Developing metrics and instruments to evaluate citizen science impacts on the environment and society

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Abstract (for dissemination)	Deliverable 4.2 provides a description of the site and set up of citizen science activities in the Italian case study where the MICS impact assessment will be applied. The Italian case study focuses on the Marzenego River and its tributaries which flow into the Venice Lagoon. The nature-based solutions (NBS) along the Marzenego River have involved restoring two wetlands (Oasi Lycaena and Oasi di Noale) and a new NBS project aims to enlarge the Noale Oasis to increase flood water retention and improve biodiversity. These NBS are the focus of the citizen scientist monitoring activities in the case study. Co-design workshops have identified that the following citizen science monitoring activities will take place: water quality monitoring, bacteriological analysis, riparian vegetation monitoring, aquatic vegetation monitoring.				
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Contents

Executive Summary

The MICS project is developing metrics and tools to measure the impacts of Citizen Science which are validated in hands-on citizen science activities in four case study sites in Europe. Deliverable 4.2 provides a description of the site and set up of citizen science activities in the Italian case study where the MICS impact assessment will be applied. The Italian case study focuses on the Marzenego River and its tributaries which flow into the Venice Lagoon. The rivers have historically been modified (e.g., channelized) which has increased flood risk; in addition, pressures from urban development and agricultural activities have affected water quality and biodiversity. The nature-based solutions (NBS) along the Marzenego River have involved restoring two wetlands (Oasi Lycaena and Oasi di Noale) and a new NBS project aims to enlarge the Noale Oasis to increase flood water retention and improve biodiversity. These NBS are the focus of the citizen science monitoring activities in the case study.

In Italy, participatory processes in which citizens can volunteer, called “river contracts” have been adopted since 2007 across Italy. The Marzenego river contract began in 2012. River contracts set out a series of rules in which the criteria of public utility, economic performance, social value and environmental sustainability have been integrated to identify effective solutions on the river basin restoration process in the water environment. However, the Marzenego river contract came to a standstill in 2017 with no fulfilment of the objectives. Therefore, the MICS project provides an opportunity to re-engage citizen scientists in the water environment.

The Ground Truth 2.0 co-design light methodology (MICS deliverable D4.6, based on Wehn and Pfeiffer, 2020) was adopted and used to guide the set of citizen science activities in the Italian case study. Co-design workshops were held with citizen scientists and local authority stakeholders associated with the management of the Marzenego River and tributaries. Co-design workshops were held in-person and online (due to the COVID-19 pandemic). In total, over the four co-design workshops, 45 people attended. The objectives of the co-design workshops were to build a common understanding of the problems related to the river and wetlands and identify priorities for citizen monitoring. The agreed challenge identified by the stakeholders at the co-design workshop was to improve the water quality and landscape, whilst reducing flood risk along the Marzenego River and tributaries. It was agreed amongst the stakeholders that the following monitoring activities would take place: water quality monitoring, bacteriological analysis, riparian vegetation monitoring, aquatic vegetation monitoring. Citizen science training for monitoring the environmental elements started in September 2020 for the case study.

1 Introduction

1.1 Background on MICS

The MICS project develops approaches and tools to assess citizen science impacts. These approaches and tools can help to plan and implement projects in ways that lead to more robust results. The MICS project specifically aims to:

- provide comprehensive, participatory and inclusive metrics and instruments to evaluate citizen science impacts;
- implement an impact-assessment knowledge-base through toolboxes for methods application, information visualisation, and delivery to decision makers, citizens and researchers;
- improve the effectiveness of nature-based solutions through test-site development and citizen-science tool validation;
- generate new approaches that strengthen the role of citizen science in supporting research and development;
- foster a citizen-science approach to increase the extent to which scientific evidence is taken up by policy makers through recommendations and guidelines.

The result is an integrated platform where these metrics and instruments are available for use by anyone involved in a citizen science project wanting to understand its impact, whether at the planning stage or several years after the project's conclusion. This platform is validated by pilot testing in test and validation sites across Europe. The test and validation sites are in the UK, Italy, Hungary and Romania. These sites explore the applicability of MICS impact-assessment tools in regions with differing needs, contexts, and approaches to nature-based solutions, and with various levels of citizen-science application. For example, in Western Europe, river restoration is increasingly carried out within an ecosystem-based management framework at river or catchment scale; in Southern Europe, river restoration tends to be issue-specific with some ecosystem relevance; in Central and Eastern Europe, river restoration is about ecosystem protection and related to existing infrastructure.

1.2 Purpose

The MICS project is tasked with setting up and implementing an Impact Assessment framework, tools and metrics for citizen science projects that serves to capture impacts in five distinct domains: society, science, environment, economy and governance. This report is a deliverable of Work Package 4 (WP4) – 'Test-site development and tool validation' which will develop and organise the pilot testing of the MICS Impact Assessment framework and tools in the test and validation sites in the UK, Hungary, Romania and Italy. The purpose of Deliverable 4.2 is to provide a description of the Italian case study and the set-up of citizen science activities in which the MICS impact assessment will be tested on and reported on in the comprehensive evaluation report (deliverable 4.5) in 2021.

1.3 Structure of the report

This deliverable reports on the set up and co-design of citizen science activities following the Ground Truth 2.0 light methodology in the MICS Italian case study. Section 2, provides a description of the Italian case study, including its location and nature-based solutions (NBS), Section 3 provides a

description of the set up and outcomes of the co-design workshops. Section 4 provides further details on the citizen science monitoring activities. Finally, section 5 presents the next steps for the case study.

2 The Italian Case Study

2.1 Introduction

The Italian case study is located along the Marzenego River and its tributary Rio Draganziolo, Italy. Within the Marzenego River Basin, settlement dispersion (where the rural life patterns are combined with those typical of the city) and intensive agriculture activities have modified river channels and caused degradation to water quality and increased flood risk. The reclamation Drainage Authority "Acquerisorgive" is therefore facing a process of water governance in a complex territory, trying to promote a shared commitment within a participative pathway, which in Italy is called a local "river contract", with both public and private subjects participating voluntarily. A "river contract" should adopt a series of rules in which the criteria of public utility, economic performance, social value and environmental sustainability have been integrated to identify effective solutions on the river basin restoration process.

In order to reduce water quality problems (e.g., eutrophication) that severely impair the quality of the Venice Lagoon waters, the Regional Government established a series of targets for the nutrients reduction that flow into the lagoon at the end of 1990s. The local Drainage Authority "Acque Risorgive" was required to integrate this objective within its main task of reducing flood risk. They chose, from the beginning, to adopt the "Working with nature" approach that allowed them to take advantage of the ecological potential of parts of the water network. Following this approach, the Consortium has begun adopting several nature-based solution's (NBS) projects related to river restoration. This approach is optimal, pursuing the objectives of both the two directives on water, the Water Framework Directive (WFD, 2000/60/EC) and the Flood Directive (2007/60/EC), to the management and sustainable use of nature to address socio-environmental challenges such as climate change, water risk, water pollution, human health, and to the environmental disaster risk management. NBS's are therefore part of an integrated approach to conserve, sustainably manage and preserve the functionality of natural ecosystems. The results are manifold, in addition to achieving the initial objectives, they significantly increased habitat diversity and therefore biodiversity, increasing landscape quality. The Marzenego river restoration project follows the NBSs approach that includes specific actions such as: conserve and replant riparian vegetation, channel enlargement and reshaping, restore natural habitats, creation of wetlands both within and out of channel.

Within the Marzenego River Basin, the MICS project will assess the effects of citizen science focused on the monitoring of improvements to the river and catchment conditions that result from river restoration, through the active participation of local citizens. The focus of the restoration, and the citizen science monitoring are related to the improvement of water quality, flood protection and increase in biodiversity. In order to achieve these objectives, in collaboration with the Drainage Authority "Acque Risorgive", public participation will be implemented. This process includes a series of workshops to define both the environmental monitoring activities carried out by citizens and the project choices best suited to the territorial context.

2.2 Location of the Marzenego River

The Marzenego River originates in the north-western part of the province of Treviso in the Venetian Region, Italy, collecting the spring waters and minor ditches. This underground water emerges at the foot of the large alluvial area made up of deposits transported during the last glaciation. Along its 45km, the Marzenego catchment includes several municipalities in the provinces of Treviso and Venice, crossing an extremely heterogeneous territory, characterized by rural, industrial and urban areas (Fig. 1). Its waters, at the exit of the historic centre of Mestre, are channelled into the artificial Osellino canal which reaches the lagoon of Venice at Tessera. The complexity and variety of pressures on the Marzenego catchment area strongly influence the state of the river, both from a biochemical and morphological point of view. In fact, despite the initial purity of the spring waters, the waters of the Marzenego that reach the lagoon are of very poor quality, both from a chemical and microbiological point of view.

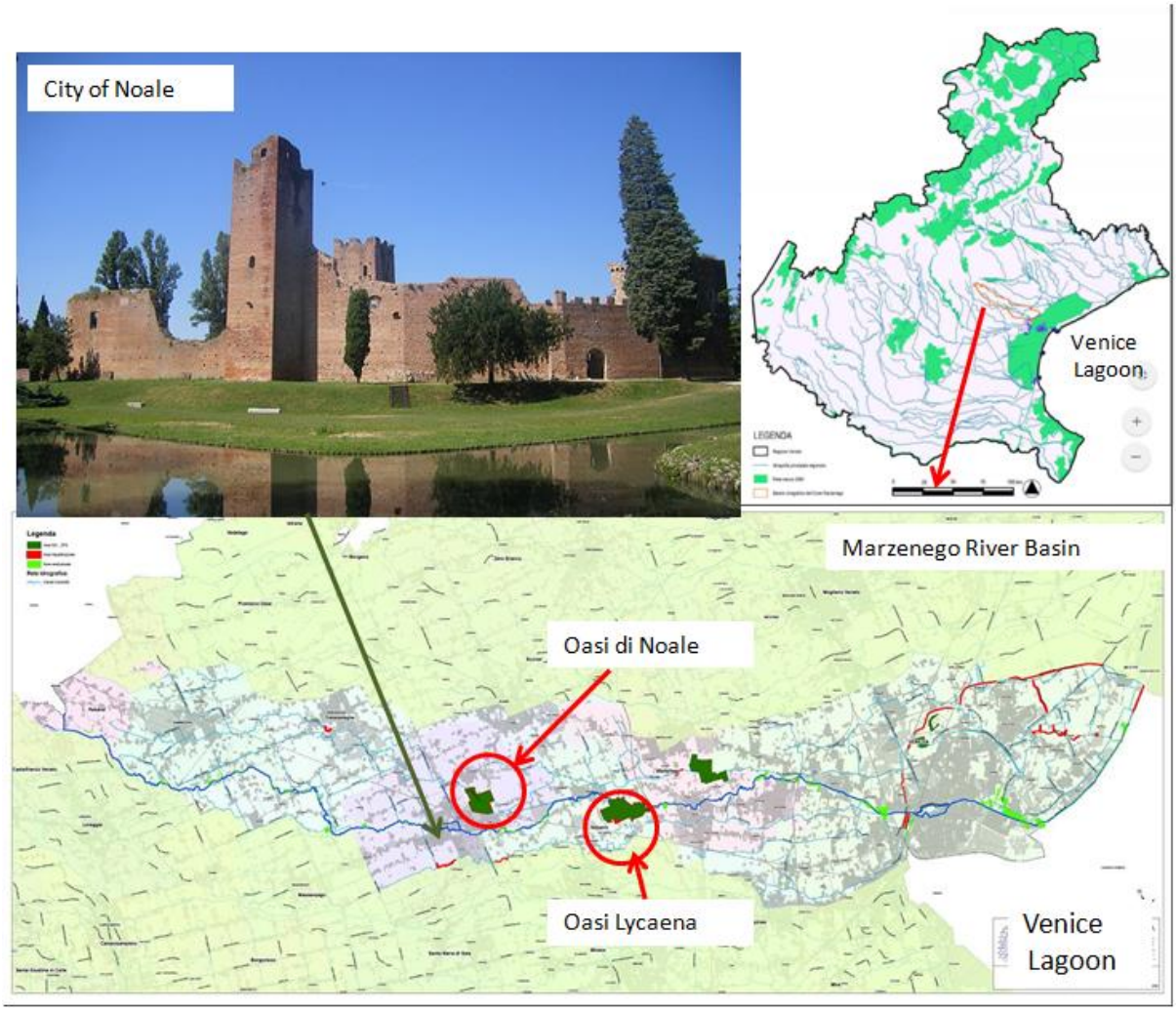

Figure 1: The location of the Marzenego River Basin within the Veneto Region (above), location of the two wetlands within the Basin; the photo shows a glimpse of the Noale city and the Marzenego river (maps and photo courtesy of DA "Acque Risorgive").

The Marzenego River receives waters from a dense network of drainage canals, which have modified the morphology of the watercourse and cause a further pressure. Past reclamation works, carried out to increase the "anthropic" use of water, often did not include the hydraulic protection of the nearest territory. As a result, the areas surrounding the Marzenego and its tributaries were at risk of flooding. In order to cope with the flood risk, the Eastern Alps District Basin Authority has foreseen, within the Flood Risk Management Plan (FRMP), a series of NBSs designed and carried out by “Acque Risorgive” to reduce the risk. It is in line with the provisions of the Floods Directive (2007/60/EC), that the measures must be compatible with the objectives of the broader Water Framework Directive (2000/60/EC), to improve the river within a context of an integrated catchment management.

2.3 Nature based solution summary

Among the various NBSs carried out, within the Marzenego River Basin the MICS project will focus on two wetlands (Oasi Lycaena and Oasi di Noale) that have been restored and on a new project with the aim of enlarging and improving the performance of the Noale Oasis.

Figure 2: Overview of the Lycaena Oasis and two glimpses on the right. At the top right butterfly Lycaena dispar ((orthophoto and photos courtesy of DA “Acque Risorgive”).

The “Oasi Lycaena” is a protected area of about 60 hectares owned by the Metropolitan City of Venice. It was a clay quarry until the mid-70s. Following the end of the excavation activities and the subsequent abandonment of the area, the quarries underwent a process of spontaneous naturalization and as a consequence the area was transformed, in a few years, into a wetland of great biodiversity value. In 2006, the area was slightly modified, by the DA “Acque Risorgive”, to promote phytodepuration (a purification process) of the Marzenego River. Thus, connections were created between Marzenego and the ponds, with incoming water, and between the ponds and the tributary Rio Roviego, with outgoing water. Currently the Oasis is a Site of Community Importance (SCI) under

the Habitat Directive 92/43/EEC and the Special Areas of Conservation (SACs) under the Birds Directive 79/409 / EEC (Fig. 2).

The oasis of Noale has a similar history to Lycaena, a quarry area that was later abandoned and therefore naturally redeveloped, and which in 2005 the "Acque Risorgive" carried out some works to increase its phyto-purification function, creating:

- A reed edge canal that runs along the west side of the former quarries (Fig. 3 and 4);
- Meandered channel that runs alongside the Rio Draganziolo on the east side;
- 3 ponds with a maximum depth of approximately 2 m inside the former quarries;
- 1 pond 50-70 cm deep outside the former quarries;
- Border Embankment;
- Pedestrian paths and tree planting;
- 2 floodplains along the right bank of the Rio Draganziolo.

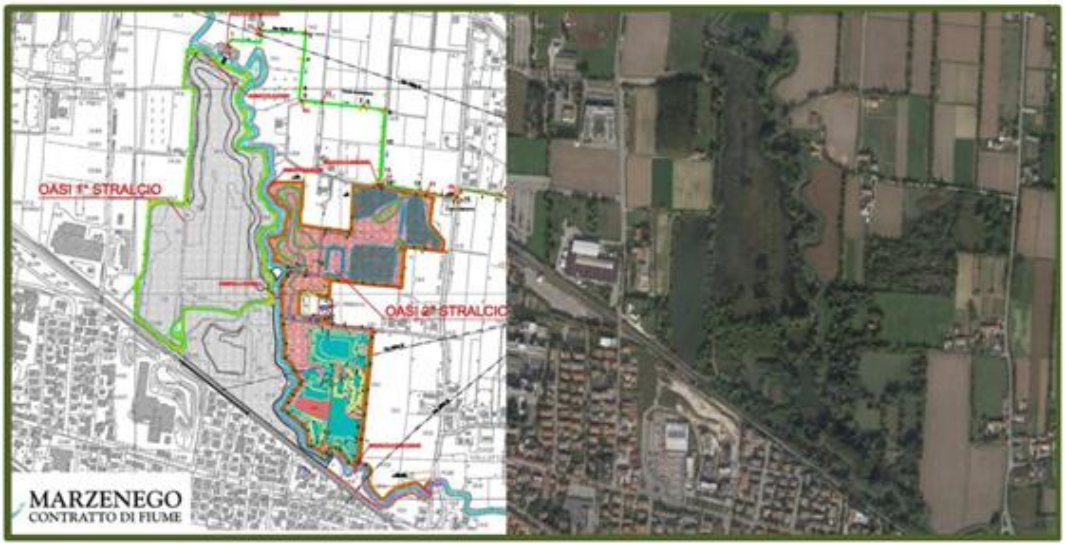

Figure 3: Drawing of the first restoration project on the left in gray and that of the second project in red. Overview of the Noale Oasis (map and orthophoto of courtesy DA "Acque Risorgive").

Figure 4: Reservoir area in case of flood with some glimpses of the wetland during a high flood (map and photos of courtesy DA "Acque Risorgive").

Since the wetland creation, there has been an increase in biodiversity and environmental quality. Example of fauna sighted after the works include *Rana Latastei* (Lataste frog), Red Heron (Fig. 5).

Figure 5: Surface of the two protected areas of Natura 2000 (map and photos of courtesy DA "Acque Risorgive").

Objectives of the new project of Noale wetland enlargement:

- Increase in the self-purification activity of the Rio Draganziolo in order to reduce the nitrogen load spilled in the Venice lagoon (Phytodepuration).
- Enlargement of the wetland volume in order to reduce the flood risk of the Rio Draganziolo;
- Improvement of recreational uses and development of structures aimed at carrying educational purpose.

Project works:

- New water withdrawal ditch;
- New wetland (2 ha) (will occupy a currently agricultural area) (Fig. 6);
- New links between existing basins;
- New ditch for returning water to the Rio Draganziolo.

It has been estimated that the project will reduce nitrogen load to Draganziolo stream of 4.3 t / year. According to this assessment, the wetland guarantees an efficiency of 43%.

Flood lamination (water storage area), project works:

- Containment embankment
- Total area affected by the project: 14.50 ha
- Useful surface for phytodepuration and floods lamination: 12 ha
- Cost: € 2,272,410.36
- Executive project closure: December 2020

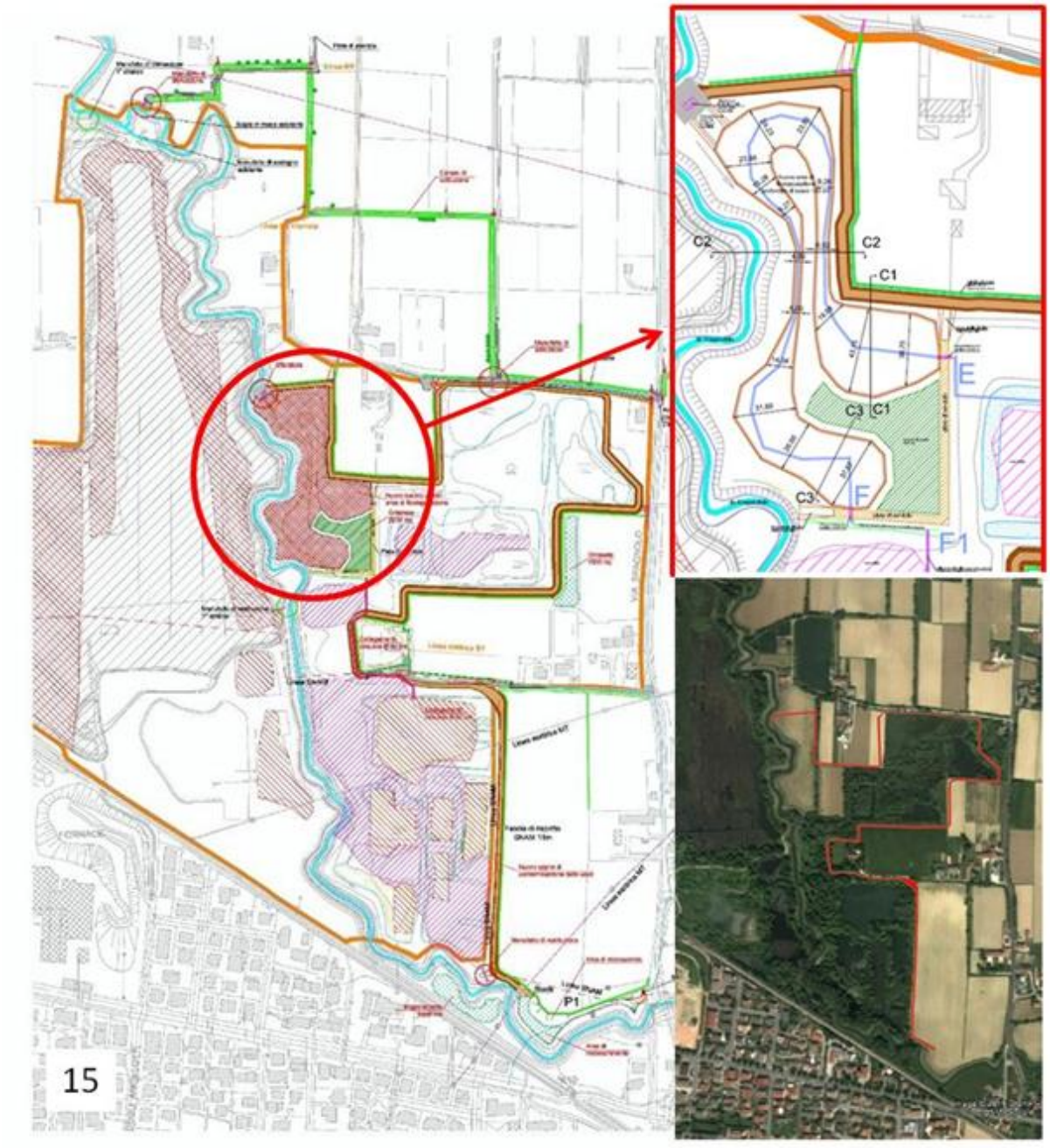

Figure 6: Details of the new restoration project, in particular the transformation from arable field to wetland (map and photos of courtesy DA "Acque Risorgive").

3 Co-design Activities

Setting up and implementing hands-on citizen science activities in the MICS case studies to evaluate the impact of NBSs requires a structured approach. The Ground Truth 2.0 co-design methodology light (MICS deliverable D4.6, based on Wehn and Pfeifer, 2020) represents best practice in the co-design of hands-on citizen science and is particularly suitable for the context of NBS with the methodology's focus on generating citizen science activities that are purpose-driven by jointly agreed societal challenges, based on a sound understanding of the social context.

In the Italian case study, the Ground Truth 2.0 co-design methodology light was used to guide the development and set up of citizen science activities. This section will describe the set-up of citizen science activities and the co-design workshops.

3.1 Ambition of Citizen Science for NBS

The Italian case study citizen science activities have several ambitions outlined below:

1. Investigate citizens' lack of knowledge about NBS and improve their perception of the environment by developing practical citizen science activities associated with restoration and management projects within the Marzenego River basin.

2. Develop citizen science activities for NBS monitoring aimed at assessing the efficiency of wetlands.

3. Improve the existing participatory process "Marzenego River Contract". The MICS project should not only give the opportunity to restart the local participatory process currently in standby from 2017 but also increase it with practical citizen science activities.

4. Take advantage of particularly active categories of stakeholders already involved in the "Marzenego River Contract" to increase the number of citizens involved in citizen science activities and raise awareness of the importance of common river management.

5. Evaluate the impact that citizen involvement in planning/management activities can have on the local community and decision-making process, as well as on project funding.

The stakeholders to be involved in the Citizen Science activities to help achieve the ambitions are outlined in Table 1.

Table 1: Stakeholders to be involved in the CS co-design group in this Case Study

Stakeholder type	**Name & organisation**
Citizens	"StoriAmestre" (Cultural association), "FIPAS" of Venice (recreational association - anglers), "Proloco" Matellago, "la Salsola" (recreational association - small woody boats), la FIAB (recreational association, cycling), "Terraviva Miranese" (environmental association), Arcobaleno (recreational association, canoeing), "Dalla guerra alla pace Forte alla Gatta" of Venice (cultural association), "I sette nani" (cultural association), WWF, associazione risorgive (local environmental association) .
Scientists	University of Bologna;

Public sector actors – legislative (policy makers)	Veneto Region Authority, AAWA;
Public sector actors - executive (local authorities; RBO; implementing agencies)	The drainage authority "Consorzio Acquerisorgive"; Municipalities of Martellago, Noale and Venice Environmental agency regional authority "ARPAV" VERITAS Authority that manages the supply of drinking water
Industry/Private sector	C.I.A. (one of the farmers union).

3.2 Co-design workshops

Four co-design workshops were held (Table 2) to identify and agree the challenge and objectives for the citizen science activities related to the NBS. This section summarises structure and outcomes of each co-design workshop.

Table 2: Stakeholders to be involved in the CS co-design group in this Case Study

Number	Date	Title of event	Location
1	3.12.2019	Co-design for Marzenego River	Noale (VENICE – ITALY)
2	14.07.2020	Co-design summary of the Noale meeting results	online
3	21.07.2020	Co-design for water quality	online
4	23.07.2020	Co-design for Vegetation/biodiversity	online
5	31.08.2020	Training on water quality and vegetation	Noale (VENICE – ITALY)
6	19.09.2020	Training on water quality and vegetation	Martellago (VENICE – ITALY)
7	2.10.2020	Training on water quality – secondary school	Mirano (VENICE-ITALY)

3.2.1 Co-design workshop 1

The first co-design workshop was held on 13/12/2019 in Noale, Venice. The workshop aimed to introduce the MICS project and the case study of the Marzenego River to the citizens and authorities, and to start the co-design process. In total, 37 people attended, with different backgrounds, including: environmental experts, engineers, scientists, teachers, etc., most of the volunteers were over the age of 60. The workshop was also attended by: eight members of the MICS team (who introduced / led the workshop), the General Secretary (AAWA) who provided an introduction to the event, and a representative from Acque Risorgive Drainage Authority.

3.2.1.1 Workshop structure

1. Introduction to the event (by AAWA and MICS team)

The General Secretary introduced the event and emphasized the role of citizen science inside AAWA and the importance for planning activities together. Citizen science activities allow the production of scientific material and data through the collaboration of scientists and citizens; each makes available their skills and time to achieve specific objectives (Fig. 7).
Advantages of citizen science:

- Raising public awareness on environmental issues
- Inform and train citizens on ecological processes
- Get large amounts of data for large study areas
- Social inclusion

2. Introduction to the MICS project (by the MICS team)

The MICS team introduced the MICS project and the experimental sites in Europe (Italy, Hungary, Romania and UK). Then described why Marzengo River was important:

1. Despite being a spring river and therefore fed by the aquifers, the Marzenego river suffers from the main problems of most of the Veneto plain rivers, as: water quality (pollution), flood risk and low biodiversity;
2. Because there is already a participatory process experience (River Contract of Marzenego) even if citizen science activities have never been done.

Figure 7: Photographs from the first co-design workshop in Noale, Venice.

The MICS team emphasised that citizens play an important role in monitoring the environment and the effects of local river restoration projects. The aim of the sessions was to cooperate together to identify and agree objectives for monitoring. This involved collaboration between researchers, citizens, managers and politicians. These participatory processes ensure that useful synergies are established to achieve plans and programs also in the medium to long term.

3. Representative from the Drainage Authority (DA) "Acque Risorgive" presented the new NBSs projects on the Marzenego River

The Marzenego River and its tributary Draganziolo restoration project is part of a larger restoration plan, of Veneto Region, that includes the entire drainage basin of the Venice lagoon, with the main objective of reducing the excess of nutrients that flow into the lagoon but without forgetting the flood risk and the landscape restoration. The DA approach, has been, from the beginning to "work with nature" and therefore to use NBSs as often as possible.

The Italian case study of MICS focuses mainly, but not only, on the Noale wetland where the DA has already developed a previous restoration project transforming a quarry into a wetland with the aim of reducing nutrient runoff, flood risk and improve landscape/biodiversity. One of the results of this project was the inclusion of the Noale wetland in Natura 2000 Network (IT3250017) which has shown an increase in biodiversity and habitat quality. A new restoration project will consist of transforming an arable field, near the Noale wetland, into a wetland. The main objective will be to increase the surface of the existing wetland.

3.2.1.2 Workshop Activities

1. Introductions: Introduce yourself with name, surname and affiliation:

When the participants had the floor, from the very beginning they focused on their problems and showed their disappointment at the interruption of the participatory process within the "Marzenego River Contract". During this participatory process, the citizens had participated in many meetings and achieved only some of the objectives. The moderator struggled to contain these controversial interventions and this caused a very long a discussion and less chance for the other participants to speak.

2. Expectations (groups):

Each participant wrote their own expectations of the MICS meetings (co-design process). Outcomes: post-it chart with expectations. Many participants worked productively (Fig. 8 and 9).

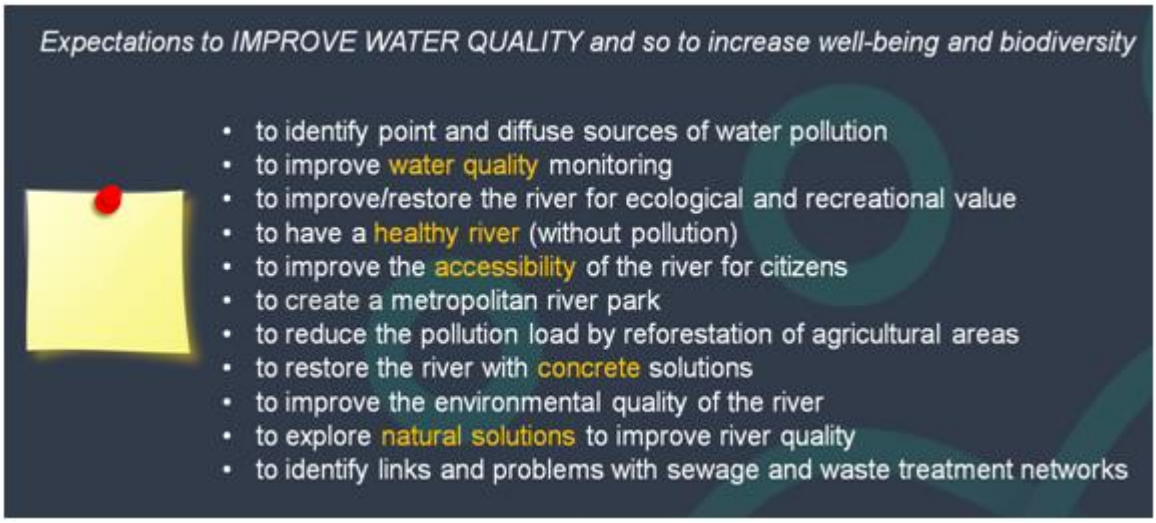

Figure 8: Results of post-it on expectations

Figure 9: More results of post-it on expectations

3. <u>Manifestation of problems with trends (groups)</u>

Each group discussed about manifestation of problems related to water quality and floods; in specific participants indicated (through stickers) the problems caused by bad water quality, those caused by flood and the lack of natural habitats in a degraded landscape.

Outcomes: post-it notes with the problems identified by citizens divided into groups (Fig. 10 and 11).

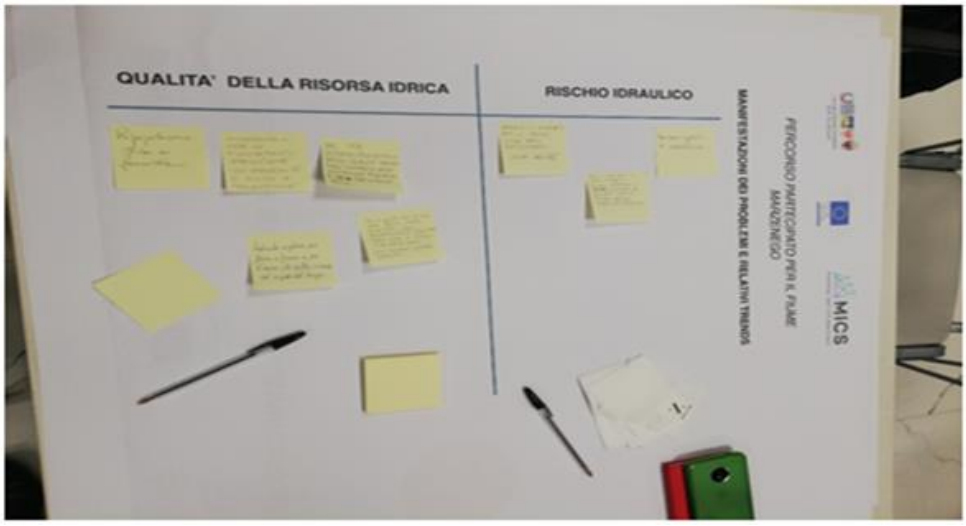

Figure 10: Post-it written by citizens and Problems highlighted.

Figure 11: Problems highlighted by groups

4. Link manifestation of problem to derive causal connections (groups)

Each group identified the causal connections between the manifestation of problems related to water quality and floods.

Outcomes: maps with causal links (Fig. 12 and 13).

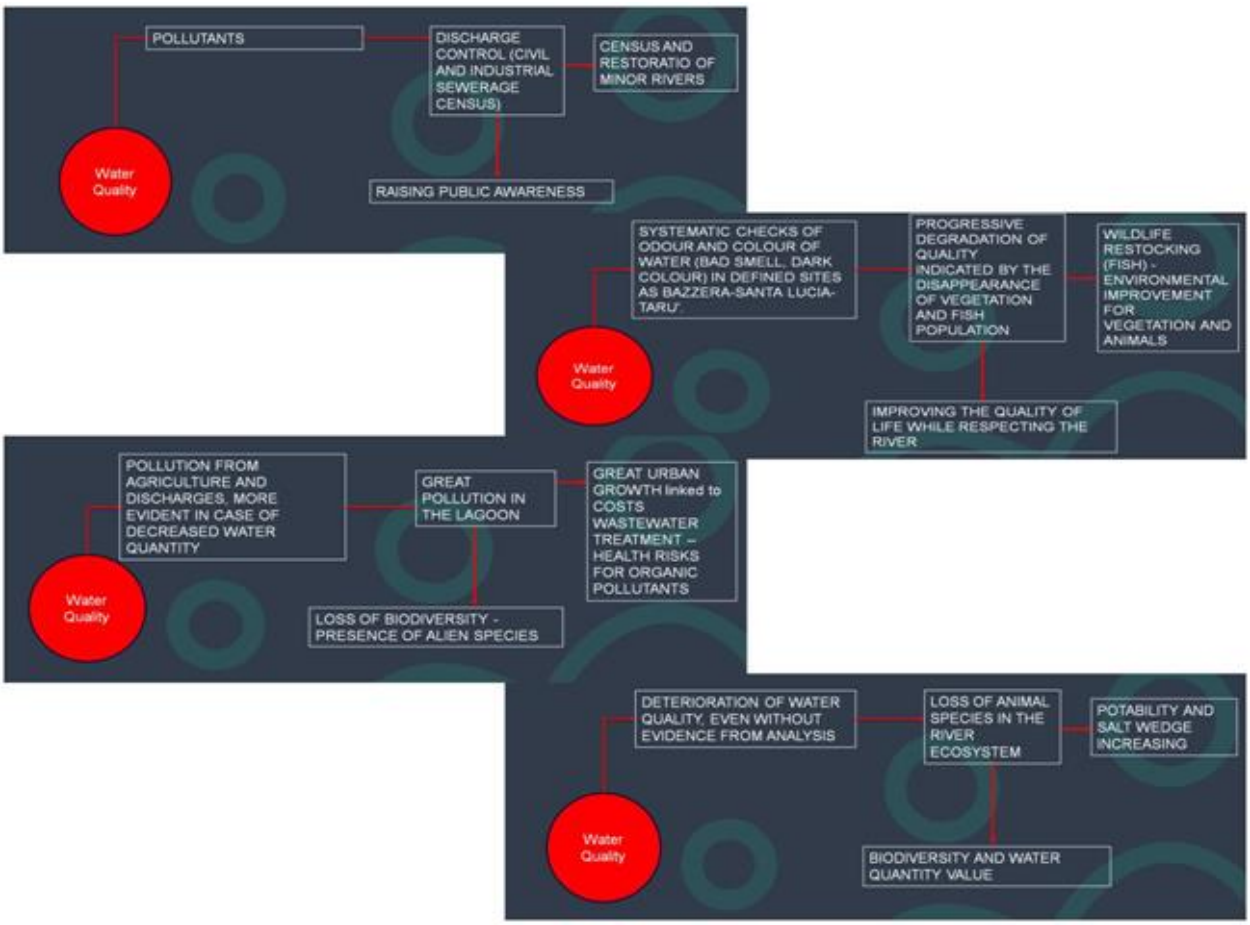

Figure 12: Casual maps with casual links about water quality for each group.

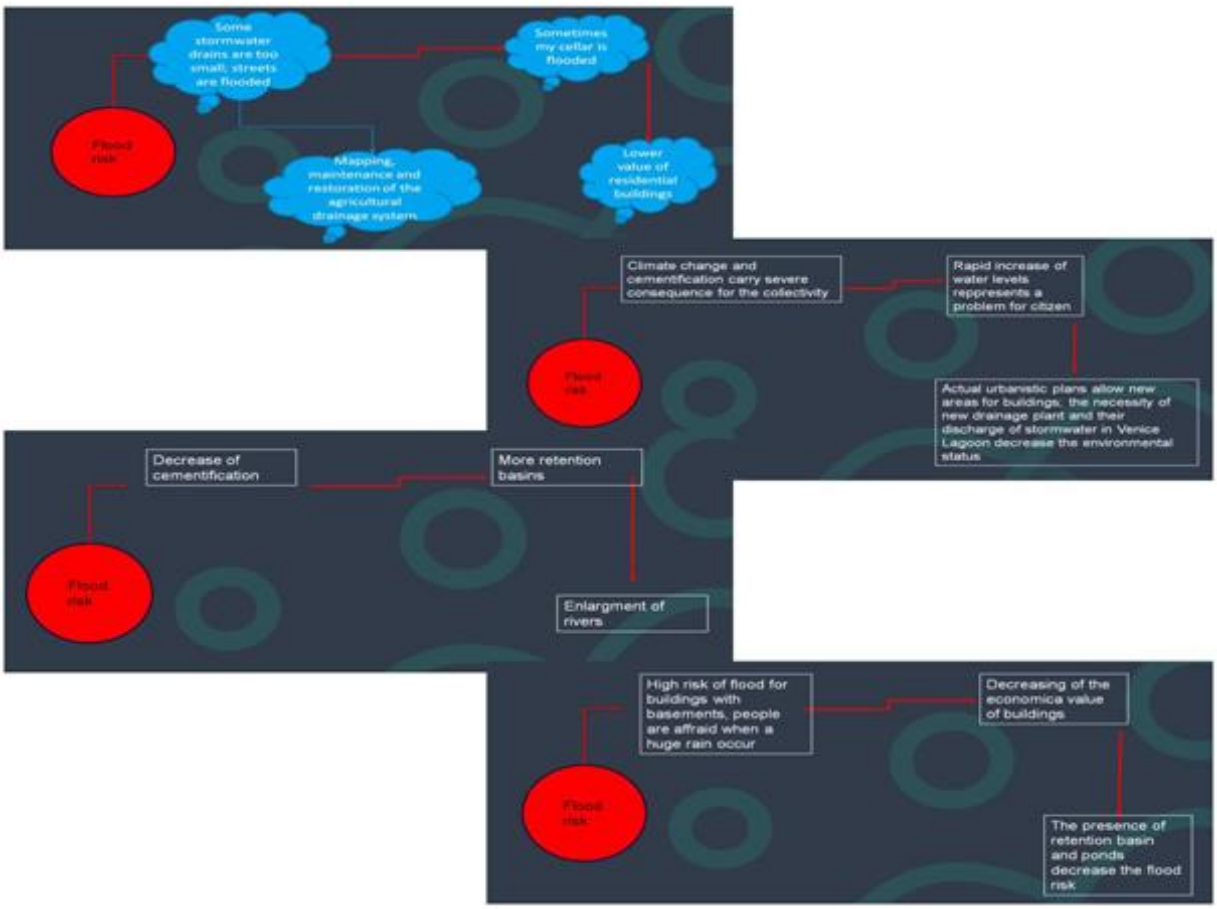

Figure 13: Casual maps with casual links about flood risk for each group.

5. <u>Identification of major axes (groups)</u>

Each group should identify the most important causal connection between the manifestation of problems.

<u>Outcomes</u>: major/most relevant problems (Fig. 14)

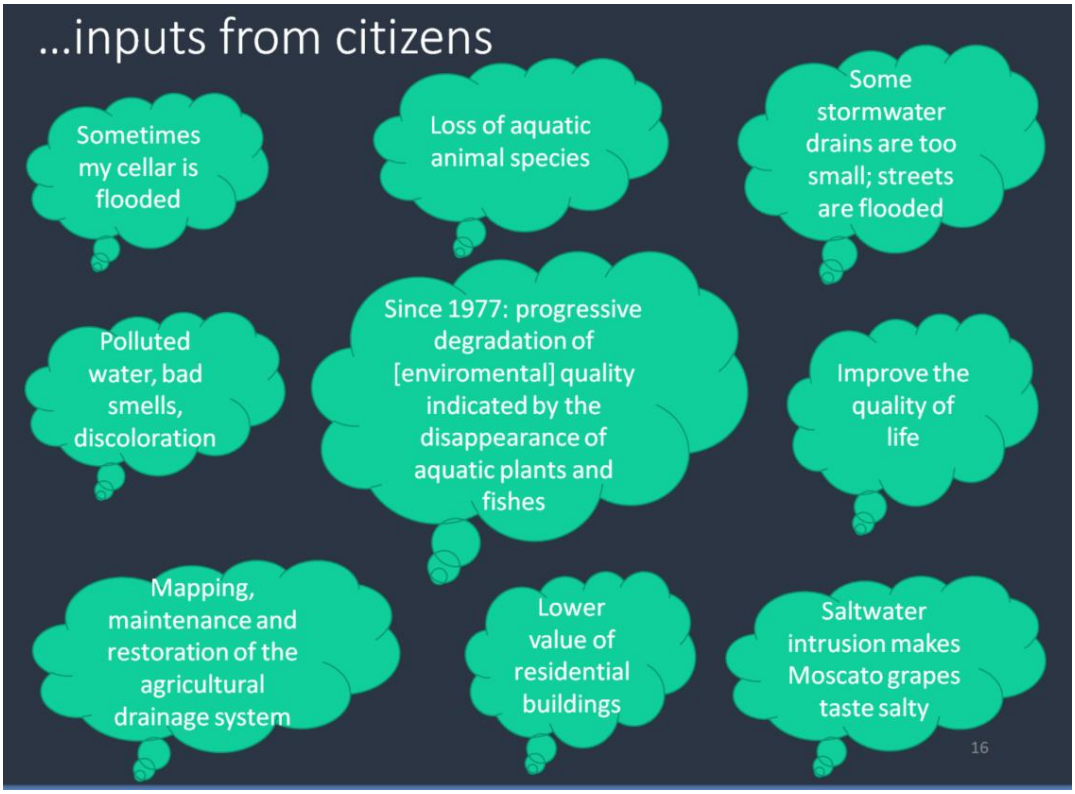

Figure 14: Other inputs from citizens

3.2.1.3 Summary of outcomes of the first co-design workshop

In general, there was sensitivity towards the river environment and an appreciation for NBSs among the participants. Thanks to the previous experience of the participatory process, (Marzenego river contract) many of the workshop attendees were aware of the different problems that affect the Marzenego River and its tributaries and they already had solutions in mind. However, many of the participants having previously been involved in the "Marzenego river contract" still have the frustration associated with that project as its objectives were not met or concluded. We should have emphasized more that the MICS project could increase the chances to restart the participatory process and at the same time give citizens the opportunity to be involved in the local territory management with practical monitoring activities. In general, previous experiences of participatory processes should not be ignored.

Some of the participants were the head/directors of association/public bodies so they were not directly interested in the field monitoring (citizen science activities). Most of the local authorities were interested in the project with one exception among those who participated. It will therefore be important to find a strategy to keep them involved even if they will not participate in monitoring citizen science activities.

The age of the participants was unbalanced, most of them were over 60's. Probably involving schools in particular secondary schools could improve age differences.

Despite the experience of the participatory process, the people who attended had not yet reached a common vision of how to restore the river, however, almost everyone had a good knowledge and sensitivity towards NBSs.

In conclusion, perhaps the most problematic aspect of this meetings was to find a balance between efficient planning in order to achieve the objectives and, on the other hand, maintain a co-design approach as required by the project.

3.2.2 Co-design workshop 2

Due to the COVID-19 lockdown it was necessary to organize co-design workshops online in order to continue the relationships developed with citizens in the first workshop. The second co-design workshop took place on 14/07/2020. The objectives of this workshop were to identify with the stakeholders (building on results from co-design workshop 1) opportunities to implement the appropriate citizen science activities to address the emerging problems. In total, 9 stakeholders attended the workshop representing different stakeholder groups:

- Representative of the 12 associations (Martellago Proloco),
- Regional Environmental Agency (ARPAV),
- The municipality of Noale (where the new NBS restoration project will be carried out),
- The municipality of Martellago, immediately downstream,
- a representative of the engineers professional order,
- Drainage Authority who will managed the NBS project,
- an association of citizens who want to protect the springs of the Marzenego river

Five of the MICS project team were involved with the delivery of the workshop.

3.2.2.1 Structure of workshop

There was a presentation of the results of the last MICS co-design meeting (December) and of the two causal maps (Fig. 15 and 16), representing the aggregate results of the work performed by participants in the last meeting. The discussion began with a focus on the first causal map, related to water quality.

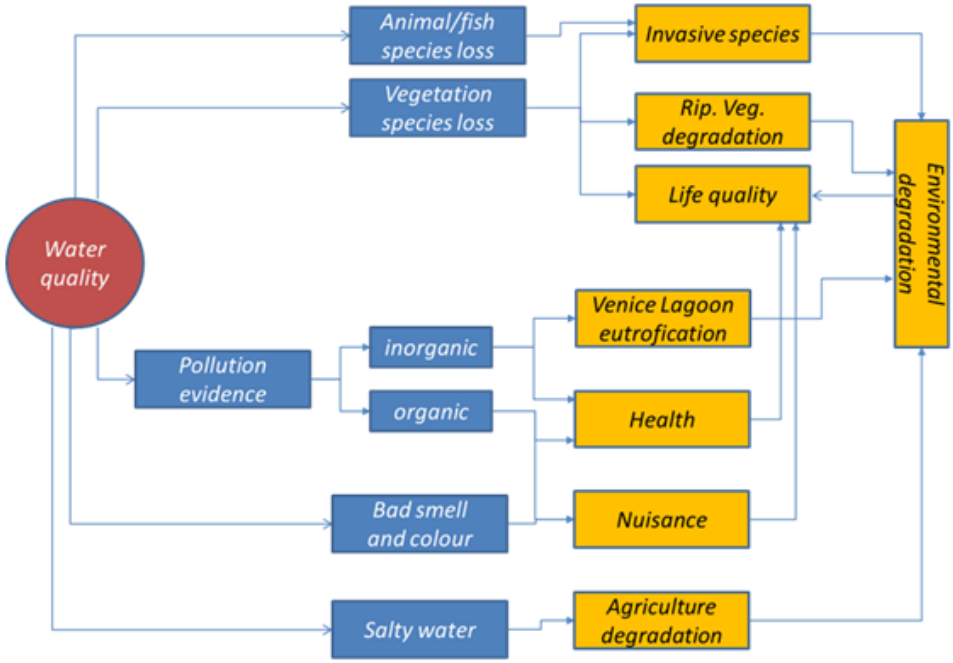

Figure 15: Casual maps of water quality

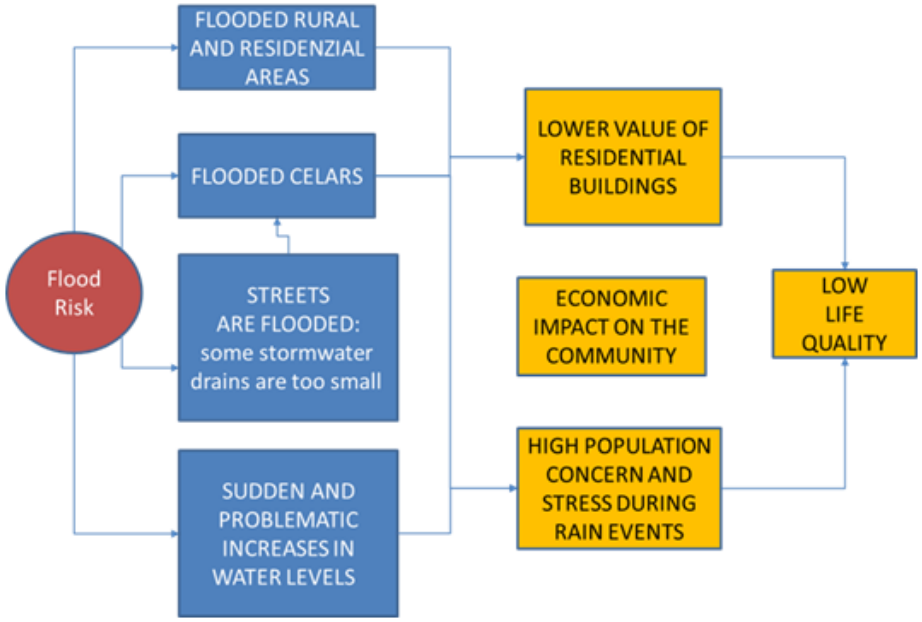

Figure 16: Casual maps of flood risk

3.2.2.2 Workshop Outcomes

The potential role of citizen science and of MICS was highlighted by the representative of the local Proloco (a co-op of associations) who informed the meeting that a regional River Park has recently been established in the part of Marzenego. It was expressed the need for an intermediary to expand this River Park and the participation of the local population along the Marzenego to Noale. He assured the support of all the associations in the group. He also said that last October they received the

Drinkable rivers kits and made the measurements but found difficulties in the English material and in the lack of feedback, so they are well prepared to use a different approach, one with more local support and that can be used with a more directed goal.

The two deputies of local municipality (Noale and Martellago) confirmed the total willingness of the two municipalities to participate and expressed the objective to allow for long-term participation, beyond the conclusion of the NBS. The long-term sustainability of the citizen science was confirmed by the MICS team as one of the main objectives while stressing that it is not an easy goal.

The representative of Regional Environmental Agency is interested in the project and the importance to integrate their data with that of the citizen scientists. He stressed the need for inter-calibration and underlined the problem of validation and certification of data collected by citizens. Discussion followed about the opportunity for citizen science activities to give the first sentinel information and that they are then associated with detailed analysis with certified methodologies (laboratory analysis) required for legal action. He suggested that citizen science monitoring could provide information on the most critical sites, needing detailed analysis and identify situations to be preserved.

The meeting concluded with a general agreement that water quality and river quality could be addressed using available tools that meet the above requirements.

Table 3: Agreed citizen science co-design outputs

Item	**Details**
Agreed challenge for the citizen science activities related to NBS in your Case Study	Improve the water quality (nutrients and E. coli reduction) and the landscape (biodiversity and mosaic) and at the same time reduce the risk of floods (water storage)
Identified leverage points	Collaboration with local Environmental Agency Secondary school involvement Restart the river contracts Encourage the expansion of the Marzenego river park
Agreed objective(s) for the citizen science Activities in your Case Study	Water quality monitoring through FWW method Bacteriological analysis (E. coli) Riparian Vegetation monitoring Aquatic vegetation monitoring
Agreed research question(s) for the citizen science activities	Citizen science activities can be effectively used as alarm monitoring in collaboration with environmental agencies? The simplified methods for the analysis of E. coli in citizen science activity have not yet been well tested. Are citizens really capable of doing this analysis? Are the results reliable? Is natural colonization good enough for NBSs such as wetlands? Why is it important to restore and protect hygrophilous forests?

3.2.3 Co-design workshop 3 and 4: Co-design for water quality and Riparian Vegetation/biodiversity

Two co-design meetings were held in the same week and were attended by ten participants and represented many stakeholder groups, with a direct interest in monitoring activities (Water quality and riparian vegetation): “Acque Risorgive”, the municipality of Martellago, and citizens of the area.

The objectives of the workshops were to identify which parameters to measure for assessing water quality and riparian vegetation. The first workshop (21/07/2020) focused on the water quality element (Fig. 17), with the second workshop (23/07/2020) focusing on riparian vegetation monitoring (Fig. 18).

Figure 17: Water quality monitoring example

Figure 18: Riparian vegetation monitoring example

The representatives of the municipality of Noale confirmed their collaboration in monitoring both riparian vegetation and water quality. The citizens, who participated, were almost the same in both meetings. One citizen described the need for monitoring related to the new river park along the Marzenego. For many citizens, the MICS project represents a good opportunity to increase their influence and participation with the local authorities related to the park. This has a long-term goal of increasing participation and attention to extend the park to Noale, where the main MICS NBS action takes place.

There was a general agreement that information about water quality should include different aspects of chemical and biological measurements, and that some measurement of flowrate would be useful to estimate changes in pollution loads as well as well as concentrations. Another citizen told us about her previous experience with “drinkable rivers” project and the need for better feedback related to results. She expressed interest in measuring *Escherichia coli* as well as nutrients in the water quality aspects. There was an extended discussion of the potential to use side by side measurements with the regional environment agency, to validate the citizen science measurements and allow for the possibility that they be included in regional reporting mechanisms. The possibility to set up a system for incubation of microbiological samples has been taken into consideration. River height data and the possibility to locate some sites near river gauges to validate qualitative estimates was discussed. We agreed about the frequency of measurements, with an optimal frequency of monthly, but a focus on the period after high rain events (when conditions permit). The sampling site locations were not defined yet, but they will be defined during the training sessions. The data gathering and uploading mechanisms were identified. The training sessions were planned for the end of August/September.

In the meeting on vegetation, the consortium expressed interest in monitoring, beside riparian vegetation, the aquatic vegetation of existing wetlands with indications of coverage. With regard to this topic, participants listed the main species present in the area. Two methods were discussed for

data gathering and data upload, and it was agreed that both would be appropriate. The frequency and spatial coverage were discussed and further discussion was agreed to occur in the training sessions.

From the two meetings, following a co-design approach, it was decided to measure (frequency, sites, method):

Water quality

1. Nutrients and turbidity (monthly), sites to be determined, FWW method;
2. Water velocity and water level (coincident with water quality, sites to be the same, FWW method)
3. E. coli (seasonally to start, sites to be the same, 3M petri film in collaboration with ARPAV for incubation, FWW app for data upload)

Vegetation

1. Aquatic vegetation (seasonal to be confirmed, sites to be determined), Method using: it was developed a specific reporting paper form
2. Riparian vegetation (seasonal to be confirmed, sites to be determined), with a specific APP called RiVe developed by ISPRA (National Environmental Agency) and Bruna Gumiero.

Following the meetings, we received several emails of interest from groups of citizens to participate in the activities, to be added to the associations and groups of citizens already active when training occurs.

We are now promoting the project and citizen science activities at different levels. AAWA have developed a brochure and a press release to be sent to: local newspapers and radios, the municipalities for their web pages and the various association representatives. Unfortunately, the recent COVID-19 lockdown and the holiday period have not helped. All agreed that it would be best to start soon monitoring the vegetation as the period for sampling, at least for this year, will end the beginning of October, while for the other activities to start in September will only mean to postpone the sampling period.

After the first face-to-face meeting and three online meetings through the co-design approach, two flow charts were developed, one on the quality of water and the environment (Fig. 19) and the second on the risk of flooding. Table 4 shows all parameters, tools and methodology to be used for monitoring water quality and biodiversity and sampling frequency.

Table 4: The parameters, tools and methodology selected during the co-design process.

Parameter to measure	How to measure the parameter	Frequency of measurements
Nutrients	FreshWater Watch	Monthly + after heavy rain
Turbidity	FreshWater Watch	Monthly + after heavy rain
E.coli	HyServe	after heavy rain
Water level	Gauge/ FreshWater Watch	Monthly + after heavy rain
Conductivity/salinity	Conductance probe/ FWW upload	Monthly + after heavy rain
Water velocity	rough assessment/FWW upload	Monthly + after heavy rain
Aquatic vegetation	CSMONT application + form	1 data collection campaign
Riparian Vegetation	RiVe application +form	1 data collection campaign

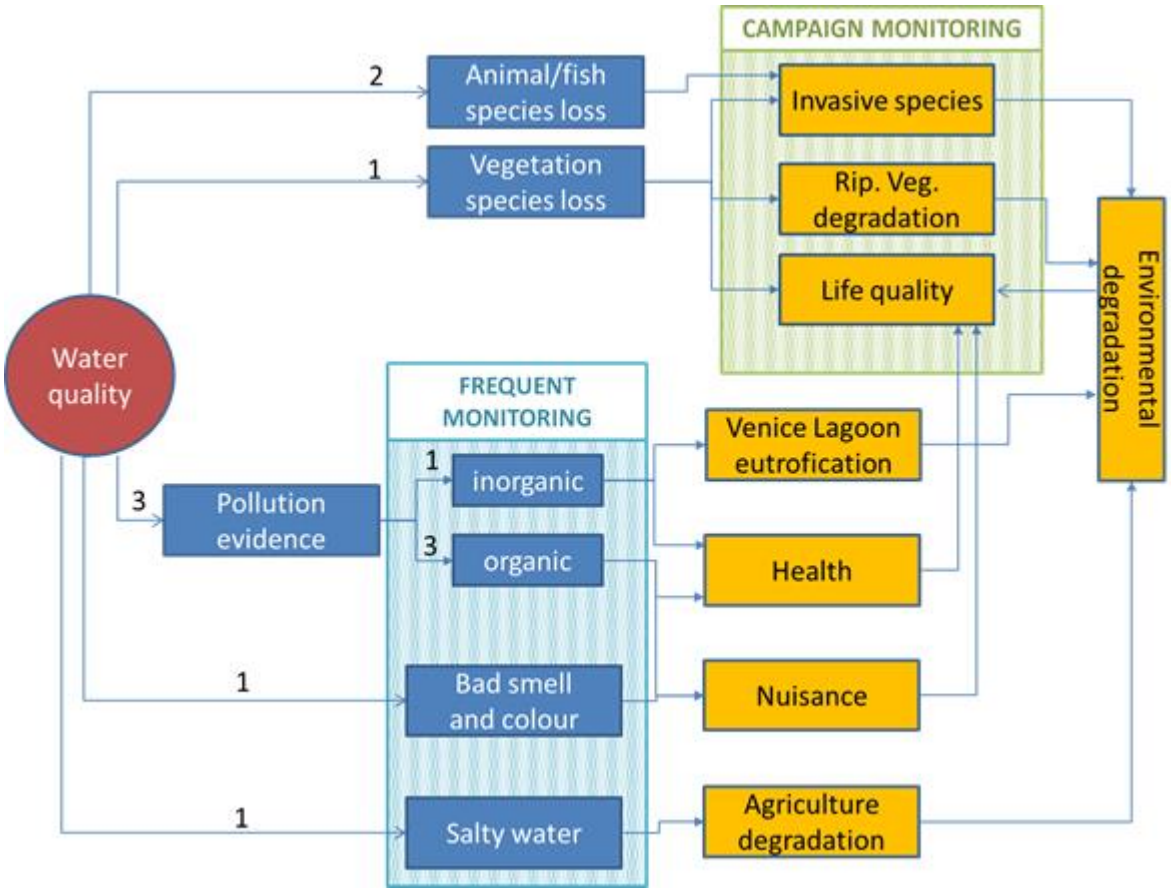

Figure 19: The complete casual map for water and environment quality developed during the co-design process

4 Citizen Science Monitoring Activities

Taking into account the results of co-design process the MICS Italian Case study team planned the following citizen science monitoring activities:

- Water quality monitoring using the Freshwater Watch (FWW) method and online platform (www.freshwaterwatch.thewaterhub.org)
- Hyserve kit for bacteriological analyses, the reliability of this tool will also be estimated.
- To monitor riparian vegetation and restoration opportunities (Marzenego fluvial park)
- To monitor aquatic vegetation both in mature and in new wetlands (is natural colonization effective?)

Although the season for monitoring vegetation was almost over, training was performed simultaneously with the water quality training through a series of workshops outlined below.

4.1.1 Citizen Science activity 1 – First general training in Noale

The first face-to-face training session was on 31/08/2020 in Noale. The main objectives were: 1) train the trainers for citizen science activities; 2) Choose sampling sites; 3) identify "expert citizens" to lead smaller citizen groups. After the long COVID-19 lockdown we were able to organize practical training to be carried out in the field. Unfortunately, bad weather conditions did not allow the regular session to be run outdoors, which instead took place indoors and discouraged many people to participate. In total, 9 stakeholders attended the workshop (Fig.20. Almost all participants were private citizens or members of the local environmental or cultural associations. One representative of the Drainage Authority (DA), one of the Noale municipality. No presence of professionals or social sciences. Although there were few participants, we had received the willingness to act as referents even from citizens who were not present at the meeting.

Figure 20: Some moments of the FWW method simulation.

The structure of the event was divided into three parts. In the first, the methodologies and tools of the planned CS activities were introduced through presentation slides. In the second part, a demonstration of water sampling was made according to the FWW method. In the third part, we worked together with the participants to identify the sampling sites. Finally, we collected the registrations of those who would become leading "expert citizens". All the participants were interested in carrying out the water quality monitoring although not everyone wants to take

responsibility for coordinating a group or becoming an “expert citizen”. The participants were very proactive and helped us and the Drainage Authority to identify the best sampling locations. Two WWF members who manage the dissemination activities for the Noale wetland were available to collaborate and encourage citizen participation including the activities planned by the MICS project in their outreach programs.

4.1.1.1 Outcomes

Despite the adversity associated with the COVID-19 pandemic, we were able to verify the continuous and active support of the D.A. “Acque Risorgive”, the Environmental Agency (ARPAV) and the municipalities. Since most of the citizens are members of cultural and environmental associations, very often only one representative comes and then transfers the learning, consequently the number of participants should be read in terms of associations involved.

The next steps will be to support citizens in the registration process on the FWW platform and in the first water quality sampling (we gave out 10 FWW kits). We aim to increase project dissemination and organize some field activities along the Marzenego River.

4.1.2 Citizen Science activity 2 – Second general training in Martellago

A second training was held on 19/09/2020 with the objectives of training the trainers, identifying new expert citizens, deciding other sampling sites in the field and to hand out FWW kits. We involved the municipality of Martellago in the meeting organization.

The meeting was organized in two separate parts:

- First part: Presentation, discussion and video connections (remote sessions) (Fig. 21);
- Coffee break offered by the local association
- Second part: in the field training (vegetation and water quality) (Fig. 22).

During the first part, a summary of project progress was presented. In addition, there was an online connection with a MICS member to underline the European scale of the event and Environmental Agency member who confirmed the interest of the agency to actively collaborate with citizens within the project. Councillor of Martellago had already informed us in a previous meeting, the interest of the Martellago municipality, was highlighted by the presence of the Mayor who gave a brief welcome.

In the second part, a practical demonstration of both the water quality monitoring following the FWW method and riparian vegetation monitoring methodology were carried out in the field on a stretch of the Marzenego River.

Most of the 27 people who attended the training actively interacted both in the discussion and in the activities and some of them gave their willingness to become expert citizens. All the objectives of the workshop were achieved: complete the identification of sampling sites (Fig. 23), the registration of new expert citizens (Table 5) and handed out FWW kits.

Figure 21: Two overview of the indoor activities.

Figure 22: Outdoor activities on Marzenego river banks

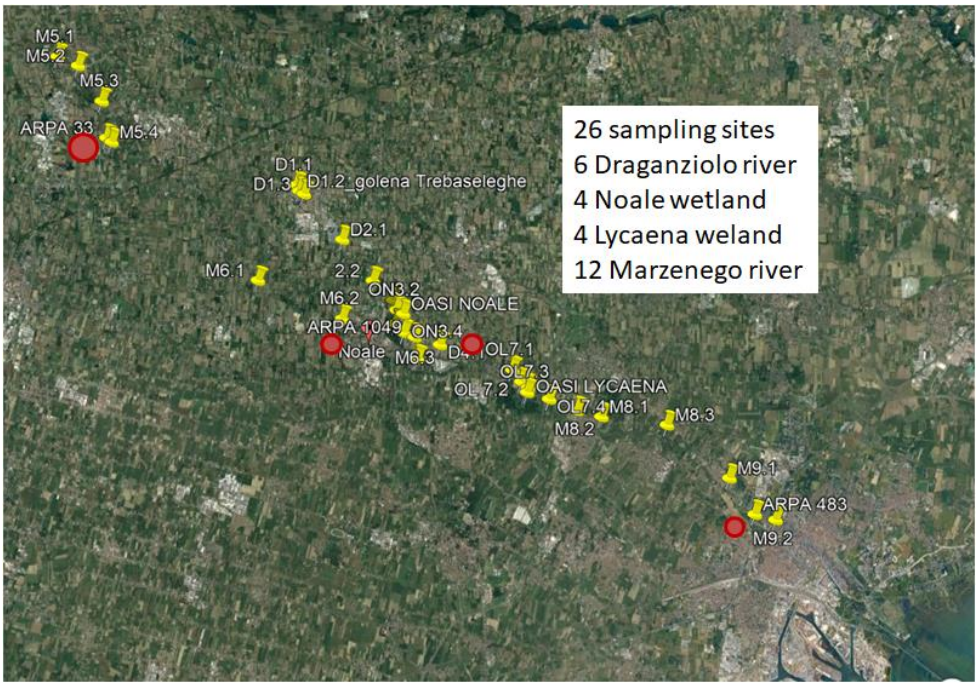

Figure 23: sampling site locations, the red points indicate the Environmental Agency official monitoring sites

Table 5: Sampling sites and the related expert citizens members of FWW

Location	site cod	expert citizen
Flood plain Trebaseleghe	D1.1	Martina Bano
	D1.2	
	D1.3	
Draganziolo	D2.1	Alessandro Lamon
	D2.2	
Oasi di Noale	ON3.1	Raffaello Pellizon WWF
	ON3.2	
	ON3.3	
	ON3.4	
Draganziolo	D4.1	Enzo Masella Noale Municipality
springs of Marzenego	5.1	Andrea Faleschini
	5.2	
	5.3	
	5.4	
Marzenego	M6.1	Enzo Masella Noale Municipality
	M6.2	
	M6.3	
Oasi Lycaena	OL7.1	Nicoletta Stevanato Secondary school
	OL7.2	
	OL7.3	
	OL7.4	
Marzenego	M8.1	Merina Frattini - Proloco Martellago
	M8.2	
	M8.3	
Marzenego	M9.1	Carlo Cappellari dalla guerra alla Pace
	M9.2	
Marzenego		Maria Grazia Zaninotto

The success of this meeting confirms two concepts:

1. Outdoor activities are the best approach to involving citizens, the adaptations we have been forced to make, like online meeting or indoor simulations, have not been able to replace adequately.
2. Developing collaborations with local associations, including in the organization of events, improves the dissemination and the sense of inclusiveness of citizens.

To maintain the interest of the people involved we need to: continue to provide technical support and the necessary tools, maintain contact even if only virtually and share the results obtained from the citizen activities.

4.1.3 Citizen Science activity 3 – third training in a secondary school

Thanks to Drainage Authority (DA) we contacted a local high school, which for about 5 years has been carrying out, within their educational programs, monitoring activities for the DA in the Lycaena wetland connected to the Marzenego River. Mutual interest and the desire to develop collaboration within the MICS project spontaneously arose. With the objectives to train the professors and find opportunities for collaboration, we organized a specific training for 12 interested professors with different skills: biology, chemistry and math.

During the meeting the sampling methods for water quality (FWW) were explained and demonstrated, we talked about riparian vegetation and bacterial analysis as well. This last point aroused the interest of two professors with whom it was decided to test the reliability of the Hyserve *E.coli* kit and identify a simple methodology feasible by citizens but rigorous. Students will compare citizen science methodologies and laboratory methods in parallel. The FWW kits have been distributed, while the Hyserve kits will be sent as soon as possible.

To complete the experimental design, we organized an online meeting with: the professors, the ARPAV representative and a citizen who had had experience with the Drinkable river kit.

Opportunities for collaboration between researchers and citizens give the possibility to develope positive and unexpected synergies that must not be lost. This possible collaboration also highlights the considerable potential that can be developed by working with local high schools. So, we should encourage the participation of the secondary schools as much as possible.

4.1.4 Citizen Science activity 4 – Riparian and Aquatic Vegetation monitoring

Except for one sample during the training activity in Martellago, the vegetation monitoring activities have not started in full, but the appropriate tools have been prepared for next spring. The figures show the sampling form and short guide leaflet for both riparian and aquatic vegetation (Fig. 24 and 25).

For the riparian vegetation surveys, a smartphone application will be used, recently developed, through a collaboration between Bruna Gumiero and the National Environmental Agency (ISPRA), still in the validation phase and not jet publish.

Figure 24: Example field guide for aquatic vegetation monitoring produced.

Figure 25: Example of field guide for riparian vegetation monitoring

5 Next steps

5.1 Citizen Science Activities

There are several uncertainties regarding social activities in the near future due to the COVID-19 pandemic, therefore the planning for the third year of MICS may undergo variations as the situation develops.

During this coming winter, we will try to maintain contact with citizens who have participated in at least one of the past events. For this purpose, the following actions will be taken:

- An online meeting in late January
- Two newsletters, one after the Christmas holidays and one at the end of February
- email notifications, the first will be sent before Christmas with good wishes
- In April a face-to-face or online meeting to review the methods and listen to citizens who have already made some measurements.
- In May-June specific training on the aquatic vegetation of the Noale oasis.
- In May a presentation (face-to-face or online) of the results obtained by the secondary school of Mirano in relation to the Lycaena oasis.
- One or two field trips in June or July, to monitor riparian vegetation
- September-October, Data analysis of the results collected during the monitoring activity
- October meeting with citizens to share the results and exchange feedbacks.

In all these activities all the authorities and associations that have, up to now, shown interest will be involved. In addition, we will make agreements with the two municipalities to develop approaches that make the project known to a greater number of people. Collaboration with the regional statutory monitoring body (ARPAV) will be increased and technical exchanges with the high school will be maintained.

It should be noted that, if the limits due to the pandemic are not significantly reduced during 2021, it will be difficult to involve new citizens. However, we expect that it will be possible to maintain and expand a group of expert citizen scientists to carry out activities in 2021.

Throughout 2021, technical, scientific and social assistance will be provided to citizens by the MICS team.

Questionnaires will be distributed via email in relation to MICS products

5.2 Impact Measurement

We will begin to identify indicators to measure impact related to the case study's aims and objectives. This will be achieved through workshops with all stakeholders involved or through discussions with the project managers. Once indicators have been selected, we will measure the impact of the citizen science activities on the five MICS domains: environment, society, economy, governance, science & technology. We will review the usability of the impact assessment and produce guidance and training so the MICS tools and metrics can be applied to any type of citizen science project. The results from these activities will be reported on in the comprehensive evaluation report (deliverable 4.5) in 2021.

6 References

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Fresh Water Watch - https://freshwaterwatch.thewaterhub.org/. Accessed 17/12/2020