

The effects of infrastructure on the Pedosphere

Differences between Nysa, Rotterdam and Buzet

Group 16



FOREWORD

The purpose of this report for GLOBE & Erasmus with the pedosphere as a subject matter is to investigate the differences between the state of the soils of Nysa, Rotterdam and Buzet. To accomplish

this, a research question regarding infrastructure and soil-pollution of the pedosphere was chosen and a fitting hypothesis was created. To prove or disprove the hypothesis a research plan was constructed, covering both the taking of observations & measurements and observing these. This report will elaborate on this topic and answer the question under investigation.

CONTENTS

Summary	2
Preface	3
Research Plan	4
Results & Analysis	5
Conclusion	8
Evaluation & Reflection	8
Resources	9
Appendix	9

SUMMARY

This report is written with the means to explore the effects of infrastructure and rapid urbanization on the pedosphere of various locations in Nysa (Poland), Buzet (Croatia) and Rotterdam (the Netherlands) through datasets gathered on three samples from locations ranging from very urbanized to non-urbanized. These sets consist of two protocols, the pH Protocol and the Soil Characterization Protocol, both set up by GLOBE. The aim was to compare data from these three international areas to determine the correlation between these topics. Although not all data was collected it was still possible to establish the effect of infrastructure on the soil, especially in Rotterdam. It was discovered that the pH of Buzet and Rotterdam are very similar and that in both towns the pH scores lowered the further away from the urban centre. Even though these differences were small, there was a clear correlation found. Nysa, on the other hand, differed immensely in pH numbers but these results could be justified. The research project explains the effects of construction residue, of which more can be found the closer you get to the city centre, on the soil pH levels and the fertility of the soil.

PREFACE

Nysa, Rotterdam and Buzet are very different when it comes to the level and amount of urbanization and infrastructure. The small town of Buzet, located in the mountains of Croatia, only has a population of just over 6.000 inhabitants. Its infrastructure is minimal and surrounding areas consist of mostly forests and grass-covered hills. Rotterdam, on the other hand, is a significant city in the Netherlands with a remarkable port. The polish town Nysa has a population of around 44.000 and used to be known for its metal industries. Infrastructure ranges in these cities from very present to almost none. The degree of infrastructure correlates with larger amounts of urbanization and thus also pollution. The guiding question that initiated the research that this report contains is:

- *“How do the soils of Nysa, Rotterdam and Buzet differ and why?”*

The aim with this project is to find out how various amounts of infrastructure have influenced the soil negatively. It is well-known that healthy soil is important for a good ecosystem and this is the reason why this particular subject has been researched. The hypothesis that is created for the guiding question goes as follows:

- *“It is expected that areas with more infrastructure, urbanized areas, have higher levels of ground pollution and lower levels of nutrients due to the larger use of transportation and increased amounts of construction residue, which leads to soil contamination and infertility.”*

For this hypothesis to be tested, soil from various locations, ranging from very urban to as far from infrastructure as possible, in each of the three cities and towns will be characterized and the pH of the soil will be determined. The characterizing of the soil will identify the number of free carbonates present in the soil and establish the type of soil. The pH test will determine how acidic or alkaline the collected soil is, with a pH of 7 being neutral. The pH will provide information about the conditions of the soil, and the soil characteristics & environment of the various locations will show how infrastructure has affected the soil and thus its surroundings, as the effects of a contaminated soil can also be examined with these data sets.

RESEARCH PLAN

In each of the countries three samples of soil from different locations will be taken and further examined. Each group will choose a location that is in the urban centre of their city/town, a location that is less-urbanized, but still has some clear signs of infrastructure, this could be somewhere in the suburbs, and lastly a location in nature, a non-urbanized area. The GLOBE protocols that will be followed

are the soil characterization protocol and the pH protocol. The measurements will be obtained during the winter, in December & January. The data from these various experiments will be compared and analysed, with the objective of answering the guiding question.

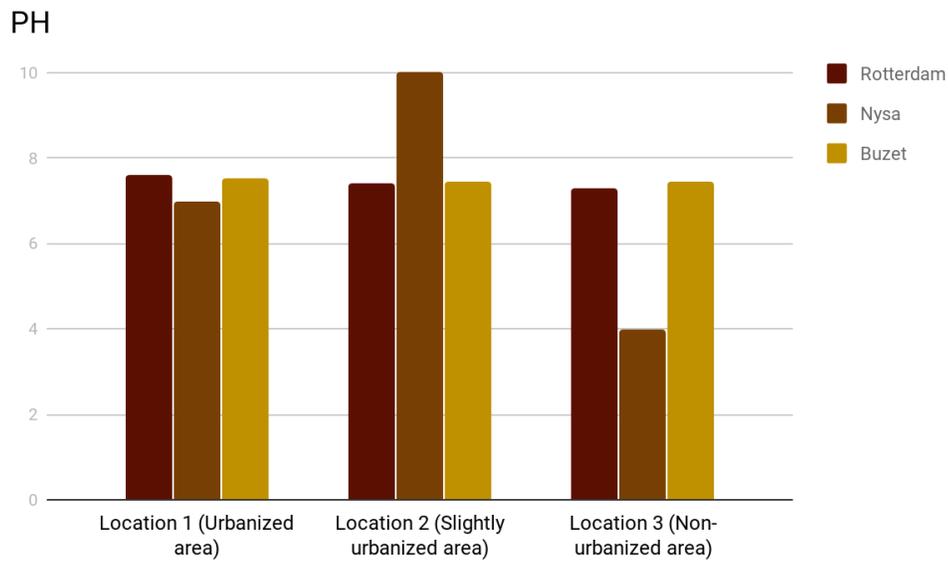


Locations of samples in Rotterdam

Locations of samples in Buzet

In order to execute the protocols, some materials will have to be obtained via school. A pH-meter was necessary for the pH test, for the characterization protocol the various materials can be found at home. It is expected that the pH and characteristics of the soil will not differ immensely over time during the winter, so measurements only have to be obtained once. The minor differences will not have any effect on the results, and are therefore excluded from the research.

RESULTS & ANALYSIS



<i>Soil characterization</i>	Urbanized area	Slightly urbanised area	Non-urbanized area
Rotterdam	<p>Busy road with a lot of traffic next to it, small patch of ground, grassy, lots of flats all around the neighbourhood, worms and ants were found</p> <p>Very dark brown soil, wet, firm/loose, granular</p> <p>Soil type: loam Some carbonates</p>	<p>Road and river next to the location, some grass and some trees, worms and roots were found</p> <p>Very dark brown soil, wet, firm/loose, granular</p> <p>Soil type: loamy sand Some to no carbonates</p>	<p>In the middle of a forest, grassy, a lot of trees, worms and a lot of roots were found</p> <p>Very dark brown, wet, firm, granular</p> <p>Soil type: Silty clay loam Some carbonates (most of the three locations)</p>
Nysa	-	-	-
Buzet	<p>Park near the city center, grassy surface with flowers, stones and sticks spread around, insects</p> <p>Soil type: not established Carbonates: not established</p>	<p>Lots of houses, agricultural lands, snails & other insects, close to the city center and near a river</p> <p>Soil type: not established Carbonates: not established</p>	<p>Near the river Mirna, wet & moist (from the rain), muddy surface, puddles, no animals present</p> <p>Soil type: not established Carbonates: not established</p>

Location 1, the urbanized location, in Rotterdam was around the Schiekade next to a railroad and a main car lane that is directly connected to the highway. This means that thousands of vehicles pass by weekly

which results in lots of emission and pollution. The pH measured at this exact location was the highest of all measurements done in Rotterdam, although all results are very close to each other. A pH of 7.6 for location 1 makes it somewhat alkaline, from a pH of 7 the soil gets more

Location 1 - Rotterdam

alkaline, these soils are known for being poorer in nutrients. Urban soils are generally expected to have a high pH as the result of alkalisating products, such as rubble or slag, mixed in the soil according to a report done by the EEA. Urban soils also contain a lot of sand and some pieces of cement due to a continuous practice of (re)construction, sand has a pH of 7 and cement has a pH between 12 and 13. This explains why urban soils are often around a pH of 7 or higher. The soil also contained some carbonates, and was identified as loam. The most carbonates, however, were found at location 3, which was in the centre of the forest in Kralingen. This is presumably caused by dead organic remains present in the soil and due to flora storing carbon dioxide in the soil. The location contained few trees, but lots of low growing grasses and weeds. The soil was identified as silty clay loam and had a pH of 7.3. This shows that infrastructure affects soil extensively, and has effects on a very wide range. Location 2 was classified as sandy loam, which could be related to a characteristic of urban soil set by the EEA, urban soils are expected to have an increased sand content due to construction material import, which relates to the fact that location 2 was inside a fairly recently constructed suburb. The pH of location 2 is 7.4, which is in between the other two locations, and integrates with the hypothesis set. The data from Rotterdam proves the thesis as the soil closer to the city centre often experiences more construction and thus has more ground pollution. The soils closer to the city are therefore more alkaline, have a higher pH, and thus less nutrients that are available for plants in the area, soils between a pH of 6.2 and 7.3 are ideal for plant growth. Most of the nutrients that plants absorb are found at a pH between these values. The locations in Rotterdam prove to be more fertile soils than was initially expected in the hypothesis. However, the soils of Rotterdam aren't as fertile as soil that is closer to pH levels around 6.7 to 6.8, which tend to be further away from the city centre.



In Buzet the results were very similar to those of Rotterdam. The most urbanized area had a pH of 7.52, which is very likely to be the result of the same motives in Rotterdam. The suburb location had a pH of 7.46 and the non-urbanized location a pH of 7.44. The pH in Buzet therefore also decreases the farther away from the urban centre, just like in Rotterdam. A pH above 7 is alkaline, which is not the most ideal for vegetation, meaning that the soil becomes more fertile as it gets further away from infrastructure, but this was already clarified.

In Nysa very different pH levels were found, but they can still be connected to the hypothesis. A pH of 7 was found in the urbanised area, which is the same as the results that were found in the urbanized areas in Rotterdam and Buzet. This result can be explained as urbanized areas have a lot of construction, as was mentioned before. However, very different results were found in the suburb and non-urbanized areas. In the suburbs of Nysa a pH of between 10 and 11 was found, which is the most alkaline out of all the results. The location was a park near a bus station. This pH could be explained due to the fact that there might be a construction site nearby or that the soil contains high amounts of sodium which makes the soil very alkaline. In the non-urbanized area a pH of 4 was found which is the most acidic out of all of the results. This can be explained as this data was found near a larch, which is a conifer species. Conifer species are generally known for their acidic pine needles. When the needles of the larch enter the soil and decompose the pH of the soil often lowers and becomes more acidic. This data deviates from the rest of our results but can still be explained due to the nature of its environment.

The soil nearer to the city centre can definitely be called more contaminated as more construction residue such as sand, cement, rubble and slag are found here. This affects the pH levels and will ultimately also affect the fertility levels. The fertility of the different soils can also suffer from construction residue as more alkaline soils contain less nutrients. However different plant species are adapted to all kinds of levels of pH. Most of the world's plants thrive at pH levels around 6.8. This does not necessarily mean that plants can not grow in other soil pH levels. Different plant species have adapted to different soils, some plants thrive in more acidic soils while others thrive in more alkaline soils. The fact that construction residue makes the soil more alkaline and the fact that most plants thrive in soil pH levels around 6.8 does correspond with our hypothesis. As most of our data generally concludes that the closer you get to the city centre, the higher the soil alkalinity gets.

CONCLUSION

In conclusion, the set hypothesis proved to be correct. The data from Rotterdam and Buzet were very similar and concluded that the soil closer to the city centre is more alkaline due to the construction residue that is present in the soil. More alkaline soils are further away from the pH level of 6.8 in which most plant species thrive, which means that soils surrounded by more infrastructure closer to the city centre prove to be less fertile. The soil in Rotterdam was also identified and it was discovered that the soil of location 2 existed mainly of sand due to being inside a new residential area. In Poland the pH level of the city centre corresponded with the results of the other city centre locations. However, the suburb location and non-urbanized location were very different than those of Buzet and Rotterdam. This was resolved, but did not altogether correspond with the hypothesis. However, it can be said that overall our hypothesis worked for the three international locations.

EVALUATION & REFLECTION

During the Erasmus to Globe research project three groups from three different countries had to work together to gather data and write a final report. The teamwork between the individuals within each group went well, plans could be made in each country and data could be gathered easily. However, teamwork between the three groups did not go as well, the communication took a long time to take off and sometimes messages were not answered or ignored completely. The Polish and Croatian groups did not really understand the ultimate goal of the project so had to be explained firstly. The Dutch group took initiative in conversing almost all of the time, primarily to get the data put into the file before the deadline and to make sure everybody understood the protocols and our research plan. The Polish group was the first to gather and put the data in the file at the end of December followed by the Dutch group that gathered and put the data in the file at the end January. The Croatian group gathered the data at the end of January as well but put in their data on the 19th of February. In the end the two protocols that were used were executed by the Dutch and partly by the Croatian group, only one of the protocols was executed by the Polish group, and a vacation interrupted the research plan. In the end the Dutch group wrote the whole final report and coordinated & analysed the data. The communication could have gone a lot better and is something which could be improved in a later research project.

RESOURCES

GLOBE - Pedosphere Protocols

- pH Protocol
- Soil Characterization Protocol

GLOBE - Soil Introduction

EEA Report - [Soil resource efficiency in urbanised areas](#)

University of California - [Effects of pH, sodicity and salinity on soil fertility](#)

Green Harvest - [Understanding Soil pH](#)

APPENDIX

- Soil pH protocol & Soil Characterization protocol - Globe

Polish group location 1 (small park near bus station - Kacper Tomáš):

date and hour of measurement	12.12.19 18:00	14.12.19 12:03	16.12.19 17:52	18.12.19 16:24	20.12.19 21:19	28.12.19 11:23
temperature	2°C	5°C	5°C	10°C	6°C	1°C
humidity	3	6	2	1	3	8
pH	11	10	10	10	10	11

Polish group location number 2 (Soil near tree (larch)) (non-urbanized area) - Gabriel Skrzypczak :

Date and hour of measurement	14.12.2019 r. 10:35	21.12.2019 r. 14:15	28.12.2019 r. 13:40
Temperature	6°C	5°C	3°C
Humidity	2	2	3
pH	4	4	4

Polish group location number 3 (Roadside at road rural) (urbanized area) - Katarzyna Kutkiewicz :

Date and hour of measurement	14.12.2019 r. 10:30	21.12.2019 r. 14:10	28.12.2019 r. 13:35
Temperature	6°C	5°C	3°C
Humidity	2	2	3
pH	7	7	7

Soil characterization Rotterdam

Rotterdam	Temperature (22/01/2020)	Soil Characterization (25/01/2020)	pH
location 1 (city centre)	6.7°C - 16:39	soil: - very dark brown - wet - firm/loose - granular - loam - some carbonates	7.6
location 2 (suburbs)	5.9°C - 16:48	soil:	7.2

		<ul style="list-style-type: none"> - very dark brown - wet - firm/loose - granular - loamy sand - some to no carbonates (least of 3 locations) 	
location 3 (outside of city/nature)	5.3°C - 17:09	soil: <ul style="list-style-type: none"> - very dark brown - wet - firm - granular - silty clay loam - some carbonates (most of 3 locations) 	7.3

Rotterdam	Location 1	Location 2	Location 3
Soil characterization in the field	city centre, soil profile is moist, worms and ants, grassy, no stones no roots, only grass	next to the water, soil profile moist, worms partly grassy, some trees, 1 stone, no roots, some grass	in the forest, soil profile is wet, worms, grassy and trees no stones, many roots and a lot of grass

Buzet, Croatia

location 1

- urbanized area
- a park near the city center
- grassy surface with flowers
- stones and sticks spread around
- insects

location 2

- small and quiet neighborhood

date	22.1.2020
time	3 pm
temperature	9°C
pH	7.52

- a lot of houses and agricultural lands
- snails, ants and other insects
- close to the city center
- near a river
- pH: 7.46

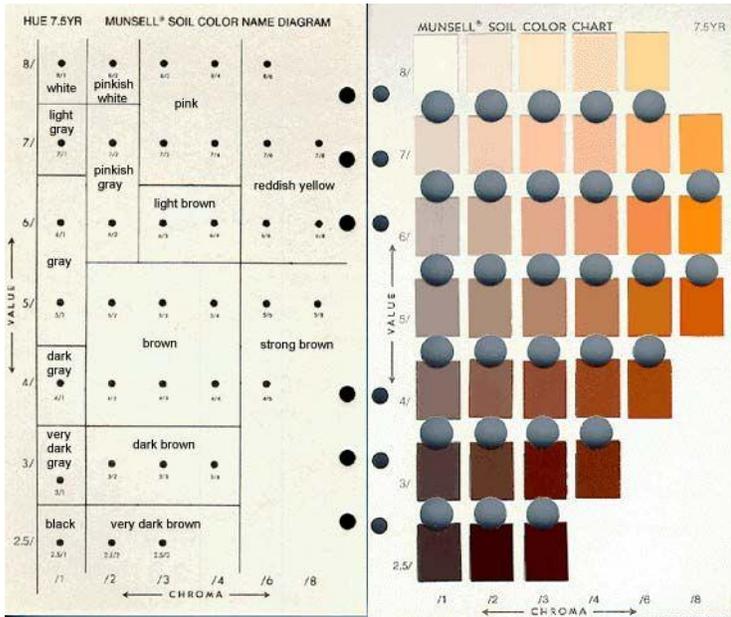
location 3

- non urbanized area
- walking path near the river Mirna
- wet and moist terrain from the rain
- muddy surface
- puddles
- poor alkaline soil (7.33 - 7.80)
- little stones and sticks
- no animals present

date	17.1.2020
time	3 pm
temperature	12° C
pH	7.44

Charts

that were used:



How soil pH affects availability of plant nutrients

