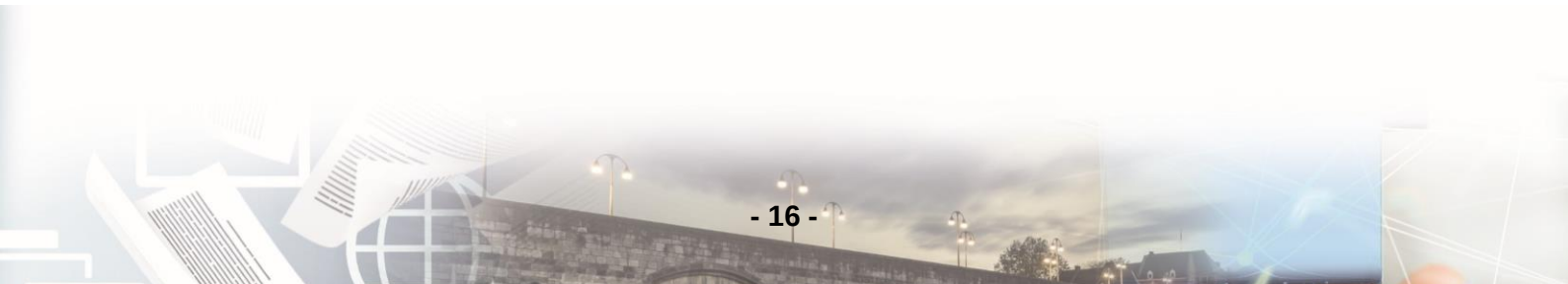
[14] Van Emmerik, T., Roebroek Hotels, C., De Winter, W., Vriend, P., Boonstra, M., & Hougee Hotels, M. (2020). Riverbank macrolitter in the Dutch Rhine–Meuse delta. Environmental Research Letters, 15(10). https://doi.org/10.1088/1748-9326/abb2c6

5.4 Conclusion

In this part of the assignment, it was investigated whether analysis technology could be carried out efficiently and workably. A draft analysis protocol has been written. Using a 'try and test' method to test the feasibility of this protocol.

The process that has been completed in Annex 6.2 has been experienced by the implementing party (2bprojects) as workable. The lab at Zuyd Hogeschool offers a laboratory where it is possible to work. In addition, the school has several tools that have been used in the process such as sieves, ovens, trays and large tables. The choice for Zuyd Hogeschool was made because they are a partner of LIVES and wanted to participate in this pilot and they could facilitate the required tools. A place providing the same tools used in the process is suitable for work. This does not necessarily have to be Zuyd Hogeschool for possible other follow-up pilots.

In Annex 6.3 all lessons learned are bundled. These lessons learned contain optimizations and advice that can be built on in a possible follow-up process.



6 General conclusion

Work package 1 of the LIVES project aims to be able to monitor litter in the Meuse river basin for the Euregion Meuse-Rhine by means of the inventory and sharing of data. Part of this work package is the testing of a sampling technique in the water column of the Meuse and the generation of a representative dataset. Currently, there is no sampling technique available, so there is limited knowledge about litter in the water column. Testing a sampling technique and generating representative dataset is a first step towards obtaining this knowledge. With the help of the following questions, answers have been sought to achieve this objective:

1. How can the chosen sampling technique be carried out efficiently, workably and safely?
2. How can the chosen analysis technique be carried out efficiently and workably?
3. What is a representative dataset and how can it be realised?
4. How can a dataset be tested for quality?
5. What lessons can be learned from the process?

The sampling technique was carried out by the performance contractor with the help of a skipper and a crane vessel. In this way, the sampling technique is carried out safely on the Meuse and therefore no people have to enter the water unauthorized. A crane vessel can position itself firmly in the water with the help of spud poles, so that work can also be done safely at higher discharges from the Meuse (up to 700 m^3/s). In addition, the crane vessel provides workspace on the deck and at low temperatures it is possible to sit warm in the cabin when the nets are in the water. The maintenance contractor of the area is directly authorized under the maintenance-contract to carry out work on the Meuse. The measurements went well and all the necessary data that has been predetermined in the information demand has been collected.

The analysis technique was carried out at Zuyd Hogeschool and is experienced as efficient and workable. Zuyd Hogeschool has several tools that have been used in the process such as sieves, ovens, trays and large tables. The choice for Zuyd Hogeschool was made because they are a partner of LIVES and wanted to participate in this pilot and they could facilitate tools. A place providing the same tools used in the process is suitable for work. This does not necessarily have to be Zuyd Hogeschool for possible other follow-up pilots.

The sampling and analysis technique can both be applied in a multi-year monitoring strategy after some further development.

This pilot also investigated what a representative dataset is and how it can be generated. A representative dataset can be generated by recording an information demand and making many agreements about how data is recorded and interpreted.

In this pilot, an information process has been integrated into the tested sampling technique and analysis technique. The information process is, regardless of the measurement method carried out, the core for providing insight into the litter problem. The inventory and sharing of data between multiple parties is only possible if agreements are made about how data is handled and the processes in which the data is created.

This is important in order to be able to share and compare data in a (cross-border) collaboration between multiple parties. This provides a cross-border insight into the litter problem, so that action can be taken more effectively in mitigating litter in the Meuse.

6.1 Recommendation

This pilot was carried out as part of Work Package 1 of project LIVES. The advice from this pilot is given to all PARTNERS of LIVES who want to monitor in the water column of a river in the future and share data in order to gain a cross-border insight into the litter problem.

Advice 1:
The advice is to further apply and elaborate the developed sampling technique and analysis technique based on the lessons learned. The core for the further development of these techniques lies mainly in the alternation of different conditions in which measurements take place.

In this pilot, various starting points were taken for the net measurements. (For example: measurement duration of 1 hour, 3 locations, 3 days in November, discharge into the Meuse of 90 – 120 m^3/s)

It is valuable to know what the effects of these principles and circumstances are (for example, at different discharges in the Meuse, other measuring locations (possibly based on the hotspot map), different periods in the year or a longer measurement duration). The workability of the sampling technique has been proven, but the 'perfect' conditions for sampling have not been investigated. If this is known, effective monitoring can be carried out at multiple locations within the Meuse-Rhine Euregion, but also beyond. This will result in a cross-border insight into the litter problem.

Advice 2:
The advice is to place data and the associated information process at the centre of every project that will generate data. By making agreements with partners about data, it becomes possible to combine data. This will contribute enormously to cross-border cooperation within the Meuse-Rhine Euregion in the field of data inventory and monitoring of litter.

Making agreements about data is of great importance in order to be able to share, compare and combine data. Agreements can be made by setting up a working group with people from participating organisations. They can record agreements together and ensure that these agreements are guaranteed in the processes of their organization. If there is insufficient knowledge from the participating organizations about this field, a party can be involved who will guide and support this process.

If data can be shared and combined, then we can work together to provide cross-border insight into the litter problem. Every organization can provide a piece of information that this insight offers. By staying in touch with each other through the working group, you can also learn from each other. This will contribute enormously to cross-border cooperation within the Euregion Meuse-Rhine in the field of data inventory and monitoring of litter.

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