groundtruth2.0

Environmental knowledge discovery of human sensed data

Deliverable D1.12

Updated validation and socio-economic impacts report

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Abstract of deliverable	Ground Truth 2.0 aims to demonstrate that sustainable Citizen Observatories are possible. This is done using the innovative approach of combining the social dimensions of citizen observatories with enabling technologies, so that the implementation of the respective citizen observatories in six Demo Cases is tailored to their envisaged societal and economic benefits. This report presents the final impact analysis of the six citizen observatories in the Ground Truth 2.0 Demonstration Cases at the end of the life time of the Ground Truth 2.0 project, the validation of each Demo Case as well as the overall validation of the Ground Truth 2.0 approach.

Versions and Contribution History

Version	Date	Modified by	Modification details
V0.1	24.11.2019	IHE Delft	Initial draft
V0.2	16.12.2019	IHE Delft	Full draft
V0.3	17.12.2019	NDConsult, VITO	Review
V0.4	20.12.2019	IHE Delft	Final edits (initial submission)
V0.5	29.2.2020	IHE Delft	Additional changes (final submission)

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List of Abbreviations

AMB	Barcelona Metropolitan Area
ANV	Agrarische Natuurvereniging
BE	Belgium
BPC	Barcelona Provincial Council
BRE	Barotse Royal Establishment
CBNRM	Community Based Natural Resource Management
CDR	Cost of Data Record
CO	Citizen Observatory
CRB	Community Resources Board
CREAF	Centre de Recerca Ecològica i Aplicacions Forestals
CSO	Civil Society Organisation
D	Deliverable
DC	Demo Case
EAB	Flemish Environmental Advisory Board
EC	European Commission
ES	Spain
EU	European Union
F2F	Face to Face
FMM	Friends of Maasai Mara
GT2.0	Ground Truth 2.0
IA	Impact Assessment
ICTs	Information and Communication Technologies
IPR	Intellectual Property Rights
KFS	Kenya Forest Service
KMD	Kenyan Meteorological Department
KNMI	Koninklijk Nederlands Meteorologisch Instituut
KWS	Kenya Wildlife Service
KWTA	Kenya Water Tower Agency
KY	Kenya
LNE	Environment, Nature and Energy department
METEOCAT	Servei Meteorològic de Catalunya
MMCO	Maasai Mara Citizen Observatory
MMM	Meet Mee Mechelen
MMWCA	Maasai Mara Wildlife Conservancies Association
MOU	Memorandum of Understanding
N/A	Not applicable
NGO	Non-Governmental Organization
NL	The Netherlands
OECD	Organisation for Economic Co-operation and Development
SC	Spatial Complementarity

SDGs	Sustainable Development Goals
SE	Sweden
SMS	Short Message Service
URTT	User Requirements Tracking Tool
VAG	Village Action Groups
VHMR	Flemish High Council for Spatial Planning and Environment
VISS	Sweden database
VITO	Vlaamse Instelling voor Technologisch Onderzoek (The Flemish institute of Innovation and Technology)
VMM	Flemish Environmental Agency
WP	Work Package
WRA	Water Resources Authority
WRUA	Water Resources Users Associations
WWF	World Wide Fund for Nature
ZLTO	Organisation of farmers in the Netherlands
ZM	Zambia

Executive Summary

The Ground Truth 2.0 project has delivered the demonstration and validation of 6 scaled-up citizen observatories in real, operational conditions, with 4 European and 2 African demonstration cases. It demonstrated the technological feasibility, the sustained use and the societal and economic benefits of such citizen observatories. The ultimate objective was the global market uptake of the concept and enabling technologies.

The work undertaken in WP1 'Social dimensions: Co-design, validation and impact assessment of citizen observatories' of Ground Truth 2.0 provided the basis for co-designing and co-creating citizen observatories via a range of social interaction mechanisms. It established a sound understanding of the social context to ensure that technological developments delibvered by other work packages achieve the desired social innovation impacts in terms of environmental monitoring, cooperative planning and environmental stewardship.

This deliverable presents the final impact assessment in the six Ground Truth 2.0 Demonstration Cases at the end of the life time of the Ground Truth 2.0 project, their validation as well as the overall validation of the Ground Truth 2.0 approach. The report is based on empirical research that was undertaken in accordance with the methodology reported in Ground Truth 2.0 deliverable D1.10, the results of which were compared to the findings of the baseline situation that was reported in Ground Truth 2.0 deliverable D1.11.

Citizen Observatories in the six Demonstration Cases

The Ground Truth 2.0 project has delivered six citizen observatories (see summary table below) coherent with the characteristics of the GT2.0 CO concept: a) involving specific types of stakeholders, forming a community (with differing levels of maturity); b) involving a platform and tools for data collection, data processing and user feedback & collaboration; and c) undertaking joint CO planning activities and data collection and linking to relevant policy and decision making processes.

Characteristics	Belgian Demo Case Meet Mee Mechelen	Dutch Demo Case Grip op Water Altena	Spanish Demo Case RitmeN-atura.cat	Swedish Demo Case VattenFokus	Kenya Demo Case Maasai Mara CO	Zambia Demo Case
CO Thematic focus	Environmental quality of life related to air quality & noise	Local flooding	Local impacts of climate change	Deteriorating water health	Human-wildlife conflict	Natural resources management, human-wildlife conflict
Stakeholder composition and status of community building						
Top 10 stakeholders match concept	Yes	Yes	Yes	Yes	Yes	Yes
Maturity of CO Community achieved	Stable, incorporated in Klimaan	Small, ANV lead	Small, formalised	Small, dedicated	Critical mass but volatile	Small, formalized
Platform & Tools						
Data Collection	airQmap sensor (VITO), sensor apps (Akvo, Altran),	Online surveys	RitmeNatura project on Natusfera	FWW Kit and App	Mara Collect app,	Zambia Collect app, TAHMO weather stations

Characteristics	Belgian Demo Case Meet Mee Mechelen	Dutch Demo Case Grip op Water Altena	Spanish Demo Case RitmeN-atura.cat	Swedish Demo Case VattenFokus	Kenya Demo Case Maasai Mara CO	Zambia Demo Case
	implicit sensing (Gavagai)				TAHMO weather stations	
Data Processing	airQmap, Akvo Flow Tygron Engine Data quality module	HydroNet ESRI Story Maps	Natusfera, incl. expert validation Data quality module	FWW Servers, Tygron Engine Data quality module	Data combination in the cloud	tbd
User Feedback & Collaboration	Online platform	Online platform, Facebook	Online platform	Online platform	MMCO app, Online platform	Online platform, institutional mail accounts
Activities & interactions realized by CO community during project period						
CO activity planning	F2F (Working Groups)	F2F (owner driven), WhatsApp Group	Planning Group (MoU)	F2F (member driven)	F2F and WhatsApp Group	F2F and Whatsapp Group
Data collection	Seasonal campaigns	Online descriptive surveys	General public & school training sessions	Seasonal blitzes, long term data collection	Continuous observation, participatory mapping via mapathons	Roadshow tech testing
Data analysis	S/DAs	S/DAs	S/DAs	S/DAs	S/DAs	n.a.
Knowledge & information sharing	**F2F**	**via platform** Share tips & tricks on flood measures to take	**F2F/Platform**	**F2F**	**F2F**	**Via Platform**
Outreach beyond the CO	Public debates, outreach at public events	Outreach at public events	Public debates	Outreach at public events	Training of students	Community rights education campaigns
Participation in policy/decision making process(es)	Urban planning: monitoring, advocacy re. 'air quality zone' policy	Floor risk management: monitoring, knowledge sharing for resilience	Biodiversity and climate change adaptation: monitor local impacts of Climate Change	Water quality management: monitoring, advocacy of control of upstream activities	Biodiversity conservation & livelihood management: monitoring, incident reporting	Natural resources management: evidence-based advocacy
Type of Citizen Observatory						
Envisaged CO	Cooperative planning	Collaborative Planning	Environmental monitoring	Environmental Stewardship	Cooperative planning	Collaborative Planning
Achieved CO during GT2.0	Cooperative planning	Environmental monitoring	Environmental monitoring	Environmental monitoring	Environmental monitoring	[Collaborative Planning]

Social, institutional and environmental impacts of citizen observatories

In the context of this report, environmental impacts refer to changes in the specific natural resource(s) quality or quantity that the respective GT2.0 citizen observatories focus on. Such **environmental changes cannot be expected to come about by the mere existence of a citizen observatory; rather, they are conditional on social and institutional changes**, i.e. changes in individual and collective behaviour, policies and/or procedures related to managing the respective natural resource(s). The impact assessment focused, therefore, on examining progress towards triggering the necessary institutional and social changes, including via the respective citizen observatories, had been made.

The analysis of the social and institutional changes captured in each Demo Case (Sections 3-8) shows that **considerable progress has been made in each of the six Demo Cases, albeit to differing degrees, with achieving the respective social and institutional outcomes** that are necessary in each case in order to, eventually, attain the envisioned environmental impacts. The most notable institutional changes have materialised in the participation dimension, with shifts towards preferred communication channels between citizens and authorities materialising (substantial changes in the Dutch, Spanish, Swedish and Kenyan Demo Cases); moderate changes in how participants interact with public discussions and decisions, along with improved support for participation and slight changes in the efforts required to participate. In all cases, access to and control over data have improved slightly, along with slight changes in the authority of different stakeholders (notably citizens) in decision making processes.

The observatories have triggered moderate social changes in terms of improving dependable information for citizens, especially by fostering shared stories (community members' shared understandings of reality) which contribute to a sense of place and connectedness related to the thematic focus of the respective observatory, and in terms of the improving the availability of timely and accurate information. Trusted sources of information for the environmental issues of concern in each observatory have improved, with the most substantial change in the Belgian Demo Cases where the data collection efforts have resulted in scientific support for the concerns that people had about air quality. Skills and competencies of the stakeholders involved in the observatories have improved in terms of working together and the ability to learn as a community, including from the past. In this regard, the Kenya Demo Case presents the strongest change, where the different parties involved went from not being explicitly interested in working together to acknowledging their mutual interest and harmonious group interactions. The level of trust between community members and their willingness to understand each other's points of view was strengthened in a number of Demo Cases, most strongly in the Dutch case where residents feel strong attachment to place and the direct communication created via the observatory between regional / local authorities and civic society was highly valued.

The analyses show that the extent to which the respective citizen observatories have contributed to changes in individual and collective behaviour and changes in policy and/or procedures related to managing the respective natural resource(s) are **highly case-specific**. They have highlighted that the required policy-related changes can range from demanding entirely new policies, to clarifying the many links of the CO issue in the policy landscape, to identifying the need for additional plans or guidelines to ensure sound implementation of existing policy, to physically enabling participation mechanisms prescribed in laws but prevented by poverty. Similarly, the COs are a means to create awareness of, support for and compliance with the implementation of (new) policies related to the respective environmental challenges addressed by the COs. The results indicate how the adoption of new technologies related to the COs enable changes in institutional practice (providing means for monitoring, compliance, enforcement) as well as in individual and collective behaviour by paying attention to things not previously noticed, changing damaging practices, and participating in actions.

Economic impact assessment

The GT2.0 assessment of economic impacts is aimed at assessing the economic outcomes and impacts that can be associated with the implementation of the GT2.0 Demo Case observatories and the project at large. It distinguishes between the economic outcomes:

a) for the *demand* side of COs, e.g. for public sector organizations benefitting from a given Demo Case CO, incl. the potential cost-reduction of the in-situ component due to the presence of citizen-sensed data
b) for the *supply* side of COs, i.e. for providers of CO solutions and expertise to implement a Demo Case CO.

a) Economic impacts of CO data for in-situ networks (demand side)

The methodology for evaluating the value of citizen observations consists of two main parts, namely the data perspective and the costs perspective. The former aims to qualify the degree of complementarity that the data collected by citizens offers to in-situ networks. The latter aims to quantify the relation between the investments required to set up a citizen observatory and the actual amount of data collected.

The results show that **setting up a CO for the sole purpose of data collection is normally an expensive undertaking**, for the demand side of COs (e.g. for public sector organizations benefitting from a given CO) that may not necessarily complement the existing in-situ monitoring network, with the potential exception of infrastructure-weak areas in developing countries. The impact of a CO can be better attributed to the social and institutional (and eventually environmental) aspects (described in detail in chapters 3-8 of this deliverable).

b) Economic impacts for the supply side of COs

In order to assess the economic impacts for the *supply side of COs*, information was collected by means of a questionnaire that was administered to all 14 GT2.0 partners during November 2019 to capture their organisations' situation during 2019, i.e. at the end of the GT2.0 project. The questions posed in this questionnaire were consistent with those posed for the baseline analysis, the method for which was presented D1.10 and the baseline results in D1.11. The results of the November survey were then compared with baseline data collected in 2016.

The results show that the implementation of the GT2.0 Demo Case observatories and the project at large have been paralleled by company growth of the Ground Truth partners and by an overall increase in the number of international clients (with many customers in the public sector). In terms of innovation and research, the number of CO projects that each GT2.0 partner is involved in had increased between 2016 and 2019. While research/academic partners still hold the largest overall budgets for CO-related projects, SME/industry partners and NGOs reported an increase in budget allocated to CO-related projects. In terms of competitiveness, the value propositions related to COs and enabling technologies now consist of knowledge-based, technology-based as well as service-oriented value propositions; the number of different revenue streams has increased slightly and the general market segments that the GT2.0 partners serve has remained very diverse. By the end of the project, the GT2.0 partners in research/academia still had larger networks for COs and enabling technologies compared to the SME/Industry and NGO partners in the consortium.

Validation

The Ground Truth 2.0, validation is undertaken with respect to both, the Ground Truth 2.0 project outcome and the Ground Truth 2.0 concept and approach, according to three main criteria: coherence, effectiveness and efficiency.

- **Validation of project outcomes** assesses the extent to which activities have initiated emerging, observable practices that involve stakeholders directly interacting with the outputs of the project coherent with expectations they themselves formulated in the Demo Case objectives.
- **Validation of the method** includes assessment of the Ground Truth 2.0 concept of a Citizen Observatory is correct and complete, and whether the Ground Truth 2.0 methodology was responsible and useful for bringing the outcome about.

Validation of the Ground Truth 2.O Outcome

The validation shows that Ground Truth 2.0 has achieved the first of project's seven objectives, namely the delivery of six citizen observatories in real operational conditions.

Judging the six citizen observatories in the Demonstration Cases against the characteristics of the GT2.0 CO concept revealed that each of the Ground Truth 2.0 citizen observatories has its own 'flavor', while placing emphasis in one of three generic major domains of the Ground Truth concept: *Environmental Monitoring* - mainly focused on implicit and explicit data collection by citizens; *Cooperative Planning* - including interactive activities between citizens and decision-makers such as consultation, feedback and discussion; and *Environmental Stewardship* - with fully realized dialogues and shared responsibility for natural resource management.

The results indicate that two Demo Cases achieved the intended type of CO, namely Belgium (CO for cooperative planning) and Spain (CO for environmental monitoring). The Zambia Demo Case has achieved its goal of a CO for cooperative planning in terms of the CO's institutional embedding (arguably most important) but not yet in terms of platform and tools maturity. The remaining three cases have not yet achieved the type of CO they had envisaged (COs for cooperative planning in the Dutch and Kenya Demo Cases, and a CO for environmental stewardship in Sweden), but two of them can be considered on their way to achieving the envisaged CO.

Moreover, considering the relatively short time (3 years) of the project, considerable progress has been made in each of the six Demo Cases with achieving the respective social and institutional outcomes that are necessary in each case in order to, eventually, attain the envisaged environmental impacts. The results of the outcome validation also indicate that the GT2.0 approach was successful in delivering a user-driven design, with platforms based on objectives and requirements defined by the participating stakeholders.

Validation of the GT2.0 Concept

The validation of the six COs delivered by the Ground Truth 2.0 project in conceptual terms showed them to be coherent with the GT2.0 concept of citizen observatories. All six have a stakeholder configuration including the three main stakeholder groups citizens, decision-makers and scientists/data aggregators, interacting to improve natural resource management, and facilitate their interactions using a technical platform. The assessment also supports the use of the three aspects (stakeholders, platform, interactions) to conceptualize citizen observatories. At the same time, the project experience also refined the understanding of the three aspects, for example with regard to the stakeholder groups involved. Most visibly, the validation of interactions and activities illustrated that citizen observatories have distinct 'flavors', for example in terms of the nature of their data collection campaigns or institutional embedding. Observatories with similar conceptual characteristics still use very different forms of interactions and activities. Longer term observation will be required to assess if the COs

move more firmly into one the conceptual domains as they evolve, or if certain mixed approaches represent additional types of observatories.

Validation of the GT2.0 Co-Design Approach

The validation of the effectiveness of the Ground Truth 2.0 approach examined the extent to which the GT2.0 approach was responsible for bringing the above results about. Overall, the validation the Ground Truth 2.0 co-design approach indicates that the steps and the instructions were helpful, and that the tools developed and provided to the demo cases provided valuable guidance. With regard to the technical platform, the DCs delivered between 42 and 75% of the functions described by users. The majority of undelivered functions were either too technically complex to be developed with the resources of the project, or recognized as obsolete as users learned.

Using a generic sequence of steps in a structured process with room for iterations, and including structured interaction moments with the stakeholders, facilitated a community building process with social learning evident on all sides. The iterative nature of the approach left room for necessary adjustments on a case-by-case basis, and led to distinctly different implementations reflecting the geographic, cultural and political settings,as well as the local pace, each DC required. The validation also suggested a number of incremental adjustments for some steps, which are incorporated in the final version of the Ground Truth 2.0 co-design approach (reported in D1.13). As a central aspect, the co-design and participatory nature of the approach can ensure that all relevant stakeholders are involved, deliver effective translation of open, story-based user requirements into technical designs based on generic tools or tool modules, and build operational sustainability into the process.

1 Introduction

1.1 Background

Citizen science, enabled by ICTs, is on the rise. Using their own observations and mobile devices, citizens provide a new data stream that generates localized information about the environmental situation on the ground, complementing existing data systems and surveys. However, many efforts to implement citizen observatories are facing problems in sustaining engagement by citizens, limited scalability and limited impact on governance processes.

The Ground Truth 2.0 project delivers the demonstration and validation of 6 scaled-up citizen observatories in real, operational conditions, with 4 European and 2 African demonstration cases. It will demonstrate the technological feasibility, the sustained use and the societal and economic benefits of such citizen observatories. The ultimate objective is the global market uptake of the concept and enabling technologies.

The work undertaken in WP1 'Social dimensions: Co-design, validation and impact assessment of citizen observatories' of Ground Truth 2.0 provides the basis for co-designing and co-creating citizen observatories via a range of social interaction mechanisms. It establishes a sound understanding of the social context which will ensure that the technological developments in the other work packages achieve the desired social innovation impacts in terms of environmental monitoring, cooperative planning and environmental stewardship. Within WP1, Task T1.6 'Validation and Impact Assessment of the Ground Truth 2.0 Citizen Observatories' is dedicated to assessing and validating the results from all six demonstration cases. This document is one of the T1.6 and T1.7 outputs.

1.2 Purpose of this report

The validation and impact assessment activities in the Ground Truth 2.0 project consist of formal, evidence-based procedures measuring project results against specific reference points:

1. The Impact assessment aims to capture social, institutional, economic and environmental changes that can be attributed to the Ground Truth 2.0 Demo Cases, comparing the situation during and following the up-scaling of the citizen observatories to an early initial baseline.
2. Validation of the Ground Truth. 2.0 approach, based on validation of the six citizen observatories in the Demo Cases.

Together, the combination of validation and impact assessment provide a comprehensive feedback tool to inform improvements to the final citizen observatories and innovate specific aspects of the Ground Truth 2.0 approach.

The methodology and procedures to be employed iteratively throughout the project life time and beyond were elaborated in Ground Truth 2.0 Deliverable D1.10 *Methodology for Validation and Impact Assessment*. Deliverable D1.11 presented the baseline situation for the impact assessment.

This deliverable presents the final impact assessment in the six Ground Truth 2.0 Demonstration Cases at the end of the life time of the Ground Truth 2.0 project, their validation as well as the overall validation of the Ground Truth 2.0 approach. The empirical research is based on the methodology reported in D1.10 and the results are compared to the findings of the baseline situation that was reported in D1.11.

1.3 Structure of this report

This report is structured as follows. Chapter 2 presents the methods for the impacts assessment and the validation of the six Ground Truth 2.0 Demonstration Cases as well as the overall validation of the Ground Truth 2.0 approach. Chapters 3 to 8 summarise the results of the social, institutional, and environmental impact assessment and the validation of each Demo Case. Chapter 9 is dedicated to the analysis of economic impacts, namely the economic impacts of CO data for in-situ networks as well as economic impacts for the supply side of COs at the end of the Ground Truth 2.0 project. In chapter 10, the validation of the overall Ground Truth 2.0 approach is presented. Finally, chapter 11 concludes the report.

Given the comprehensive nature of this report, the reader may wish to 'jump' to sections of specific interest immediately, guided by the roadmap below.

If you are interested in…	…then turn to:

Impacts
• of the Ground Truth 2.0 citizen observatories
  • Social, institutional and environmental impacts
  • Economic impacts of CO data for in-situ networks
• Of GT2.0 for the supply side of COs (economic impact)
	• Chapter 3-8
	• Chapter 9.1
	• Chapter 9.2

Validation • of specific citizen observatories • of the Ground Truth 2.0 method	• Chapter 3-8 • Chapter 10
Methods • used for measuring impacts • used for validation	• Chapter 2.1 • Chapter 2.2
Conclusions	• Chapter 11

2 Methods

2.1 Impact Assessment Method

The impact assessment of the Ground Truth 2.0 citizen observatories consists of analysing the social, economic, institutional and environmental changes triggered by the observatories (see Figure 1). As explained in GT2.0 Deliverable D1.10 *Methodology for Validation and Impact Assessment,* such changes can be expected or unexpected, desirable or adverse, can vary in space and time, and be cumulative versus counterbalancing.

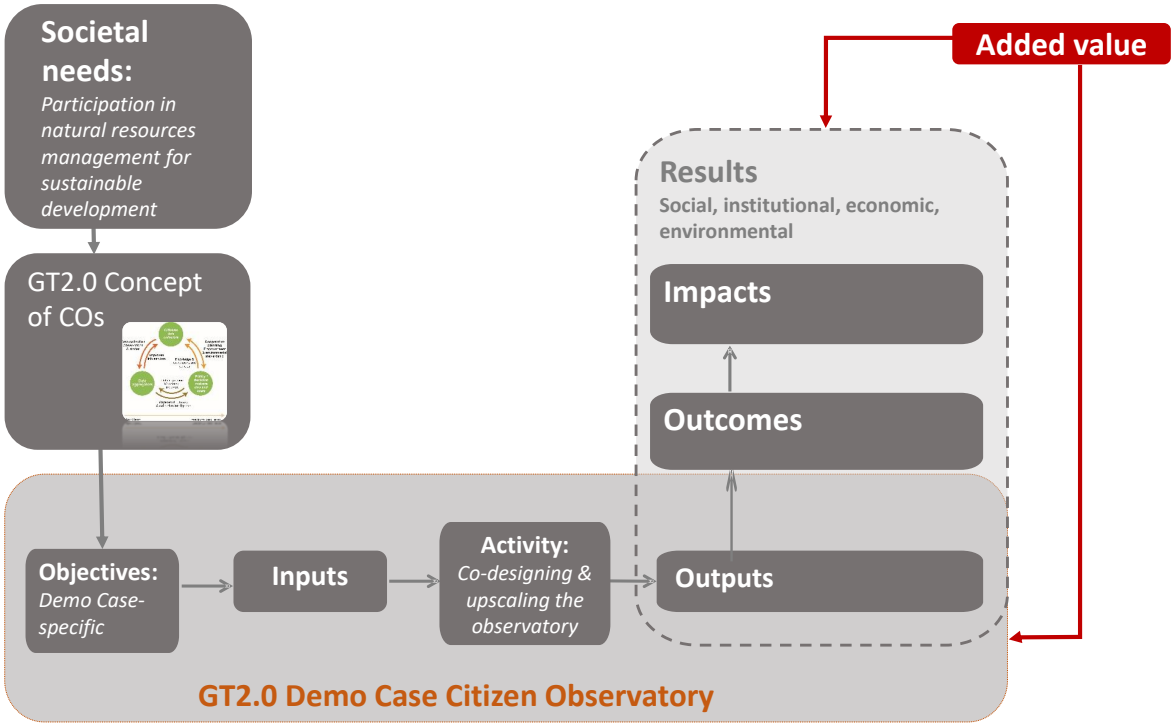

Figure 1. Ground Truth 2.0 Impact Assessment focus (in red)

Source: D1.10 - Wehn et al. (2017)

The full details of the GT2.0 Impact Assessment methodology were presented in D1.10 and are not repeated here. Below, we present the implementation of the methods for collecting and analysing data about the social, institutional and economic environmental situation, respectively, in the GT2.0 Demo Cases as well as the approach for data analysis.

2.1.1 Capturing social and institutional impacts

In order to be able to capture the social and institutional outputs, outcomes and impacts resulting from the GT2.0 Citizen Observatories, 52 in-depth interviews were conducted in the Netherlands, Sweden, Spain, Belgium, and Kenya Demo Cases[1]. Figure 2 shows the number of interviews conducted for each citizen observatory.

[1] For data collection in the Zambian Demo Case, see section 8.1

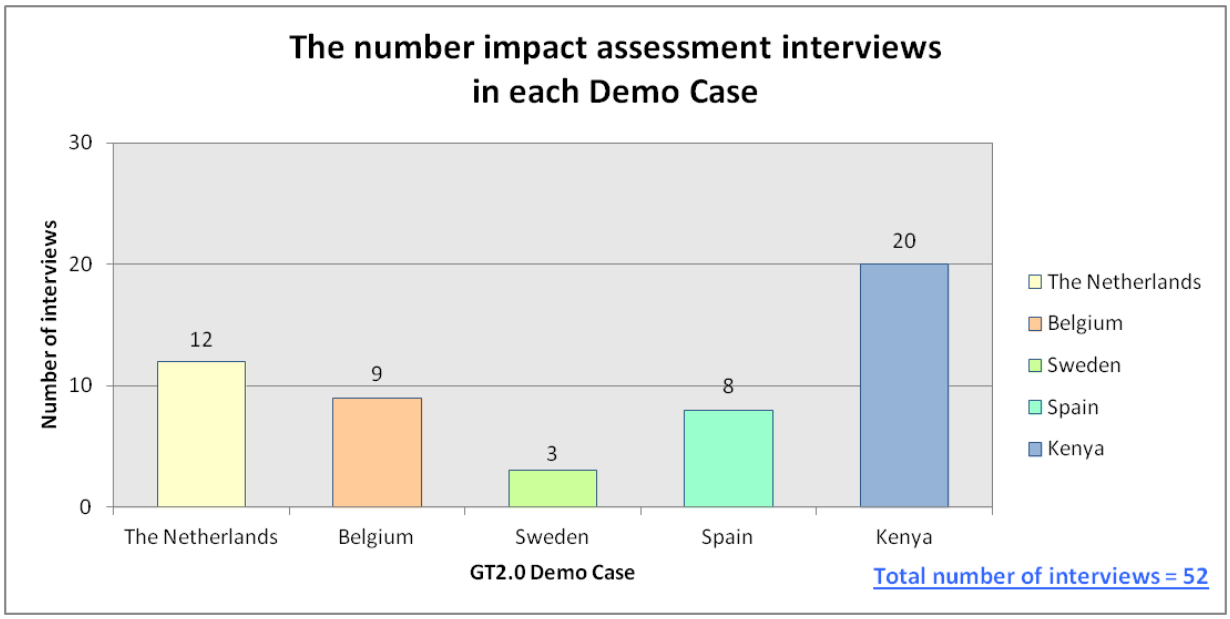

Figure 2. Number of impact assessment interviews per Demo Case

The average length of the interviews was 50 minutes and they were conducted either face to face or via phone/Skype. The interviews were transcribed and coded in accordance with the conceptual framework presented in D1.10. The insights from these interviews were then compared against the baseline situation that was reported in D1.11 in order to analyse the (expected) social and institutional impacts of citizen observatories in these Demo Cases. Data was also extracted from the documented highlights and outcomes from the co-design process (D1.9) and team observations from the CO meetings.

In order to examine the social and institutional impacts of the COs, we aimed to interview respondents who had a relatively good overview of processes and activities related to each CO. Therefore, we approached and interviewed three main categories of stakeholders; namely, (1) CO members who had participated in co-design meetings, (2) CO members who did not participate in co-design meetings but knew the CO via other means, e.g. the end-users of the tools developed in the CO, or volunteers participating in data collection campaigns, (3) Demo Case leads or members of the GT2.0 teams who were actively involved in setting up the citizen observatories in each Demo Case. The samples from the first two groups were selected using cluster and snowball sampling and the respondents from the third group included all Demo Case leads and a number of active team members.[2]

Figure 3 depicts the age and gender distribution of the interviewees from the Netherlands, Sweden, Spain, Belgium, and Kenya Demo Cases. It is important to mention that the distribution of the interviewees in terms of age and gender was strongly determined by the (age and gender) composition of the participants in the three aforementioned clusters of respondents.

[2] For detailed description of sampling methods see D1.10 (Methodology for Validation and Impact Assessment), P39&40 Wehn et al. (2017)

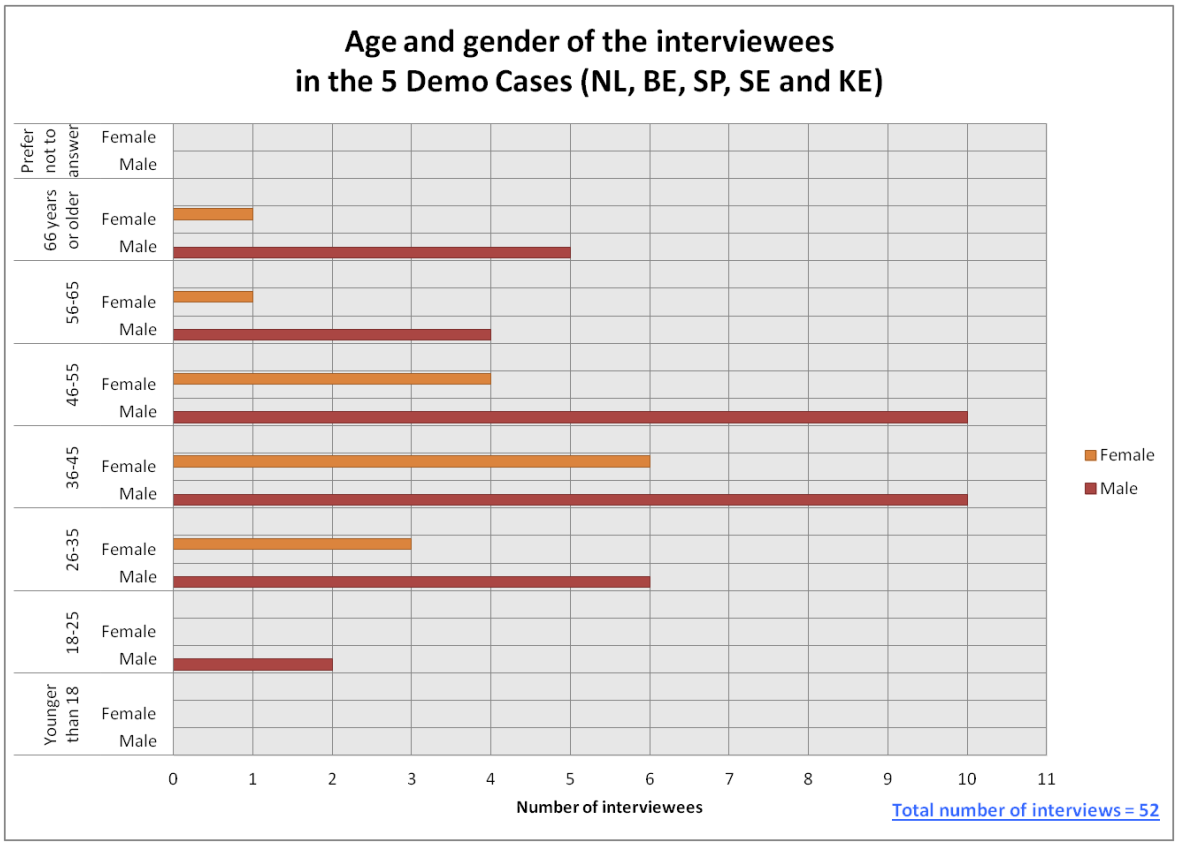

Figure 3. Age and gender of interviewees for the updated impact assessment

The data collection for the institutional impact assessment resulted in comprehensive results that are presented in detail in Annex 1 for each Demo Case.

2.1.2 Capturing environmental impacts

In the context of this report, environmental impacts refer to changes in the specific natural resource(s) quality or quantity that a respective GT2.0 citizen observatory focuses on. In principle, such environmental changes cannot be expected to come about by the mere existence of a citizen observatory; rather, they are reliant on social and institutional changes, i.e. changes in individual and collective behaviour and changes in policy and/or procedures related to managing the given natural resource(s). This rationale follows and extends earlier discussions on first, second and third order impacts of ICTs on environmental sustainability (e.g. Rodriguez Cascal et al., 2004).

Given the dependency of measurable environmental outcomes and impacts on social and institutional changes, we therefore examine a) what type of social and institutional changes are needed in relation to each GT2.0 citizen observatory's environmental issue and b) whether and to what extent the required change process(es) have started during the project lifetime. This assessment is based on the data collected for the analysis of social and institutional impacts.

2.1.3 Capturing economic impacts

The GT2.0 Impact Assessment is aimed at assessing the economic outcomes and impacts that can be associated with the implementation of the GT2.0 Demo Case observatories and the project at large. It distinguishes between the economic outcomes:

a) for the *demand* side of COs, e.g. for public sector organizations benefitting from a given Demo Case CO, incl. the potential cost-reduction of the in-situ component due to the presence of citizen-sensed data

b) for the *supply* side of COs, i.e. for providers of CO solutions and expertise to implement a Demo Case CO.

Furthermore, the analysis of the impacts for the *demand-side of COs* is analysed with respect to the economic impacts of data fusion for the following four cases: Belgium, Spain, Sweden and Kenya since these citizen observatories are collecting data that is complementary to existing in-situ monitoring networks. The Zambia and Dutch Demo Cases are not (yet) collecting such data. The elaborate methodology for this second aspect is presented in Annex 2.

In order to assess the economic impacts for the *supply side of COs*, information was collected by means of a questionnaire that was administered to all 14 GT2.0 partners during November 2019 to capture their organisations' situation during 2019, i.e. at the end of the GT2.0 project. The questions posed in this questionnaire were consistent with those posed for the baseline analysis, the method for which was presented D1.10 and the baseline results in D1.11. The results of the November survey were then compared with baseline data collected in 2016.

2.2 Validation Method

Validation is a form of assessment that establishes if an action, decision, concept, or plan is correct, complete, implemented as intended, and/or is delivering the intended outcome. This means the assessment result includes a judgement such as yes/no, achieved/not achieved, correct/incorrect. In the context of this framework, the validation activities focus on comparing information on project progress and outcomes with documented intentions. The conceptual underpinning of the Ground Truth 2.0 validation was presented in detail in D1.10. In essence, in Ground Truth 2.0, validation is undertaken with respect to both, the Ground Truth 2.0 project outcome and the Ground Truth 2.0 approach, according to three main criteria: coherence, effectiveness and efficiency (see Figure 4).

The validation is presented in two parts. **Validation of project outcomes** is documented per Demo Case at the end of each Demo Case-specific chapter (Chapter 3-8). Validation of outcomes assesses the extent to which activities have initiated emerging, observable practices that involve stakeholders directly interacting with the outputs of the project coherent with expectations formulated in the Demo Case objectives.

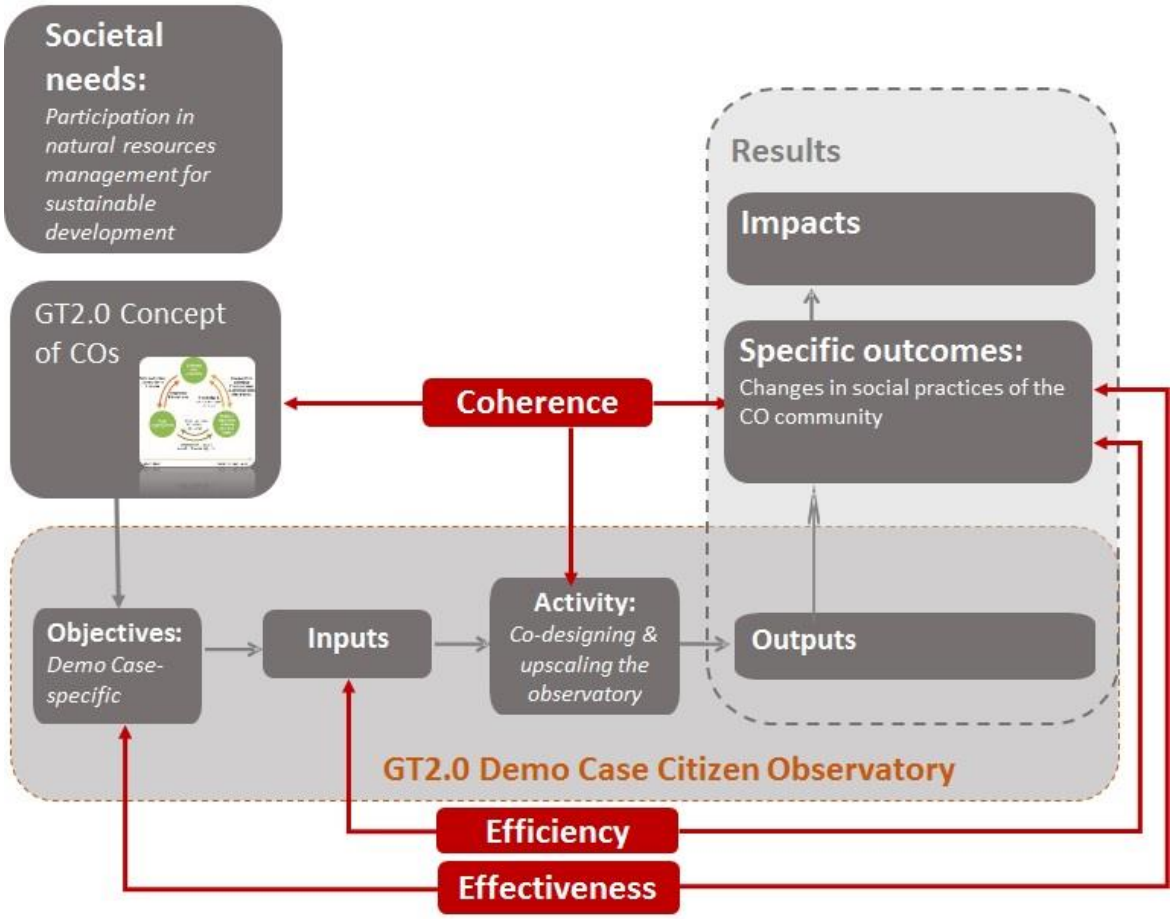

Figure 4. GT2.0 Demo Case-level intervention logic and validation focus (in red)

Source: D1.10 - Wehn et al. (2017)

Validation of the Ground Truth 2.0 approach was conducted across all demo cases, with results presented in section 10. Validation of the method includes assessment of the concept of a Citizen Observatory is correct and complete (correct/incorrect), whether assumptions are wrong and/or whether instructions useful and complete.

Guiding Questions:

- **Coherence:** *To what extent do the Demo Case Citizen Observatories conform to the concept of citizen observatories envisioned in GT2.0 in terms of users involved and types of interactions?*
- **Effectiveness:** *To what extent did the GT2.0 co-design approach contribute to bringing the results about? ("Doing the right things")*
- **Efficiency:** *Which of the observed inputs can be avoided by improvements to the approach? ("Doing things right")*

Note: the results of the validation of the Ground Truth 2.0 approach are presented in Chapter 10.

The data sources for the Demo Case validation consist of the results of the respective impact assessment detailed in this report as well as Ground Truth 2.0 deliverables reporting on the co-design process and user requirements (D1.5 and D1.9), collected data (D2.15) and platform performance (D2.16). The validation of the Ground Truth 2.0 approach, in turn, relies on a cross-case analysis of the results of the Demo Case validation. Moreover, the analysis of the Demo Case experiences informs the development of generic guidelines for the Ground Truth 2.0 approach. The resulting guidelines are reported in D1.13.

3 Belgian Demo Case

In the Belgian Demo Case, the local stakeholders wanted to address the air pollution and noise disturbance in the city of Mechelen which have an impact on health, quality of life and social cohesion in the city's neighbourhoods and villages. The Demo Case started its activities in Mechelen, Flanders' fifth biggest city in terms of population. The central challenge of this citizen observatory, as agreed by the participants in the co-design group, was "Air pollution and noise disturbance have an impact on health, quality of life and social cohesion in all neighbourhoods and villages of Mechelen". Environmental quality of life related to air quality and level of noise is a dynamically changing issue in urban environments, and the spatial and temporal availability of data about these issues was not sufficient for the city of Mechelen. The citizen observatory is called *Meet Mee Mechelen* ("measure with us in Mechelen") to reflect that it reaches out to the whole city to join the initiative. The (potential) pool of participants in this Citizen Observatory consists of the 85665[3] residents in this urban area. A summary of Meet Mee Mechelen in terms of its vision, mission and objectives, CO core members and CO participants, types of key activities and outputs is provided in Table 1.

[3] Based on the 2017 official statistics provided by the Statistics Belgium (STATBEL): http://statbel.fgov.be/sites/default/files/files/documents/bevolking/5.1%20Structuur%20van%20de%20bevolking/Wettelijke_bevolking_per_gemeente_2011_2017.xls

Table 1. Summary of the Meet Mee Mechelen citizen observatory

Issue, Vision and Mission of Meet Mee Mechelen		Objectives
Issue addressed: One of the main challenges in Mechelen is air pollution and noise disturbance. These issues have an impact on health, quality of life and social cohesion in all neighbourhoods and villages of Mechelen **Vision**: In Mechelen, all stakeholders cooperate in a sustainable and constructive manner to keep on improving the air quality and the soundscape. **Mission**: The citizen observatory becomes an online and offline meeting place where we gather and build data, information and knowledge about air quality and ambient noise and make all accessible for everyone, to support policymaking and initiatives for a better living environment.		1. Organize civilian campaigns on air quality, sound and perception of both topics in Mechelen. 2. Launch an online web platform (November 2017) where our measurement results are visualized, together with public data and information, and available as open data for joint analysis of the results. 3. Support and launch from the platform local initiatives, both online and offline, and visible in the city, to improve air quality, reduce noise and thus support awareness raising and behavioural change towards sustainability in Mechelen in 2018. 4. Support an open and constructive dialogue between all parties involved in Mechelen from the start and expand the network of stakeholders into a true community. 5. Prepare the sustainable continuation of this CO after GT2.0 as of 2018.
CO core members		**Participants**
Citizens/civil society organisations	Stedelijk Milieuraad, members of environmental NGOs such as Leefmilieugroep Mechelen-Zuid, Fietsersbond Mechelen, Natuurpunt, Thuis in Nekkerspoel and Klimaan	*Active*: • 50 volunteers for data collection campaigns • 250 participants best attended public event • 120 followers of the MMM Facebook page • 110 followers of MMM twitter account *Reach*: • 200 via MMM email list • 250 via Klimaan email list • Up to 850 per social media posts • More via newspapers and radio
Scientists/data aggregators	Research Institute VITO, science education center Technopolis	
Decision/policy makers	City of Mechelen (City administration) and Flemish department of Environment	
Key activities		**Summary of outputs**
• CO activity planning meetings • Data collection campaigns & data analysis • Public debates and outreach events		**Online platform & tools**: *mechelen.meetmee.be* Air quality measurement instruments coupled with a GPS - works offline and sends the data to a server and database in VITO to process
		Data & information: Soot observations along 2800 km of cycle paths, over 4 seasons (2017-2018), 4 routes; scientific analysis resulting in maps and scientific papers
		Communication & interaction practices: *progress towards cooperative planning* – citizens communicating with policy and decision makers, via CO and based on MMM data and results
Envisaged environmental impacts		
• Improved Air Quality • Reduced noise level		

This Demo case has up scaled to a second location in Antwerp where initial steps toward setting up another citizen observatory were taken, following the Ground Truth 2.0 methodology. The details of this upscaling activity, resulting in the KlimaatRobuust citizen observatory focused on heat stress are presented in Annex 3.

3.1 Social outcomes and impacts

For the Belgium Demo Case, in order to assess the social changes compared to the baseline situation reported in D1.11, data was extracted from the documented highlights and outcomes from the co-design process (D1.9), team observations from 18 CO meetings and eight interviews with CO members.

The most substantial social change that Meet Mee Mechelen has triggered is related to 'dependable information'. It has produced a much more detailed picture of local air quality, which was missing in the past. Since the data has been validated and the concerns that people had about air quality are now scientifically supported, the topic has gained traction as a shared story - with more people in Mechelen triggered to get involved. The coinciding, famous initiative 'Curieuze Neuzen' in Antwerp and Flanders has likely amplified that support but Meet Mee Mechelen also received a lot of attention from the media itself and the website is findable and accessible. The data is also trusted, after four measuring campaigns more measurements were seen as unnecessary (if actions for mitigations were not taken) and the core group of Meet Mee Mechelen shifted their focus to taking actions based on the results.

Table 2. Summary of social outcomes and impacts of Meet Mee Mechelen

Relevant aspect	Baseline	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
Dependable Information				
Shared stories	The air quality and noise pollution are considered an urgent or very urgent topic.	**Yes** The urgency of the CO topic will be shared more unanimously by the residents of Mechelen	**Yes** More people in Mechelen are aware of the challenges concerning air quality in the city	**Yes** MMM communication about air quality will not stop to reach new people
Trusted sources	They have access to dependable and complete information.	**Yes** The datasets collected by MMM will be more specific than data now available	**Yes** MMM produced new datasets about the air quality specifically in (certain locations in) Mechelen	**No** No new data will be collected as long as the related policies in the city did not change.

Relevant aspect	Baseline	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
Timely and accurate information	The data on air quality and noise pollution that is available in Mechelen is reliable but not specific enough.	**Yes** Data collected by MMM will be easier to understand and find	**Yes** Although the website could be better communicated about, the data on it are made easy to understand	**No**
Skills and Competences				
Working together	Prefer face to face communication about the topic of the observatory.	**No**	**Yes** Despite earlier disagreements between some, the CO participants remained open to each other's opinions	**No**
Creativity & flexibility	Regulations and rules are commonly maintained quite strictly, but there are always exceptions, signalling that there is room for some creativity at the government level.	**No**	**No**	**No**
Ability to learn		**Yes** A majority of the interviewed public never looked for this kind of data before, but will.	**Yes** More people actively look for the data and understand how to use it in discussions	**No**
Internet savviness	Use the internet (social media, e-mail, websites & blogs) daily or multiple times per day and another large group that does not.	**No**	**Yes** The online visualisation of the data was appreciated by all. Planning in MMM is still done face to face.	**No**
Social Capital				
Formal engagement	The formal groups represented in the CO community (Fietsbond, Milieuraad, Natuurpunt) function solely on volunteers and voluntary members	**Yes** None of the respondents thought individual citizens can influence decision making and policies air quality and noise.	**Yes** Individual citizens gained more recognition in the consultation with policy makers.	**No**
Trust and belonging (neighbourhood)	People trust the expertise of the city council and other government agencies on environmental issues	**Yes** Residents will feel more personal responsibility	**Yes**	**No**

Relevant aspect	Baseline	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
		for air quality and related policies	New members joining the CO because they feel responsible for the liveability of their city.	
Helping behaviour		**Yes** At the start, only two of the interviewed CO community members indicated that they planned to undertake monitoring activities themselves.	**Yes** Finding enough volunteers to join the monitoring campaign was not difficult at all	**No**
Distribution of risks				
Distribution of resources		**No**	**No**	**No**
Digital divide		**No**	**No**	**No**
Distribution of adverse effects		**Yes** Initially, the ambition of the CO was also to involve automobilists and other air polluters in the CO.	**No**	**No**

The already existing culture in Mechelen of involving citizens via organized citizen groups, often drawing on citizens who are already experienced in those 'formal' processes, was also present in Meet Mee Mechelen. This created hurdles for new, inexperienced, community members to participate in activities other than the measuring campaigns, such as the CO planning meetings. During the three year process of setting up Meet Mee Mechelen, power play was observed between some citizens and policymakers, especially when defining the problem to be addressed by the CO. Still, everyone kept listening to other opinions and in the final set of interviews, one of the respondents pointed out that s/he felt that citizens gained more recognition in the consultation with policy makers. On the topics of air quality, the CO members gained knowledge and insights and became more confident in having discussions and developing solutions.

The CO group started forming a bond around the third co-design session: a group identity started to evolve, but never solidified – because the city employees joining the CO were still regarded as representatives of the policies the group was fighting against. When the city offered to host the CO platform on the municipal website, there were objections from the involved citizens. Also, the difference be-

tween volunteers and professionals may have obstructed the group to become close knit. The difference in resources (time available to spend on the initiative) did not change and this concern was explicitly expressed in two of the interviews. Finally, although a lot of interactions in the CO were done online and via email, the community members involved in the CO were more internet-savvy than they initially indicated to be. There is no evidence that the digital divide that was identified in the baseline was closed or even addressed in the larger community of Mechelen. Also, the distribution of nuisance from polluted air or noise did not change yet. Some CO members attribute policies which are currently implemented as partly inspired by MMM, such as the creation of a cycling zone (limiting freedom of cars) in the whole inner city.

The information of the social changes presented above indicates alignment with one of the objectives that the CO members had, namely 'to gather and build data, information and knowledge about air quality and ambient noise and make it accessible for everyone'.

3.2 Institutional outcomes and impacts

"Air quality has become a much more important topic among politicians and citizens. Politicians talk about it in their campaigns" (interviewee from MMM)

"… it's all the little things that matter. You have taken measurements, and those measurements remain an argument and scientific proof of what the situation is like. That's something you have."

(interviewee from MMM)

The results of the assessment of the institutional outcomes and impacts of Meet Mee Mechelen (MMM) are summarised in Table X and presented in detail in Annex 1.1. It covers details related to the participation paradigm and power dynamics among stakeholders.

Among the expected changes in the participation dimension that materlised to a slight extent, is the diversification of **participants**, with citizens (beyond organised civil society organisation) and other stakeholders participating via MMM co-design process, the measurement campaigns and in the public events. Also, the MMM presence online and offline constitutes access to local knowledge and improvements in the **efforts required to participate**; nevertheless, efforts are required to attend CO meetings and for the cycling during the air quality measurement campaigns.

In view of the one-way communication paradigm about air quality that was identified during the baseline analysis and accompanying lack of support for participation, **support for participation** is provided now for interested volunteers via the existence of the MMM platform, tools and organisational structure, constituting moderate change compared to expectiations. This development is expected to continue further, with MMM joining of the Klimaan initiative as part of which it will be able to support and launch further local initiatives, provide further training on data collection tools and hold public events to discuss the interpretation of campaign results.

Substantial changes appear to have materialised in terms of the **communications paradigm** related to air quality, with MMM now providing information via the preferred communication channels, namely face-to-face and via email. The CO core group also constitutes an instantiation of a more interactive (rather than uni-directional) communication paradigm. Related to this, the **communication and decision modes** regarding air quality have also undergone substantial changes, via the stakeholder interactions (bringing citizens, scientists and policy makers together) and via the data provision created by Meet Mee Mechelen. In all these respects, future positive changes are expected.

Table 3. Summary of institutional outcomes and impacts of Meet Mee Mechelen

Relevant aspect (dimensions and indicators)	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
Participation Dimension				
Geographic scope	Citiy of Mechelen	**No**	**No**	**No**
Participant groups	Flemish government, City council of Mechelen, nature associations, research institutes, neighbourhood committees	**Yes** Enable participation of citizens and other stakeholders in decision making processes regarding air quality and noise pollution	**Yes** Diversification of participants: citizens and other stakeholders participate via MMM co-design, campaigns & public events	**Yes** Engagement of additional citizens and other stakeholders in the CO core group/CO activities
Efforts required to participate	Regulatory entities and expert advisors: time, knowledge & expertise General public: little known about required efforts	**Yes** Provide online & offline means to facilitate participation of various stakeholder groups	**Yes** MMM online & offline presence provides access to local knowledge; time for meetings and cycling during campaigns	**Yes** Thorough transfer of MMM history to future participants
Support offered for participation	For the public: little to none, given one-way communication and top-down decision mode	**Yes** Support and launch local initiatives, training on data collection tools, public events to discuss interpretation of results	**Yes** MMM platform, tools and organisational structure supports participation of interested volunteers	**Yes** Continued support for participation to be provided by MMM becoming part of Klimaan
Communication paradigm	Uni-directional information flow about air quality by authorities F2F preferred channel of communication	**Yes** Use of preferred channels for communication and flow of information about air quality and noise pollution among stakeholders	**Yes** Very good match between preferred communication channels and actual channels provided by Meet Mee Mechelen	**Yes** Authorities: increase public support by going beyond public awareness raising, encourage citizens & policy makers to implement (existing) plans
Communication and decision mode	Public mostly at the receiving end of decisions Express preferences: interest groups feed opinions, ideas and preferences into decision making processes	**Yes** Create new (or strengthen existing) mechanisms for stakeholder interactions in decision making processes, especially via intentional data provision	**Yes** New communication modes related to air quality via stakeholder interactions and data provision created by Meet Mee Mechelen	**Yes** Advance communication mode to aggregate & bargain, turning air quality preferences into a social choice

Relevant aspect (dimensions and indicators)	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
Power Dynamics Dimension				
Access to and control over data	Difficulties and lack of experience with data access by public; data not specific enough, not easy to understand	**Yes** Increased/improved access to and control over data	**Yes** Produced missing air quality data; MMM website provides access and guidance re. interpretation of data	**Yes** Additional observations and greater data uptake
Authority and power	Advice/consultation by Environmental Advisory Board to policy makers Communicative influence: some interest groups try to shape public opinion	**Yes** Change in the level of influence in decision and policy making processes; new forms of political dialogue	**Yes** MMM recognized by politicians and the media; new ways of involving the public; additional possibilities for influencing public opinion; using the produced data as evidence & as a bargaining chip	**Yes** Using (additional) data as a bargaining chip; even greater attention by politicians and the media

In terms of power dynamics among stakeholders, **access to and control over data** has change moderately compared to expectations, with the production of missing air quality data by the MMM data collection campaigns, and with the MMM online platform providing access and guidance re. the interpretation of this data. The assessment of the **power dynamics** also considers the authority and power of distinct stakeholder groups in relevant decision making processes. The baseline situation indicated a closed system in terms of public participation, except for organised civil society organisation providing expert advice. Changes were expected in their level of influence in decision and policy making processes and even new forms of political dialogue. The impact assessment indicates moderate changes in this regard, with MMM being recognized by politicians and the media, constituting new possibilities for involving the public and additional ways of influencing public opinion, and using the produced data as evidence and as a bargaining chip. With the continuation of MMM, (these) new stakeholder relations are expected to be consolidated, additional evidence generated and used for further bargaining in political processes.

3.3 Environmental outcomes and impacts

"…my two neighbours still drive 600 meters by car to get bread" (interviewee from MMM)

As for the other impacts examined in this report, environmental impacts are stipulated to relate directly to the Meet Mee Mechelen outputs and such environmental changes are unlikely to manifest during the project life time as a result of MMM's implementation.

Envisioned environment impact

The environmental changes intended by Meet Mee Mechelen concern improved environmental quality of life in the dimensions air quality and, in the future, to levels of noise. Improvements in air quality and noise levels are expected to, in turn, lead to improved health, quality of life and social cohesion. The air quality data collected during the MMM campaigns provides salient information about the status of air quality at the start of this citizen observatory (see Annex 1.1).

Required social and institutional changes

Improved air quality (and noise levels) are reliant on social as well as institutional changes. To achieve the intended environmental impacts, related institutional changes in Mechelen would have to concern the (re)formulation and implementation of urban planning policy instruments (such extensions of car-free zones), fostering environmentally friendly behaviour by citizens as well as business, and alignment and agreement at regional level (e.g. on low emission zone) of rules, regulations and actions beyond the city boundaries that nevertheless influence air quality in the city. Social changes that impact air quality consist of the uptake of environmentally friendly behaviour related to air quality (either via regulation or increased awareness), namely reducing car usage (by walking, cycling or using public transport) or the use of 'cleaner' cars, especially for vary short distances, and maintaining (rather than cutting down) trees.

Evidence of starting the required social and institutional change processes

During the lifetime of the MMM, the city of Mechelen advanced an 'air quality zone' along with its decision against the introduction of a low emission zone at city level, arguing that the absence of uniform rules at regional level (province of Flanders) for low emission zones (which some large cities have implemented) would lead to fragmentation of rules and fines. The alternative 'air quality zone' is intended as a collaborative approach to which 'everyone can contribute', including via air quality measurements by citizens such as MMM. The topic of air quality featured in recent local election campaigns, including during town hall meetings, not least due the publication and public debates on the results of the MMM measurement campaigns.

Table 4. Summary of environmental outcomes and impacts of Meet Mee Mechelen

Envisioned environmental Impact	*Required institutional changes to achieve intended impact*	*CO Contribution to required change*	*Required social changes to achieve intended impact*	*CO Contribution to required change*
		Direct		**Direct**
		Indirect		**Indirect**
		No		**No**
	Policy changes: (Re)formulation and implementation of urban planning policy instruments	**Direct** Communicative influence of citizens & other stakeholders in 'air quality zone' policy	**Compliance** with car free zones	**Indirect** Awareness of air quality status & causes and need for (extension of) car free zones

Envisioned environmental Impact	*Required institutional changes to achieve intended impact*	*CO Contribution to required change*	*Required social changes to achieve intended impact*	*CO Contribution to required change*
		Direct		**Direct**
		Indirect		**Indirect**
		No		**No**
Improve Air Quality	Alignment and agreement of policies at regional level	**Indirect** Individual education about low emission zone policies at provincial level		
	Integration of new technologies: Technical integration of official in-situ and citizen-based monitoring of air quality	**Indirect** Visualisation of available MMM data and link to official sources	**Adoption of new technologies:** Buy & use low(er) emission cars; make use of car sharing schemes instead of car ownership	**Indirect** Awareness of air quality status & causes and need for reduction of vehicle-based emissions
	Changes in institutional practice: increased monitoring of air quality	**Direct** Communicative influence of citizen via involvement in air quality monitoring in Mechelen	**Behaviour change:** Reduce car usage, increase bicycle usage/walking/public transport	**Indirect** Access to information about and awareness of transport projects, cycling zone in the city, 'cycling city' and 'shared mobility' scheme
			Increase amount of green spaces through planting / maintenance of trees in private spaces	**Indirect** Understanding of role of (mature) trees for air quality & collective action via Klimaan

Following the local elections in 2019, the post-election agreement among the elected parties (bestuursakkoord voor Mechelen) elaborated this further with plans to collaborate (in terms of rules and timing) with neighbouring cities on an extended 'air quality zone' area, to install fixed air quality measurement points and to undertake air quality measurements via air quality sensors of placed bikes of the public sector, police and bike sharing schemes, as well as citizens. However, this political initiative is met with scepticism by MMM members who expected concrete actions rather than increased monitoring activities. Other complementary policy actions include the extension of the car-free zone in the city, the introduction of a cycling zone in the city centre, the ambition to become a 'cycling city' and a drive towards 'shared mobility'. At city level, cooperation with the regional government (LNE) is envisaged to work out how a low emission zone can be introduced at larger scale (than city level) within the province of Flanders.

Overall, there is increased awareness among the MMM members that urban planning and air pollution are closely connected and that solutions for improving air quality will have to involve the regional authorities and additional city units. Provinces serve the municipalities and have funds and support systems available that the towns can tap into when implementing air quality improvement measures.

Moreover, the CO members expect that the continuation of their MMM activities as part of the Klimaan initiative will allow them to combine efforts with like-minded initiatives and to combine the effects of their own measurement and awareness raising activities with the diffusion of technological developments such as cars that run on hydrogen, wind turbines and other renewable energies to trigger behaviour change 'bottom up'.

3.4 Validation

The validation of Meet Mee Mechelen assesses the extent to which activities undertaken by Ground Truth 2.0 have been i) *effective* in delivering the intended outcomes,; ii) *efficient* in terms of inputs used and outputs generated and iii) *coherent* in terms of alignment of the Demo Case citizen observatory align with stakeholder requirements and the concept of a CO.

In terms of outputs, outcomes and impacts of MMM, the data produced about air quality demonstrated interest in air quality by citizens and politicians. The channels and opportunities created for communicating with policy and decision makers constitute realised **outputs of MMM** that represent moderate changes compared expectations (which included data on noise). Changed practices in stakeholder interactions constitute **outcomes of MMM** that have already been achieved, albeit on a small scale, with the formed relationships and regular interactions among the MMM CO members on the topic of air quality. The CO members are using the channels and opportunities created for communicating with policy and decision makers, although stronger link to the city council are still ambitioned. Moreover, changes in the awareness of different stakeholders, including citizens, experts, authorities and politicians is illustrated by air quality being a frequent point in the debates during the recent elections in the city of Mechelen. However, these changes in understanding cannot be attributed to only one initiative such as Meet Mee Mechelen because other parallel efforts (e.g. initiatives such as Curieuze Neuzen) have also contributed to this. Expectations of potential future changes that could result from the activities of Meet Mee Mechelen include greater emphasis on environment and health policies, moving towards green energy sources such as wind power, electric cars, etc., construction of more free parking spaces on the outskirts of the city, and setting a speed limit on the E19 Highway that surrounds the city.

Expected **impacts** in terms of changes in the level of involvement of citizens in decision making processes, e.g. via the formation of citizen panels and integrating citizen participation in policy and decision making processes related to air quality have not yet materialised. Furthermore, this expectation also reveals what may be a wider lack of knowledge among the public of how decision making processes on specific policy issues are organised. Organised citizen groups have already entered such processes but with little awareness and involvement of the public at large. Rather than constituting 'yet another' organised group, Meet Mee Mechelen does present the opportunity to reach out to and involve the public in new ways via its data collection campaigns and public debates with some influence on agenda setting and monitoring of policy implementation.

Table 5. Summary of (expected) outputs, outcomes and impacts of Meet Mee Mechelen

	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
Outputs	**Yes** Citizen observatory tools, data and information about air quality and noise pollution, new channels of communication with policy and decision makers	**Yes** Data produced about air quality; demonstrated interest in air quality by citizens and politicians; new possibilities created for communicating with policy & decision makers	**Yes** Continued activities (incl. data collection) of Meet Mee Mechelen as part of the Klimaan initiative
Outcomes	**Yes** Citizens' increased awareness of, and influence on, benefits and risks of local environmental quality. Promotion of environment-friendly behaviour by policy makers.	**Yes** Increased attention and awareness of different stakeholders; recent post-election political agenda includes air quality.	**Yes** Translation of air quality policy intentions into concrete actions; more tangible institutional changes. Improved toolbox for environmental policy making
Impacts	**Yes** Changes in the balance of power in decision making processes regarding air quality, noise and other environmental quality issues	**No**	**Yes** Translation of MMM results into policy formulation and more tangible institutional changes; wider public participation in other policy domains

In summary, in terms of effectiveness, the results presented in Table 1 indicate that MMM consists of the targeted **stakeholder configuration**, with CO members consisting of citizens and civil society organisations (Stedelijk Milieuraad, members of environmental NGOs such as Leefmilieugroep Mechelen-Zuid, Fietsersbond Mechelen, Natuurpunt, Thuis in Nekkerspoel and Klimaan), scientists/data aggregators (research institute VITO, science education centre Technopolis), decision and policy makers (City of Mechelen (City administration) and Flemish department of Environment).

Moreover, Table 2 and above indicate that the social and instructional changes expected for MMM mostly have materialised already (to differing degrees); there is no single expected change that has not materialised at all. This confirms the effectiveness of the Ground Truth 2.0 co-design approach to deliver the desired outcomes in this Demo Case. Furthermore, the expected future changes signal that the Demo Case is on a trajectory to achieving the expected outcomes in full in the medium-long term.

4 Dutch Demo Case

The GT2.0 Dutch Demo Case is located in the 'Land van Heusden en Altena' which is a part of the Dutch province of North-Brabant. In terms of water management, this area falls under the jurisdiction of the Rivierenland Water Board and the municipality Altenia (which until 1 January 2019 consisted of the three municipalities of Werkendam, Woudrichem, and Aalburg). Based on this, the (potential) pool of participants in this Citizen Observatory stems from the 54757[4] residents living in these three municipalities.

With an increase in the number of intense rainfalls incidents in the recent years (two extreme rainfall events in the summers of 2014 and 2015, respectively), pluvial flooding has become a major concern and has negatively affected a number of residents in this area. Policy makers take measures to prevent and reduce the damage caused by such events, but citizens can also contribute to making their neighbourhood climate proof. For instance by reducing the percentage of paved surface in their gardens or by contributing to weather and water related observations. The common goal of the stakeholders for their citizen observatory is to prevent damage from extreme precipitation; this is reflected in the name selected for the platform: *Grip op water Altena*.

Table 6. Summary of Grip op Water Altena

Issue, Vision and Mission of Grip op water		Objectives
Issue addressed: If we do not take measures, our urban and rural areas will keep being affected by local flooding because of the extreme weather resulting from climate change. **Vision**: In Land van Heusden en Altena the municipality, water authority, citizens and farmers understand each other's interests and ways of working and are together responsible for limiting the damage by pluvial flooding in urban and rural **Mission**: The citizen observatory is a place (on- and offline) where collected observations, knowledge and warnings are shared, where bottlenecks and measures are constructively discussed along short communication lines and where it is clear which actions are taken by which party.		1. Facilitate the exchange of observations and information about the weather and water systems [in October 2017] to allow all stakeholders to act or plan ahead. 2. Support short communication lines and insight in plans and activities of stakeholders regarding water management in Land van Heusden en Altena [early 2018] 3. Set up a knowledge platform with action perspectives and tips to take measures against damage from pluvial flooding [in the course of 2018] 4. Support an open and constructive dialogue between all involved parties in Land van Heusden en Altena [from the start] and expand the network towards a real water community. 5. Prepare the sustainable continuation of this CO after GT2.0 [in 2018 and 2019].
CO core members		**Participants**
Citizens/civil society organisations	Agrarische Natuurvereniging Altena, Altenatuur	19 active Core group members • in total 263 responses on online questionnaire • 98 followers of the Grip op Water Facebook page • 120 followers of the Grip op Water twitter account *Reach*: • 65 via email list • More via newspapers and radio
Scientists/data aggregators	HydroLogic Research	
Decision/policy makers	Municipality of Altena, Waterboard Rivierenland	

[4] Based on the 2017 official statistics provided by the Statistics Netherlands (CBS); retrieved from http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=37230NED&D1=17-18&D2=57-650&D3=l&LA=EN&HDR=T&STB=G1,G2&VW=T

Key activities	Summary of outputs
• CO activity planning meetings • Enhance the CO platform with inputs by citizens (tips & tricks for flood resilience) and authorities (updates about flood risk measures) • CO outreach activities	**Online platform**: *http://altena.gripopwater.nl/*
	Data & information: StoryMaps with operational information on water levels and rainfall, information from research in pluvial flooding, information on measures taken by municipality, water board and citizens, observations from citizens
	Communication & interactions: improved communication channels between authorities and citizens via Face-to-Face meetings in the area, and the online information
Envisaged environmental impacts	
• Limited the damage by pluvial flooding in urban and rural areas	

4.1 Social outcomes and impacts

For the Dutch Demo Case, in order to assess the social changes compared to the baseline situation reported in D1.11, data was extracted from the documented highlights and outcomes from the co-design process (D1.9), team observations from nine CO meetings as well as from interviews with CO members and GT2.0 partners.

Table 7. Summary of social outcomes and impacts of Grip op Water Altena

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Information				
Shared stories	The understanding of the problem and interpretation of the relevant issues vary significantly.	**No**	**Yes** problem statement evolved into one shared story	**No**
Trusted sources	Teletext and Rijkswaterstaat are dependable sources.	**No**	**No** Existing sources did not change and little additional data was created	**No**

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Timely and accurate information	Weather forecasts, are shared by (national) weather institutes, is time and place-specific & easily accessible for citizens. Local flood alerts are less available and also less advanced in how specific they get. Historical data on flood-related damages and the extent of rain induced flood events is not available at all. This information might have been collected but it is not accessible.	**Yes** Information about acute risks or exceedance will be made available and better accessible	**Yes** Previously closed-off datasets (from water board) are now made publicly available	**Yes** In case of a future flood event the Grip op Water platform will be used for data collection
Participation Dimension				
Working together	"when something big happens, we help each other"	**Yes** Better collaboration between water board (provides permits) and municipality (decides on land use)	**Yes** Representatives of the water authority and the municipality communicate with each other (also informally)	**No**
Creativity & flexibility		**No**	**No**	**No**
Ability to learn		**Yes** Lessons observed from previous flood events will be kept alive and urgent	**Yes** Revived the memory of the latest flood incidents five years ago, the perceived urgency is still low.	**Yes** A future flood event will reinforce the lessons observed before and shared by Grip op Water
Internet savviness	High. They used social media and apps multiple times a day, websites, blogs and email at least daily.	**No**	**Yes** Story maps were created - older participants still had trouble finding their way around the platform.	**Yes** The website will be hosted and maintained by volunteers.
Social Capital				
Formal engagement	Many stakeholders and the responsibilities of various, local and national, governmental bodies (municipality, water boards, Rijkswaterstaat, etc.)	**Yes** Citizens do not (yet) feel very involved, responsible or able to influence decision making	**Yes** Involved authorities seem more willing to commit to citizen participation initiatives.	**Yes** The communication platform of Grip op Water will remain a valuable engagement line for the local authorities

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Trust and belonging	The authorities and experts see the added value of the help of citizens; however, the role of individual citizens is not recognized by those citizens.	**Yes** Residents feel strong attachment to place, regional authorities are not yet part of that	**Yes** Direct communication between regional / local authorities and civic society is valued	**Yes** Communication lines will continue to exist
Helping behaviour		**Yes** The group of volunteers communicating about Grip op Water will grow	**No** CO group became smaller and did not register many new participants	**Yes** With the uptake of the CO by the ANV more volunteers will likely get involved
Distribution of risks				
Distribution of resources		**No**	**No**	**No**
Digital divide		**No**	**No**	**No**
Distribution of adverse effects		**No**.	**No**	**No**

The biggest impact that Grip op Water has made on the (potential for) empowerment of citizens, has been on the aspect of 'working together'. Representatives of the water authority and of the (newly formed) municipality communicated, also informally, with each other about Grip op Water planning meetings and their collaboration became easier because of the goodwill created between them. For the citizens participating in Grip op Water, extending their network was one of the valued outcomes that were reported. One of the CO members noted that s/he felt like 'currently the government has a different view on these kind of initiatives compared to the start of this project. They seem more willing to commit to citizen participation initiatives.' Although the CO member group got to know each other and bonded over time, it became smaller and did not register many new participants in its course, mostly likely because the latest flood incidents were five years ago and the perceived urgency low. When another flood occurs on the island of Altena, the infrastructure is ready to support more participants. Although the digital savviness had been assessed to be high in this Demo Case, the older participants experienced problems with the technology and had trouble finding their way around the online platform.

On the information aspect, the trusted sources with timely and accurate information, such as Buienradar and the KNMI, did not change and little additional data was created to supplement those. The disputes about the problem statement however did evolve into one shared story about the importance of green spaces on public and privately owned land, for the infiltration of rainwater and thus

to prevent flooding. The social capital was already high with residents feeling a strong attachment to the island. Formally, the engagement of citizens in the work of the municipality and water board did not change – but informally, valued connections were made. Involved community members indicated that they appreciate the opportunity to discuss their concerns directly with water board and municipality. Vice versa, the authorities involved are planning to stay involved and even provide a small budget, because they value the direct communication line with civic society that was established by Grip op Water. Considering the main objective of Grip op Water to facilitate better communication, this is a successful outcome for the Observatory.

4.2 Institutional outcomes and impacts

The results of the assessment of the institutional outcomes and impacts of Grip op Water Altena are summarised in Table X and presented in detail in Annex 1.2. It covers details related to the participation paradigm and power dynamics among stakeholders.

In the participation dimension, the geographic scope of Grip op Water Altena has not changed, and as planned, this CO was established in Land van Heudsen en Altena.

Among the expected changes in the participation dimension that materialized to a slight extent is the diversification of **participants**. Citizens, the Rivierenland water authorities and the municipality of Altena participated in Grip op Water co-design process and outreach events. Also, Grip op Water Altena provided for online & offline interaction, access to weather and water-related data and information, as well as organizational and technical support for meetings and online interactions that resulted in improvements in the **efforts required to participate**; nevertheless, efforts such as time and financial resources are required for continued future online and offline interactions.

In view of the one-way communication paradigm (i.e. from authorities to citizens) and the top-down model of decision regarding water management in the Netherlands, Grip op Water provided **support for participation** and interaction of interested stakeholder in both online and offline modes. This development is expected to continue further, as part of an environmental NGO called Agrarische Natuurvereniging (ANV) who is taking over after the GT2.0.

Substantial changes appear to have materialised in terms of the **communications paradigm** related to management of pluvial flooding in Altena, with Grip op Water Altena now providing information via the preferred communication channels, namely face-to-face and via email. The CO core group also constitutes an instantiation of a more interactive (rather than uni-directional) communication paradigm. Related to this, the **communication and decision modes** regarding management of pluvial flooding in Altena have also changed moderately, via both online and offline modes of interaction and dialogue among stakeholders in Grip op Water Altena. In all these respects, future positive changes are expected.

In terms of power dynamics among stakeholders, although Grip op Water website integrates a lot of publicly available data, **access to and control over data** has changed slightly compared to expectations. This is because citizen-contributed data is (still) limited. The assessment of the **power dynamics** also considers the authority and power of distinct stakeholder groups in relevant decision making processes. The baseline situation indicated a closed system in terms of public participation. Changes were expected in the level of influence of different stakeholders (especially citizens) in decision and policy making processes. The impact assessment indicates a slight change in this regard, with Grip op Water Altena providing new opportunities for raising awareness, expressing concerns and share information among stakeholders. Nevertheless, this is expected to further change in the future, with active participation of a larger number of community members and more organizations.

Table 8. Summary of institutional outcomes and impacts of Grip op Water Altena

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Participation Dimension				
Geographic scope	Land van Heudsen en Altena	**No**	**No**	**No**
Participant groups	Water authorities, union of Water Boards, municipalities, the Association of Dutch municipalities, Rijkswaterstaat, Provinces, Rioned Foundation, and ZLTO	**Yes** Enable participation of citizens and other stakeholders (e.g. water authorities, municipalities) in decision making processes	**Yes** Diversification of participants: citizens, Rivierenland water authorities and municipality of Altena participate via Grip op Water co-design & outreach events	**Yes** Engagement of additional citizens and other stakeholders in the CO core group/CO activities.
Efforts required to participate	Regulatory entities: Time and communication efforts needed for raising awareness Community members: Time, and efforts needed for attending meetings hosted by authorities becoming a member of a political party Experts advisors:	**Yes** Provide online & offline means to facilitate participation of various stakeholder groups	**Yes** Grip op Water Altena provided for online & offline interaction, access to weather and water-related data and information; organizational and technical support for meetings and online interactions	**Yes** Thorough transfer of knowledge and common understanding developed in Grip op Water to future participants.
	Time and financial resources needed for starting a citizen-led initiative General public: time, financial resources, communication skills, finding contacts, expertise			
Support offered for participation	For the general public: little to none, given one-way communication and top-down decision mode regarding water management decisions	**Yes** Support and launch of a local initiative, integrating relevant data and information on a web-platform, new forms of communication and interaction among stakeholders	**Yes** Grip op Water offline and online interactions, support sharing data and information and participation of interested volunteers	**Yes** Continued support for participation and information exchange to be provided by Agrarische Natuurvereniging (ANV) who is taking over after the GT2.0

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Communication paradigm	Using telephone, emails and face to face communication	**Yes** Use of preferred channels for communication and flow of information about pluvial flooding among stakeholders	**Yes** Good match between the preferred communication channels and the actual channels used for communication purposes.	**Yes** Continued dialogue between water authorities, municipality and citizens using online and online interaction possibility created by Grip op Water Altena
Communication and decision mode	Top-down decision making model: water authorities and municipalities are considered as the main organization in charge of decisions about management of pluvial floods Public mostly at the receiving end of decisions	**Yes** Create new (or strengthen existing) mechanisms for stakeholder interactions in decision making processes, especially via interactions and new channels of communication	**Yes** Grip op Water Altena has provided an alternative way of communication about pluvial flooding between different stakeholders Yet, no mechanism for participation in decision-making processes.	**Yes** Continued online and offline communication and exchange of information
Power Dynamics Dimension				
Access to and control over data	A lot of weather and water data are available, but the general public is not aware of this	**Yes** Increase awareness about and access to weather and water data especially for citizens, increase the availability of citizen-contributed data to be used by the authorities	**Yes** Grip op Water website integrates a lot of publicly available data, citizen-contributed data is (yet) limited	**Yes** Additional observations (especially by citizens) and greater data uptake of available data and information
Authority and power	Regulatory entities: direct influence. Expert advisors: influence via advice and consultation CO members and general public: minimal or no influence	**Yes** Change in the level of influence in decision and policy making processes; new forms of political dialogue	**Yes** Opportunity to raise awareness, express concerns and share information among stakeholders.	**Yes** Awareness raising and dialogue among a larger number of community members and more organizations

4.3 Environmental outcomes and impacts

Envisioned environment impact

Grip op Water Altena aims to contribute to reducing the damage from pluvial flooding in urban and rural areas in Altena. Achieving this positive environmental change requires collaboration of all involved stakeholders and a better understanding of the issue of pluvial flooding. In addition, stakeholders need to be aware of possible measures for limiting the damage from pluvial flooding and how they can contribute themselves. Grip op Water Altena provides offline and online possibilities for these interactions and information exchanges.

Required social and institutional changes

Reducing the damage from pluvial flooding in Altena requires a close collaboration between all stakeholders. Nevertheless, the current water management policies in the Netherlands barely have provisions for public participation. Therefore, there is a need for reformulation of current water management policies in a way that allows for participation of all stakeholders. There is also a need for technological changes that allow for integration of citizen-contributed data into the current and rather established decision making processes. In addition, understanding of available water retention areas (including those in residential buildings e.g. garden or roofs) needs to be improved and water authority and municipality should improve their response to problems caused by pluvial flooding. For citizens to be able to contribute to management of pluvial flooding, they first need to raise their awareness about water management practices and the risk of pluvial flooding. Moreover, instead of relying solely on authorities for protection against pluvial flooding, citizens need to contribute to limiting the problem by taking measures themselves in their homes (e.g. creating more water retention capacity by removing unnecessary tiles form their garden).

Evidence of starting the required social and institutional change processes

Although current water management policies and regulations in the Netherlands do not (explicitly) have provisions for public participation, regional water authorities and municipalities are increasingly interested in raising public awareness about water management issues and explore possibilities of public participation these processes. This interest existed in the Regional Water Authority Rivierenland and the Municipality of Altena. Grip op water Altena facilitated exploring options for reducing the risk of pluvial flooding in Altena in a participatory way and through interactions and communication among local stakeholders. Nevertheless, there are well-established data collection and processing mechanisms in the Regional Water Authority Rivierenland and the Municipality of Altena that require change in order to integrate data and information generated by Grip op Water Altena. Online and offline Interaction, communication and information exchange between authorities, citizens and other stakeholders via Grip op Water Altena contributes to the much needed raise in awareness among local community members about water management processes in their living area and among the authorities about citizens' needs and concerns. A better understanding of the measures taken by authorities to limit the problems with pluvial flooding in Altena and identifying places that (still) face challenges when an intense rainfall event happens are examples of these information exchanges.

Information generated via Grip op Water Altena can also contribute to a better understanding of the available water retention capacity of Altena. This can help authorities improve their preparedness for, and response to, pluvial flooding e.g. by better planning the construction, maintenance and operation of water infrastructures such as drainage system or weirs. Moreover data and information shared in Grip op Water Altena also include perspectives, tips and practical measures for limiting the damage from pluvial flooding by citizens. Availability of this information can contribute to enhancing citizens' understanding of possibilities for their participation, and as a result to a change in behavior towards

more responsible practices such as installing a rain barrel for collecting the rainwater or removing a few tiles for creating more water retention capacity. This is in line with implementation of an existing policy by the Regional Water Authority Rivierenland for initiatives called 'Subsidie Klimaatactief' that tries to incentivise citizens to work together with authorities to make their garden, house or street more climate-proof through subsidies.

Table 9. Summary of environmental outcomes and impacts of Grip op Water Altena

Envisioned environmental Impact	*Required institutional changes to achieve intended impact*	*CO Contribution to required change*	*Required social changes to achieve intended impact*	*CO Contribution to required change*
		Direct		**Direct**
		Indirect		**Indirect**
		No		**No**
Limited damage from pluvial flooding in urban and rural areas	**Policy changes:** (Re)formulation of water management policies to include public participation in management of pluvial flooding	**Indirect** Communicative influence of members of Grip op Water Altena to identify possibilities and mechanisms for reducing the risk of pluvial flooding in a participatory way	**Awareness:** Increased awareness of local flood risks (closed/limited existing awareness gap about water management among Dutch citizens)	**Direct** Online and offline interaction, communication and information exchange between citizens, Regional Water Authority Rivierenland and municipality of Altena via Grip op Water Altena
	Integration of new technologies: Integration of citizen-contributed data into decision making processes	**Indirect** Existence of Grip op Water illustrates need to integrate citzen contributed data		
	Changes in institutional practice: Climate proof water management based on increased understanding of available water retention areas	**Direct** Information generated through the garden survey and available forms on Grip op Water Altena & the shared tips & tricks	**Change in behaviour:** measures taken by citizens to limit the damage of pluvial flooding	**Indirect** Sharing perspectives, tips and practical measures to limit damage from pluvial flooding
	Changes in institutional practice: Improved response to problems caused by pluvial flooding by authorities	**Indirect** Pluvial flooding observations submitted via Grip op Water Altena web-platform		

4.4 Validation

The validation of Grip op Water Altena assesses the extent to which activities undertaken by Ground Truth 2.0 have been i) *effective* in delivering the intended outcomes,; ii) *efficient* in terms of inputs used and outputs generated and iii) *coherent* in terms of alignment of the Demo Case citizen observatory align with stakeholder requirements and the concept of a CO.

"Maybe we can have a risk dialog via Grip op Water Altena" (interviewee from Grip op Water Altena)

This section summarizes the views of GT2.0 team members, authorities and community members about the expected outputs of Grip op Water Altena.

One of the main **expected outputs** for the GT2.0 team members was the establishment of a CO that engages different organizations and local community members in collection and sharing of weather and water data and information. Data about measures taken by different stakeholders for reducing the risk of pluvial flooding and information about water storage capacity of private gardens in the case study area were mentioned as examples of these water- and weather-related data and information. This information was expected to be shared via a web-platform that is used by authorities and a large number of community members. Moreover, the GT2.0 team members expected to facilitate communication about the issue of pluvial flooding by establishing an institutionalized communication procedure. Interviewees from this group believed Grip op Water Altena was successful in developing a web-platform for sharing data and information and engaging the municipality of Altena, the water authority Rivierenland and a small number of community members. However, data and information sharing on the platform was described as mainly one directional and from authorities to citizens. It was mentioned that a very limited amount of data and information was shared by citizens, and this was mainly limited to the results of the two surveys (about gardens as well as memories of floods, see Annex 1.2).

The water authority Rivierenland was expecting to create more awareness and also obtain area-specific information that can help improve decision making processes related to the management of pluvial floods towards more collaborative ways. The interviewees from this organization believed that Grip op Water Altena has been successful in creating a web-platform and facilitating occasional interactions between citizens and several organizations.

The interviewee from the municipality mentioned that he did not expected a specific outcome from Grip op Water Altena; however, he described the website of this CO as a good communication tool that contributed to awareness raising at a small scale and facilitated creating contact with other organizations. Interviewees from the community member identified quite a diverse range of outputs that they expected to see as a result of Grip op Water Altena. Minimizing water nuisance in the CO area by taking measures against pluvial flooding, communicating with authorities about existing issues, having a say in decision making processes related to the management of pluvial floods, sharing information and creating a support base for the authorities were among these expected outputs. The **actual outputs** of Grip op Water Altena were considered to consist of the communication and the direct contact between different stakeholders in Grip op Water Altena, they authorities are now more aware of the problems of other stakeholders. Moreover, some information is shared via the CO website; however, the interviewees believed that this information has resulted in limited awareness raising and no practical measure has been taken based on this information.

Most interviewees across the stakeholder categories believed that the **realized outcomes** of Grip op Water Altena are still limited; however, they identified a number of governance-related outcomes for this CO. Creating a small community of stakeholders around the topic of pluvial flooding, awareness raising about participatory approaches for reducing the risk of pluvial flooding (mainly within this community), and a creating a new way of communication and interaction between municipality, water

authorities and citizens were considered the main realized outcome of Grip op Water Altena. Similarly, the majority of the interviewees did not expect major short-term changes resulting from this CO in the near future; however, some mentioned that Grip op Water Altena has the potential to contribute to data sharing and improved communication and interactions among the stakeholders.

Table 10. Summary of (expected) outputs, outcomes and impacts of Grip op Water Altena

Relevant aspect	Expected changes (Yes/No)	Realized changes (Yes/No) & the extent of their achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Outputs	**Yes** Awareness raising and information exchange, facilitating online and offline interactions between citizens and authorities	**Yes** Awareness raising and information exchange, facilitating online and offline interactions between citizens and authorities, but for citizens, this happened at a small scale	**Yes** Continued awareness raising, information exchange, and interactions among stakeholders
Outcomes	**Yes** Increase information exchange and communication about risk of pluvial flooding that results in awareness raising and opening up a dialouge among stakeholders.	**Yes** Creating a small community of stakeholders around the topic of pluvial flooding, awareness raising about participatory approaches for reducing the risk of pluvial flooding, and a creating a new way of communication and interaction between municipality, water authorities and citizens	**Yes** More data sharing and better communication and interaction among stakeholders and creating a real a risk dialog among stakeholders via Grip op Water Altena
Impacts	**Yes** Moving towards collaboration in management of pluvial floods	**No**	**Yes** Closer collaboration among different stakeholders for creating a climate-proof Altena. Increased two-way trust and transparency among stakeholders.

Although a number of interviewees from all groups were skeptical about the **future impacts** of Grip op Water Altena, or described it as largely unknown, others identified possible impacts resulting from this CO. The identified impacts were environmental, societal and governance-related, the realization of which depend on the future uptake of the activities in Grip op Water Altena.

An interviewee from the water authority Rivierenland mentioned that Grip op Water Altena, along with a series of other efforts at the local and national level, has contributed to planting a seed for participatory approaches for water management in Altena. Some interviewees believed that this participatory approach will result in a closer collaboration among different stakeholders and will eventually help with 'getting water more under control' and creating 'more space for water'. Moreover, it was also expected that improved communication among stakeholders will result in increased trust and transparency among stakeholders.

5 Spanish Demo Case

The GT2.0 Spanish Demo Case is located in Catalonia that is an autonomous region located in the north-eastern of Spain, and has a population of roughly 7.5 million inhabitants[5]. Noticeable increase in the temperature and decrease of rainfall has started to affect the natural systems in this region. Analyzing phenological changes can serve as a proxy of monitoring climate change. This is due to the fact that even small variations in the climate may have severe effects on plant and animal life cycle. Although several instances of collecting phenological records exist, these efforts are isolated, disconnected, very specific and generally speaking, incomplete. A long-term observation that results in a complete set of phenological records requires collaboration of a significant number of participants and thus, citizens and biodiversity enthusiasts are uniquely placed to carry out this task. The (potential) pool of participants in this Demo Case consists of the 7.5 million[6] residents of Catalonia who live across this region.

The aim of the stakeholders in this Demo Case is a citizen observatory where phenological observations provided by the citizens in real time are collected to form an information base that will allow influencing public policy decisions in Catalonia, Spain and that is constituted in a way that the CO is sustainable over time. Its stakeholders have named their citizen observatory "RitmeNatura.cat" (follow the rhythm of nature).

Table 11. Summary of RitmeNatura.cat

Issue, Vision and Mission of RitmeNatura	Objectives
Issue addressed: The main challenge in the Spain Demo Case is the lack of a place in which to create collective knowledge about the local impact of climate change on nature and its rhythms in Catalonia, to contribute to better adaptation policies Vision: In the digital world there will be a place that allow citizens, managers and politicians to access and share phenological information. Such a place will allow communication among stakeholders and will be sustainable in time. Mission: The Observatory will be the place where phenological data, in particular that collected by citizens, will be stored and make it accessible in real time, with the aim of influencing decision making.	1. To create an open Citizen Science platform dedicated to store, comment, share and disseminate facts, opinions and proposals about the effects of Climate change on Nature and influence related decision-making processes. (a) To disseminate proposals related to the effects of Climate Change on Nature and promote a space to discuss them (b) To share opinions with other users regarding the effects of Climate Change on Nature 2. Through data collection by citizens and by a guided observation protocol, to generate useful information to understand the impact of Climate Change on Nature. (a) That allows sharing and validating the collected observations (b) That allows accessing relevant information (data, studies, etc.) (c) Motivate and promote relevant educational activities 3. To find synergies with existing platforms and ensure that the Observatory becomes an umbrella of information and organizations related to the effect of Climate Change on nature (a) To share self-generated content as well as the observers' contributions 4. To promote the sustainability of the Citizen Observatory beyond the end of the project.

[5] Based on the 2017 official statistics provided by The Statistical Institute of Catalonia (Idescat): https://www.idescat.cat/pub/?id=aec&n=249&lang=en

[6] Based on the 2017 official statistics provided by The Statistical Institute of Catalonia (Idescat): https://www.idescat.cat/pub/?id=aec&n=249&lang=en

CO core members		Participants
Citizens/civil society organisations	Butterfly and bird enthusiasts, nature associations, other existing Citizen Observatories (e.g. Natusfera), NGOs.	*Active*: • 186 volunteers for data collection • 671 observations • 320 participants best attended public events • 150 students attended training sessions • 452 followers of RitmeNatura twitter account *Reach*: • Up to 439 per social media posts • 3 media appearances with more than 142.000 audience
Scientists/data aggregators	CREAF, Meteorological Service of Catalonia' (Meteocat)	
Decision/policy makers	Catalan Office of Climate Change, Department of Territory, Sustainability and Housing Agency of Catalonia, the Barcelona Provincial Council (Diputacio de Barcelona), the Barcelona Metropolitan Area (AMB).	
Key activities		**Summary of outputs**
• CO activity planning meetings • General public & school training sessions • Public debates and outreach events		Online platform: *http://ritmenatura.cat/en/home_en/* Project within the Natusfera platform that can be accessed through the web or via the Natusfera app
		Data & information: 435 occasional observations and 233 recurrent observations. 127 species or groups observed.
		Communication & interactions: Agreement signed between CREAF and the Catalan Meteorological Service to continue supporting and promoting the Observatory. Interaction between the Catalan Meteorological Service and the Barcelona Provincial Council to promote the phenological observation within natural parks in the province.
Envisaged environmental impacts		
• Improved adaptation of natural areas to climate change		

5.1 Social outcomes and impacts

"…at the citizen level, increasing awareness is the way to have relevance" (interviewee of RitmeNatura)

For the Spanish Demo Case, in order to assess the social changes compared to the baseline situation reported in D1.11, data was extracted from the documented highlights and outcomes from the co-design process (reported in D1.9), team observations from five CO meetings and six interviews with CO members.

Three years is too short to create the kind of data series that are useful for phenology. The observation data is now used to monitor (increased) participation. The platform is perceived as not being perfect but it doing a good enough job. The biggest impact that RitmeNatura.cat has made on the (potential for) empowerment of citizens is on the social capital aspect. The synergies that were created in the institutional network of RitmeNatura are considered to have the potential to make a difference in

raising awareness among relevant organisations and levels. Although all members of the RitmeNatura.cat CO were people representing organisations and many were not adequately mandated by their employers from the start, they eventually took ownership and the mood in the group was lively.

Table 12. Summary of social outcomes and impacts of RitmeNatura.cat

Relevant aspect	Baseline	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Information				
Shared stories	There is a sense of urgency for collecting long term data in order to obtain awareness of the problem. Climate Change and the environment are important themes in Catalonia. There is a shared understanding of the importance of these themes for the future of the region.	**Yes**	**Yes** Collected observations are also used to monitor participation: more than half of the Catalonian population *still* shares the urgency perceived by CO members.	**No**
Trusted sources	Reliable data is not available yet.	**Yes**	**Yes** Easier to find and to interpret, but three years is too short to create data series useful for phenology.	**Yes** Longer data series will be increasingly useful
Timely and accurate information	Phenological observations are collected but only on a few locations and there are certainly no long time series of information.	**Yes**	**Yes** The platform is not perfect but doing a good enough job in collecting consistent series of data	**Yes** Longer data series will be increasingly accurate
Participation Dimension				
Working together	An extra difficulty for getting involved is that public administration in Catalonia has several levels and it is not always clear who is responsible for overarching themes like climate change.	**Yes** Between the different levels of public administration in Catalonia, one should be held responsible for the theme of climate change	**Yes** A regional law on climate change was passed but the capacity of RitmeNatura to influence policies is not recognized by the respondents	**No**
Creativity & flexibility		**No**	**No**	**No**

Ability to learn	Community members who do have experience with looking for the data, found it difficult to find and interpret.	**No**	Regarding climate change RitmeNatura has had an awareness raising and agenda setting role	**No**
Internet savviness	High; daily use of the internet (email, websites, social media and apps) is very common. The preferred communication channel about climate change and phenological observations is social media, closely followed by either websites or email. Still, face to face communication is highly valued as well.	**No**	**No**	**No**
Social Capital				
Formal engagement	Apart from very local actions at neighbourhood or community level, individual respondents do not have the feeling that they have influence or can contribute to decision making on this topic. Also, the scientists who are members of the CO community state that they can only advise and make recommendations but do not have real influence.	**No**	**No**	**No**
Trust and belonging		**Yes** Involved organisations aim to work together and collaborate instead of compete	**Yes** Representatives of involved organisations bonded on a personal level and took ownership	**Yes** The personal relations between representatives in the CO will continue to exist
Helping behaviour		**Yes** Building a network between relevant organisations, strengthening each other's work	**Yes** The synergies in the CO network raised awareness among relevant organisations and levels.	**Yes** This dynamic will continue to be relevant
Distribution of risks				
Distribution of resources		**No**	**No**	**No**
Digital divide		**No**	**No**	**No**
Distribution of adverse effects		**No**	**No**	**No**

RitmeNatura serves as a good platform for raising awareness, but its capacity to influence policies is not recognized by the CO members that were interviewed. Over the last few years, there has been a clear increase in activism regarding the issue of Climate Change and phenology. Scientists are seen to be more outspoken and to have turned into climate activists in recent years. The regional parliament also approved a law on climate change (although it is being contested), but apart from maybe the awareness raising and agenda setting role on Climate Change and phenology, this cannot be credited to RitmeNatura.

The objective of the CO to become in an umbrella of information and organizations on phenology explains the focus on collaboration, rather than information or capacities, among the social impact dimensions.

5.2 Institutional outcomes and impacts

The results of the assessment of the institutional outcomes and impacts of RitmeNatura.cat are summarised in Table X and presented in detail in Annex 1.3. It covers details related to the participation paradigm and power dynamics among stakeholders.

In the participation dimension, the geographic scope of the activities of RitmeNatura.cat, as expected compared to the baseline assessment, is the only aspect that has not changed, i.e. the region of Catalonia. Other changes in the participation dimension have materialised to various extents.

RitmeNatura.cat presents the opportunity for various **participant groups**, especially professionals and phenology and biodiversity enthusiasts, to engage in the production of data and knowledge about phenology and climate change in Catalonia. The online and offline means (RitmeNatura.cat online platform, submission of observations via Natusfera) reduce the **efforts required to participate** by generally raising awareness of phenology and climate change and the links between them, and providing the tools for making and submitting phenological observations. Although time is still a considerable effort required to go to a specific observation location and fill in the details, the level of required expertise is limited since experts in Natusfera help with identifying the species. This link between expert knowledge from the Natusfera network to validate the observations submitted via RitmeNatura.cat constitute an expected change in terms of **support for participation**, along with the organisation, technical and communication support provided to set up RitmeNatura by the Ground Truth 2.0 partners. The expert support by Natusfera is expected to be continuously provided via RitmeNatura in the future, but implies the parallel growth of experts for vetting observations as observer numbers and/or observations increase.

The most substantial changes in the participation dimension appear to have materialised in terms of the **communications paradigm** that address the preferred flow of information about phenological observations among stakeholders in terms of tools (smartphones, apps, social media) and coordination of RitmeNatura activities via email. While in line with expectations and successful in that respect, these channels align with RitmeNatura's aim of acting as an umbrella organisation for information and organizations on phenology more than its opaque objective of influencing decision making processes related to climate change. Accordingly, the expected and realised changes in the **communication and decision making modes** reflect this, with the implementation of new ways of communicating about the topic of climate change in Catalonia and attracting media attention to the topic. However, concrete ways in which the information and insights generated by RitmeNatura could be channelled into relevant decision making processes were not foreseen.

With respect to power dynamics among stakeholders, **access to and control over data** has increased in terms of exposure to phenological data, evidenced by the observations made in RitmeNatura.

Table 13. Summary of institutional outcomes and impacts of RitmeNatura.cat

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
Participation Dimension				
Geographic scope	Catalonia region	**No**	**No**	**No**
Participant groups	EU, national (Spanish), regional governments and the municipalities in Catalonia. Nature associations, research institutions, and other existing science initiatives (e.g. Natusfera).	**Yes** Organizations involved in making decisions regarding biodiversity and climate change adaptation in Catalonia.	**Yes** Increased participation of professionals, and phenology and biodiversity enthusiasts.	**Yes** Individual citizens or professionals with an interest in nature or phenological observations. Schools.
Efforts required to participate	Regulatory entities and CO members: time, technical skills, knowledge and expertise, financial resources and equipment General public: motivation and interest, awareness about the topic.	**Yes** Provide online & offline means to facilitate participation of various stakeholder groups	**Yes** RitmeNatura online & offline presence; time required for making observations	**Yes** Thorough transfer of RitmeNatura history to future participants
Support offered for participation	Support offered for participation by other citizen science initiatives (e.g. Natusfera)	**Yes** Organizational, technical and communicative support.	**Yes** Natusfera community helps with identifying and validating the RitmeNatura observations.	**Yes** Continued support for participation to be provided by RitmeNatura and Natusfera More support from expert community for increased # of citizen observations
Communication paradigm	Using Smartphone Apps, and social media	**Yes** Use of preferred channels for communication and flow of information about phenological observations among stakeholders	**Yes** Good match between preferred communication channels and actual channels provided by RitmeNatura, e.g. coordination efforts via email; entering, viewing & searching information done by websites.	**Yes** Advance communication mode to share information

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
Communication and decision mode	Regulatory entities: very much involved via their jobs. Expert advisors: not directly involved (only via the research) CO members: some sort of involvement	**Yes** Improve communication about the topics of phenology and climate change among different stakeholders	**Yes** Ritme Natura has allowed for a new way of communication about the topic of climate change in Catalonia. Attracting more media attention to the topic of climate change. Providing valuable information to volunteers.	**Yes** Produced data in RitmeNatura will create knowledge, raise awareness
Power Dynamics Dimension				
Access to and control over data	Little or no previous experience with accessing to phenological data. Knowledge and expertise are required for analysing phenological data.	**Yes** Increasing the access to and control over data for different stakeholders	**Yes** Access to data has increased, because of observations in RitmeNatura, but only small # of observations. Need for continuous observations over a long period of time.	**Yes** Continuous observations in RitmeNatura and greater data uptake
Authority and power	Regulatory entities: influence in policy and decision making process. Expert advisor, CO members have influence on public opinion General public: little or no influence	**Yes** Establish links with decision and policy making processes regarding climate change adaptation in Catalonia	**Yes** Raised awareness of climate change among community of biodiversity & phenology enthusiasts, researchers, and the general public.	**Yes** Provide advice to local climate change policy making processes.

However, the amount of data produced so far in RitmeNatura is not enough for creating a meaningful change in access to data. RitmeNatura is seen as having contributed to awareness raising about the fact that phenological data can be an indicator for monitoring the impacts of climate change. For this data to become useful though, several years of continuous monitoring are required. Control over data by design depends on the user's role in RitmeNatura. Observers can view the data they submitted and others, but they cannot validate, filter or quality control the data. Only validators (i.e. experts in Natusfera) can control the quality of the observations and validate them, but not delete the data or information. The highest level of control remains with Natusfera that hosts RitmeNatura.

The assessment of **authority and power**, i.e. the level of impact of different stakeholders on relevant decision making processes, shows that RitmeNatura is credited with raising awareness among a community of biodiversity and phenology enthusiasts, researchers with a focus on climate change, and perhaps even the general public, to increase attention of the media to the topic of climate change. Concretely, influence on decision making processes by the RitmeNatura members or the observers

was not deemed to have changed. Interestingly, the cause for this was seen in the absence of access to long-term time series and the limitations of the current (small number of) observations in RitmeNatura rather than the lack of establishing and/or strengthening links with relevant policy making processes on climate change adaptation in Catalonia.

5.3 Environmental outcomes and impacts

Envisioned environment impact

Climate change impacts in Catalonia are the core environmental focus of RitmeNatura. Stakeholder interactions and Phenological observations made in this CO are envisioned to help a better understanding of climate change patterns and impacts, which in turn can help improve preparedness and adaptation to climate change in Catalonia.

Required social and institutional changes

Adaptation to climate change includes many uncertainties and among other things requires implementation of policies and legislations that enable planning for future scenarios. Law 31/2010 is the current framework for climate change adaptation planning in the Barcelona Metropolitan Area (AMB) created a frame for climate change adaptation planning which is currently being implemented in the AMB. A climate change mitigation strategy, climate change adaptation plan, and an energy and climate plan have been developed; a sub-national law on climate change as framed by COP 21 is under development. Activities by the Catalan Office for Climate Change include a Voluntary Agreement Programme for CO2 emission reduction in municipalities. However, policy implementation is affected by rivalries and over-laps in competencies between departments and actors both inside Catalonia and between Catalan and Spanish national agencies. The related roles need to be clearly defined and accompanied by policy compliance by relevant societal actors.

Evidence of starting the required social and institutional change processes

The clarification needed among institutional actors regarding their roles and responsibility in the implementation of climate change adaptation planning and mitigation strategies is not under immediate influence of RitmeNatura. Nevertheless, the dialogue established during the co-design of RitmeNatura and its activities provides indirect influence on generating the required clarity by making explicit the divided institutional landscape to which the observatory is trying link its activities. The agreement (Memorandum of Understanding) between Meteocat and CREAF and another one between Meteocat and Diputació de Barcelona are important milestones in this respect. Similarly, the phenological observations of RitmeNatura indirectly contribute to improvements in the policies for natural park management in the context of climate change. The most direct contribution of RitmeNatura to changes in institutional practices is continued monitoring of climate change indicators.

Social change processes that RitmeNatura contributes to varying degrees relate to awareness raising of the impacts of climate change on nature in their local environment, of the existence and implementation of policies and measures related to climate change adaptation and mitigation, and the need to treat nature with respect and care to ensure sustainability of natural resources and therefore change lifestyles.

Table 14. Summary of environmental outcomes and impacts of RitmeNatura.cat

Envisioned environmental Impact	*Required institutional changes to achieve intended impact*	*CO Contribution to required change*	*Required social changes to achieve intended impact*	*CO Contribution to required change*
		Direct **Indirect** **No**		**Direct** **Indirect** **No**
Improved adaptation to climate change	**Policy:** clarification of roles of institutional actors in policy implementation	**Indirect** Dialogue among some rivalling institutional actors via RitmeNatura activities	**Policy compliance/ awareness** via participation in monitoring environmental indicators of climate change	**Indirect** Facilitation of data collection & sharing via RitmeNatura tools, as well as validation of collected data by phenology experts
	Improved national park management policies in order to cope with climate change impacts	**Indirect** Communicative influence based on continued phenological observations in RitmeNatura		
	Integration of new technologies: Integration of citizen-contributed phenological observations with official data in Catalonia	**Indirect** Availability of phenological observations in RitmeNatura	**Adoption of new technologies**: Raising awareness of impacts of climate change on nature in their local environment	**Direct** Access to reliable information on phenology and how climate change is impacting nature in Catalonia
	Changes in institutional practice: Continued monitoring of climate change indicators (e.g. in national parks)	**Direct** Recurrent and random phenological observations in RitmeNatura	**Changes in behaviour** of citizens towards more sustainable lifestyles (e.g. reduction of CO2 emissions)	**Indirect** Increased awareness on why it is important to treat nature with respect and care to ensure sustainability of natural resources

5.4 Validation

The validation of RitmeNatura assesses the extent to which activities undertaken by Ground Truth 2.0 have been i) *effective* in delivering the intended outcomes,; ii) *efficient* in terms of inputs used and outputs generated and iii) *coherent* in terms of alignment of the Demo Case citizen observatory align with stakeholder requirements and the concept of a CO.

Almost all interviewees identified phenological observations made in RitmeNatura as the main **expected output** of this initiative, arguing that if a large enough data set is created, it can contribute to a better understanding of climate change in Catalonia. However, it was mentioned that so far only a small number of observations have been collected. The majority of interviewees expected a much larger number of observations and more participants, which in turn contribute to better understanding of climate change and inform decisions with this regard. The data that RitmeNatura could be connected to other bigger platforms (such as GBIF) and, in this way, contribute to elaborating indicators

on climate change. As a negative output, it was also mentioned that the low amount of data produced may have disappointed other potential participants and resulted in a low number of data contributors.

The main realized institutional **outcome** of RitmeNatura was generating synergies between different actors that led to two new collaboration agreements between these stakeholders. This includes a new agreement (Memorandum of Understanding) between Meteocat and CREAF and another one between Meteocat and Diputació de Barcelona. These MOUs have formalised new actor relationships and collaborations that did not exist before RitmeNatura. Moreover, another outcome is increased public awareness about climate change impacts and the importance of phenology to evaluate and quantify this change. This awareness provides the basis for potential behavioural change.

Table 15. Summary of (expected) outputs, outcomes and impacts of RitmeNatura

Relevant aspect	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Outputs	**Yes** Phenological observations made in RitmeNatura.	**Yes** RitmeNatura.cat platform A small number of observations collected.	**Yes** Increase the number of observations and contribute to elaboration of indicators on climate change.
Outcomes	**Yes** Create synergies between different actors.	**Yes** RitmeNatura generated synergies that led to two new collaboration agreements between different actors: MoU METEOCAT & CREAF; MoU METEOCAT & Diputació de Barcelona	**Yes** Grow further and create a bigger community of observers; greater awareness of climate change impacts in the region.
Impacts	**Yes** Informed climate adaptation and land management policies	**Yes** Contributed to creating datasets to be used in decision making process to cope with climate change.	**Yes** Translation of RitmeNatura results into policy formulation. Integrate climate change and conservation policies.

Some interviewees expected that in the future RitmeNatura grows and creates a bigger community that contributes to early detection of phenological changes and creating much needed long-term data sets. These datasets can contribute to better informed decisions for climate change mitigation. For example, it was mentioned that if more elaborated information is produced in RitmeNatura, it can have a direct influence on the work carried out by Diputació de Barcelona for planning and management of natural protected areas and management of conservations efforts. It was also expected that

random observers collaborate with professionals of Diputació de Barcelona; this may result in observation of the rural areas with a better geographic and temporal coverage. Besides an increase in the number of members, it may be expected that RitmeNatura merges with other existing initiatives such as Fenocat and becomes one community. Nevertheless, a couple of interviewees perceived little or no future institutional outcome for RitmeNatura or believed that future institutional outcomes of this initiative will not be significant.

The majority of interviewees believed that long term **impacts** of RitmeNatura highly depend on creating big enough datasets that can be utilized by decision makers to make better decisions on how to cope with climate change. Moreover, through the awareness that this data and information will create in the society, the general public may make demands from decision makers and put pressure on politicians. In addition, it was mentioned that currently climate change and conservation policies are not integrated, however, initiatives such as RitmeNatura will help clarify these links and hopefully this will result in integrated policies in these areas.

6 Swedish Demo Case

The focus of the CO in the Swedish Demo Case is on water quality management in socio-economic systems in the Mälarendalen region (includes Stockholm). The identified key challenge in this Demo Case is the deterioration of water health due to current lifestyle choices and consumption patterns. The citizen observatory is called 'VattenFokus' to emphasize the urgency for the larger community to focus on water (Swedish: Vatten) issues, the role they can play and the need for a life-cycle perspective of 'what is going in and what is being taken out'.

Table 16. Summary of VattenFokus

Issue, Vision and Mission of VattenFokus		Objectives
Issue addressed: The key challenge for the Swedish Demo Case is the deteriorating water health due to current life-style choices, consumption patterns. Without a life-cycle perspective of what is going in and what is being taken out, we risk fixing one and starting many more problems. **Vision**: We envision a society where government, business, citizens, researchers and civil society organisations collaborate to be active stewards of a sustainable environment. **Mission**: Our mission is a citizen observatory that supports all stakeholders to collaborate in the governance and action of the aquatic ecosystems by collecting data, sharing knowledge, making data accessible that complements established governmental initiatives		1. To group the community by watershed and get citizen inputs (observations, data, from for instance Water-Blitz) on the water health of lakes in the Flen municipality and the Nyköpingsåarna watershed and get these inputs verified by expert groups in 2017. 2. To include existing water data platforms in order to make those more visible and accessible and by so doing generating incentives to innovate with data in 2018. 3. To provide visualisation on the existing data platforms and the new data to make the gathered data more accessible in 2018 4. To initiate discussions / help finding a physical space for citizen to discuss, plan and engage in actions toward the open monitoring and stewardship of water quality and causes of stress visualized in the CO- in 2019. 5. Added objective: To raise awareness of water quality issues and how lifestyle choices impact upon the aquatic environment.
CO core members		**Participants**
Citizens/civil society organisations	Group Dunkern (Grupp Dunkern), The association Föreningen Dunkers och Gryts väl, Local residents association, Farmers.	*Active*: • 5 people, long term data collection • 50 volunteers for data collection campaigns, two different occations • 35 followers on VattenFokus1 Twitter account *Reach*: • Hundreds at Vattenveckan events (Water Week) • Dozens of returning visitors to VattenFokus web site • Thousands via several newspaper articles
Scientists/data aggregators	Nyköpingsåarnas vattenvårdsförbund.	
Decision/policy makers	Flens kommun (council), Länsstyrelsen i Södermanland (region)	
Key activities		**Summary of outputs**
• CO activity planning meetings • Data collection campaigns (Water Blitzes) & data analysis • Long term data collection (Group Dunkern) • Outreach events		**Online platform**: *https://vattenfokus.se/* *https://freshwaterwatch.thewaterhub.org/content/vattenfokus-blitz* Water quality measurements with environmental observations entered into an app or online form, which sends data to a server and database at FreshWater Watch to process, store and visualise. Data is also visualised on the VattenFokus web site.
		Data & information: Hundreds of water quality observations during two seasonal campaigns. Long term tests for several years around the Lake Dunkern water system. Scientific analysis resulting in maps and reports
		Communication & interactions: Progress towards collaborative stewardship of water resources. Citizens communicating with policy and decision makers, via CO based on the VattenFokus activities, data and results.
Envisaged environmental impacts		
• Improved water health		

6.1 Social outcomes and impacts

For the Swedish Demo Case, in order to assess the social changes compared to the baseline situation reported in D1.11, data was extracted from the documented highlights and outcomes from the co-design process (D1.9), team observations from six CO meetings and two interviews with CO members.

Complete water tests by the municipality were done in 2008 but not after that. The data collected in the WaterBlitzes by VattenFokus has provided the information to start a discussion about water quality. Not only because of VattenFokus, but during the last year the community of Flen and the regional government became more concerned about the quality of water. The water quality tests used in the water blitz were relatively easy and quick to do, but along the way there was uncertainty about their results, because the analysis of the Vatten Fokus tests generated results that were a bit different from the official lab results. The issue related to data interpretation (phosphorus vs dissolved phosphorous) and was quickly solved, but it might have affected the trust that people had in the VattenFokus measurements.

Identifying community leaders and keeping CO members engaged throughout the (lengthy and abstract) process, in general, has been challenging. A lot of effort was spent on bilateral meetings, calls, etc. to maintain engagement of politicians and some water authorities because there appears to be a perception that testing water quality is only for experts. This made it even harder to engage citizens since they cannot see the meaning of taking part if they can't influence politicians. Most of the successfully engaged contacts stem from the personal networks of the Ground Truth 2.0 project partners.

Nevertheless, as a result of this project, the CO members are more imbued with the importance of engagement and collaboration between different types of stakeholders. Not expecting the government to take care of things is different from the culture that was observed in the baseline for this CO. One respondent stated that the initiative of Vatten Fokus 'has helped' in that respect: 'The people living here started to question about their own practices.' Still that same person stated that: ‘the authorities should address the problems with water quality if we find any.’

Given the focus on visualisation of the collected data and developing a platform according to the objectives of the CO, it is a little surprising that the respondents are not very confident about how to handle the database and homepage of VattenFokus.

Table 17. Summary of social outcomes and impacts of VattenFokus

Relevant aspect	Baseline	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Information				
Shared stories	The issue of water quality is important but not very urgent. The water quality is less than it could and should be, but	**Yes** Water quality will rise from being important to also being urgent.	**Yes** The data collected in the WaterBlitzes by VattenFokus has provided the information to start a discussion about water quality.	**No**

Relevant aspect	Baseline	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
	there is no acute problem to be addressed.			
Trusted sources	All drinking water is extensively regulated and measured. VISS database is open for everyone but not very well-known. The interviewed citizens trust the information of the municipality.	**Yes** Actual data on water quality will be collected and accessible	**Yes** Accurate water quality data was collected, but trust issues because of an data interpretation issue.	**No**
Timely and accurate information	Water quality data is available but not enough and not really accessible. Hard to get hold of the data. Parameters might lack robustness though and there is no year round monitoring.	**Yes** Parameters might lack robustness and there is no year round monitoring.	**Yes** Accurate water quality data was collected, and the FWW tests were very straightforward	**No**
Participation Dimension				
Working together	Influence and involvement of individual citizens is not very large or deemed important.	**Yes** Water management should not be the isolated work of one authority	**Yes** Keeping CO members engaged was challenging, required lots of bilateral contacts	**No**
Creativity & flexibility		**No**	**No**	**No**
Ability to learn		**Yes** Investigate beyond the trust people have in the water quality assessment by the municipality	**Yes** Waterblitzes were well attended, but testing water quality is still perceived to be ‚for experts'.	**Yes** Water testing and communication about activities will continue and reach more people
Internet savviness	Good. Email is the preferred communication channel closely followed by face to face and social media.	**Yes** The CO aims for visualisation of the collected data for easy interpretation	**Yes** But how to handle the database and homepage is still difficult	**No**
Social Capital				
Formal engagement		**Yes** Abandon the notion that you rely on the authorities to handle all	**Yes** collaboration between different types of stakeholders was Initiated	**Yes** Other stakeholders are now involved and will want to keep collaborating

Relevant aspect	Baseline	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
		issues related to managing water.		
Trust and belonging	The strictness with which the water quality norms are maintained allows for this kind of trust.	No	No	No
Helping behaviour		No	No	No
Distribution of risks				
Distribution of resources		No	No	No
Digital divide		No	No	No
Distribution of adverse effects		No	No	No

6.2 Institutional outcomes and impacts

The results of the assessment of the institutional outcomes and VattenFokus are summarised in Table 18 and presented in detail in Annex 1.4. It covers details related to the participation paradigm and power dynamics among stakeholders.

Among the expected changes in the participation dimension that materialized to a slight extent is the diversification of **participants**. Representatives of water boards and a few champions from the Donken community and Flen actively participated in VattenFokus and a dedicated group for long term monitoring has formed (Group Dunkern). However, there is room for participation of more community members and other organizations involved in water management in the Södermanland region. VattenFokus provided for online and offline possibilities for interactions among the stakeholders, developed a web-platform and provided an app for reporting observations which resulted in improvements in the **efforts required to participate**; nevertheless, efforts such as time needed to commute to meeting and observation locations and financial resources to cover commute and communication costs are required for continued future online and offline interactions.

VattenFokus provided organizational, technical and financial **support for participation** and interaction of interested stakeholder in both online and offline modes. This included organizational support required for holding co-design meetings, planning and implementation of data collection campaigns (Blitzes), as well as providing test kits, and technical support and trainings needed for the participants in the campaigns.

Table 18. Summary of institutional outcomes and impacts of VattenFokus

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Participation Dimension				
Geographic scope	In the region of Södermanland, in the municipality and town called Flen.	**No**	**No**	**No**
Participant groups	EU, national level organizations (e.g. Ministry of the Environment and Energy, the Swedish Environmental Protection Agency, etc.), regional and local authorities (including municipalities, River Basin District Authorities, and the County Administration Boards), water councils and environmental courts.	**Yes** Organizations involved in making decisions regarding water quality.	**Yes** Increased participation of community members and representatives from the water boards.	**Yes** Engagement of additional local community members and citizens.
Efforts required to participate	Regulatory entities: involved in decision making, but they can have more influence. Expert advisor: time and efforts to convince colleagues CO members: financial resources, time and efforts to participate.	**Yes** Provide online & offline means to facilitate participation of various stakeholder groups.	**Yes** VattenFocus online & offline presence provides opportunity for meetings and financial resources.	**Yes** Thorough transfer of VattenFokus history to future participants
Support offered for participation	Little evidence of support offered for participation	**Yes** Organizational, technical and communicative support.	**Yes** VattenFokus supports the planning and implementation of data collection campaigns. Moreover, it provides technical support and training to participants.	**Yes** Continued support for participation to be provided by VattenFokus
Communication paradigm	Using phone (call or SMS), emails, or a smartphone App.	**Yes** Use of preferred channels for communication and flow of information about water (quality) management among stakeholders	**Yes** Good match between preferred communication channels and actual channels provided by VattenFokus	**Yes** Advance communication mode to share information about water (quality) management

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Communication and decision mode	Regulatory entities: involved via their jobs Expert advisors: participating in decision making process due to their technical expertise. CO members: involved in projects and research about water management General public: no involvement in water management	**Yes** Improve communication about the topics of water (quality) management among different stakeholders	**Yes** Learning more about water quality and scientific aspects of water quality monitoring and management.	**Yes** Advance communication mode to share information
Power Dynamics Dimension				
Access to and control over data	Regulatory entity respondents: water quality data is generally not very accessible. Expert advisors: spatial and temporal availability of water quality data is good enough, but the available data is accessible for everyone. CO members and the general public: not enough information or experience with accessing water quality data.	**Yes** Increasing access to and control over data for different stakeholders.	**Yes** Access to data and information have increased (sharing and viewing data), but it has been mentioned that they do not have much control over the data.	**Yes** Additional observations and greater data uptake
Authority and power	Regulatory entities: provide advice and consultation to decision makers. CO members and general public: little or no expectation to influence decisions.	**Yes** Change in the level of influence in decision and policy making processes regarding water quality; new forms of political dialogue	**Yes** Opportunity to test the water quality and communicate the issue to the authorities. Demonstrate to authorities that closer water quality monitory is required	**Yes** Continue increasing awareness among the general public.

Substantial changes appear to have materialised in terms of the **communications paradigm** related to interactions and exchange of information, with VattenFokus now providing information via the preferred communication channels. More specifically, emails and phone calls were used as the main channels for coordination about the events and keeping the members informed about upcoming activities and sharing results or feedbacks from past campaigns. Related to this, a slight change in **communication and decision modes** regarding water quality management in Södermanland region has been recorded. This is because VattenFokus has provided new learning opportunities about scientific aspects

of water quality monitoring and management and this has enabled participants in this CO to communicate about this topic with other community members and organizations.

In terms of power dynamics among stakeholders, **access to and control over data** has changed slightly, via an increase in access to data and information about the level of Nitrate and Phosphate in the lakes. This information is accessible to participants of the CO and others who hear about it through various channels e.g. the website or casual conversations with members of VattenFokus. Nevertheless, control over the data has not changed much beyond sharing and viewing the data. The assessment of the **power dynamics** also considers the authority and power of distinct stakeholder groups in relevant decision making processes. The baseline situation indicated a top-down system in which authorities have a direct influence on decision making processes and citizens have limited or no say. VattenFokus provided an opportunity for citizens to test the water quality and communicate about this with authorities. Citizens expected that through these tests they can show the authorities that a change in water quality monitoring and management is required.

6.3 Environmental outcomes and impacts

Envisioned environment impact

The environmental issue in focus of VattenFokus is quality of water in water bodies in Mälarendalen region. Current lifestyle choices and consumption patterns have resulted in deteriorating health of water bodies in this region. The VattenFokus envisioned environmental impact is therefore to contribute to improving the health of water bodies in Mälarendalen region.

Required social and institutional changes

(Re) formulation of water quality monitoring policies is a way that can help better monitor and manage deteriorating health of water bodies in Mälarendalen is a prerequisite for achieving the desired environmental impact in this case. Moreover, continued monitoring of water resources and integration of additional data sources are required to inform decisions and help stabilise and improve the health of deteriorating water bodies in this area. Increased awareness about possibilities for participation of citizens is a required social change for achieving the aforementioned environmental impact. In addition, community members should participate in taking practical steps towards monitoring and improving health of water bodies and adopting more environmental friendly behaviour.

Evidence of starting the required social and institutional change processes

Water (quality) management in Sweden is highly decentralized, with almost autonomous municipalities, and follows a top-down model of decision making. Numerous point and distributed sources of water pollution makes it very difficult for the authorities to monitor and manage water quality in all the water bodies in Mälarendalen region. Participation of all stakeholders in (re)formulation of policies regarding management of water bodies can provide opportunities for improvement of current practices. By facilitating interaction and information exchange between local stakeholders, VattenFokus has created opportunities for local community members to express their opinion and communicate about water quality monitoring points and intervals, which can indirectly feed into development of future local water management policies and procedure. On the one hand, WaterBlitzes in VattenFokus were an entry point to discussions with authorities on data quality and the types of data can be trusted and integrated with available official data, and on the other hand they provided the local stakeholders with a tangible tool for discussions about implementation of water quality monitoring and management in Mälarendalen by authorities.

Table 19. Summary of environmental outcomes and impacts of VattenFokus

Envisioned environmental Impact	*Required institutional changes to achieve intended impact*	*CO Contribution to required change*	*Required social changes to achieve intended impact*	*CO Contribution to required change*
		Direct		**Direct**
		Indirect		**Indirect**
		No		**No**
Improved water health	**Policy changes:** (Re) formulation of policies regarding monitoring and management of water bodies	**Indirect** Communicative influence by local community members and other stakeholders for deciding on water quality monitoring points and intervals	**Awareness raising:** Collection of water data quality no longer to be seen as something that taxes are paid for, but something citizens can actively engage in	**Indirect** Awareness raising about the role that local community members can play in improving the water health
	Integration of new technologies: Integration of citizen science collected data with official data streams on water quality	**Indirect** The collection of water data by citizens opened a discussion on data quality and what types of data can be trusted and used as official data	**Changes in behaviour:** Adoption of water quality as something citizens can do reliably and not seen as 'for experts only'	**Indirect** Continued carrying out of WaterBlitzes and collection of good quality water data creating reliable data generated by citizens
	Changes in institutional practice: Continued monitoring of water quality in Mälarendalen and enforcement of policies to ensure stabilised and improved water health	**Indirect** The data collected in the WaterBlitzes by VattenFokus has provided the information to start a discussion about water quality.	**Changes in behaviour:** Change in practice of local community members towards improved health of water bodies	**Indirect** Providing a better picture of water quality in water bodies via information generated in WaterBlitzes

The results of the WaterBlitzes contribute to raising awareness among the local community members and provided them with a better picture of water quality in water bodies. As a result, it is expected that continued WaterBlitzes and collection of good quality water data creates a more detailed picture of water quality in water bodies in Mälarendalen, which in turn can trigger a change in behaviour towards improved health of these water bodies.

6.4 Validation

The validation of VattenFokus assesses the extent to which activities undertaken by Ground Truth 2.0 have been i) *effective* in delivering the intended outcomes,; ii) *efficient* in terms of inputs used and outputs generated and iii) *coherent* in terms of alignment of the Demo Case citizen observatory align with stakeholder requirements and the concept of a CO.

The main **output** of VattenFokus perceived by the interviewees was the data and information produced about the quality of water in the lakes; however, they mentioned that they wanted to have more water blitzes, and more water quality tests. Moreover, a limnology expert commented that he

was interested to see this initiative upscale to many more municipalities and counties, to be able to see more results for different regions within Sweden. Most of the identified (realized and expected) **outcomes** in this case relate to awareness raising within the community. However, it was also expected that VattenFocus would create more opportunities for communications with authorities and other community members which has not yet been realised. Moreover, the community members are planning to apply for grants to create one or more wetlands before Lake Dunkern in the local watershed for the purpose of capturing low quality water and stopping it from entering the lakes. The information produced in VattenFocus will help with the preparation of those plans and the application. The envisioned institutional **impacts** of VattenFocus related to changes in the current water management practices of municipalities in order to improve water quality in the lakes, e.g. by stronger controls of upstream activities.

Table 20. Summary of (expected) outputs, outcomes and impacts of VattenFokus

Relevant aspect	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Outputs	**Yes** Data collection about water quality	**Yes** Data and information produced about the quality of water in lakes. However, more blitzes & water quality tests were ambitioned.	**Yes** To upscale to more municipalities and countries, to be able to see more results from different regions.
Outcomes	**Yes** Awareness raising and create more opportunities for communications with authorities and other community members	**Yes** Awareness raising within the community. Plan to apply for funding to create a wetland.	**Yes** Grow further and create a bigger communities; enhanced communication. Construction of one or more wetlands.
Impacts	**Yes** Changes in the current water management practices of municipalities in order to improve water quality in lakes.	**No**	**Yes** Translation of VattenFokus results into policy formulation. Cleaner lakes.

7 Kenya Demo Case

The GT2.0 Kenyan Demo Case is located in the Narok County at the south-west Kenya, and includes the Mara Triangle, the Maasai Mara National Reserve, and the conservancies around this reserve. This area is a part of the greater Mara ecosystem, which is located inside the Kenya borders, and is managed by the Narok County government. Narok County has a total population of 850920[7] inhabitants.

The Kenya Demo Case CO intends to support the balancing of sustainable livelihoods with sustainable biodiversity management in the Mara ecosystem. Called the 'Maasai Mara citizen observatory', this CO aims to constitute a multi-stakeholder platform for generating and sharing of data, information and knowledge to improve policy making and implementation for sustainable livelihoods and biodiversity management in the Mara ecosystem.

Table 21. Summary of Maasai Mara Citizen Observatory

Issue, Vision and Mission of Maasai Mara Citizen Observatory		Objectives
Issue addressed: The key challenge addressed by the Maasai Mara CO is "balancing livelihoods and sustainable biodiversity management in the Mara ecosystem". **Vision**: We envisage a society in which all stakeholders are working together to ensure the balance between sustainable livelihoods and biodiversity management in the Mara ecosystem. **Mission**: The citizen observatory will constitute a multi-stakeholder platform for generating and sharing of data, information and knowledge to improve policy making and implementation for sustainable livelihoods and biodiversity management in the Mara ecosystem.		1. To provide a monitoring system for biodiversity, livestock and crop, land and water resources, and climate across the Mara ecosystem by 2017. 2. To establish a repository on Mara biodiversity, livestock and crop, land and water resources and climate information that is accessible to all stakeholders by the end of 2017. 3. To develop a platform by the end of 2018 for the engagement of citizens, government, research and the private sector to promote practices that create the balance between livelihoods and biodiversity in the Mara ecosystem. 4. To improve data, information and knowledge generation and sharing on biodiversity and livelihoods between citizens, practitioners, researchers and policy makers by 2018 for informed policies and policy implementation
CO core members		**Participants**
Citizens/civil society organisations	Organized community groups such as WRUAs and conservancies, NGOs (e.g. WWF), the African Conservation Centre, Friends of Maasai Mara, Maasai Mara Wildlife Conservancies Association (MMWCA)	*Active*: - 60 members of CO via WhatsApp Group *Reach*: - Scientists: > 500 - Citizens will be over 12000 (proportion of 290,000 tourists per year + about 10,000 out of the 850,000+ inhabitants)
Scientists/ data aggregators	Kenya Meteorological Department, National Museums of Kenya, Egerton University, Maasai Mara University.	
Decision/policy makers	The Parliament of Kenya, Kenya Wildlife Service (KWS), Kenya Forest Service (KFS), Kenya Water Resources Authority (WRA), Kenya Water Tower Agency (KWTA), Kenya Ministry of Defence, the Narok County Government.	

[7] Based on the 2010 census provided by the Kenya National Bureau of Statistics; retrieved from: https://www.knbs.or.ke/overview-of-census-2009/

Key activities	Summary of outputs
• CO activity planning meetings • Data collection via MMCO app & weather stations • Participatory mapping in Mapathons • Training of students on Citizen Science and Climate Related subjects	**Online platform**: *http://mara.info.ke/*
	Data & information: - 14 TAHMO stations for meteorological measurements installed (4 out of the project funds) - 3 Low cost sensors for water level measurements - Data collection via MMCO app (232 observations submitted)
	Communication & interactions: Active WhatsApp group (>60 members) where all stakeholders can communicate with each other and discuss biodiversity and livelihood issues. Trained over 200 students on the use of the App and on data collection (Mapathons)
Envisaged environmental impacts	
• Sustainable livelihoods and biodiversity	

7.1 Social outcomes and impacts

For the Kenyan Demo Case, in order to assess the social changes compared to the baseline situation reported in D1.11, data was extracted from the documented highlights and outcomes from the co-design process (D1.9), team observations from CO meetings and sixteen interviews with CO members.

The biggest social impact that the Maasai Mara Citizen Observatory has made on the (potential for) the empowerment of citizens, is in the capacities dimension. The different parties involved went from not being explicitly interested in working together to acknowledging their mutual interest and harmonious group interactions. Also, community members who participated became more aware of their potential to influence authorities. Perceptions of the importance of conservation have changed among the authorities.

Despite the increased capacity to work together and harmonious group interactions, the struggle to arrive at a finalised policy on data sharing illustrates that trust issues between CO members still exist. This has hindered community mobilization and data collection activities and, therefore, may have also slowed down the formal engagement of community members in decision making processes. On the information aspect, one interviewee mentioned that his “knowledge had improved, but the access to the data not yet”. The collected data is still very scarce and scattered, so 12 out of 16 interviewees deemed the information landscape to be the same as before, overall presenting only slight improvements in terms of timely and accurate information availability; yet this perception is linked with the interviewees’ IT savviness.

The digital divide and the need to communicate (also) face-to-face has not changed much, nor has the distribution of adverse effects. Even though Narok County and the local Maasai got better at working together, balancing sustainable livelihoods with sustainable biodiversity management remains a challenge.

Table 22. Summary of social outcomes and impacts of Maasai Mara Citizen Observatory

Relevant aspect	Baseline	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Information				
Shared stories	Some stakeholder work from an abstract understanding about biodiversity, others from a very practical understanding of dead game and cattle – but in the basis they do address the same problem and do agree on the urgency of the topic.	**Yes** Although the feeling of urgency is shared, involved stakeholders have very different perspectives	**Yes** Mutual understanding between involved stakeholders improved	**Yes** Shared, reliable and accurate data will further converge their perspectives
Trusted sources		**Yes** The MMCO should produce data that is reliable and accessible.	**Yes** Training on the MMCO app is creating understanding of type & sources of data	**Yes** Finalisation of the data sharing policy will accelerate MMCO data collection
Timely and accurate information	Data is scarce and the data that is collected is not stored centrally or in an orderly way. The data is available but difficult to find.	**Yes** The MMCO should produce data that is up to date and fairly accurate.	**Yes** Combination of existing and MMCO data presents more timely and accessible data source	**Yes** Finalisation of the data sharing policy will accelerate MMCO data collection & availability
Participation Dimension				
Working together		**Yes** Lack of coordination between organizations in terms of collecting and sharing data was an elicited issue in the baseline analysis	**Yes** CO members collaborated harmoniously and managed to arrive at a shared data sharing policy	**Yes** Collecting data through the MMCO app, and using it, will continue to need collaboration and coordination
Creativity & flexibility		**No**	**No**	**No**
Ability to learn		**Yes** Organizations are invited to look beyond their usual work and daily routines	**Yes** Perceptions of the importance of conservation have changed among the authorities.	**No**
Internet savviness	Internet access, at least on their smartphones, is widely spread. Most stakeholders use WhatsApp and Facebook daily; email used less fre-	**No**	**No**	**No**

Relevant aspect	Baseline	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
	quently, basically no websites or blogs are used for structural communication. F2F contact is also still important, for example to engage women. Radio is used for communication to a wider audience.			
Social Capital				
Formal engagement	In order to have involvement and influence, citizens need to be members of community associations or other organisations.	**Yes** Data collection can mobilize communities and help them to influence policy	**Yes** Community more aware of their potential to influence authorities. But data collection needed.	**Yes** MMCO app can empower individual community members to have involvement and influence.
Trust and belonging	High sense of community, shared traditions, values and norms	**No**	**Yes** Representatives of relevant organisations got to know each other better. Trust issues between partners still exist	**No**
Helping behaviour		**No**	**No**	**No**
Distribution of risks				
Distribution of resources		**No**	**No**	**No**
Digital divide		**No**	**No**	**No**
Distribution of adverse effects		**Yes** Hostile animals might affect both; but without MMCO data only people living near the reserve get compensations, not those living further away.	**No**	**Yes** When data collection ramps up, this might still change the distribution of compensations

Most of the objectives of the CO dealt with data collection and monitoring, which proved to be more difficult than expected to achieve. The final objective was to develop a platform to bring together the actors in the Mara by the end of June 2017. The analysis of the social impacts of the MMCO suggest that this is the objective towards which most progress has been made.

7.2 Institutional outcomes and impacts

The results of the assessment of the institutional outcomes and Maasai Mara Citizen Observatory (MMCO) are summarised in Table 23 and presented in detail in Annex 1.5. It covers details related to the participation paradigm and power dynamics among stakeholders.

In the participation dimension, the geographic scope of MMCO has not changed, and as planned, this CO was established in Mara region in the Narok County.

Among the expected changes in the participation dimension that materialized to a slight extent is the diversification of **participants**. Representative of several organizations participated in co-design meetings and exchange of information, with the aim of creating a balance between biodiversity conservation and sustainable management of livelihoods in the Mara. However, some stakeholders, especially local community members so far had limited representation. Also, MMCO provided for online and offline possibilities for interactions among the stakeholders; developed tools (including two Apps and a web-platform), and organized training sessions for using these tools, which resulted in improvements in the **efforts required to participate**; nevertheless, efforts such as time and financial resources are required for continued future online and offline interactions.

In view of the one-way communication paradigm (i.e. from authorities to community members) and limited amount of information available regarding the topics of biodiversity conservation and livelihood management in the Mara, MMCO provided **support for participation** and interaction of interested stakeholder in both online and offline modes. This development is expected to continue further, in a collaborative way, and with involvement of all interested stakeholders.

Substantial changes appear to have materialised in terms of the **communications paradigm** related to interactions and exchange of information, with MMCO now providing information via the preferred communication channels, namely the MMCO Apps and the MMCO WhatsApp group. The CO core group also constitutes an instantiation of a more interactive (rather than uni-directional) communication paradigm. Related to this, the **communication and decision modes** regarding biodiversity conservation and sustainable livelihood management in the Mara have also changed moderately, via alternative ways of communication, data collection and sharing, to understand the living environment, to increase stakeholder interactions and as an educational tool. In all these respects, future positive changes are expected.

In terms of power dynamics among stakeholders, **access to and control over data** has changed moderately, via an increase in access to weather and water level data, information produced during mapathon events, as well as the observations that have been submitted via the MMCO App. However, uptake of the App by stakeholders such as community members and rangers needs to further improve in the future. The assessment of the **power dynamics** also considers the authority and power of distinct stakeholder groups in relevant decision making processes. The baseline situation indicated a closed system in terms of public participation; a system in which authorities have a direct influence on decision making processes and citizens have limited or no say. Changes were expected in the level of influence of different stakeholders (especially citizens) in decision and policy making processes. The impact assessment indicates a slight change in this regard, with MMCO providing new possibilities for online and offline interactions and communications, awareness raising and data sharing among stakeholders. Nevertheless, this is expected to further change in the future, with continued online and offline interactions and communication among different stakeholders, which aims at moving towards evidence-based decision making.

Table 23. Summary of institutional outcomes and impacts of Maasai Mara Citizen Observatory

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
Participation Dimension				
Geographic scope	Mara region in Narok County	**No**	**No**	**No**
Participant groups	Parliament of Kenya, Kenya Wildlife Service (KWS), Kenya Forest Service (KFS), Kenya Water Resources Authority (WRMA), National Museums of Kenya, Kenya Water Tower Agency (KWTA), Kenya Ministry of Defence, Conservancies and NGOs (e.g. WWF).	**Yes** Enable participation and collaboration of different stakeholders in creating a balance between biodiversity conservation and sustainable management of livelihoods in the Mara	**Yes** Representatives of several organizations participated in co-design meetings and exchange of information Some stakeholders, especially local community members had limited representation.	**Yes** Engagement of additional community members and other stakeholders in the CO core group/CO activities.
Efforts required to participate	Regulatory entities: Time and need for gaining expertise. Community members and experts advisors: Time, and efforts for attending meetings, financial resources, equipment, ability to communicate ideas. General public: time for travelling, educating others, equipment, expertise, financial resources.	**Yes** Provide online & offline means to facilitate participation of various stakeholder groups	**Yes** MMCO provided for online & offline means of interaction, developed tools and organized training sessions for using the tools.	**Yes** Thorough transfer of MMCO history and interaction possibilities to future participants.
Support offered for participation	Possibilities for participation and information sharing among different stakeholders.	**Yes** Support development of tools and processes for interaction of different stakeholders, as well as capacity development for using the tools	**Yes** By providing tools, raising awareness and capacity building of participants.	**Yes** Continued support for participation to be provided by MMCO
Communication paradigm	Using the telephone and an App on the smartphone.	**Yes** Use of preferred channels for communication and flow of information about the topics of biodiversity conservation and livelihood management	**Yes** Good match between the preferred communication channels and the actual channels used for communication purposes.	**Yes** Continued dialogue and exchange of information between citizens, government organizations and other stakeholders using online and offline interaction possibilities created by MMCO

Relevant aspect	Baseline situation	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderate Slight Not at all	Expected future changes (Yes/No)
Communication and decision mode	Regulatory entities, expert advisors, CO members: Direct or indirect influence (providing expert knowledge) in decision making. General public: barely or not at all a part of the decisions	**Yes** Platforms designed for data collection and sharing, to understand the living environment, to increase stakeholder interactions and as an educational tool.	**Yes** MMCO has provided alternative ways of communication, data collection and sharing, to understand the living environment, to increase stakeholder interactions and as an educational tool. Yet, no mechanism for participation in decision-making processes.	**Yes** Continued online and offline communication and exchange of information, with the aim of having a better understanding of the environment and take better decisions.
Power Dynamics Dimension				
Access to and control over data	Spatial and temporal availability of data about biodiversity and livelihoods is not very good (outdated, not accurate, not available, not publicly shared).	**Yes** Increase of access to relevant data for biodiversity conservation and livelihood management for all stakeholders	**Yes** MMCO has increased access to weather, water level data, seven mapathons have been organized as a part of this CO, and 232 observations have been submitted via the MMCO App. However, uptake of the App is (yet) limted.	**Yes** Additional observations using both physical sensors and the App is expected in the future. Additional mapathons will be organized by the university.
Authority and power	Regulatory entities: direct influence. CO members and expert advisors: minimal influence. General public: influence others through education	**Yes** Change in the level of influence in decision and policy making processes; new forms of communication and collaboration	**Yes** Increase in online and offline interactions and communications through MMCO tools and by participation in collaborative meetings	**Yes** Continued online and offline interactions and communication among different stakeholders. Moving towards evidence-based decision making, based on the information produced in MMCO.

7.3 Environmental outcomes and impacts

Envisioned environment impact

Livelihoods of local community members living in the Mara depend on grazing areas, free roaming with herds and access to water but are threatened by overgrazing, overstocking, human-wildlife conflicts, fencing and tourism. The contribution of MMCO to balancing sustainable livelihood management and biodiversity conservation in the Mara is envisioned to contribute to sustainable livelihoods

and biodiversity. The data collected and shared via the MMCO Apps along with data from in-situ weather stations and water level sensors provide various insights on these aspects in order to move towards sustainability (Annex 1.5).

Table 24. Summary of environmental outcomes and impacts of Maasai Mara Citizen Observatory

Envisioned environmental Impact	*Required institutional changes to achieve intended impact*	*CO Contribution to required change* **Direct** **Indirect** **No**	*Required social changes to achieve intended impact*	*CO Contribution to required change* **Direct** **Indirect** **No**
Sustainable livelihoods and biodiversity	**Policy changes:** (Re)formulation of legislation and policy guidelines at the county level	**Indirect** Communicative influence of local stakeholders in formulation of legislation and policies that affect their livelihoods and conservation efforts in the Mara via face to face and online interactions in MMCO	**Awareness:** Increased awareness, use and exchange of data and information on overgrazed/overstocked/fenced areas	**Direct** Awareness of tools, methods and processes of data collection and sharing by participation in MMCO online and offline activities
	Integration of new technologies: Increased integration of citizen-contributed observations, and data from in-situ weather and water level sensors in decision making processes	**Direct** Contribution by facilitating data collection and sharing by citizens and providing access to weather and water-related data produced by in-situ sensors in MMCO	**Adoption of new technologies:** For creating an increased understanding of the need for changing unsustainable practices related to biodiversity conservation and livelihood management	**Indirect** Access to data and information about harmful practices via MMCO tools (e.g. off-road driving in the park, poaching, fencing, etc.)
	Changes in institutional practice: Identifying and planning for closing data gaps	**Indirect** Individual education on data needs and how different stakeholders can contribute to closing data gaps using MMCO tools	**Change in behaviour:** Towards avoiding or limiting overgrazing, overstocking, fencing and human-wildlife conflict	**Indirect** Access to biodiversity, water and weather-related data and information and reporting of incidents
	Changes in institutional practice: Increased monitoring of natural resources (incl. biodiversity, water, pasture, etc.) and incidents such as human-wildlife conflict	**Direct** Communicative influence of stakeholders via submitting observations using the Mara Collect App.		

Required social and institutional changes

Achieving a balance between biodiversity conservation and sustainable livelihood management is a complex issue that requires a number of institutional and social changes. First of all, there is a need for policy changes that identify the need for creating such a balance. Moreover, existing data gaps

need to be identified and new technologies and data sources considered for closing these gaps. In addition, increased monitoring of natural resources (incl. biodiversity, water, pasture, etc.) and incidents such as human-wildlife conflict are necessary for achieving a balance between biodiversity conservation and sustainable livelihood management. In terms of social changes, there is a need for increased awareness about harmful practices such as overstocking, overgrazing and fencing. Adoption of new technologies for collecting and sharing relevant information about available resources and (un)sustainable practices can help raise awareness among local stakeholders. This raised awareness then needs to be translated into change in practices towards promoting sustainable tourism and avoiding (or limiting) harmful practices such as overgrazing, overstocking, fencing and human-wildlife conflict.

Evidence of starting the required social and institutional change processes

Devolution of power in Kenya is relatively new, and during the lifetime of MMCO, the Narok County Government was working towards developing legislations and policy guidelines at the county level (e.g. the Maasai Mara Management Plan, the Narok County Tourism Act, the Environmental Management Act and the Livestock Act). Face to face and online interactions in MMCO provided opportunities for discussion and information exchange between different stakeholders. These possibilities for expressing opinion and sharing concern enabled local stakeholders to better communicative and interact. Lessons learned from these interactions, can result in formulation of legislation that are more inclusive and reflect the ideas and concerns of different stakeholders about biodiversity conservation and livelihood management in the Mara.

MMCO directly contributed to data collection and sharing by citizens and through providing access to weather and water-related data produced by in-situ sensors in MMCO. The information from weather stations is already being using by the meteorological department of the Narok County for improving weather forecasts and by local stakeholders for having a better overview of water resources, droughts and floods. Moreover, diverse possibilities for collection and sharing information in MMCO (including mapathons, the Mara Collect and MMCO Apps and in-situ sensors) contributed to identification of data needs and resulted in a better understanding of how different stakeholders can contribute to closing the existing data gaps. Moreover, MMCO facilitated collection and sharing of data through its Apps, in-situ sensors and other collaborative data collection and sharing processes such as mapathons. These are directly linked to the existing needs for monitoring of biodiversity and having a better overview of the extent and geographic spread of issues such as human-wildlife conflict, fencing, overgrazing and overstocking. It is expected that a better overview of these challenges contribute to a change in behaviour of the local stakeholders towards avoiding or limiting these harmful and unsustainable practices.

7.4 Validation

The validation of the Maasai Mara Citizen Observatory assesses the extent to which activities undertaken by Ground Truth 2.0 have been i) *effective* in delivering the intended outcomes,; ii) *efficient* in terms of inputs used and outputs generated and iii) *coherent* in terms of alignment of the Demo Case citizen observatory align with stakeholder requirements and the concept of a CO.

The technological components of MMCO, including the two Apps, the website as well as the weather stations and screens that were installed, were the most tangible **realized outputs** (direct products) of MMCO for the local stakeholders. In addition to these tools, the interviewees from the Ground Truth 2.0 team also mentioned the integrated components of existing tools and services as well as the creation of the MMCO WhatsApp group (which has some 60 members) as the main technology-related outputs of MMCO. The data and information produced in MMCO was perceived as a prerequisite for

making better decisions. This includes the photos and observations submitted using MMCO App, weather data, and the maps produced during the mapathon events which were also identified by the citizen observatory members as a direct product of MMCO, however, interviewees often described this data as 'dispersed' or 'occasional'.

Another identified output of MMCO consists of the educational material related to mapathons and weather stations that can be used for teaching and training purposes. Maasai Mara University and the involved high schools perceived immediate benefits for enhancing their education curricula and research activities, using mapathons, the data from the weather stations and the functionalities of the App.

Increased engagement of stakeholders and better uptake of the MMCO tools which result in improved datasets on biodiversity, meteorology, livestock, etc., were mentioned quite frequently as **expected outputs** of MMCO. Interviewees highlighted that they anticipated more efforts on training, awareness raising, and outreach, and they expected to see more or improved engagement of some stakeholders, especially government agencies (e.g. National Environment Management Authority, NEMA, Water Resources Authority and Drought Monitoring Authority), NGOs, as well as local communities such as pastoralists and farmers. Some interviewees from Narok County Government, KWS and conservancies believed that MMCO has the potential to provide a lot of information that is relevant for a large number of organizations, but currently this information is difficult to use. They described the data and information produced by MMCO as generic and unstructured and mentioned that they expected to see this data and information in a more processed and organized way. One of these interviewees used the term 'clean data' to describe this defined 'clean data' as data that has a theme, is vetted, categorized and is usable for different purposes. Finally, the data sharing policy produced in MMCO is an agreed upon procedure for sharing the data and information in MMCO and as such a tangible output of MMCO.

The results of the interviews indicate that most of the **expected outcomes** of MMCO are community-related. Quite a number of interviewees envision future institutional outcomes for MMCO, but almost all of these interviewees mentioned that the realization of these outcomes depends on the continued involvement of already engaged stakeholders and increased uptake of the citizen observatory activities by more people. MMCO was also envisioned as a channel through which community members, government organizations and researchers can communicate and exchange data and information. This process was seen as a mechanism that can generate scientific outcomes that can be used by different organizations (e.g. by the Narok County, KWS or conservancies) for better-informed decision making. In addition, MMCO was seen by some interviewees as a platform that can help community-members' voice be heard by decision makers, e.g. on the issue of human-wildlife conflict.

The **envisioned impacts** of MMCO are quite broad, spanning from increased accessibility of information over time and a better understanding of the environment, giving community members a voice and increasing their environmental awareness, evidence-based environmental decisions and conservation actions, planning for uncertainties such as climate change and improving reforestation, as well as facilitating more transparent and accountable environmental governance. Some even envisage a much broader move towards COs, having offices established in government agencies and universities dealing with citizen science.

Table 25. Summary of (expected) outputs, outcomes and impacts of Maasai Mara Citizen Observatory

Relevant aspect	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Outputs	**Yes** Awareness raising, capacity building, facilitating online and offline interactions between citizens and authorities, generate data and information.	**Yes** Diverse outputs, including; two apps, the website, weather stations and screens installed, communication and information exchange via MMCO web-platform, App, and a WhatsApp group, educational materials, data policy	**Yes** Increased engagement of stakeholders and a better uptake of the MMCO tools is expected in the future
Outcomes	**Yes** Increased interactions and information exchange about the topics of biodiverity conservation and livelihood management among community members, government organizations and researchers.	**Yes** Creating online and offline possibilities for communication information exchange via MMCO	**Yes** Translation of Maasai Mara results on decision making regarding biodiversity conservation and livelihood management.
Impacts	**Yes** Governance related impacts - environmental decision and policy making and conservation actions, engaging community members and giving them a voice.	**No**	**Yes** Translation of MMCO tools, processes and results into possibilities for fact-based environmental decision and policy making, conservation actions, engaging community member and giving them a voice in decision making, as well as facilitating more transparent and accountable environmental governance.

8 Zambia Demo Case

8.1 Note on the method and data collection for this segment

The Ground Truth 2.0 project implemented a co-design process designed to ensure that "*technological developments […] achieve the desired social innovation impacts in terms of environmental monitoring, cooperative planning and environmental stewardship*." In the Zambian Demo Case, following this paradigm led to a fundamental transformation of the envisioned observatory compared to the GT2.0 proposal stage, driven by the insight that a local observatory would have to be embedded into a national umbrella platform to achieve the social innovation impacts the local co-design group described. The key factor shaping the design is the fact that citizen participation in Natural Resource Management in Zambia is full formalized and codified in primary policies. Citizen groups may apply to co-manage wildlife, forestry, fisheries and water resources of geographically specified areas. The respective policies describe the mandate, rights and obligations of such groups, and prescribes, in detail, related stakeholder interactions. In terms of the interaction model applied by GT2.0, the described system combines elements of cooperative planning and environmental stewardship.

Having citizen participation fully formalized might raise the question to what degree co-designing a citizen observatory can foster social innovation with substantive impacts. In this regard, the rationale for initiation of the Demo Case was the large discrepancy between the theoretical and practical reality of community involvement in natural resource management. Few community committees are functional without support from donors, and community entitlements under benefit sharing schemes are withheld routinely by departments and political interference seems to be a frequent occurrence. Accordingly, the observatory vision and objectives essentially ask to create a reality of stakeholder interactions that matches the legal mandate.

For the purpose of this deliverable, the technical complexity, institutional embedding and multi-level structure of the CO has a number of implications. Most prominently, the process has taken more time than the other cases, and the CO is not fully operational yet. An empirical assessment was, therefore, not possible – there are no measurable impacts of the observatory at this point, beyond impacts created by the co-design process itself. Furthermore, the institutional embedding required an expansion of the thematic and geographical scope, in order to include authorities relevant to the objectives of the case. Decisions regarding the design and use of a CO have to be taken by national level departments, with decision-makers at the district level acting mainly as implementing parties once the higher level decision has been taken. In particular, data is collected at the local level, but reported to central authorities, with all decisions about data use and data policy at the central level. The result is the design for a national platform with a central policies and oversight by national level departments. Finally, the need to align functionalities with legal mandates means that the outcome of the co-design process is, in essence, a detailed construction of expected outcomes, describing what kind of changes would have to occur to align the social practices with a very specific future state.

Accordingly, this segment will outline the final design of the observatory, validate which indicators of the baseline analysis are still valid in the new scope, and report on the expected impacts mentioned above. This report can serve to support the owners of the future owners of the observatory in conducting a complete impact assessment in the future. With regard to the reflections presented in this chapter, the analysis takes as an opportunity the amount of individual interactions that was required to support a co-design process in a culture placing strong emphasis on face-to-face interaction and political courtesy, and a low capacity environment with the need to provide additional support to stakeholder groups. The process required a wide range of meetings and workshops in addition to the

formal interaction moments. In particular, over a dozen workshops, trainings and larger scale briefings of individual stakeholder groups were held ahead and around interaction moments, bringing the individual perspective of community representatives, wildlife police officers and national level decision-makers into sharper focus. 17 village meetings in two roadshows were conducted to discuss the observatory with hundreds of regular community members. Language and cultural barriers meant that the DC Team engaged in extensive discussions with translators and community facilitators after each event to fully grasp the outcomes and their implications, amounting to the data equivalent of dozens of semi-structured interviews. Three MSc thesis projects carried out in the pilot area conducted over 120 in-depth interviews on aspects of local culture and community-based natural resource management, the result of which also served to inform this section. And finally, at least 50 individual meetings with ranking decision makers at various levels took place. While often arranged as courtesy calls to keep key stakeholder involved, or to secure approval for next steps, the questions asked and issues raised in such individual meetings provide rich insights into the attitudes and concerns of the actors.

8.2 Demo Case summary

The National CBNRM Observatory Zambia is a community-based monitoring system tailor-made to support the day-to-day work of the community-based groups sharing legal responsibility for natural resource management under Zambia's decentralized policies. At the local level, it will serve to simplify access to information, increase influence of communities in decisions, and reduce bottlenecks in processes created by distances and lack of resources. At the national level, it will serve to aggregate information from multiple community groups. The Citizen Observatory offers tools to collect and submit data currently collected with pen and paper and make information more easily available in remote areas. Furthermore, it will provide services for improved implementation of CBNRM related laws, for example providing mapping functions in support of zoning decisions, communication channels to submit reports to authorities, or provide access to data relevant to evidence-based advocacy.

The Zambian DC focused on the design of functions for a local group in a pilot area in the Silowana Complex in Western Province, which suffers from continuous natural resource degradation and poverty. Local benefits of conservation efforts are limited in part due to inadequate information and lack of coordination, communication and transparency between different governance levels in the planning and implementation of programmes on the one hand, and insufficient attention from the side of Community Resources Board (CRB) to the needs of the Village Action Groups (VAGs). The challenges of the CRB in the pilot area are representative for the problems of most CRBs across the country. Therefore, the core functionality of the National Observatory is based on functional requirements identified for the "Niti Luli" subgroup in the pilot area.

The envisioned operational and upscaling model is that local community-based natural resource committees, in collaboration with their local councils and district administrations, will be able to make a range of choices to customize the platform for their purposes. This includes the definition of a local central challenge, vision, mission and objectives, as well as choices which data will be collected and which local actors are responsible for reacting to which observation. For example, only groups in Game Management Areas (GMAs) deal with wildlife conservation. Accordingly, community groups outside GMAs can opt to exclude data collection on wildlife sightings. Furthermore, some data will be available publicly and nationally; some data, such as the minutes of meetings, will be only available to a local subgroup.

Table 26 Summary of Zambian CBNRM Observatory

Issue, Vision and Mission of Zambian National CBNRM Observatory	Objectives
Issue addressed: In Zambia, inadequate information, communication, and coordination between different governance levels and structures, in particular the fragmentation of CBNRM legislation and incomplete devolution of authority necessary to implement existing policies as well as the failure of authorities to recognize, involve and effectively respond to community institutions in day-to-day decisions related to natural resource management, made worse by political interference, funding constraints and logistical challenges, affects the ability of communities to realize their rights and benefit from sustainable resource management, which undermines trust in conservation efforts, results in continuous natural resource degradation, and makes communities poorer. **Vision:** Communities, government agencies, civil society organizations and partners collaborate respectfully and effectively in implementing natural resource management and conservation efforts that benefit local communities. **Mission**: The National CBRNM Observatory will provide a virtual space for communication, coordination and information exchange among local communities, regional and national associations, government institutions, NGOs and donors, to realize rights and improve resource ownership by communities, giving them more influence in decisions affecting their lives and livelihoods.	**National Objectives:** 1. Establish an active exchange between communities, government institutions, NGOs and donors regarding natural resource management, working to build shared language; 2. Digitize data collection and feedback of results, and create tools that simplify reporting and information sharing with and among communities 3. Create two-way communication channels between CBNRM stakeholders that enable evidence-based advocacy and the tracking of responses to concerns raised by communities 4. Provide communities with easy access to information, training materials and communication tools that strengthen the organizational capacity and autonomy of VAGs and CRBs their decision-making and in holding VAG members, the CRB and other local actors to account. **Objectives of the Niti Luli Pilot group:** 1. To establish an active exchange between government departments and donors regarding planned activities and projects in the Silowana complex; 2. To create communication channels that facilitate and simplify two-way communication with communities in decisions over their resources; 3. To create tools that support tracking of responses of donors and government agencies to concerns and priorities raised by communities; 4. To provide communities with information and training that allows them to be more pro-active in their decision-making and in holding VAG members, the CRB and other local actors to account.

CO core members		Participants
Citizens/civil society organisations	Village Action Groups (elected) and similar village committees National/Regional CRB Associations Conservation CSOs and NGOs (WWF, CBNRM Forum, Environmental Hub, The Nature Conservancy) International Crane Foundation, Zambia Climate Change Network, OSM Chapter Zambia)	*Active*: • 20 Village Action Groups linked to 2 CRBs • Community Facilitators • Regional Coordinators, National Secretariat and Executive Board of National CRB Association *Reach*: • Active communities: Game Management Area Lower West Zambezi • Central node for the national-level observatory established
Scientists/data aggregators	Scientific units within government departments (Wildlife, fisheries, forestry) National CRB Association (through the observatory)	
Decision/policy makers	Community Resource Boards and similar committees, District Administration Sesheke, Local Council Sesheke, National Assembly Representative	

Key activities	Summary of outputs
• Observatory activity planning meetings • Community outreach meetings • Technical trainings and community rights educations campaigns • Evidence-based advocacy for community rights to natural resources	**Online platform**: prototype collection app an GeoServer platform online
	Data & information: Comprehensive data model for collection of data collating monitoring information across department boundaries. ;Migration of database with 2000 existing community observations
	Communication & interactions: Formal resolutions by local CRB, regional and national CRB Associations to include observatory in bylaws and policies Letter of collaboration between National CRB Association and 6 local NGOs to support observatory roll-out (being finalized at reporting time)
Envisioned environmental impact	
(Niti Luli Pilot Group) • Reduced illegal logging • Increased wildlife numbers	

8.3 Social outcomes and impacts

"Our children go in the forest cutting down trees and we know this is illegal, but when they are arrested, we turn against forestry officers and curse them. Maybe we should rather sit down with our children and ask them: When we die and you go on like this, what will you leave your children?" (Community member during a village meeting in Kalobelelwa)

For the Zambian Demo Case, the social baseline situation reported in D1.11 was validated and updated using team observations from the second village roadshow with 8 community meetings, the outcomes of the national level co-design workshop (reported in D1.9), and 4 national level planning and consultation meetings. If noted in the table,

Table 27. Summary of social outcomes and impacts of Zambian CBNRM Observatory

Relevant aspect	Baseline (Niti Luli Subgroup only)	Validated Baseline, additions and revisions (National Observatory)	Expected changes (Yes/No)
Shared stories	The need for community involvement in natural resource management is very or extremely urgent.	**Revise** Common understanding of resource issues within stakeholder groups is high and a strong source of identity, but relationship between groups is shaped by mistrust and conflict. Community members feel that officials value animals over human life. Rangers describing operating in some communities use language recall physical risks of a war zone. Discussion of causes and implications frequently includes blaming the other side.	**Yes** Increased understanding of roles and restrictions of the 'other side'. Increased reporting and response capacity alleviates perceptions of conscious neglect.

Relevant aspect	Baseline (Niti Luli Subgroup only)	Validated Baseline, additions and revisions (National Observatory)	Expected changes (Yes/No)
Trusted sources	[no baseline provided]	**Add** For citizens, dominance of specific local actors; quality of information depending on personal opinion and superstitions. Decision-makers trust their own in-house data. Locally collected data is considered unreliable.	**Yes** Shared set of accepted data, increased trust of departments in community generated data through reputation-building
Timely and accurate information	Datasets about NRM do exist, but the availability and accessibility of such data vary. It is scattered, not found in one location, and its quality is difficult to assess.	**Revise** Communities have almost no access to information they collect. Local council provides inputs to planning processes, but also limited access to data relevant for local actions. Access to existing datasets strictly controlled within individual departments.	**Yes** Collected data, crossing thematic areas, available in near real-time for online communities, and synched monthly in offline communities
Working together	[no baseline provided]	**Add** Community Resource Boards elected, but meeting rarely and with little impact. Community-based groups frequently ignored (i.e. no invitations to council meetings thematically relevant)	**Yes** Frequency of contacts increases, CRB board reacts to VAG concerns; departments react to reports submitted by committees.
Creativity & flexibility	The rules are strict, their implementation is less strict indicating some degree of flexibility.	**Add** Capacity of community representatives and local level officials very low, focus is on knowing and understanding existing rules. Strict hierarchies discourage creativity and initiative outside instructions issued top down.	**No** (but long term objective)
Ability to learn	The required skills and expertise to work with the data could be found in the government departments and NGOs.	**Revise** Citizens mainly semi-literate or illiterate subsistence farmers, with no access or exposure to the expert advice available.	**Yes** Use of training material in video format in local languages on the platform
Internet savviness	Internet savviness is low. Social media mentioned as potential lines for professionals but not for the general public.	**Add** In the pilot area extremely low, maybe 2% of community members have smartphones This aspect varies widely across Zambia, baseline to be checked for each new group during upscaling	**Yes** Community access points created through smartphones and platforms provided to VAGs

Relevant aspect	Baseline (Niti Luli Subgroup only)	Validated Baseline, additions and revisions (National Observatory)	Expected changes (Yes/No)
Formal engagement	National, international and traditional stakeholders are involved in policy and decision making, communities to a degree. All of them believe to have a significant influence on the decisions (mainly via public opinion).	**Revise** Community members are elected in fully formalized process for CBNRM. Community groups are formally registered legal entities governed by bylaws. Management plans developed with community-based groups (e.g. on zoning) are legally binding and enforceable.	**No** [Does not require further formalization, only implementation]
Trust and belonging	The involvement of respondents in the practice of NRM differs. CRBs and VAGs are sensitizing and educating communities, a few physically manage or chasing poachers. A quarter of the general public indicated not to feel involved in NRM practice at all.	**Add** In pilot area closed social structure, high mistrust towards outsiders. CBNRM structures not trusted in the pilot area Participating in formal CBNRM structures Aspect will differ regionally, pilot area not representative.	**Yes** Connecting community groups with exposure to peers and their activities
Helping behaviour	Not provided	**Add** Very weak, due to poverty ("poverty makes selfish") and mistrust Aspect will differ regionally	**(Yes)** Increase community support for members in elected committees
Distribution of resources	[no baseline provided]	**Add** Very unequal, in particular between citizen (poverty) and decision makers	**Yes** Core purpose of observatory is support of benefit sharing mechanisms (e.g. monitoring of licenses and concessions)
Digital divide	[no baseline provided]	**Add** Very high. Small share with access to digital technologies and internet (officials, teachers, some youth), remaining population uses feature phones. Aspect will differ regionally.	**Yes** Technology exposure in remote communities.
Distribution of adverse effects	[no baseline provided]	**Add** Very unequal. Small share of population and decision makers profits in the short term from over-exploitation of natural resources at the expense of communities.	**Yes** Some functions specifically designed for increased social accountability.

Since community-based organizations like CRBs and Forestry Committees are fully formalized in Zambia, the observatory is designed to impact social aspects that currently obstruct or complicate the effective functioning of these groups. Core mechanism for social impact is the provision of **reliable and trusted information**, with a particular focus on information on financial benefits from natural

resources (tracking of licenses and license fees), access to data collected in communities, and accessibility of training materials to guide how community committees can fulfil their functions (e.g. how to register a community forest). This aspect is pivotal for a range of additional aspects. Mistaken assumption about financial benefits create mistrust and currently undermine the ability to work together, trust in the neighbourhood and helping behaviour. The expected impacts are created by making public information on the exact amount of income a community derives from licenses (or absence of such income, preventing false accusation of graft), by clarifying the purpose for which data is collected (counteracting accusations of spying for outside interests), and increase the ability of elected representatives to generate benefits for their community.

As second core mechanism for social impact is increased ability for **working together**. Physical distance is a key factor preventing effective community coordination, as VAGs and CRBs have little opportunity to meet their constituents or engage authorities relevant to implement plans. As key example, VAGS are expected to meet on a monthly basis and discuss local concerns that should be brought to the attention of the CRB. However, as the CRBs typically only meet quarterly, effectively addressing VAG issues each CRB meeting would have to review and react to the minutes of up to 30 VAG meetings. In many cases the time gap alone would prevent a proper response (e.g. to a predator sightings), even if all minutes were fully addressed. Related core functions of the observatory include the immediate electronic submission of meeting minutes for review and reaction of the CRB executive board. Such reaction often involves contacting authorities, which is again made easier (or possible) through the communication channels of the observatory, by eliminating the need of (multi-day) travel. However, the extent to which this aspect will be impacted is influenced by impacts in **internet savviness** and **ability to learn**. The local culture relies almost entirely on personal contact, and using communication technologies to complement or replace (some) meetings requires building of acceptance and practice.

A final core determinant for social impact of the future is the limited observed sense of community representatives to actively search for information and take initiative. While active VAG members in the DC meetings focused on the question how the can fulfil their mandate, many community members actively questions whether they should. Observations in the DC meetings suggest a major break in **shared stories** when laws established wildlife conservation in the 1970. Statements like “we used to deal with [problem animals] but we are no longer allowed to and now we are helpless” or “in current law humans in communities are not considered, but you, protecting animals, have jobs” represent typical attitudes among citizens in communities. In this perspective, killing animals is either perceived as legitimate because it does not serve the community, or even as a tool to ‘punish’ the wildlife department, disregarding the harm this behaviour does to the community itself.

8.4 Institutional outcomes and impacts

“This is the first time since the CCCDP programme started [in 2003] that the VAGs have been called in and asked to engage at that level” (Imusho VAG member))

The validated baseline and expected impacts of the Zambian National CBNRM Observatory and results of the For the Zambia Demo Case are summarised in Table 29. It covers details related to the participation paradigm and power dynamics among stakeholders.

Table 28. Summary of Institutional impact assessment Zambian CBNRM Observatory

Relevant aspect	Baseline (Niti Luli Sub-group only)	Validated Baseline, additions and revisions (National Observatory)	Expected changes (Yes/No)
Participation Dimension			
Geographic scope	Sesheke and Sioma districts	**Revise** National Platform with local subgroup in Sioma and Sesheke	**Yes** Roll out in more resource management areas across Zambia
Participant groups	International level (UN agencies and international NGOs), national level (the Cabinet Office and ministries), local level (local authorities, traditional leaders, local NGOs)	**Validated** Nominally National (Government Departments), CRB Associations, Local Level (council and district administrations, traditional leaders, village committees	**Yes** Enable faster and new forms of interactions of actors, enable participation of Village Actions Groups and subsistence farmers
Efforts required to participate	Regulatory entities: Time, financial means, human resources, right skill sets, enabling legislation, availability of information and logistics. Expert advisor: time, human resources, skills and logistics CO members: financial means, skills, time, logistics, availability of data and information.	**validated** Regulatory entities: Time, financial means, human resources, right skill sets, enabling legislation, availability of information and logistics. Expert advisor: time, human resources, skills and logistics CO members: financial means, skills, time, logistics, availability of data and information.	**Yes** Reduce efforts needed to interact significantly. Participations currently almost impossible due to distances and absence of transport & communication.
Support offered for participation	[no baseline]	**Add** Committees supported by departments and NGOs (organization of meetings, trainings)	**Yes** Virtual infrastructure supports autonomous activities reducing dependency on NGOs Information and training materials to support village representatives in fulfilling their mandates
Communication paradigm	F2F communication and using the telephone. Digital telecommunication channels are not very accessible.	**Revise** Pen & Paper data collection, results (sometimes) shared in hardcopy reports, community meetings as core platform for information exchange	**Yes** Platform becomes core form of communications, including speedier invitation to events, sharing of minutes and reports, and results of data collection
Communication and decision mode	Regulatory entities: national level (direct or indirect say in the decisions related to their job) and local level (educating local communities) Expert advisor: providing to the authorities with consultation in areas of expertise	**Validated** Regulatory entities: national level (direct or indirect say in the decisions related to their job) and local level (educating local communities) Expert advisor: providing to the authorities with consultation in areas of expertise	**Yes** Focus on communications and coordination between levels (local to national), different government departments, and with donor projects

Relevant aspect	Baseline (Niti Luli Sub-group only)	Validated Baseline, additions and revisions (National Observatory)	Expected changes (Yes/No)
	General public: advising or educating other community members, holding or attending meetings.	General public: advising or educating other community members, holding or attending meetings.	
Power Dynamics Dimension			
Access to and control over data	Regulatory entities: spatial and temporal availability of the data about natural resources is low. The level of access to data is often defined by producers and owners (government departments and NGOs).	**Revise** Regulatory entities: data available within departments, but spatial and temporal resolution low. Local authorities little access to data. Communities committees no access to data	**Yes** Access to data expanded from communities and between departments Control over NR data will largely remain with government departments Creation of new data sets on CBNRM activities and evidence controlled by citizens
Authority and power	Regulatory entities: influence on processes of making decisions about natural resources management. Expert advisors: to a certain extent (via providing advice or consultation) CO members: no significant influence on decisions	**Validated** Regulatory entities: influence on processes of making decisions about natural resources management. Expert advisors: to a certain extent (via providing advice or consultation) CO members: no significant influence on decisions	**Yes** Increased visibility and consideration for community concerns in decisions Increased collaboration between community committees and law enforcement bodies

As mentioned in section 8.1, community participation in natural resources management in Zambia is fully formalized in laws and primary policies. However, the current communication paradigms and power relationships do not reflect the rights and entitlements enshrined in such laws. The effort to participate exceeds the resources and capacities of most communities, leading to full dependence on support for participation offered by government departments and NGOs. Combined with access to data fully controlled by national departments, the result is an institutional structure in which communities are, and feel, de facto, powerless. In community meetings, the role of communities in resource management is seen sceptical, and as offering little benefit to communities. Statements like “we used to deal with [problem animals] but we are no longer allowed to and now we are helpless” or “In this law, humans are not considered, but you, protecting animals, have jobs” are typical examples.

The design of the CBNRM observatory focuses on impacts in three specific aspects. The most direct contributions is the change in **support for participation** and **access to information**. The platform contains not only environmental monitoring data, but also collections of policy documents and information materials. The CO team plans to produce and distribute additional training materials through the platform, including in the form of videos in local languages, for example step-by-step explanations how to register a community forestry area. In this aspect, the platform itself relieves the dependency of communities on external support.

The second aspect is the change in communication paradigm and **communication and decision mode**. On a practical level, the platform design has a strong focus on communication functions, to alleviate the reliance on face-to-face meetings (see previous sections). In institutional terms, the more relevant related contribution is that the platform connects communities more directly to authorities and peers at higher levels. On the citizen side, aggregating information from local CRBs is expected to allow the regional and national associations to support advocacy with evidence. On the authorities' side, the platform can create more transparency on a number of issues critical to the success of environmental stewardship. In particular, it allows for the monitoring of concessions that generate income from natural resources, for example forestry licenses. During the co-design process, representatives of national authorities pointed out that it is as difficult for them to validate reports they receive from the local level, as it is for communities to report issues. However, the lack of transparency is also exploited by a number of stakeholders for their own benefit, with the GT2.0 research indicating that some of these actors seem to enjoy protection by the responsible authority.

This last aspect highlights the main challenge in achieving the desired institutional impact: Shifting the power balance towards communities is the stated goal of all stakeholders involved, but in practice has to be actively embraced by departments currently able to control the decision-making process, and, potentially, by staff benefitting from the current power imbalance. In this regard, the GT2.0 co-design approach itself was of crucial importance to prepare the desired impacts, as it allowed the DC team to adapt the process to these political realities.

8.5 Environmental outcomes and impacts

"People do not poach because they don't like wildlife. The poach because they have to survive" (Coordinator, Western Region CRB Association)

As for the other impacts examined in this report, environmental impacts to which the National Observatory is expected to contribute are not manifest during the project life time.

Envisioned environment impact

At a general level, the Zambian National CBNRM Observatory is expected to contribute to halting the degradation of all natural resources co-managed by communities in Zambia (Wildlife, water, timber, soils, fisheries, mining, heritage sites). In the structure of the National Observatory, specific environmental impacts are defined at the local, subgroup, level. In the Niti Luli polito area, two environmental impacts are envisioned. First, to halt deforestation, and second, to increase the wildlife numbers in the National Park and Game Management Area.

Required social and institutional changes

The lead causes of environmental degradation in areas under community management are either illegal, such as poaching, or represent a failure to effectively implement policies designed to protect wildlife and other resources. Therefore, required institutional change have to focus on enforcement of and compliance with existing policies and regulations. With regard to law enforcement key changes are to improve the ability of communities to report illegal activities at all (distances), anonymously to prevent repercussions, to improve the documentation of evidence, and to track if and how authorities react to reports and observations. Furthermore, the ability of well-connected actors both industrial and including local indunas to generate big short-term financial benefits at the expense of community

wellbeing. In terms of increased compliance, required changes include increased awareness and acceptance for conservation. Key mechanism for increasing acceptance for conservation is to ensure communities can realize economic benefits from natural resources in sustainable ways, as intended by CBNRM laws and to reduce poverty and main motivator for illegal activities.

Table 29 Summary of Environmental Impacts

Envisioned environmental Impact	*Required institutional changes to achieve intended impact*	*CO Contribution to required change*	*Required social changes to achieve intended impact*	*CO Contribution to required change*
		Direct		**Direct**
		Indirect		**Indirect**
		No		**No**
Halt defrorestation	Better integration of CBNRM policies	**No** Platform will support collaborative effort by making data accessible across departments	Increase awareness and knowledge for community rights to natural resources	**Indirect** Publication of policy documents and educational materials
	Use of IT for improved monitoring of due process in timber concessions	**Direct** Publication of timber licenses to authenticate permissions	Increase civilian monitoring and reporting of illegal logging activities	**Direct** Submission of reports through CBNRM observatory
	Use of IT for law enforcement	**Direct** Create channel to Report illegal logging activities	Decreased willingness to engage with illegal activities through increased benefits	**Indirect** Support community forestry groups with materials for sensitization and social accountability
Increase wildlife numbers	Use of IT for improved conservation actions	**Indirect** Enable preventive actions on sighting of predators in communities	Use of IT for improved conservation actions	**Direct** Improve the ability of community based groups to function through communication and training materials
	Use community observations to improve environmental monitoring for management actions	**Indirect** Design for data quality assurance in CO helps overcome reservations to use community date	Increase influence of communities on decision making	**Indirect** Provide reliable data on natural resource issues and community action to enable evidence based advocacy
Both	Increased benefits of communities from CBNRM, reducing incentives for participation in illegal logging and poaching	**Indirect** Track and publish licensing fees to enable social accountability and show who benefits	Increased benefits of communities from CBNRM, reducing incentives for participation in illegal logging and poaching	**Indirect** Instruction manuals support for establishing community forest areas and other community managed operations

Evidence of starting the required social and institutional change processes

The core objectives of the Zambian observatory place a focus on communication and coordination. Therefore, already throughout the co-design process, activities included coordinative actions. This included lateral coordination, meaning the inclusion of multiple departments in village meetings, and vertically, with direct discussions of issues raised at the local level at the national level. The changes with the strongest anticipated impact refer to actions that the CO will enable, i.e. actions current stakeholders already want to take but are made impossible by the current lack of infrastructure. For example, currently communities have no practical way to confirm if a timber license shown by a logger is legal, if the place the logging takes place is the area stated on the paperwork, or if the local traditional leadership approved the concession. Similarly, the national department has no way to confirm if signatures by traditional leaders were granted with due process regarding community benefits. Both problems can be addressed by simply publishing timber licenses, an action both sides agreed to include in the observatory, so that coordinates and paperwork can be compared to maps and pictures accessible in the observatory. This makes reporting actionable for law enforcement. Local law enforcement and the local administration highlighted that much information becomes only available to them when it is too late to react.

A second area of change already observed during the project period is the relevance of simple procedural information on how to generate community benefits from resources. Communities are informed that the option for resource management groups exist, but not what steps are necessary to generate income. Creating transparency on exactly who earns which income from resources, and advising how certain income sources can be established by communities themselves will reduce mistrust towards conservation activists in communities, and increase motivation to participate in conservation.

8.6 Validation

The validation of the Zambian CBNRM Observatory assesses the extent to which activities undertaken by Ground Truth 2.0 have been i) *effective* in delivering the intended outcomes,; ii) *efficient* in terms of inputs used and outputs generated and iii) *coherent* in terms of alignment of the Demo Case citizen observatory align with stakeholder requirements and the concept of a CO. This section summarizes the state of delivery on expected outcomes as envisioned by authorities and community members.

The objectives of the Zambian observatory show a strong focus on communication and channels for sharing of information, rather than new forms of data collection altogether. As an issue of capacity and infrstaructure, successful delivery of the envisioned CO requires three types of **expected outputs,** a tool for digital collection and submission of data replacing pen and paper reporting, collections of information accessible to communities, hardware to create access points in disconnected communities. In this regard, the observatory has made substantial progress. Deliverables include the provision of budget phones for Village Action Groups, set up with a structure of instututionalized email-addresses to speed up communication with community groups, the development of hardware solutions for offline synchronization of CO data, briefing materials and policy documents made available to communities. The data collection app is available as prototype and is currently being tested.

In terms of **expected outcomes** and **impacts**, the core expectations of communities is an increased response on authorities to reports community concerns, more collaboration between departments and projects, and increase community income from natural resources. It is difficult to assess the real expectations of communities, as statements of community members range from 'magical thinking' (an outside power will come and simply fix complex problems) and deep cynicism ("*poaching is not going*

to stop because of you"). On the side of authorites, expectations are similarly difficult to assess. Interviews with projects tend to elicit very positive answers (see for example D3.3 on economic impacts), that do not fully match statements made by the same officials in co-design interactions, where a more critical attitude is on display. Overall, the impression is that authorities have few active expectations on the platform itself, but expect the Observatory to demonstrate its fit with their existing systems before its use can be considered. Accordingly, realizing the expected impacts (authorities accept and use communications made through the observatory), requires delivery of a platform that fits into the work environment of authorities, and can be integrated with their existing systems and workplans.

Given this priority, the DC co-design process placed a premium on the instituitional structures that will allow full formal adoption of the platform by authorities. All major authorities relevant actively collaborate with this process. Delays in the technical development of the platform made it impossible to complete the approval process by the reporting deadline, but the process is continued by local actors with accepted mandates for such negotiations. A key outcome will be the planned inclusion of the National Observatory in the formal National CBNRM policy currently under development, which would create a legal mandate for all involved departments to use the observatory. As the observatory is not yet fully operational due to technical delays, no impacts have been realized at this point.

Table 30. Summary of (expected) outputs, outcomes and impacts of Zambian National CBNRM Observatory

Relevant aspect	Expected changes (Yes/No)	Realized changes (Yes/No) & extent of achievement Substantial Moderately Slightly Not at all	Expected future changes (Yes/No)
Outputs	**Yes** Data collection tool and platform, new channels of communication with policy and decision makers, information accessible to communities, hardware for access and synchronization in communities, briefing materials trainings	**Yes** Diverse outputs, including prototype apps, briefing materials, community hardware and training	**Yes** Further development and implementation of tools, training of further CRBs by regional associations
Outcomes	**Yes** Increased communication between communities and authorities, communities better informed and more supportive of conservation, more collaboration between departments, increased responsiveness of authorities to community concerns	**Yes** Project process created communication channels and constellations of collaboration previously not available. Initiated mechanism to better direct reports to enable higher responsiveness	**Yes** Formation of an inter-departmental Steering Committee for the National Observatory, inclusion of Observatory in new collaborate CBNRM policy.
Impacts	**Yes** Increased influence of communities on decisions about natural resources, Reduced resource degradation, Increased socio-economic benefits from resources	**No**	**Yes** Use of observatory data to support advocacy by National Association for local CRBs with evidence, increased use of benefit-generating tools by communities due to information and process support (e.g. registration community forests)

9 Economic impacts

This section presents the results of the analysis of economic outcomes that can be associated with the implementation of the GT2.0 Demo Case observatories and the project at large as follows:

a) for the *demand* side of COs, e.g. for public sector organizations benefitting from a given Demo Case CO, incl. the potential cost-reduction of the in-situ component due to the presence of citizen-sensed data

b) for the *supply* side of COs, i.e. for providers of CO solutions and expertise to implement a Demo Case CO.

9.1 Economic impacts of CO data for in-situ networks

In D1.11, we presented a generic approach to evaluate the economic impact of data fusion, including aspects of crowdsourcing networks following Blaney et al (2016). Two approaches were presented. First, a cost comparison between crowdsourcing and in-situ networks, where impact was evaluated as the difference between the costs of the current network and the costs of the fused (in-situ + citizens) network. The method included a temporal evolution of the costs of both networks and hypothesised about the ideal condition in which the costs of the in-situ network is reduced in time because of the presence of the CO data, and that the cost of the crowdsourcing network will have a strong initial investment which would decay in time as no additional effort to maintain it would be needed. A second approach included the concept of Value of Information to evaluate the value a decision maker is willing to pay to get extra information before making a decision. Unfortunately, none of the Demo Cases achieved the stage of using the collected citizen data for decision-making and therefore this approach could not be applied. For this reason, in the later stages of the project, the scope of the task was adjusted based on the amount of data collected in each Demo Case. For this reason, a modified methodology to evaluate the impact of CO data from the value for the in-situ network was developed (see the rationale and details of the new method in Annex 2), which partly include the cost methodology presented in D1.11. This section starts with the definition of the vocabulary used and shows the application of the methodology to each Demo Case. Then, the analysis of the results is presented and conclusions are reported in section 9.1.6.

In order to avoid confusion in the use of some of concepts and wording, especially those used in the other parts of this deliverable and other tasks of Ground Truth 2.0 WP1 on the Social dimensions of citizen observatories, we present the following vocabulary, which will be used in this section.

Observation: "*…an act associated with a discrete time instant or period through which a number, term or other symbol is assigned to a phenomenon. It involves application of a specified procedure, such as a sensor, instrument, algorithm or process chain. The procedure may be applied in-situ, remotely, or ex-situ with respect to the sampling location. The result of an observation is an estimate of the value of a property of some feature.*" (ISO19156 – Observations and Measurements)

Initiative: any CS activity having citizen-based monitoring as a main purpose.

Citizen-based monitoring (citizen data): activity in which citizens are involved in collecting observations or carrying out measurements of a particular environmental variable.

Value of an observation: metric to define how useful is a record of citizen-contributed data from the perspectives of complementarity and costs, with respect to the existing in-situ monitoring network. Impacts related to the benefits such as the increase in awareness are not accounted for in this value.

Complementarity: degree in which existing data, generally collected by in-situ monitoring networks or official sources, is complemented (in time and space) by citizen-based monitoring.

The overall methodology for evaluating the value of citizen observations is presented in detail in Annex 2. It consists of two main parts, namely the data perspective and the costs perspective. The former aims to qualify the degree of complementarity that the data collected by citizens offers to in-situ networks. The latter aims to quantify the relation between the investments required to set up a citizen observatory and the actual amount of data collected.

9.1.1 Results of economic impact assessment of CO data for in-situ networks

As explained in Annex 2, the value of a citizen observation with respect to in-situ monitoring networks is considered as a function of complementarity and costs. A data record is to be considered of maximum value if its complementarity is the maximum and if the cost to produce it is the minimum. On the contrary, it has little value if its complementarity is the minimum and its cost is high. In the present analysis, the cost of one observed environmental variable is estimated by dividing the total cost of building the observatory into the number of environmental variables that the observatory collects.

The results of both Complementarity Index and Cost Evolution (see Annex 2 for details on these definitions) are presented in this section. The summary of input data and results for each Demo Case is presented in Table 31**Error! Reference source not found.**, which was produced under the following assumptions and considerations:

- Costs are estimated proportionally according to the efforts of the Ground Truth 2.0 partners involved in each case.
- Although the data in the Periodic Activity Sheets (PAS) extends until March 2019, the project runs until December 2019. For this reason, in the graphs below, the effort is shown until March 2019. To calculate CDR, it was assumed that the cost of building the observatory remained constant from March 2019 onwards, in all Demo Cases.
- The total costs of building the citizen observatory includes the cost of events with stakeholders, which include co-design sessions, measurement campaigns and other meetings, as reported in co-design logbooks and platform and launch compendia. The costs of these events are assumed to be 5% of the total cost of all involved partners in the corresponding Demo Case. Moreover, the temporal distribution of costs is assumed to be proportional to the amount of stakeholders involved in each event.
- Due to the nature of the Belgian Demo Case, the unit of spatial discretisation is length, not area.

The values of cost and the number of observations were mapped against the dates and both were collected as they were occurring. This allowed to calculate the values of cost of data record (CDR) with Eq (4). The resulting values were used to produce the graphs shown below for each Demo Case.

Table 31. Summary of input data and results for each Demo Case

Case	Citizen Observatory	Number of total variables considered in the CO	Variable considered in this analysis	Total number of collected records between Jan 2017- Mar 2019	Total area (km2)	Relevant cell size (km)	Total number of cells (C)	Total cost CO
Belgium[1]	MetMeMechelen	1	Black carbon	8607	30	0.2	750	€ 323,157
Sweden	VattenFokus	4	Phosphate	427	124.2	2	31.05	€ 422,219
Kenya	Maasai Mara	25	Biodiversity	239	7000	2	1855	€ 253,858
Spain	RitmeNatura	10	Phenology	350	100	0.5	400	€ 282,872

Table 32. Summary of input data and results for each Demo Case

Case	Number of cells covered by In-Situ network	Number of cells covered by CO	Total number of seasons (months)	Total number of seasons covered by CO	Spatial Complementarity (SC)	Temporal Complementarity (TC)	Spatial weight	Temporal weight	Complementarity index, CI
Belgium[1]	170	225	25	9	1.324	0.36	0.5	0.5	0.84
Sweden	70.2	32	25	24	0.456	0.96	0.5	0.5	0.71
Kenya	556.5	55	25	9	0.099	0.36	0.5	0.5	0.23
Spain	0	40	25	12	1.000	0.48	0.5	0.5	0.74

9.1.2 Belgian Demo Case

The cumulative effort in time and the timing and size of the interaction events can be observed in Figure 5.

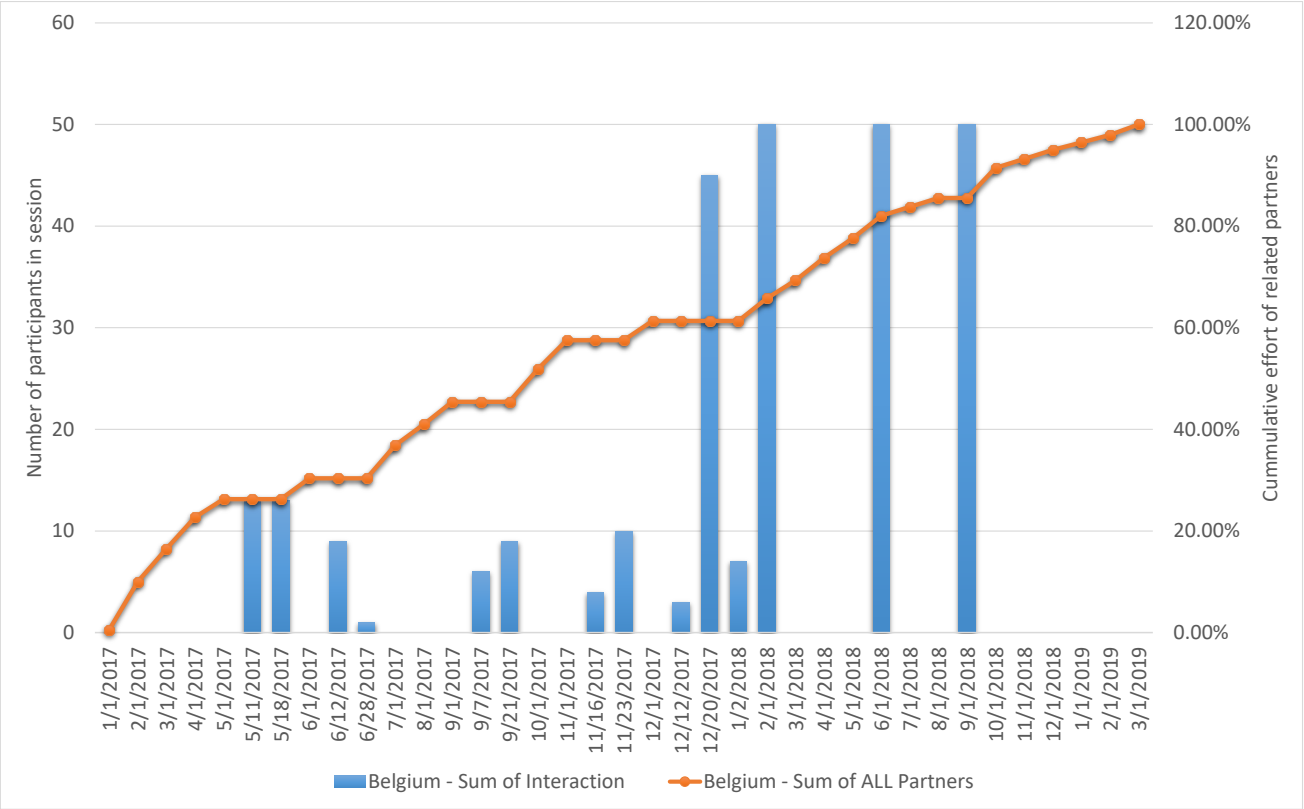

Figure 5. Cumulative total effort and timing and size of the interaction events in Belgium.

The evolution of the Cost of Data Record (CDR) in the Belgian Demo Case clearly shows four stages, corresponding to the four campaigns.

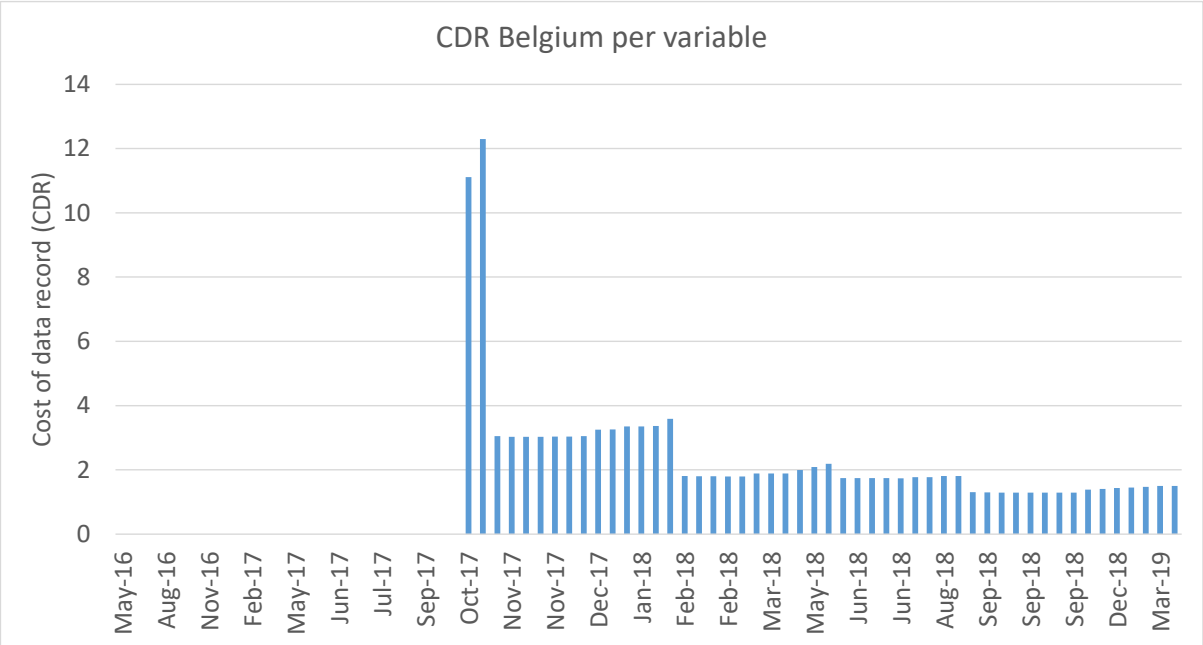

Figure 6. Evolution of the Cost of Data Record (CDR, Eur) in the Belgian Demo Case.

9.1.3 Kenyan Demo Case

The Kenya Demo Case includes several data collection initiatives by the observatory, including the Mara Collect app for data collection of biodiversity as well as the deployment of the TAHMO low cost weather stations. This section concentrates on the former, via which 239 entries (at the time of edition of this document) were received on the platform, for the equivalent of 25 different environmental variables.

The application of Eq (4) per period yields the estimated evolution of the cost of data record (CDR) per variable per time shown in Figure 7. Cumulative total effort and timing and size of the interaction events in Kenya.. It shows that the efforts to carry out events with stakeholders at the beginning of the project does not correlate with the number of collected data at those times. This is because these events were made to define what and how the data would be collected, so the actual data collection started to happen towards the middle term of the project. The amount of observations towards the end of the project significantly reduced the CDR.

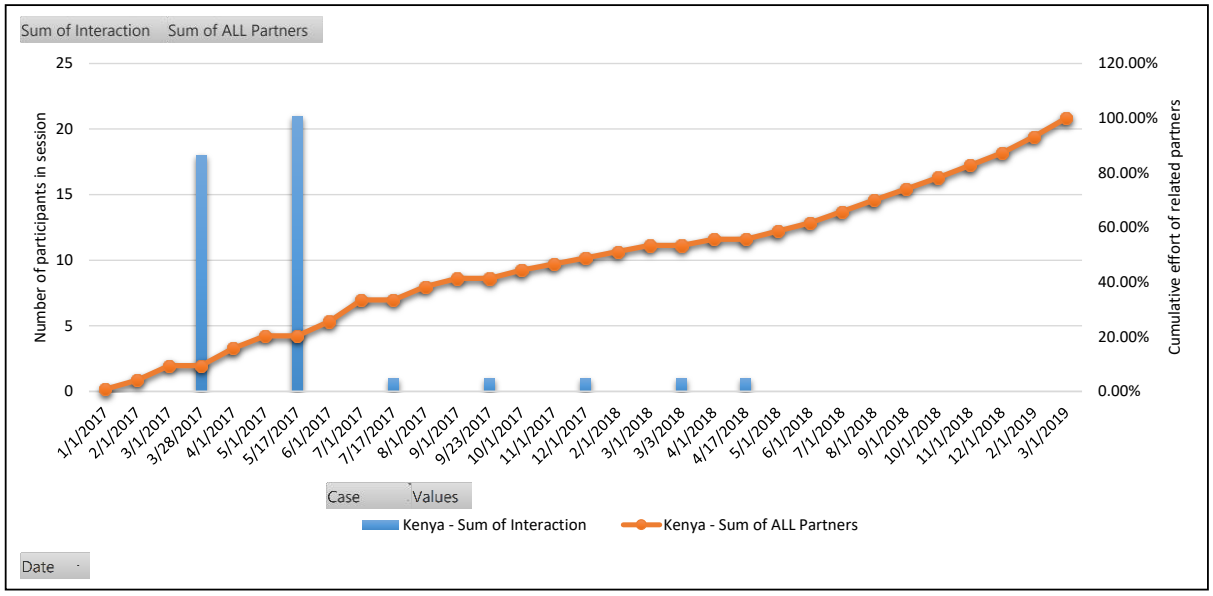

Figure 7. Cumulative total effort and timing and size of the interaction events in Kenya.

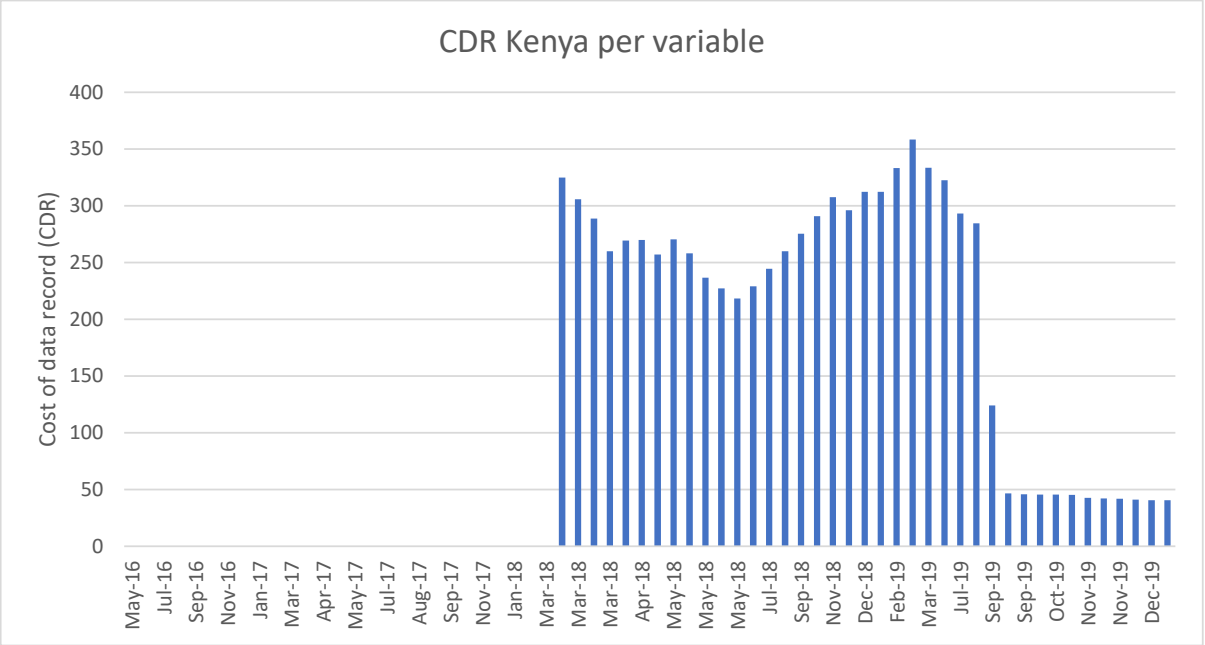

Figure 8. Evolution of CDR (Eur) in time, Kenya use case

9.1.4 Spanish Demo Case

Seven main events with stakeholders were carried out in this Demo Case. These interaction moments as well as the cumulative effort of the Ground Truth 2.0 partners to build the CO are presented in Figure 9.

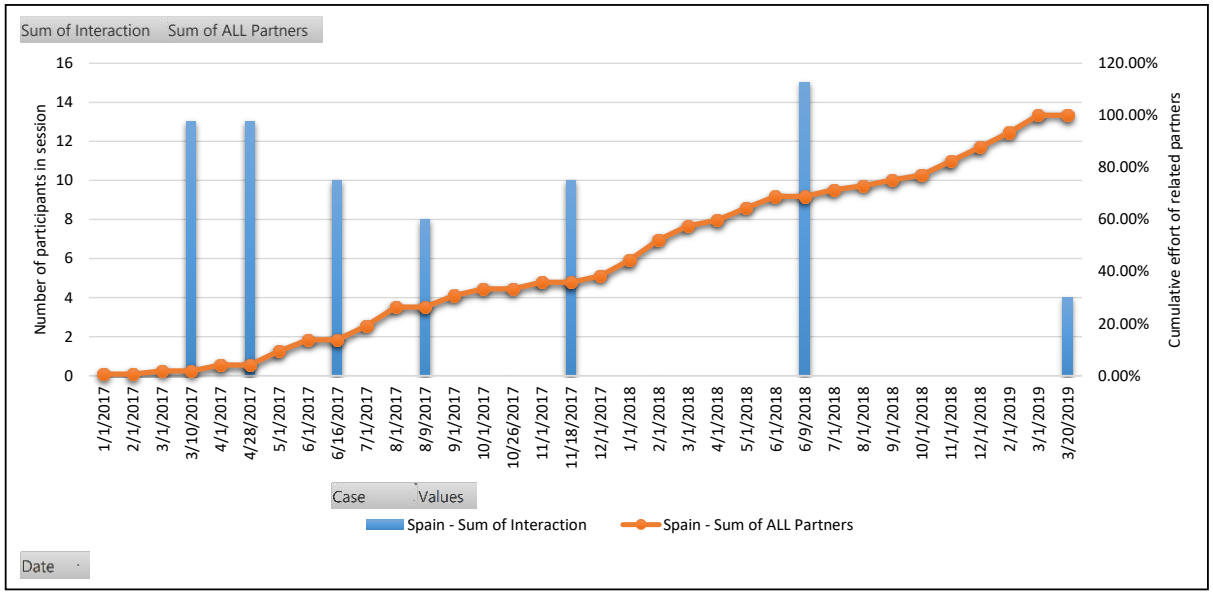

Figure 9. Cumulative total effort and timing and size of the interaction events in the Spanish Demo Case.

The evolution of CDR is shown in Figure 10. The relatively high values obtained can be explained by the small number of collected observations were collected in the last year of the Ground Truth 2.0 project. In 2019 the costs continue to decrease due to the increment in observations.

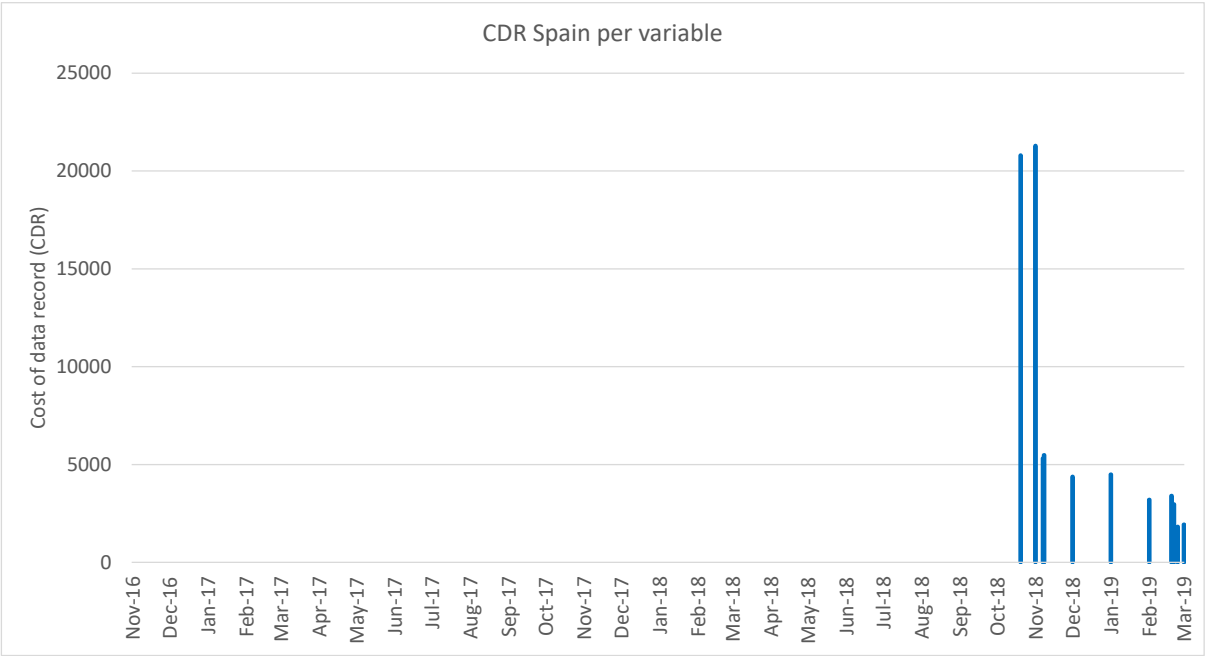

Figure 10. Evolution of CDR (Eur) in time, Spanish Demo Case

9.1.5 Swedish Demo Case

Twelve main interaction moments were carried out in this Demo Case. These interaction moments as well as the cumulative effort of the Ground Truth 2.0 partners to build the CO are presented in Figure 11.

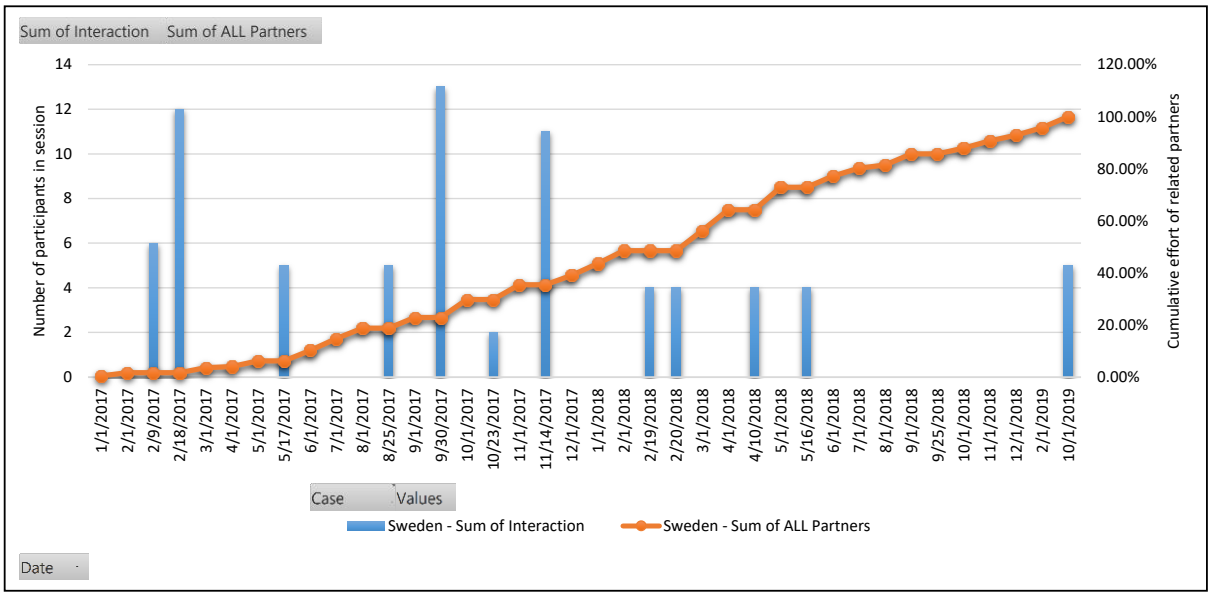

Figure 11. Cumulative total effort and timing and size of the interaction events in Sweden.

The evolution of CDR in time for the Swedish Demo Case is presented in Figure 12. In this case, during the first half of the period more citizen observations were gathered than in the second half. The fact that the effort was continuous throughout the entire period is reflected in the quasi-constant value of CDR towards the end of the Ground Truth 2.0 project.

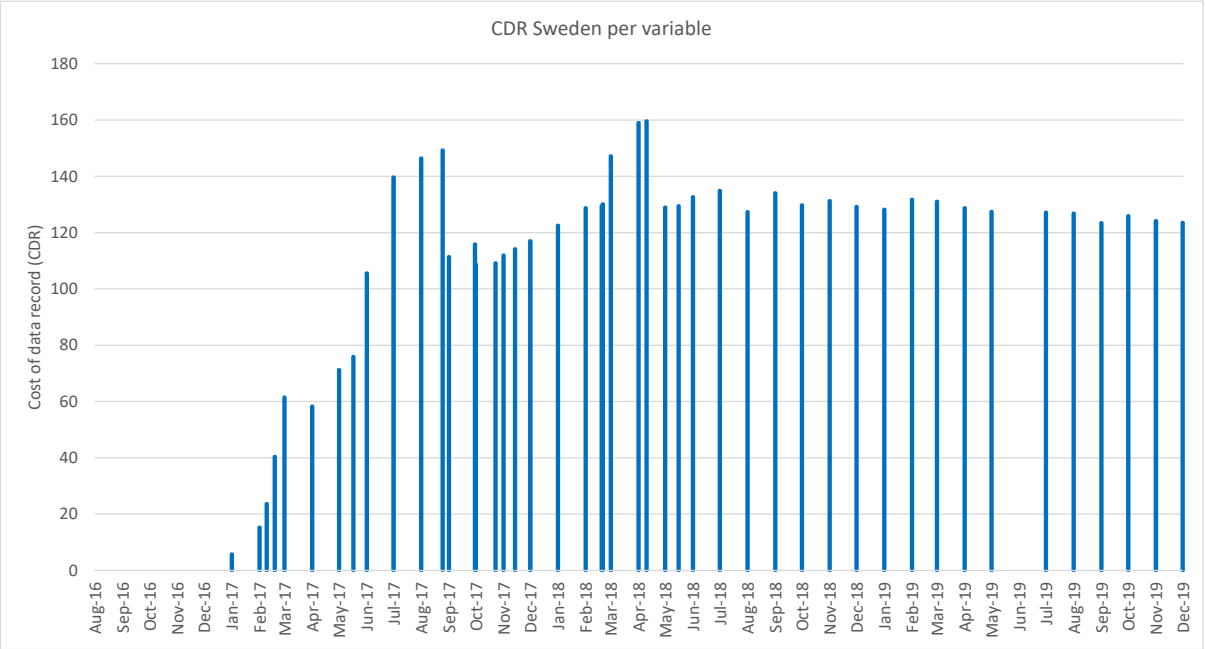

Figure 12. Evolution of CDR (Eur) in time, Swedish Demo Case

9.1.6 Conclusions

As explained in Annex 2, the value of a citizen observation with respect to in-situ monitoring networks is considered as a function of complementarity and costs. A data record is to be considered of maximum value if its complementarity is the maximum and if the cost to produce it is the minimum. The application of the proposed

methodology shows that the economic impact of CO data on the existing in-situ networks is sensitive to the size of the element of discretization in time and space, and that these definitions are not trivial to choose.

The evolution of the Ground Truth 2.0 citizen observatories in terms of effort of all Ground Truth 2.0 partners did not show salient changes in any of the Demo Cases when compared to the occurrence of interaction moments, as it was initially expected. This means that the interaction moments have a much lower cost than the effort of preparing them. In none of the Demo Cases did an increment in the interaction moments translate into an immediate increase in collected observations.

The Belgian Demo Case (Meet Mee Mechelen) is remarkable because of the amount of collected data. In this case the effort required by the citizens was limited to carrying a sensor while biking through pre-determined paths, in a campaign-based event. In contrast, for the variables we considered here, the effort required by a citizen in the Kenyan Demo Case (Maasai Mara Citizen Observatory) implies the use of a smartphone app that has a comprehensive survey and that includes taking and uploading photos, which requires a bigger effort. This could explain the difficulty in collecting data in this Demo Case, which was solved towards the end of the project by a campaign-like event. A similar situation occurred in the Spanish Demo Case. Therefore, it can be concluded that the amount of collected observations depends on both the effort required by the citizens (e.g., the extent to which devices or sensors need to be manipulated) and the degree of guidance in the field (e.g., dedicated campaign-based events within groups vs independent initiative).

However, in the presented analysis of costs one should avoid direct comparison among cases, due to their very different nature and evolution. Not all CO's had the same focus on collecting additional data, and a different topic and different local stakeholder requests can lead to a totally different approach for data collection.

The results also show that setting up a CO for the sole purpose of data collection is an expensive undertaking, for the demand side, that may not necessarily complement the existing in-situ monitoring network. The impact of a CO can be better attributed to the social and institutional (and eventually environmental) aspects described in detail in chapters 3-8 of this deliverable. A possible exception might be provided by the Zambian CO in the future. The DC presents a scenario in which the CO serves to replace pen and paper data collections for multiple public actors, leading to cost savings or enabling data collection that are not currently affordable due to absence of proper transport, power and communication infrastructure. However, at this point the observatory has not matured enough to allow formal assessment.

9.2 Economic impacts (supply side)

The GT2.0 Impact Assessment is aimed at assessing the economic outcomes and impacts that can be associated with the implementation of the GT2.0 Demo Case observatories and the project at large. It distinguishes between the economic outcomes for the *demand* side of COs, e.g. for public sector organizations benefitting from a given Demo Case CO and the *supply* side of COs, i.e. for providers of CO solutions and expertise to implement a Demo Case CO.

In order to establish the economic impacts for the supply side of COs at the end of the Ground Truth 2.0 project, we compare the *baseline* data of the supply side of COs captured from the 14 GT2.0 partners in 2016 with the findings collected in 2019. Given the confidential nature of some of the responses (e.g. annual turnover), only selected items are reported on here. The responses for all GT2.0 partners have been anonymised.

9.2.1 Company growth

In this section, we report on the number of jobs related to enabling technologies for COs that the GT2.0 partners had in 2016 and 2019, the number of clients in the CO business and the number of relevant products/services for CO provision that the respective organisations provided.

The number of jobs in the partner organisations that were directly related to the enabling technologies for

COs and to the topics of the GT2.0 Demo Cases are presented in Figure 13 . Not all of the jobs reported here are full time positions nor focused fulltime on CO-related topics. Overall, at the start of the GT2.0 project in 2016, the research and academic partners presented stronger manpower on COs than the SME/industry partners or the NGOs in the consortium. Comparing this data to the findings of 2019, an increase in the number of jobs can be seen for seven of the GT2.0 partners overall, i.e. half of the consortium, with especially the SME/industry partners and the NGOs having undergone considerable growth in the number of CO-related jobs.

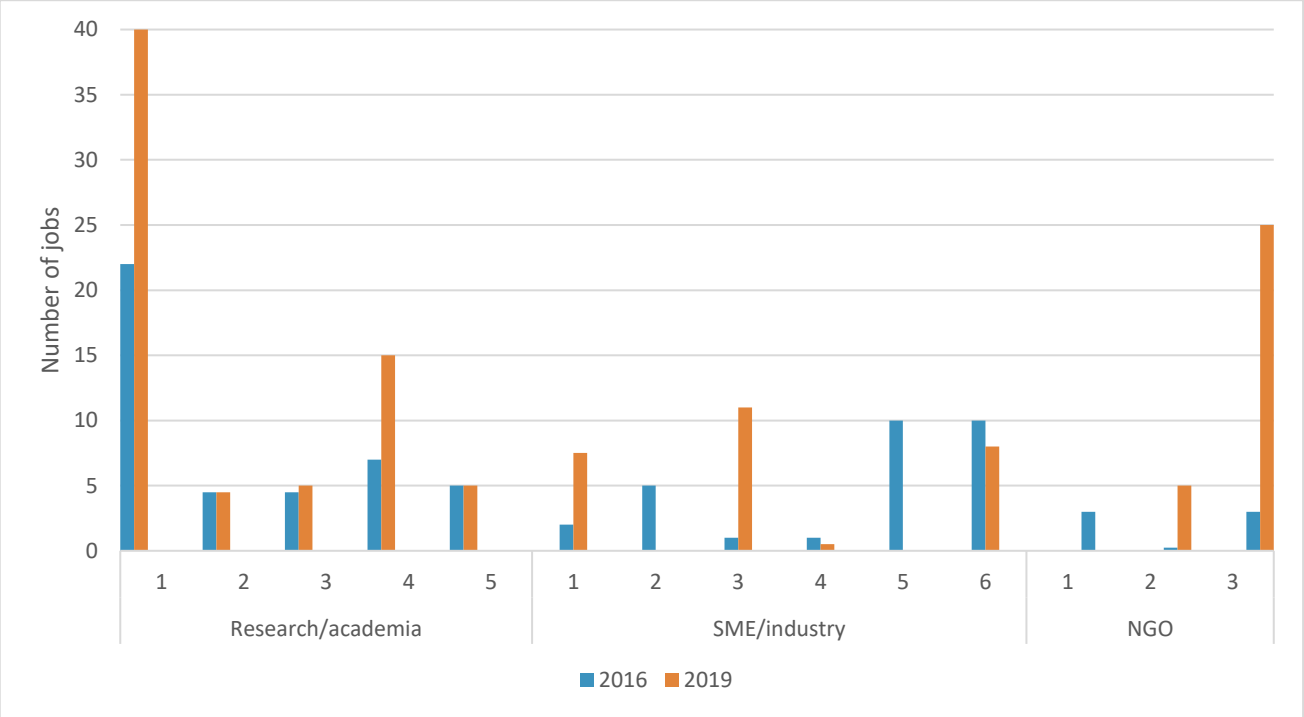

Figure 13. Jobs directly related to enabling technologies for Cos and to the topics of the GT2.0 Demo Case(s) (n=13)

Figure 14 presents the number of clients that the GT2.0 partners had in the CO business in 2016 and 2019. In 2016, six of the GT2.0 partners had two or more clients, whereas in 2019, five of the GT2.0 partners had two or more clients. Two GT2.0 partners which had no CO clients in 2016, have acquired one or more clients by 2019. Three GT2.0 partners have seen an increase in clients in 2019 in comparison to 2016, whereas two partners have experienced a slight decrease in clients.

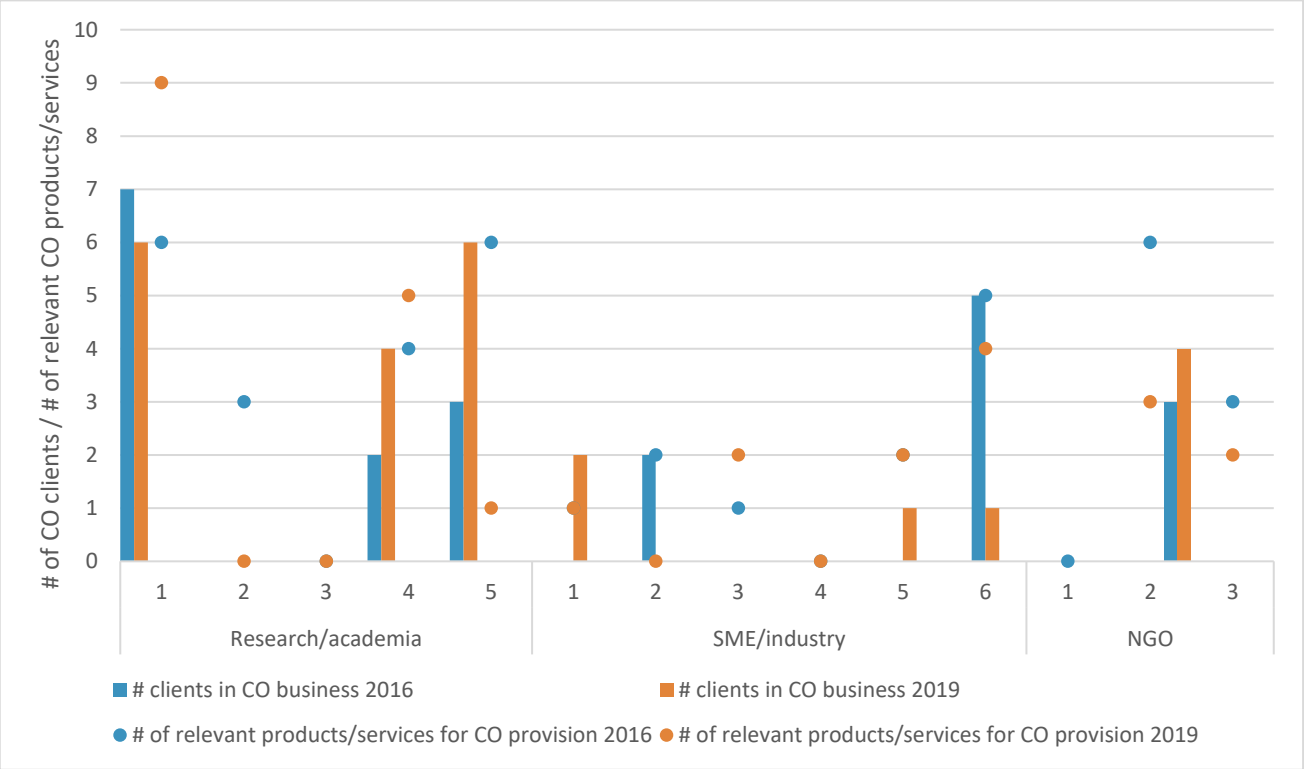

Figure 14. Number of clients in the CO business, number of relevant products/services for CO provision (n=13)

The same figure presents the number of products or services relevant for CO provision which the GT2.0 partners had on offer at the beginning and the end of the GT2.0 project. More than half the GT2.0 partners (9 in total) had two or more such products or services on offer in 2016 and in 2019. Five GT2.0 partners have more CO products or services on offer in 2019 in comparison to 2016, whereas the number products or services has decreased slightly for six of the GT2.0 partners.

9.2.2 International trade & investment

In the international trade and investment dimension of the economic outcomes of GT2.0, we consider the number of international clients in the CO business, the specific customer segments whom the GT2.0 partners served in 2016 and 2019 and the level of their investments in CO.

Regarding the number of international clients that the GT2.0 partners had in the CO business in 2016 (see Figure 15), this can be considered reasonably limited, with only 6 of the GT2.0 partners having two or more international clients. Nevertheless, all three partner categories (research/academia, SME/industry and NGO) had links into the international CO client base. Comparing these findings to the data collected in 2019, three of the GT2.0 partners have seen an increase in the number of international clients, one GT2.0 partner who had no international clients in 2016 has acquired one international client and only one GT2.0 partner has experienced a drop in the number of international clients.

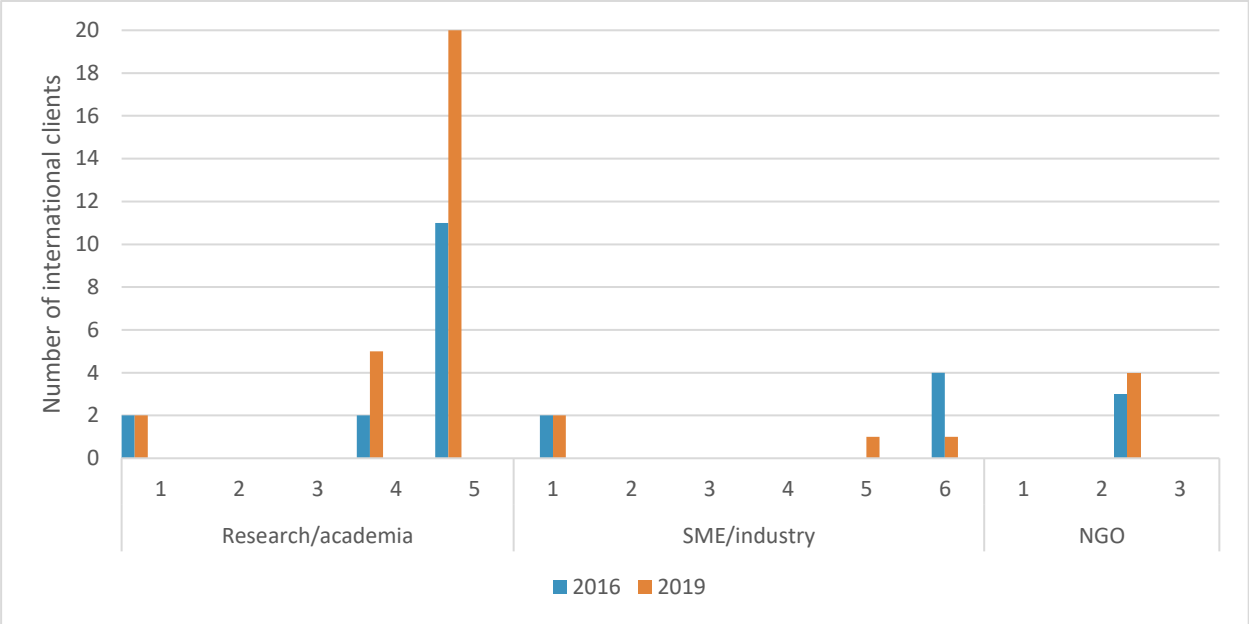

Figure 15. Number of international clients in CO business (n=13)

The specific customer segments that various GT2.0 partners served in 2016 and 2019 related to COs are listed in Table 33. In 2016, perhaps not surprising given the nature of COs, many of these customer segments are in the public sector (local, regional and provincial levels of administration), although some diversity in terms of the range of different segments (education, NGOs, media companies) is also evident. Comparing this to the situation in 2019, the customer segments have not changed much for most of the GT2.0 partners, with many of them still predominantly serving the public sector.

Table 33. Specific customer segment(s) served related to COs

GT2.0 Partner ID	Customer segments served related to COs in 2016	Customer segments served related to COs in 2019
Research/academia 1	Mainly public agencies, also private and non-profit organisations	Mainly public agencies wanting to support new innovative research. Also private foundations and non-profit organizations wanting to improve life quality and environmental knowledge.
Research/academia 2	Provincial administration	National administration and cities. In some of these projects, COs can be a valuable addition to gather more comprehensive data. Currently, this is not a paid-service however and stay in the phase 'Valuable addition if money is available'.
Research/academia 3	N/A	N/A
Research/academia 4	Local authorities	NGOs, local and national authorities, local communities
Research/academia 5	Primary education, further education (university), families, middle-to high income members of society and retirees	The water provision industry, NGOs related to fresh water, Community groups related to fresh water
SME/industry 1	N/A	Universities

GT2.0 Partner ID	Customer segments served related to COs in 2016	Customer segments served related to COs in 2019
SME/industry 2	Regional governments and Media companies	N/A
SME/industry 3	Water board and municipalities	N/A
SME/industry 4	None	N/A
SME/industry 5	Media monitoring and survey processing	Opinion research, market research
SME/industry 6	Water managers, county governments, researchers, media, education	Communities/pastoralists, researchers/academia, government
NGO 1	N/A	N/A
NGO 2	N/A	Public authorities, private sector, knowledge institutes and International NGO's
NGO 3	N/A	N/A

The GT2.0 partners' investment in COs (such as co-financing CO projects, investing in related R&D) is presented as a share of their annual turnover (see Figure 16). In 2016, one SME/industry GT2.0 partner was investing 40% of its annual turnover in COs, whereas only six other partners (mostly also SMEs/industry) were investing (but less than 5%) and the remaining half of the consortium reported no investment in COs at all. In 2019, six GT2.0 partners reported higher investments in COs in comparison to 2016 and eight GT2.0 partners reported no investment in COs at all. The SME/industry GT2.0 partner that was investing 40% of its annual turnover in COs in 2016 has reported a significantly lower investment in COs in 2019.

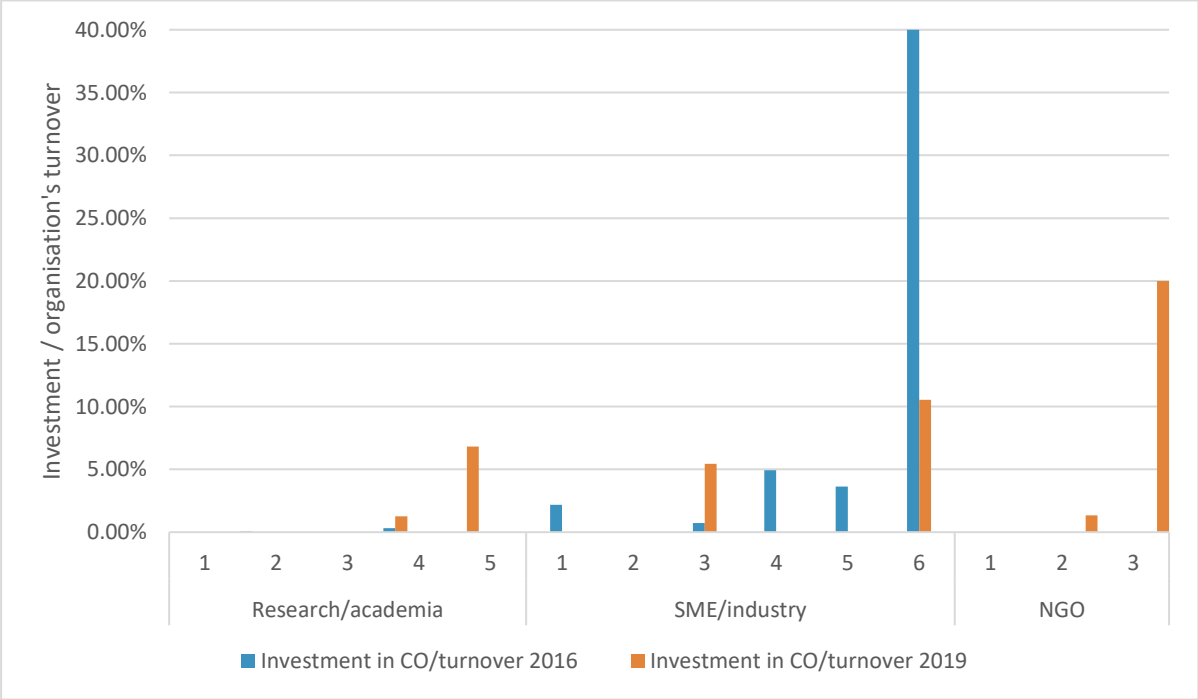

Figure 16. Investment in CO/annual turnover (n=13)

9.2.3 Innovation & Research

The innovation and research dimension of the economic outcomes we consider includes intellectual property rights (IPRs) related to COs and enabling technologies as well as the scope of involvement of the GT2.0 partners in CO projects.

In terms of IPRs (patents, trademarks, copyright, other know-how rights), only three GT2.0 partners reported to be holding IPRs related to COs and enabling technologies in both 2016 and 2019. In 2019, one partner noted that they made all of their developments available open source, whereas others reported that for ICTs, the time, effort and costs involved in registering IPRs is very high, which is why it is not seen as worthwhile.

Regarding the GT2.0 partners' involvement in CO projects that provided them the chance to generate relevant knowledge, insights and technology, Figure 17 presents both the number of CO projects each partner was involved in and the overall budget per partner for these CO-related projects in 2016 and 2019. This shows that in 2016, half the consortium was involved in three or more CO projects, with the research/academic partners holding the largest overall budgets (summed up across their various CO projects). In 2019, eight GT2.0 partners were involved in two or more CO projects. Nine partners were involved in more CO-related projects in comparison to 2016, whereas three GT2.0 partners reported a slightly lower involvement in CO-related projects in comparison to 2016.

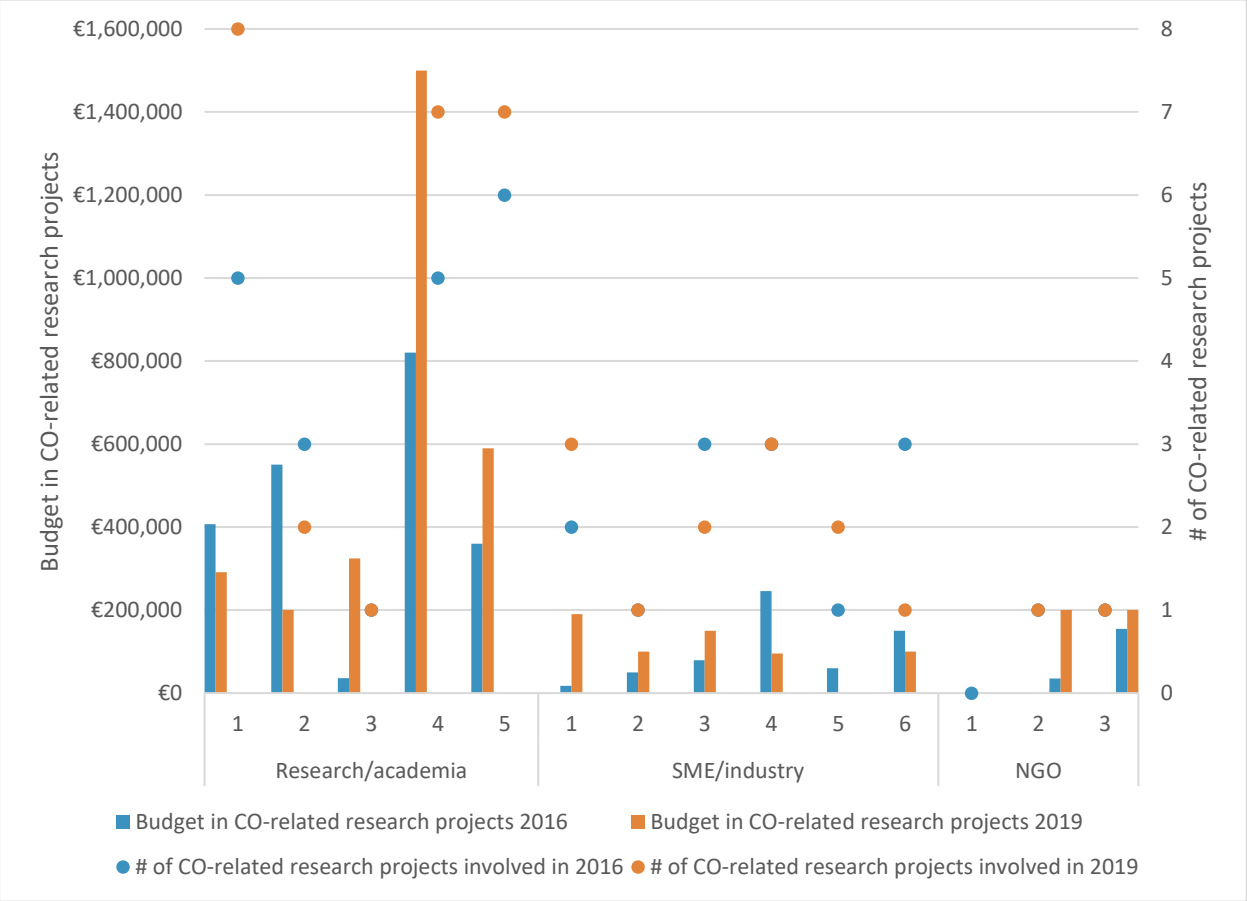

Figure 17. Budget & involvement in CO projects (n=13)

With regard to the budget per partner for these CO-related projects, four of the partners in research/academia reported holding lower budgets in 2019 than in 2016. While the research/academic partners still

held the largest overall budgets, five of the SME/industry partners and NGOs reported an increase in budget allocated to CO-related projects.

9.2.4 Competitiveness

The economic outcomes in terms of competitiveness include consideration of the GT2.0 partners' value propositions related to COs and enabling technologies and the number of revenue streams for CO-related value proposition; the type and range of market segments served (not just those related to COs); and the partners' networks in terms of partners for COs and enabling technologies.

With respect to the specific value propositions for COs reported by the GT2.0 partners in 2016 and 2019, these include knowledge-based, technology-based as well as service-oriented value propositions (see Table 34). Note that inconsistencies in Table X in terms of in the value propositions mentioned for some partners in 2016 but not in 2019, (e.g. for SME/Industry 2-5 and NGO3) are likely to stem from having different respondents reporting for the same organization. This limits the interpretation in terms of the 'disappearance' of value propositions in 2019.

Table 34. Value propositions related to COs and enabling technologies (2016)

GT2.0 Partner ID	Value proposition in 2016	Value proposition in 2019
Research/academia 1		Building citizen science projects; standardizing citizen science data in order to enhance their legitimacy and fitness for real-world; development of citizen science-based early warning systems
Research/academia 2		Environmental expert role to provide guidance to set up measurement campaigns or a knowledge hub; IT-support
Research/academia 3		Citizen observatory (Demo Case)
Research/academia 4	Provision of the social and technical approaches and tools as well as subject knowledge for implementing participatory environmental governance.	Setting up sustainable COs using expertise in the social dimensions of COs: co-design, stakeholder & governance analysis, data sharing, incentives & barriers analysis, social innovation impacts; Setting up sustainable COs using technical expertise in modelling, data processing, quality assurance and validation, data capture using open source tools, data sharing; Strengthening capacity of various stakeholders, using social & technical CO-related expertise
Research/academia 5	We create knowledge and inspire action through hands-on science and environmental engagement. This is backed up by credible science and strong partnership working.	We create knowledge and inspire action through hands-on science and environmental engagement. This is backed up by credible science and strong partnership working. We have 2 data gathering platforms and numerous engagement models
SME/industry 1		n/a
SME/industry 2	Our deep domain knowledge in strategic consulting including participation, open government, etc. combined with our specific technological	n/a

GT2.0 Partner ID	Value proposition in 2016	Value proposition in 2019
	components VueForge Sense & Think	
SME/industry 3	Mobile phone application, portal with apps and dashboards	Only indirect one through WRC and StoryMaps for clients, which they provide to their inhabitants.
SME/industry 4		We offer data exploitation of the data produced by COs for creating relevant products and services
SME/industry 5	Improved outreach to non-participant members of the (writing) general public and aggregation of news items of relevance	We provide a unique technology to cluster textual data related to opinion and its change over time.
SME/industry 6		Smart phone based data collection, Smart phone based access to CO data, weather data, river level, market prices, etc., Narrow casting of CO data on flat screens at key locations, Website development of CO platform, Open data based hosting of GIS data Mapathon
NGO 1		
NGO 2		Combination of data services (training, support) and data solutions on data collection, -analyses, -visualisation and online data sharing
NGO 3	Improved weather forecasts with citizens' input (which will lead to trust and use of information) could lead to up to 30% increment in production if all other factors of production are held constant and could also help reduce losses due to drought.	n/a

Figure 18 indicates that in 2016, the number of different revenue streams for the CO-related value propositions that were reported by the GT2.0 partners was very limited. In 2019, the number of different revenue streams was slightly higher (four revenue streams (2 partners), three revenue streams (2 partners), 2 revenue stream (3 partners), 1 revenue stream (3 partners) and none at all (3 partners)).

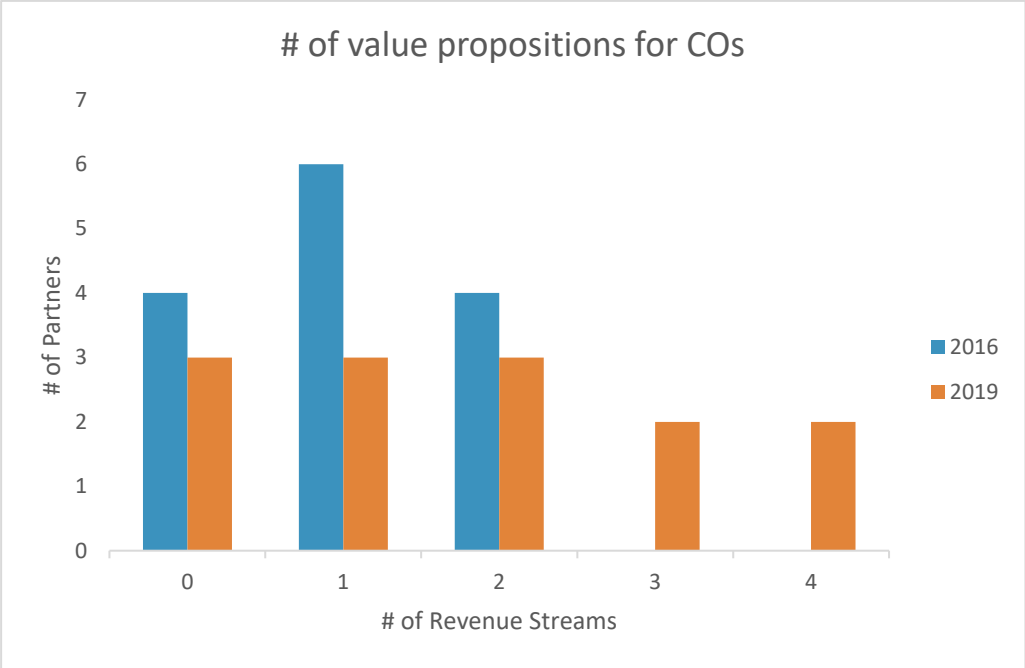

Figure 18. Number of revenue streams for the CO-related value propositions

The general market segments that the GT2.0 partners served in 2016 and 2019 (see Table 35) is very diverse and extends considerably beyond the customer segments that were served for COs alone (cf. Table 33). This held for all three GT2.0 partner categories (research/academia, SME/industry and NGO) in both 2016 and 2019.

Table 35. Market segments that GT2.0 partners served (n=13)

GT2.0 Partner ID	Market segment served in 2016	Market segment served in 2019
Research/academia 1	Mainly public agencies, also private, non-profit and research organisations	Mainly public agencies, also private foundations, research bodies, non-profit organizations
Research/academia 2	N/A	Public administrations (Foreign, federal, regional and cities) and private companies (focus on national industry including energy, chemistry and health sectors)
Research/academia 3	N/A	N/A
Research/academia 4	Public sector (local authorities)	Public sector (local and national authorities), NGOs, local communities
Research/academia 5	Academic institutions, community groups, applied research institutes and statutory bodies	Academic institutions, community groups, applied research institutes and statutory bodies
SME/industry 1	Governments, water boards and consultancies	Governments, water boards and consultancies
SME/industry 2	Our company provide services to key players in: Aerospace and Defence;	N/A

GT2.0 Partner ID	Market segment served in 2016	Market segment served in 2019
	Public Sector; Automotive, Infrastructure and Transport; Biotechnology, Pharmaceutical and Health; Energy and Industry; Rail; Financial Services; Telecom, Media and Services	
SME/industry 3	Water boards, municipalities, national government, international water authorities	Water managers at water boards, municipalities, national government in the Netherlands, Australia, South-Africa and Germany.
SME/industry 4	Supra national organizations, local public bodies and private sector	Agriculture, land management, urban environment, smart cities
SME/industry 5	market research, media analysis	Opinion research, market research
SME/industry 6	Research organisations, government, NGOs, private sector	Community, academia/research, government, private sector
NGO 1	N/A	N/A
NGO 2	Mainly international development projects	NGO's, Government, local authorities, private sector, knowledge institutes
NGO 3	Mining and Minerals, Agriculture (Farmers), Government and Education (Schools)	Water and Climate Segments

The respective networks of the GT2.0 partners in 2016 is captured in Figure 19 which indicates the number of partners each GT2.0 partner had for COs and the enabling technologies (excluding the GT2.0 partners). This shows that in 2016, the research/academia partners had wide-ranging networks (with up to 50 CO-related partners) compared to the SME/Industry and NGO partners in the consortium. In 2019, three of the partners in research/academia reported an increase in the number of partners for COs and enabling technologies, while two partners in academia/research reported a decrease. Nevertheless, in 2019 the GT2.0 partners in research/academia still had larger networks compared to the SME/Industry and NGO partners in the consortium.

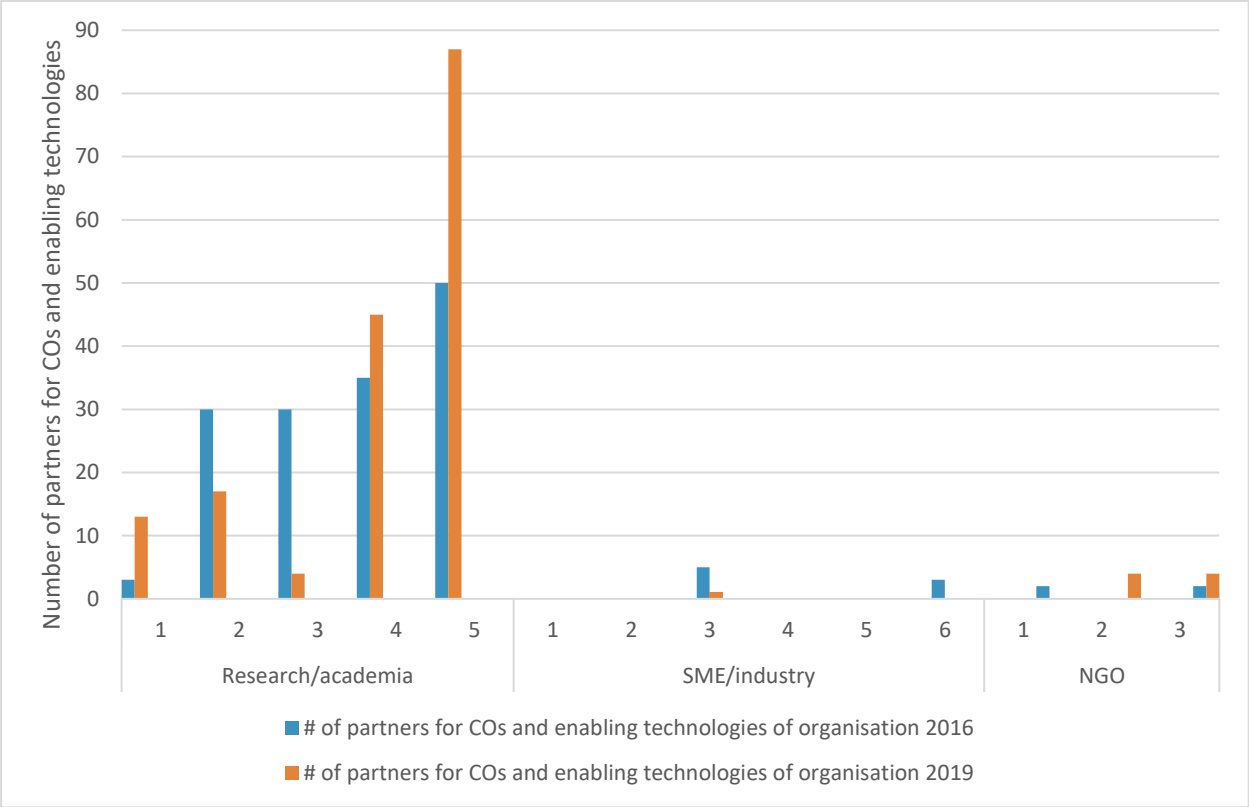

Figure 19. Number of partners for COs and enabling technologies (n=13)

9.2.5 Conclusions

To evaluate the economic impact of involvement in the Ground Truth 2.0 citizen observatories for the supply side of the COs, several dimensions had been considered such as company growth, international trade & investment capability, innovation & research capacity, and competitiveness of the Ground Truth 2.0 partners.

The results presented above have shown that these activities have been paralleled by company growth of the Ground Truth partners and by an overall increase in the number of international clients (with many customers in the public sector). In terms of innovation and research, the number of CO projects that each GT2.0 partner is involved in had increased between 2016 and 2019. While research/academic partners still hold the largest overall budgets for CO-related projects, SME/industry partners and NGOs reported an increase in budget allocated to CO-related projects.

In terms of competitiveness, the value propositions related to COs and enabling technologies now consist of knowledge-based, technology-based as well as service-oriented value propositions; the number of different revenue streams has increased slightly and the general market segments that the GT2.0 partners serve has remained very diverse. By the end of the project, the GT2.0 partners in research/academia still had larger networks for COs and enabling technologies compared to the SME/Industry and NGO partners in the consortium.

10 Validation of the Ground Truth 2.0 approach

As outlined in section 2.2, validation of the Ground Truth 2.0 Approach serves to assess both concepts and assumptions underlying the project interventions, and methods used during the co-design process. The Ground Truth 2.0 project defined Citizen Observatories broadly as "*a community of citizens, policy-makers and scientists using a IT platform and tools to support stakeholder participation and the collection, exchange and use of information and knowledge to improve decision-making on a shared issue"***.** The integral link to policy-related decision-making forms a defining feature of citizen observatories, as one specific form of citizen science. The character of a citizen science initiatives as a citizen observatory according to this concept is established by assessing the configuration of stakeholders involved, and the types of interaction facilitated with the help of the technical platform.

The validation assessment is conducted considering the three dimensions coherence (conformity of resulting DC COs with CO concept), effectiveness (contribution of GT method to bringing this result about) and efficiency (effort required to implement the method and which observed inputs can be avoided by improvements to the approach).

10.1 Coherence

The GT2.0 concept of a CO (Wehn, et al., 2015) is focused on strengthening the full feedback loop in the information chain from citizen-based data collection to knowledge sharing and cooperative planning. This concept requires involvement of three types of stakeholders - namely citizens, scientists and/or commercial data aggregators, and decision/policy makers (see D1.1 and Figure 20); a technical platform designed to support data collection, knowledge sharing and participation (see D2.1 and Figure 21; and certain categories of interactions between stakeholders (see D1.5 and Figure 22).

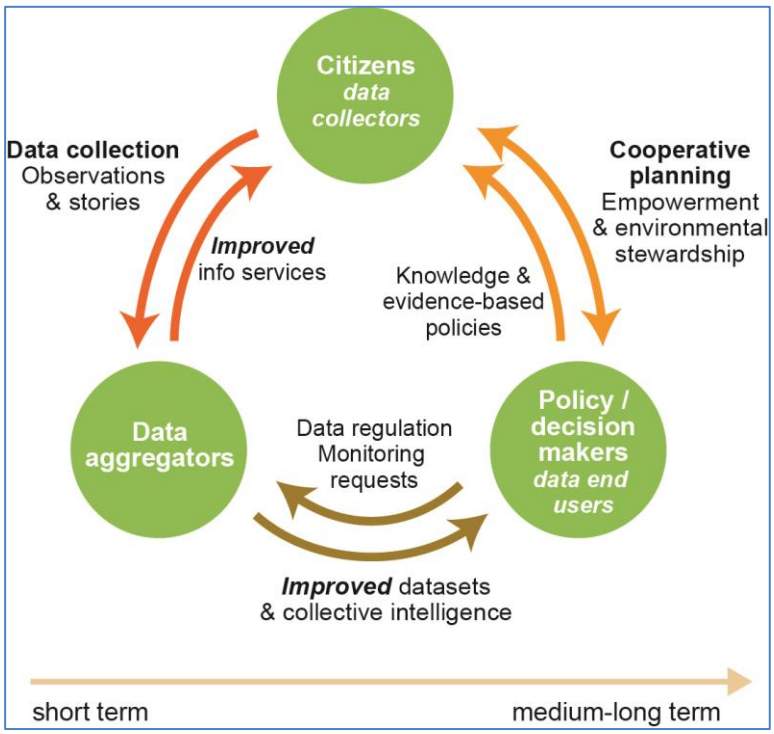

Figure 20 The GT2.0 Concept of Citizen Observatories - Stakeholder Groups

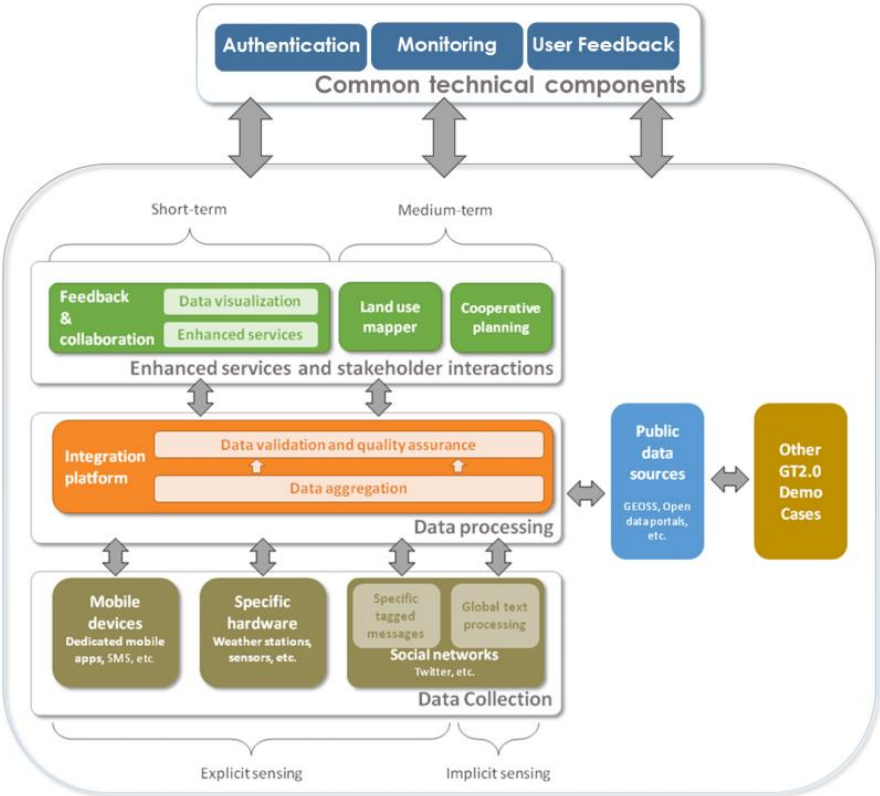

Figure 21 Concept of Citizen Observatories – Architecture of Global Components

With regard to stakeholder interactions, the project approach categorizes activities facilitated via a CO in terms of three major domains, Environmental Monitoring mainly focused on implicit and explicit data collection by citizens; Cooperative Planning including interactive activities between citizens and decision-makers such as consultation, feedback and discussion; and Environmental Stewardship with fully realized dialogues and shared responsibility for natural resource management.

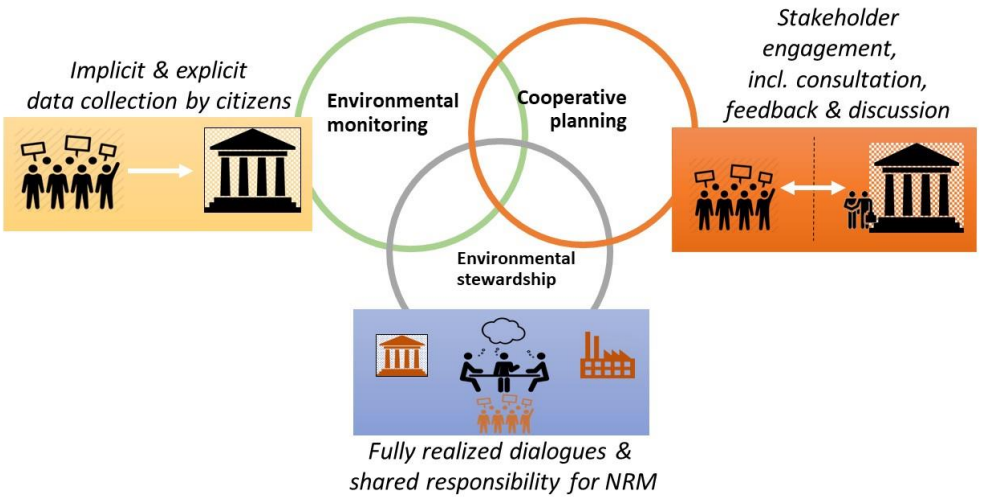

Figure 22 Concept of citizen observatories – Interaction Types

Table 36 summarizes the six COs delivered by the Ground Truth 2.0 project in terms of the characteristics of the GT2.0 CO concept. It shows that each CO a) consists of the required types of stakeholders for a citizen observatory, forming a community (with differing levels of maturity); b) involving a platform and tools for data collection, data processing and user feedback & collaboration; and c) is undertaking joint CO planning activities and data collection and linking to relevant policy and decision making processes.

Table 36 Summary of the Ground Truth 2.0 Citizen observatories

Characteristics	Belgian Demo Case Meet Mee Mechelen	Dutch Demo Case Grip op Water Altena	Spanish Demo Case RitmeN-atura.cat	Swedish Demo Case VattenFokus	Kenya Demo Case Maasai Mara CO	Zambia Demo Case
CO Thematic focus	Environmental quality of life related to air quality & noise	Local flooding	Local impacts of climate change	Deteriorating water health	Human-wildlife conflict	Natural resources management, human-wildlife conflict
Stakeholder composition and status of community building						
Top 10 stakeholders match concept	Yes	Yes	Yes	Yes	Yes	Yes
Maturity of CO Community achieved	Stable, incorporated in Klimaan	Small, ANV lead	Small, formalised	Small, dedicated	Critical mass but volatile	Small, formalized
Platform & Tools						
Data Collection	airQmap sensor (VITO), sensor apps (Akvo, Altran), implicit sensing (Gavagai)	Online surveys	RitmeNatura project on Natusfera	FWW Kit and App	Mara Collect app, TAHMO weather stations	Zambia Collect app, TAHMO weather stations
Data Processing	airQmap, Akvo Flow Tygron Engine Data quality module	HydroNet ESRI Story Maps	Natusfera, incl. expert validation Data quality module	FWW Servers, Tygron Engine Data quality module	Data combination in the cloud	tbd
User Feedback & Collaboration	Online platform	Online platform, Facebook	Online platform	Online platform	MMCO app, Online platform	Online platform, institutional mail accounts
Activities & interactions realized by CO community during project period						
CO activity planning	F2F (Working Groups)	F2F (owner driven), Whatsapp Group	Planning Group (MoU)	F2F (member driven)	F2F and WhatsApp Group	F2F and Whatsapp Group
Data collection	Seasonal campaigns	Online descriptive surveys	General public & school training sessions	Seasonal blitzes, long term data collection	Continuous observation, participatory mapping via mapathons	Roadshow tech testing
Data analysis	S/DAs	S/DAs	S/DAs	S/DAs	S/DAs	n.a.

Characteristics	Belgian Demo Case Meet Mee Mechelen	Dutch Demo Case Grip op Water Altena	Spanish Demo Case RitmeN-atura.cat	Swedish Demo Case VattenFokus	Kenya Demo Case Maasai Mara CO	Zambia Demo Case
Knowledge & information sharing	**F2F**	**via platform** Share tips & tricks on flood measures to take	**F2F/Platform**	**F2F**	**F2F**	**Via Platform**
Outreach beyond the CO	Public debates, outreach at public events	Outreach at public events	Public debates	Outreach at public events	Training of students	Community rights education campaigns
Participation in policy/decision making process(es)	Urban planning: monitoring, advocacy re. 'air quality zone' policy	Floor risk management: monitoring, knowledge sharing for resilience	Biodiversity and climate change adaptation: monitor local impacts of Climate Change	Water quality management: monitoring, advocacy of control of upstream activities	Biodiversity conservation & livelihood management: monitoring, incident reporting	Natural resources management: evidence-based advocacy
Type of Citizen Observatory						
Envisaged CO	Cooperative planning	Collaborative Planning	Environmental monitoring	Environmental Stewardship	Cooperative planning	Collaborative Planning
Achieved CO during GT2.0	Cooperative planning	Environmental monitoring	Environmental monitoring	Environmental monitoring	Environmental monitoring	[Collaborative Planning]

Legend

	On the way
	Built as intended
	Not realised

The table clarifies the status of progress of the COs according the three characteristics of the Ground Truth 2.0 concept (community; platform and tools; CO activities).Overall, it shows that the six emerging COs delivered by the project activities are coherent with the GT2.0 concept of Citizen Observatories. All six have a stakeholder configuration including the three main stakeholder groups interacting to improve natural resource management, and facilitate their interactions using a technical platform. The types of interactions, platforms and stakeholder configurations are assessed in more detail below.

Interaction Types

With regard to the type of interactions facilitated by observatories, all six COs remain in the conceptual space of the three 'domains' (See D1.5). This was confirmed both for the CO as the co-design group had envisaged it (focusing on environmental monitoring, cooperative planning or environmental stewardship) and for the actual COs that emerged at the end of the Ground Truth 2.0 project (December 2019). The results indicate that in two Demo Cases the emergent type matched the intended type of CO, namely Belgium (CO for cooperative planning) and Spain (CO for environmental monitoring). The Zambia Demo Case matched its vision of a CO for cooperative planning in terms of the CO's institutional embedding (arguably most important) but not yet in terms of platform and tools maturity. The remaining three cases the realized CO does not yet match the type of CO they had envisaged (COs for cooperative planning in the Dutch and Kenya Demo Cases, and a CO for environmental stewardship in Sweden), but in the Dutch

and Kenyan Demo Cases the environmental monitoring established can be considered a step on their way to achieving the envisaged CO in the medium term. In the Swedish Demo Case, the results so far imply that several key stakeholders, both citizens and decision-makers, remain skeptical toward genuine shared responsibility. Therefore, the explicit initial vision might not be achieved.

The detailed overview of interactions and activities presented in Table 36 also serves to illustrate that the each of the Ground Truth 2.0 citizen observatories has a distinct 'flavour'. For example, in terms of the nature of their data collection campaigns or the emphasis on knowledge sharing (in the Dutch Demo Case), observatories with similar conceptual characteristics still use very different forms of interactions and activities. Such differences reflect contextual factors revealed during the co-design process. As examples, the Belgian DC initially assumed limited space for civilian engagement in decision-making, but discovered a deep culture of organized civilian expertise involved in decision-making processes that the – less organized - CO could link to. The Zambian Demo Case reflects contradictions of a system that pays lip service to community empowerment, but hesitates to share information and tools that would allow communities to act autonomously. In the Spanish Demo Case, the political and policy landscape on climate change appeared well aligned and coherent, but collaboration in and through a CO is complicated by hidden rivalries 'behind the scenes'. The Swedish Demo Case seems unlikely to achieve the original vision of environmental stewardship, but this judgement could represent a misinterpretation of the initial vision as much as overconfidence of the co-design group. As social innovation, citizen observatories are emergent phenomena, consisting of perceptions and experiences (intrinsic knowledge) as much as of measurable facts. The Demo Case teams formulated a vision and objectives that represent a conscious plan matching accepted values. However, how stakeholders interpret the written word, what meanings they associate with the described actions, and what role the see for themselves and other stakeholders in the intended result, can differ significantly. In practice, the intended and emergent COs show characteristics of more than one domain (see Figure 23). Longer term observation will be required to assess if the COs move more firmly into one the conceptual domains as they evolve, or if certain mixed approaches represent additional, types of observatories.

Figure 23 Flavour of the six GT2.0 COs

Stakeholder Configuration

The updated stakeholder analysis (see D1.2) assessed the Top 10 stakeholder in each DC, as the stakeholders most crucial to the success of the observatory. The summary results show that the GT2.0 COs were developed in line with the overall conceptual stakeholder configuration. In all six DCs, the top 10 stakeholder groups include citizens, scientists and/or commercial data aggregators, and decision/policy makers (see Figure 24). Similar to the validation of the interactions facilitated by the CO, the configurations have slightly different 'flavours', with the Spanish DC driven by slightly more by civilian stakeholders, the Zambian case dominated by decision-makers because core citizen groups are institutionalized and thus identify as decision makers, and the Dutch and Swedish case showing a slightly more data or science-driven composition.

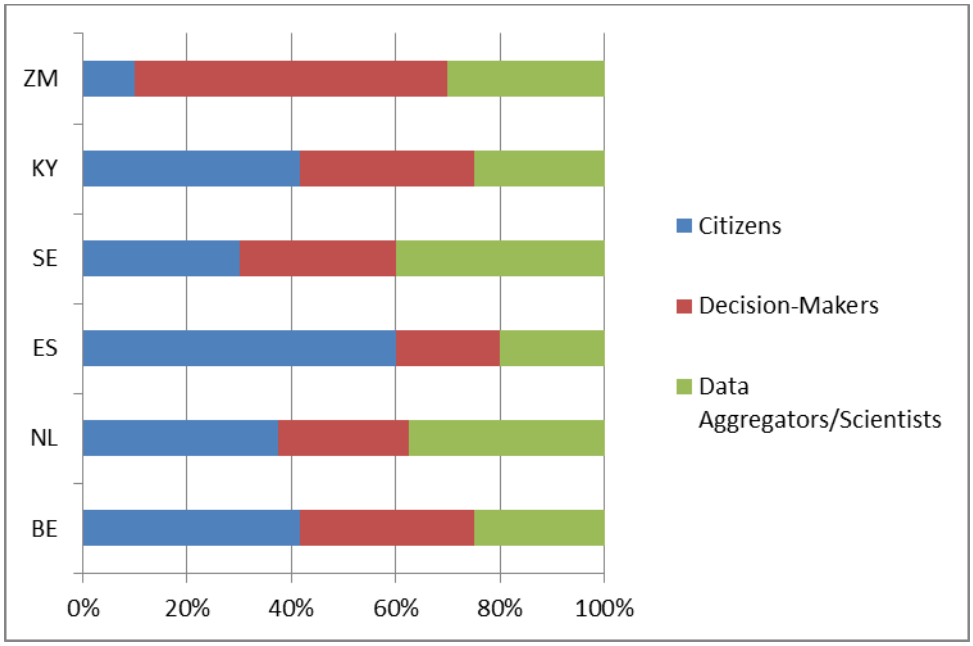

Figure 24 Stakeholder Configuration of the six Gt2.0 COs

Detailed analysis of the stakeholder landscapes in the six cases suggests that the conceptual stakeholder categories might benefit from a slight revision, with a number of key observations.

The civilian side of an observatory is limited to 'Citizens', hiding the crucial importance of the private sector for existing and potential CO communities, for example businesses dependent on local natural resources, major employers with outsizes influence on a local community, or 'corporate citizens' with strong CSR programmes. The decision-maker side of the observatory concept hides the crucial differences between administrations with permanent professional staff and legislative bodies with elected representatives. While citizen observatories as providers of localized information can be important tools for technocrats in administrative entities, and administrations can provide the stability needed for a sustainable observatory, changing policies and setting political agendas requires involvement of legislators. This was pointed out in analytical terms in the initial stakeholder analysis (see D1.1), but also empirically observed in the evolution of the DCs. Legislative actors became more involved in several cases over time, for example in the Belgian case or the Dutch Case (Water Board council). On the 'data' side, the case experience shows that there is a significant difference between involvement of scientists and commercial data aggregators. Finally, it was observed that the dynamic of a co-design process is influenced by the involvement

of an investor (from either stakeholder group). Analysis of the stakeholder configuration in a more granular way shows more nuanced differences between the six cases. Longer term assessment will be needed to clarify whether these types of stakeholder configuration merely shape the 'flavour' and practice of a CO, or if the sustainability and potential of a CO is affected by involvement of any of these groups, i.e. if they should be fully incorporated into the conceptual model.

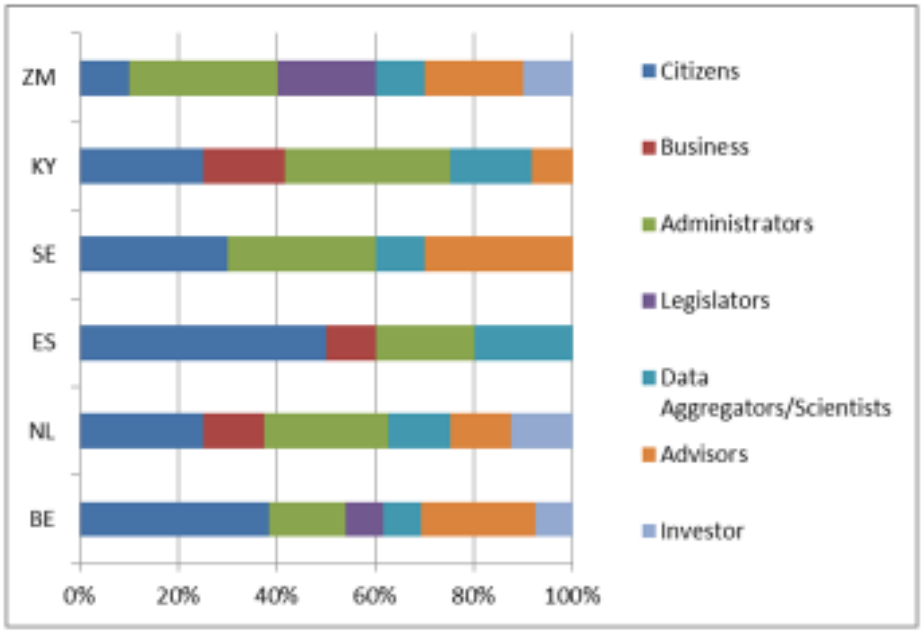

Figure 25 Stakeholder Configuration of the six Gt2.0 COs - refined stakeholder types

10.2 Effectiveness

The validation of the effectiveness of the Ground Truth 2.0 co-design approach examines the extent to which the GT2.0 approach was responsible for bringing the results about. This part of the validation process also served to identify a number of issues that can influence the effectiveness of the Ground Truth 2.0 co-design approach.

Table 37 presents the originally conceived steps of the GT2.0 co-design approach, and the contribution of the of the GT2.0 approach (per step) to the outcomes based on summarised experiences across the Demo Cases (for details see D1.9). Moreover, it indicates on recommended corrections per step.

Table 37 Evaluation of effectiveness of GT2.0 co-design approach (per step)

Steps in the GT2.0 co-design process	Demo Cases experiences: Contribution of GT2.0 approach to outcome	Implications for GT2.0 approach
Tailor methodology	Process planning needed and useful Roles of partners not yet clear, some questions (tools, criteria) cannot be chosen until objectives are co-designed	Tailoring methods to local context, competencies and setting is essential Split. initial (rapid) process planning and tailoring of methods in step one. Refine methods in a later step.
Baseline Analyses	Yields useful information but too elaborate, had to be revised in some cases after issue to addressed by the future CO were defined	Reduce to rapid context screening Initial step before process planning

Steps in the GT2.0 co-design process	Demo Cases experiences: Contribution of GT2.0 approach to outcome	Implications for GT2.0 approach
Initiate Co-design group and Interactive capture of user requirements	Methods of 'starting with a blank page' (but for a purpose: link to policy) and supporting development of demand-driven, agreed central (environmental) challenge, vision, mission and CO objectives found useful in all cases CO user stories: specific and participatory, generate great inventory of needs Too detailed in some aspects, can kill creativity Difficult to imagine unknown platform, and to differentiate between describing social and political changes and describing a platform function Users ignore technical and organizational 'stories' Incentives & barriers analysis generated useful insights for tailored engagement strategies	Keep blank page approach for developing agreement and focus on policy impact Provide generic set of user stories and activities supported by an observatory Integrate revised baseline analyses (original step 2) in interactive stakeholder activities and link to incentives & barriers analysis & engagement strategies
Review case architecture and technical requirements (functional design)	Not applicable in most cases due to project design (listed technical DC partners) Revealed relevant operational details in Zambian DC Translation of (highly diverse) user stories into (standardized) technical functions through generic 'headlines' effective, though initial set of headlines too complex Selection of tools against requirements raised sustainability implications early on (open source vs. partner tools with licenses)	Selection of technical tools & partners should be based on match between actual requirements identified during co-design with tool functionalities (to avoid push of 'solutions looking for a problem') Keep system of generic activity headlines to describe observatory functions match tools
Interactive validation of final user requirements and functional design	Validation of CO design using headlines was useful in most cases but too abstract for some stakeholders (especially citizens) The iterative interaction moments with the co-design groups helped verify if GT team interpretations of their requirements were correct	"Raw" user stories need to be reviewed by design team before validation (e.g. exclusion of stories without connection to using a technical platform)
Technical development and interactive design of political processes	Need to balance use of selected standard components with responsiveness to user requirements, has implications if there is need for customization, integration of multiple tools or custom developments Prioritisation of requirements to be implemented first proved useful to get platforms up and running Many citizens not familiar with political processes and mechanisms of participation, created difficulties in linking use of a technical platform with intended political outcomes	Improve technical review of user stories (feasibility effort) Address potential resource implications of user driven platform design in recommendations Update and integrate methods supporting impact-oriented activity planning
Interactive design of interfaces	Mock ups and guided feedback capture found useful in all cases Language issues can create challenge (multiple languages in African countries, preferences for English vs local languages depending on age group) Need to check if preferences co-design group members are representative for future users	Keep mock-up session and guidance for feedback capture

Steps in the GT2.0 co-design process	Demo Cases experiences: Contribution of GT2.0 approach to outcome	Implications for GT2.0 approach
Public Launch CO	Engagement guidance on selection of launch opportunities and possible types of launch events proved useful in all cases	Keep careful selection of launch event and tailoring of launch activities to CO purpose
Plan community mobilization and CO activities	Community organization central aspect of a successful CO, but underestimated in several DCs. Guidance useful, but needs continued engagement activities. Reverse Objectives journey proved useful to identify, prioritise and keep focus on the activities to achieve CO objectives	Keep community building guidance, stakeholder engagement matrix, and Reverse Objectives Journey Update role and highlight relevance of community organizer in guidelines, and keep visible with planning as distinct step.
Implement CO activities with community	Guidance on handover of CO to CO community deemed useful in all cases ('Demo Case leads work themselves out of a job'), though mixed results implementing it Challenge of generating sufficient organised activities, self-organised action and use of the platform and tools. Users expect frequent feedback, some DC teams overestimated potential of self-organized action	Setting up community organizers part of initial stakeholder engagement planning. Requires more follow up throughout the co-design process to 'groom' CO organizational team among local stakeholders.
Enhance CO platform	Enhancement of platforms mainly implemented additional functions based on user requirements. Due to differing speeds in Demo Cases, no standardized approach to guide collection of feedback from initial use of platform	Include guidance on updating the platform based on case experiences.
Develop model for long-term operation and growth of CO	Sustainability planning integrated into method from the start, non-profit business models and exploitation strategies proposed Embeddingof CO into existing institutional structure successful and helpful for long-term operation 'Organized citizens' & mid-level authorities strongest stakeholders for long-term continuity	Keep sustainability aspect prominent in guidelines, needs to be closely tied to incentives & barriers analysis and engagement. Update guidance on preparing handover of CO to local stakeholder group

The Demo Case experience documented in D1.9 and summary valuation presented in Table 37 indicates that, overall, the instructions of the Ground Truth 2.0 co-design approach per step were consistently applied in the Demo Cases and that they were helpful in bringing the results about (step by step). It indicates that the large majority of the instructions/methods in the distinct steps were readily applicable and appropriate. Demo Case teams reported that the process of interaction moments with a structured evolution of the discussion was a useful, and facilitated a social learning process on all sides.

Overall, the iterative nature of the approach left room for necessary adjustments on a case-by-case basis. The parallel application of the approach in six Demo Cases in distinctly different geographic, cultural and political settings highlighted that the pace of each DC was quite different. The type and extent of engagement activities between formal Interaction Moments, needed to maintain meaningful participation of specific stakeholder groups in the process, emerged as a core mechanism to adapt the method to different contexts and as one factor affecting the pacing. Examples are the reported need to 'woo' organized groups and authorities in Sweden, or the need for village roadshows and preparatory workshops with participating groups in Zambia. This also presented a challenges for the management of the project, with the need

to support Demo Cases at their speed and ensure that the methodology is consistently applied while keeping the overall project progress coherent. Nevertheless, it served to demonstrate the strength of the Ground Truth 2.0 co-design approach to deal with such diverse settings and deliver results in each.

Tools provided to the DC teams to screen for stakeholder to engage and 'formulas' helping with the selection of appropriate engagement strategies were considered useful guidance. On the technical side, the GT2.0 functional design approach helped to translate highly diverse real world "user stories" into customized versions of observatories based on standardized and tested tools. Conducting in-depth assessments on incentives and barriers, as well as and on impacts in parallel to the process revealed valuable information for the engagement process, supporting the development of comprehensive sustainability models.

With regard to user requirements, the GT2.0 Demo Cases delivered between 42% and 75% of the functionality required by users, as captured in user stories (see Table 38, for a detailed overview, see D1.9). Overall, this implies that the approach was successful in delivering tailored platforms as requested by the CO community.

Table 38 Delivery on user stories per GT2.0 DC

Demo Case	Number of User Stories	User stories delivered by CO	Function can be delivered with standard tool	Function requires additional tool	Function requires custom development	Function became obsolete as users learned in co-design
Belgium	69	35	35	3	0	32
Netherlands	85	48	69	7	3	32
Spain	85	48	37	9	20	8
Sweden	41	31	27	4	5	5
Kenya	85	57	56	12	1	13
Zambia	79	33	27	14	22	15

More detailed analysis of the technical effort required to deliver a required function, and identification of functions users no longer required at the end of the process, reveal additional insights regarding the GT2.0 concept and approach (see Figure 26). Two Demo Cases, Kenya and Sweden, delivered the majority of requested functions with the standard tools used as enabling technology in the case. Only a small number of user stories turned out to be too technically complex, or were abandoned as users improved their understanding of the issue. In the Netherlands and Belgium and Belgium, only around half of the user stories were delivered, but almost all of the undelivered functions were rated "obsolete" by the end of the project. These cases most strongly illustrate the social learning taking place during a co-design process with multiple interaction moments. The result implies that at the time user stories were written, stakeholders either had little clarity what kind of activities are needed to effectively address their core issue (e.g. data already available, political procedure), or what kind of activities can be facilitated by a platform. As they became more familiar with the issue, or the notion of a 'platform', stories become obsolete. The final scenario, in Zambia and Spain, shows a large number of functions not delivered because delivery

would have required the integration of additional tools or custom development of functionality. This finding implies that customized standard tools are not always sufficient for the delivery of a CO. In the Zambian case, the result is directly linked to the intended large-scale institutional function of the CO, which goes beyond the scope of projects many current citizen science tools were developed for.

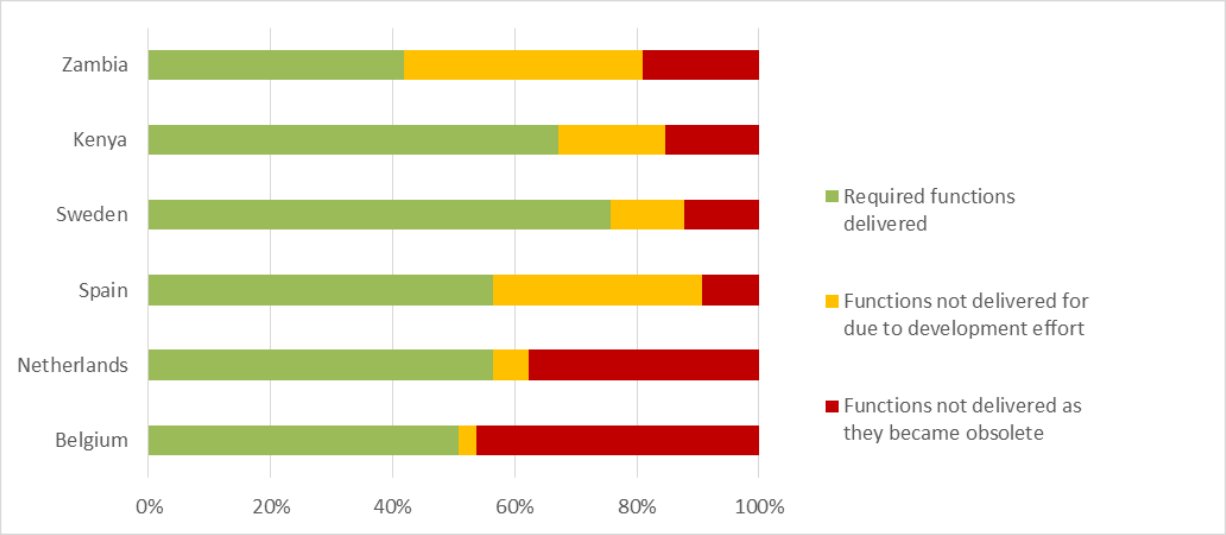

Figure 26 Delivery on User requirments and main resons for non-delivery

At the same time, the experimental process in the project also revealed room for improvement (see "Implications for process" in Table 37). In most Demo Cases, the concept of a citizen observatory was not known and the notion of a "platform" was too abstract for most stakeholders which meant that it was unclear and difficult to grasp what it is they were co-designing. Since it took some time for the respective COs to materialize, they were ambiguous for some stakeholders. This also has practical implications for the design output, as stakeholders might overlook required fucntions needed for the coordination and moderation of community activities. Fortunately, given the experience and existence of the Ground Truth 2.0 citizen observatories, future CO co-design efforts can draw on these examples of COs in each step of the process. Some of the tools, such as the stakeholder analysis and functional design, required too much information too early, and too little in later stages of the process. The implied adjustments to the approach will be presented in D1.13.

Several DCs made significant changes compared to the planning at the proposal stage. Sweden and Belgium originally planned to work with two communities each, one urban and one rural. The Dutch case reduced the target area from a water board jurisdiction to the municipal level. Analysis of the changes contained relevant lessons the co-design approach[8]. In the Belgium case, the plan to develop an observatory in a more rural community was dropped. The DC team felt that in terms of motivations and coherence of the community, the rural site was very well suited for a CO, maybe even better than the urban site, but the smaller municipal authority felt it did not have the capacity and resources to engage in a co-design process. This raises the general question if there are conflicts between the demands of the co-design process and the value of a CO for a specific community. Ideally, it should be possible to initiate the development of a CO in any context where it generates value. The co-design process should ensure this value is realized, not determine if the initiative can be taken forward.

[8] Some adjustments were made based on time and resource limitations of the DC teams. These reasons are not further discussed here, as they are specific to the GT2.0 project, and are not relevant from a general methodical point of view.

10.3 Efficiency

In the validation of the efficiency of the Ground Truth 2.0 co-design approach, we summarise the outcomes that have been generated already during the project life time (based on the detailed impact assessment per Demo Case) and then consider which of the observed inputs can be avoided by improvements to the approach by future applications of the Ground Truth 2.0 approach.

Table Table 39 summarises the assessment of realised social and institutional changes detailed in the Demo Case analyses (Sections 3-8). Note: the Zambia Demo Case is not included in this table since the corresponding analyses differed from the other cases, owing to the Zambia case not being fully operational at the time of this research.

Overall, Table 37 indicates that considerable progress has been made in each of the six Demo Cases during the relatively short time (3 years) of the project, albeit to differing degrees, with achieving the respective social and institutional outcomes that are necessary in each case to, eventually, attain the envisaged environmental impacts. The most notable institutional changes have materialised in the participation dimension, with shifts towards preferred communication channels between citizens and authorities materialising (substantial changes in the Dutch, Spanish, Swedish and Kenyan Demo Cases); moderate changes in how participants interact with public discussions and decisions, along with improved support for participation and slight changes in the efforts required to participate. In all cases, access to and control over data have improved slightly, along with slight changes in the authority of different stakeholders (notably citizens) in decision making processes.

The observatories have triggered moderate social changes in terms of improving dependable information for citizens, especially in terms of fostering shared stories (community members' shared understandings of reality) which contribute to a sense of place and connectedness related to the thematic focus of the respective observatory, and in terms of the improving the availability of timely and accurate information. Trusted sources of information for the environmental issues of concern in each observatory have improved, with the most substantial change in the Belgian Demo Cases where the data collection efforts have resulted in scientific support for the concerns that people had about air quality. Skills and competencies of the stakeholders involved in the observatories have improved in terms of working together and the ability to learn as a community, including from the past. In this respect, the Kenya Demo Case presents the strongest change, where the different parties involved went from not being explicitly interested in working together to acknowledging their mutual interest and harmonious group interactions. The level of trust between community members and their willingness to understand each other's points of view was strengthened in a number of Demo Cases, most strongly in the Dutch Demo Case where residents feel strong attachment to place and the direct communication created via the observatory between regional / local authorities and civic society was highly valued.

Turning to the inputs used to bring these changes about and which of these could be avoided, we consider the financial costs as well as efforts during the co-design process, the accompanying engagement activities as well as the research efforts for the incentives and barriers analysis and the impact assessment.

Table 39 Assessment of realised social and institutional changes (per Demo Case)

Relevant aspect	Belgian Demo Case Meet Mee Mechelen	Dutch Demo Case Grip op Water Altena	Spanish Demo Case RitmeNatura.cat	Swedish Demo Case VattenFokus	Kenya Demo Case Maasai Mara CO
Dependable Information					
Shared stories					
Trusted sources		n.a.			
Timely & accurate info					
Skills and Competences					
Working together					
Creativity & flexibility	n.a.	n.a.	n.a.	n.a.	n.a.
Ability to learn					
Internet savviness			n.a.		n.a.
Social Capital					
Formal engagement			n.a.		
Trust and belonging				n.a.	
Helping behaviour				n.a.	n.a.
Distribution of risks					
Distribution of resources	n.a.	n.a.	n.a.	n.a.	n.a.
Digital divide	n.a.		n.a.	n.a.	n.a.
Distrib. of adverse effects	n.a.		n.a.	n.a.	
Participation dimension					
Geographic scope	n.a.	n.a.	n.a.	n.a.	n.a.
Participant groups					
Efforts to participate					
Support for participation					
Comms. paradigm					
Comm. & decision mode					
Power dynamics					
Data access/ control					
Authority and power					

Legend

	Slight change realised
	Moderate change realised
	Substantial change realised
	Not at all realised
n.a.	No change was expected

As the detailed economic analysis in section 9.1. had presented, the economic costs of setting up the Ground Truth 2.0 citizen observatories (staff time, equipment and out of pocket costs for co-design sessions, measurement campaigns and other meetings) ranged between Euro 280k to 420k. This calculation does not include the efforts of developing the Ground Truth 2.0 co-design methodology itself. Given that the methodology now exists and is readily available (in D1.13), any subsequent application - especially by the Ground Truth 2.0 partners who have gained valuable tacit knowledge on how to apply it – can be expected to be more resource efficient. Moreover, the experience and competencies of facilitator, analysts, developers, etc. is a key factor that can influence the cost efficiency of the co-design process of distinct observatories. Another factor influencing the cost pertains to the geographic and socio-economic setting of the Demo Cases: in the African case, vast distances had to be travelled; moreover, local stakeholders in Kenya typically received a daily subsistence allowance as well as transport cost refunds to enable their participation in F2F events.

Table 40 Summary of co-design process indicators (per Demo Case)

Demo Case	Co-design process indicators
Belgium	8 co-design sessions and meetings (incl. some bilateral/split groups), 18 working group meetings (monthly - 9 x air quality and 9 x noise pollution), 4 planning/discussion meetings, 5 bilateral meetings, 2 public discussion evenings on noise, GTW event.
Netherlands	5 co-design sessions 10 planning meetings 9 bi-lateral meetings
Spain	5 co-design sessions 1 workshop
Sweden	3 co-design sessions 3 further stakeholder meetings to present tools, website, and gather stakeholder feedback and engagement of local citizens.
Kenya	5 co-design sessions 1 Training
Zambia	5 co-design sessions (4 in pilot area, 1 national) with >100 stakeholders 12 preparatory and special planning sessions (VAGs, CRB, Rangers, Technical staff, internal stakeholders) 1 high-level workshop and >20 briefings/presentations to decision-makers committees and authorities 2 roadshows with 17 village meetings in 13 communities with > 800 participants

As indicated by the co-design process indicators for the Demo Cases in Table 40, the intensity of the co-design process varied across the different Demo Cases. The Interaction Moments had emerged as a key modality in terms of the effectiveness of the Ground Truth 2.0 co-design approach (see section 10.2) and ranged across the Demo Cases in terms of frequency (from 3 to 8 co-design sessions and with up to 27 planning and bilateral meetings). Based on the experiences of the cases, a reduction in the number of the events is not generally recommendable, however. For example, the Belgian Demo Case held a large number of Interaction Moments because the initial sessions had to be held with separate stakeholder groups at times that were convenient to the respective groups (citizens outside working hours; authorities during working hours). Given the particular geographical and institutional setting in the Zambia Demo Case, a large number of preparatory and special planning sessions was required with key stakeholder groups and entire village communities.

In terms of content, the Interaction Moments could be made more efficient in subsequent applications of the Ground Truth 2.0 approach based on the future codification of the developed methods (e.g. illustrated, appealing ready to use User Story cards for distinct stakeholders; CO activity planning; monitoring & evaluation against CO objectives; blueprint for CO sustainability plans).

The efforts related to the initial and updated stakeholder analyses can be rendered more efficient by the conceptual change towards an initial rapid screening (during step 2) and the subsequent integration of a follow up analyses in interactive stakeholder activities and direct links to the incentives and barriers analysis as well as the engagement strategies (during step 3). Moreover, the data collection for the baseline and follow up measurements of the incentives and barriers for participation as well as the impact assessment proved too resource intensive. These would benefit from more innovative and less resource intensive data collection methods – such as data collection by the CO themselves – during the interaction moments and via communication channels established with the CO co-design groups and members during the course of setting up the CO.

Overall, the stakeholder engagement efforts has been the most resource intensive aspect for most of the Demo Cases. In this respect, it is important to stress that the Ground Truth 2.0 co-design approach is based on the realisation that a sustainable CO relies not only on the involvement of all relevant stakeholders but on the formation of an evolving, stable *community* of stakeholders who jointly define and pursue the agreed purpose of their citizen observatory. The experience of the Demo Cases suggests that the much of the stakeholder engagement effort still has to be done via face-to-face interactions rather than being predominantly mediated via ICT-based channels and even the CO platforms themselves, although it is noteworthy that out of the three Demo Cases that are using WhatsApp groups for some CO activity planning, two are the African Demo Cases (the third one being the Dutch Demo Case). Moreover, a key input would consist of professionals experienced in 'grooming' community leaders in volunteer efforts, in order to support the initial formation of the respective CO community and help it transition to sustainability beyond the initially funded period of existence.

Overall, the implementation of the measures indicated above in combination with use of the guidelines for the Ground Truth 2.0 co-design methodology (detailed in D1.13) can be expected to result in considerable efficiency gains.

11 Conclusions

The Ground Truth 2.0 project aimed to demonstrate that sustainable Citizen Observatories are possible. This was done using the innovative approach of combining the social dimensions of citizen observatories with enabling technologies, so that the implementation of the respective citizen observatories in six Demo Cases is tailored to their envisaged societal and economic benefits. This report presented the final impact analysis of the six citizen observatories in the Ground Truth 2.0 Demonstration Cases at the end of the life time of the Ground Truth 2.0 project, the validation of each Demo Case as well as the overall validation of the Ground Truth 2.0 approach.

Here we present concluding remarks on the impact analysis of the Demo Cases and on the results of the validation of the overall Ground Truth 2.0 approach.

11.1 Conclusions on the Impact analysis

Social, institutional and environmental impacts

In the context of this report, environmental impacts refer to changes in the specific natural resource(s) quality or quantity that the respective GT2.0 citizen observatories focus on. Such environmental changes cannot be expected to come about by the mere existence of a citizen observatory; rather, they are reliant on social and institutional changes, i.e. changes in individual and collective behaviour and changes in policy and/or procedures related to managing the respective natural resource(s). The impact assessment therefore focused on examining the extent to which progress towards triggering the necessary institutional and social changes, including via the respective citizen observatories, had been made.

The analysis of the social and institutional changes captured in each Demo Case (Sections 3-8) shows that considerable progress has been made in each of the six Demo Cases, albeit to differing degrees, with achieving the respective social and institutional outcomes that are necessary in each case in order to, eventually, attain the envisaged environmental impacts. The most notable institutional changes have materialised in the participation dimension, with shifts towards preferred communication channels between citizens and authorities materialising (substantial changes in the Dutch, Spanish, Swedish and Kenyan Demo Cases); moderate changes in how participants interact with public discussions and decisions, along with improved support for participation and slight changes in the efforts required to participate. In all cases, access to and control over data have improved slightly, along with slight changes in the authority of different stakeholders (notably citizens) in decision making processes.

The observatories have triggered moderate social changes in terms of improving dependable information for citizens, especially in terms of fostering shared stories (community members' shared understandings of reality) which contribute to a sense of place and connectedness related to the thematic focus of the respective observatory, and in terms of the improving the availability of timely and accurate information. Trusted sources of information for the environmental issues of concern in each observatory have improved, with the most substantial change in the Belgian Demo Cases where the data collection efforts have resulted in scientific support for the concerns that people had about air quality. Skills and competencies of the stakeholders involved in the observatories have improved in terms of working together and the ability to learn as a community, including from the past. In this regard, the Kenya Demo Case presents the strongest change, where the different parties involved went from not being explicitly interested in working together to acknowledging their mutual interest and harmonious group interactions. The level of trust between community members and their willingness to understand each other's points of view was strengthened in a number of Demo Cases, most strongly in the Dutch Demo Case where residents feel

strong attachment to place and the direct communication created via the observatory between regional / local authorities and civic society was highly valued.

The analyses show that the extent to which the respective citizen observatories have contributed to changes in individual and collective behaviour and changes in policy and/or procedures related to managing the respective natural resource(s) are highly case-specific. They have highlighted that the required policy-related changes can range from demanding entirely new policies, to clarifying the many links of the CO issue in the policy landscape, to demanding additional plans or guidelines to ensure sound implementation of existing policy, to physically enabling participation mechanisms prescribed in laws but prevented by poverty. Similarly, the COs are a means to create awareness of, support for and compliance with the implementation of (new) policies related to the respective environmental challenges addressed by the COs. The results indicate how the adoption of new technologies related to the COs enable changes in institutional practice (providing means for monitoring, compliance, enforcement) as well as in individual and collective behaviour by paying attention to things not previously noticed, changing damaging practices, and participating in actions.

Economic impacts of CO data for in-situ networks (demand side)

The analysis presented in Section 9.1 showed that setting up a CO for the sole purpose of data collection is an expensive undertaking, for the demand side of COs (e.g. for public sector organizations benefitting from a given CO) that may not necessarily complement the existing in-situ monitoring network. The impact of a CO can be better attributed to the social and institutional (and eventually environmental) aspects

Economic impacts for the supply side of COs

The analysis presented in Section 9.2 captured the economic impacts for the supply side of COs (i.e. the GT2.0 partners). This showed that the implementation of the GT2.0 Demo Case observatories and the project at large have been paralleled by company growth of the Ground Truth partners and by an overall increase in the number of international clients (with many customers in the public sector). In terms of innovation and research, the number of CO projects that each GT2.0 partner is involved in had increased between 2016 and 2019. While research/academic partners still hold the largest overall budgets for CO-related projects, SME/industry partners and NGOs reported an increase in budget allocated to CO-related projects. In terms of competitiveness, the value propositions related to COs and enabling technologies now consist of knowledge-based, technology-based as well as service-oriented value propositions; the number of different revenue streams has increased slightly and the general market segments that the GT2.0 partners serve has remained very diverse. By the end of the project, the GT2.0 partners in research/academia still had larger networks for COs and enabling technologies compared to the SME/Industry and NGO partners in the consortium.

11.2 Conclusions on the validation

Validation of the Ground Truth 2.O Outcome

The validation has shown that Ground Truth 2.0 has achieved the first of project's seven objectives, namely the delivery of six citizen observatories in real operational conditions. Judged against the characteristics of the GT2.0 CO concept, each Ground Truth 2.0 citizen observatory a) consists of the required types of stakeholders for a citizen observatory, forming a community (with differing levels of maturity); b) has the platforms and tools for data collection, data processing and user feedback & collaboration; and c) is undertaking joint CO planning activities and data collection and linking to relevant policy and decision making processes.

Each Ground Truth 2.0 citizen observatory has its own 'flavour' in terms of the emphasis placed in one of three major domains of the Ground Truth concept: *Environmental Monitoring* - mainly focused on implicit and explicit data collection by citizens; *Cooperative Planning* - including interactive activities between citizens and decision-makers such as consultation, feedback and discussion; and *Environmental Stewardship* - with fully realized dialogues and shared responsibility for natural resource management.

The results indicate that two Demo Cases achieved the intended type of CO, namely Belgium (CO for cooperative planning) and Spain (CO for environmental monitoring). The Zambia Demo Case has achieved its goal of a CO for cooperative planning in terms of the CO's institutional embedding (arguably most important) but not yet in terms of platform and tools maturity. The remaining three cases have not yet achieved the type of CO they had envisaged (COs for cooperative planning in the Dutch and Kenya Demo Cases, and a CO for environmental stewardship in Sweden), but two of them can be considered on their way to achieving the envisaged CO. The Swedish Demo Case seems unlikely to achieve the original vision of environmental stewardship, but this judgement could represent a misinterpretation of the initial vision as much as overconfidence of the co-design group. As social innovation, citizen observatories are emergent phenomena, consisting of perceptions and experiences (intrinsic knowledge) as much as of measurable facts. The Demo Case teams formulated a vision and objectives that represent a conscious plan matching accepted values. However, how stakeholder interpret the written word, what meanings they associate with the described actions, and what role the see for themselves and other stakeholders in the intended result, can differ significantly. Future research might evolve the assessment methods to capture intrinsic elements of stakeholder intentions revealed in choices of platform functionality.

Moreover, considering the relatively short time (3 years) of the project, considerable progress has been made in each of the six Demo Cases with achieving the respective social and institutional outcomes that are necessary in each case in order to, eventually, attain the envisaged environmental impacts.

Validation of the GT2.0 Concept

The validation of the six COs delivered by the Ground Truth 2.0 project in conceptual terms showed them to be coherent with the GT2.0 concept of citizen observatories. All six have a stakeholder configuration including the three main stakeholder groups interacting to improve natural resource management, and facilitate their interactions using a technical platform. The assessment also supports the use of the three aspects (stakeholders, platform, interactions) to conceptualize citizen observatories, though the project experience refined the understanding of the three aspects, for example with regard to the stakeholder groups involved. Most visibly, the validation of interactions and activities illustrated that citizen observatories have distinct 'flavours', for example in terms of the nature of their data collection campaigns or institutional embedding. Observatories with similar conceptual characteristics still use very different forms of interactions and activities. Longer term observation will be required to assess if the COs move more firmly into one the conceptual domains as they evolve, or if certain mixed approaches represent additional, types of observatories.

Validation of the GT2.0 Co-Design Approach

The validation of the effectiveness of the Ground Truth 2.0 approach examined the extent to which the GT2.0 approach was responsible for bringing the above results about. Overall, the validation the Ground Truth 2.0 co-design approach indicates that the steps and the instructions were helpful, and that the tools developed and provided to the demo cases provided valuable guidance. the DCs delivered between 42 and 75% of the functions described by users. The majority of undelivered functions were either too technically complex to be developed with the resources of the project, or recognized as obsolete as users learned.

Using a generic sequence of steps in a structured process with room for iterations, and including structures interaction moments with the stakeholders facilitated a social learning process on all sides. The iterative nature of the approach left room for necessary adjustments on a case-by-case basis, and led to distinctly different implementations reflecting the geographic, cultural and political settings, and at the pace each DC required. The validation also resulted in a number of incremental adjustments for some steps that are incorporated in the final version of the Ground Truth 2.0 co-design approach (reported in D1.13). As a central aspect, the co-design and participatory nature of the approach can ensure that all relevant stakeholders are involved.

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Annexes

Annex 1 Detailed institutional impact assessment

The data collection for the institutional impact assessment resulted in lengthy results that are presented below for each Demo Case.

A1.1 Belgium Demo Case

Section 3.2 and Annex 2 of D1.11 provided an overview of the baseline situation of the GT2.0 Belgium Demo Case. In order to examine the institutional impacts of Meet Mee Mechelen achieved towards the end of 2019, nine in-depth interviews were conducted with eight active participants of the co-design group and the Demo Case lead of this GT2.0 Demo Case. The members of Meet Mee Mechelen who participated in the interviews included citizens, representatives of the city of Mechelen, Stedelijk Milieuraad, and members of environmental NGO such as Leefmilieugroep Mechelen-Zuid, Fietsersbond Mechelen, Natuurpunt, Fietsersbond and Klimaan. In order to analyse the (expected) changes, the results of these interviews where compared against the baseline situation in this case and are elaborated according to the conceptual framework for analysis institutional impacts of COs presented in D1.10.

Participation

Geographic scope

As described in the baseline analysis of this Demo Case, Meet Mee Mechelen is located in Flanders; a densely populated area (close to 500 inhabitants /Km2) in Belgium. Almost 20% of its surface area in Flanders is built-up environment. This has degraded the environmental quality of life for the Flemish citizens especially in urban areas. Meet Mee Mechelen focuses on the issue of environmental quality of life in the City of Mechelen that is an urban area with a population of 86304[9] in the Province of Antwerp. This city is located between Brussels and Antwerp; two other major urban and industrial cities in Belgium. More specifically, the Meet Mee Mechelen focuses on the air quality and noise pollution aspects of the environmental quality of life in Mechelen. Environmental quality of life related to air quality and level of noise is a dynamically changing issue in urban environments that need to be studied at the local level. As a part of the activities of Meet Mee Mechelen, four air quality measurement campaigns were organized, during which 50 volunteers measured the soot concentrations in Mechelen. Each campaign lasted two weeks, during which the soot concentrations was measured in the morning and evening rush hours along pre-defined cycle paths. Overall, these campaigns produced air quality data that covers a total distance of 2800 kilometres of cycle paths. The following figure provides an overview of the geographic coverage and timeframe of the four air quality campaigns in Meet Mee Mechelen.

[9] Source: https://www.wikidata.org/wiki/Q12480

Air quality campaigns in Meet Mee Mechelen

Participant groups

In the baseline analysis of this Demo Case, the Environment, Nature and Energy Department of the Flemish Government, City council of Mechelen, and the Flemish High Council for Spatial Planning and Environment (VHRM) were identified as the main organizations involved in making decisions regarding air quality and noise pollution in Mechelen. Moreover, nature associations, research organizations, and neighbourhood Committees were also identified as stakeholders who might be able to influence the decisions and policies regarding air quality/noise pollution in Mechelen.

A group of interested people, including representatives of the city administration and individual volunteers (mostly individual citizens and members on environmental NGOs) took part in the GT2.0 co-design process that resulted in designing the citizen observatory ‚Meet Mee Mechelen'. The composition of the participants in each co-design session was slightly different. In terms of age and gender distribution, although young people and females were occasionally present in the meetings, the majority of volunteers were senior male participants. Moreover, involving politicians (e.g. the city consular) proved to be difficult and this stakeholder group was not represented during the co-design process. Having said so, the tools and information produced in Meet Mee Mechelen are accessible to all interested individuals and organizations and based on the results of the interviews in this Demo Case, it is assumed that the end-users of Meet Mee Mechelen are much more diverse in terms of age and gender.

After the co-design phase, more participants joined the CO as other activities were initiated such as monitoring campaings and public outreach events. Mainly, individual citizens joined the CO during a later

phase and a few local neighbourhood organizations, including *Thuis in Nekkerspoel* and *Wijkraad Mechelen-Centrum*. Also, many volunteers for the monitoring campaigns joined by request of their fellow NGO members who joined MMM earlier.

Efforts required to participate in Meet Mee Mechelen

The efforts required to participate refers to the types of investments and requirements that are necessary for the participation of different stakeholder groups, e.g. the time or monetary investments required for their participation, or the need to gain expertise on a topic. For a citizen observatory to be able to function and produce results, its members need to be willing to invest these efforts. In case of Meet Mee Mechelen, the interviewees identified three main categories of efforts that they need to invest, in order to be able to participate in this initiative.

The first category relates to the time that people need to spend to participate, which highly depends on the intended extent of their involvement. Participation in collaborative meetings required time investment (approximately 2 hours per month); in order to participate in data collection campaigns, volunteers needed to invest time cycling through the pre-defined cycle paths at pre-defined times of the day.

Physical efforts required to participate in Meet Mee Mechelen are particularly salient for the data collection campaigns. Participants of the campaigns occasionally had to wake up earlier, cycle in cold weather, at slow speed (that did not allow them to get warm) and during rush hour when air pollution was problematic. In this regard, one of the interviewees mentioned "the first time was in November, which was really not pleasant because you could really smell the soot, and then you see the truck pull up next to you". Nevertheless, some participants found the physical effort that they needed to invest a positive aspect, because they enjoyed cycling and physical activities.

The third category of efforts relates to the required knowledge that participants have to gain in order to be able to participate. New people joining Meet Mee Mechelen did not know the history of the citizen observatory and did not know what had already happened. They needed some efforts to get up to date and this will also be the case for others joining the initiative in the future.

Support offered for participation in Meet Mee Mechelen

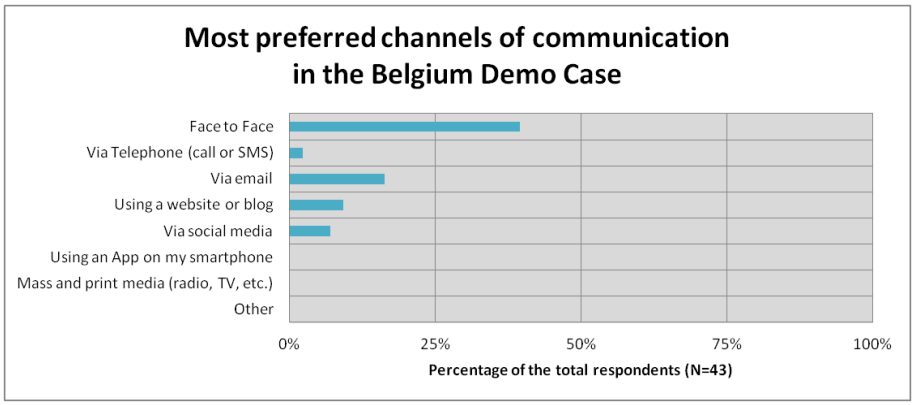
Organizational and technical support required for setting up Meet Mee Mechelen was provided by the GT2.0 project partners and many interviewees evaluated this very positively. Organizational support included scheduling, setting up, hosting and moderating the co-design meetings and inviting different stakeholders to participate in these meetings. Moreover, the GT2.0 team also supported the planning and implementation of data collection campaigns. Technical support and trainings were provided by GT2.0 partners for the participants in these campaigns and volunteers were provided with the air quality measurement sensors. In addition, a number of public information evenings were held with the support of the project team to promote the activities of Meet Mee Mechelen and to disseminate the results produced in this citizen observatory. Inviting air quality experts to these information evenings was evaluated positively by the interviewees.

Communication paradigm

During the baseline interviews in this Demo Case, the interviewees had been asked to indicate their preferred channels for communicating about air quality and/or noise pollution in Mechelen. This question was designed to help prioritize the preferred communication channels from the users' point of view. The

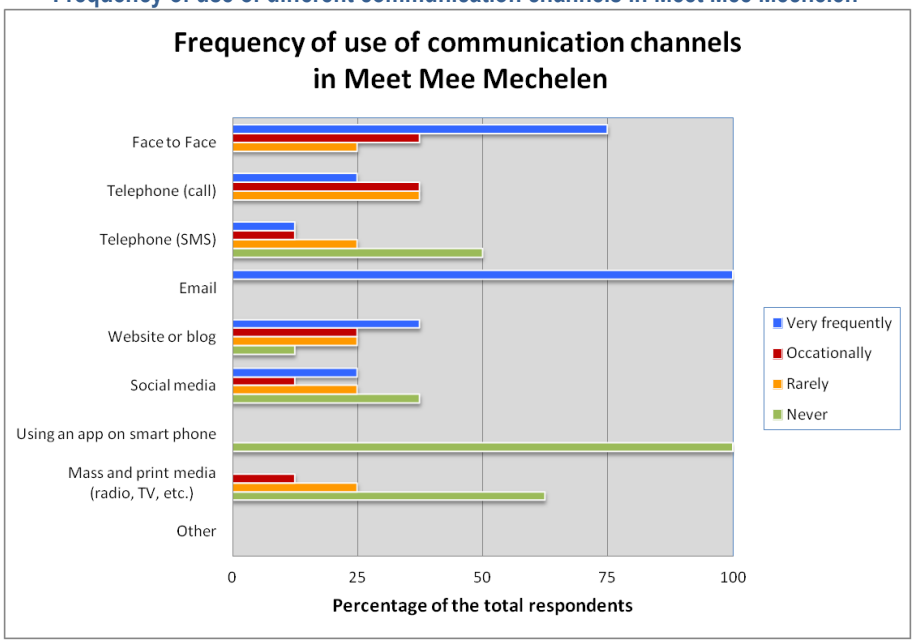
following bar chart summarizes the answer to this question. Based on this figure the most preferred channel of communication among the interviewees about air quality and/or noise pollution was face to face and communication emails.

Most preferred channels of communication in the Belgium Demo Case



The results of the impact assessment interviews show a good match between the preferred communication channels and the actual channels used for communication purposes in Meet Mee Mechelen. In practice, emails and face to face communication were the most frequently used communication channels by the members of Meet Mee Mechelen. Face to face communications mostly happened during the collaborative meetings and for discussing different issues and agreeing on the way forward. Members of Meet Mee Mechelen also met outside of the collaborative meetings (for example during the public information evenings) to disseminate the results of their activities and to recruit more members. Emails were used as the main channel for keeping the CO members informed about upcoming activities and sharing results or feedback from past events. Overall, visiting the website was not as frequent as the two aforementioned channels and it was mainly used for viewing measurements and maps or directing others to this information.

Frequency of use of different communication channels in Meet Mee Mechelen



Communication & decision mode

All interviewees indicated that Meet Mee Mechelen has provided them with new possibilities for communicating about air quality. They mentioned that through this initiative, they were able listen to discussions on the topic of air quality and noise pollution, discuss with others, express their preferences and develop preferences on how they think this issue needs to be monitored or managed at the city of Mechelen. Furthermore, some interviewees mentioned that via their participation in data collection campaigns, they have collected and shared air quality data that did not exist before. This data is shared with a wider public through various channels such as the website and public information evenings. In this regard, one interviewee mentioned that Meet Mee Mechelen has provided its members with opportunities to promote the results of the air quality measurement campaigns to the public and show that this topic is attracting attention. The same interviewee believed that because Meet Mee Mechelen is organized by a politically neutral organization (VITO), its results are more interesting for some people. Furthermore, some interviewees believed that because of Meet Mee Mechelen, citizens have gained more recognition and policy makers cannot easily ignore their demands. One of the interviewees framed this as "we are being talked about". Therefore, they believed that they are being taken more seriously, and because of this, they will have an indirect influence on decision-making processes regarding air quality in the city of Mechelen. Comparing these results with the communication and decision modes captured in the baseline situation of this Demo Case indicates that quite a number of new communication and participation possibilities have been created as a results of Meet Mee Mechelen.

Power Dynamics

Access to & control over data

Overall, the results of the impact assessment interviews for Meet Mee Mechelen show increased access to data and information for both, participants in this CO and others who have heard about its results via various channels e.g. the website, casual conversations with members of Meet Mee Mechelen, or information evenings.

Almost all interviewees mentioned that their awareness has been raised via their participation in Meet Mee Mechelen, they now use the results of the air quality campaigns and what they have learned in the process to open up conversation with others. A number of interviewees mentioned that they use the results from the air quality campaigns to communicate about the health hazards of cycling in bad air quality with family members and friends. Moreover, some respondent mentioned that they can now approach the city council and use the results produced in Meet Mee Mechelen as a bargaining chip to convince the city authorities that 'there is a problem'.

Although thus far the air quality data has been limited to data produced during the four campaigns in 2018 and 2019, several interviewees evaluated this data as accessible and as a positive addition to the data and information that they had before. The produced data was often described as 'missing in the past', 'detailed' and 'scientifically correct'. In this regard, one of the interviewees mentioned that "from a scientific point of view, it was just a good addition, but because it was produced in the campaigns it is very valuable. The fact that we measured it in a collaborative way confirms the problems to the city". Moreover, this interviewee believed that he can use the contacts made in Meet Mee Mechelen for accessing more data/information if and when needed.

When asked about the extent of control over the data/information that is being produced in Meet Mee Mechelen, most interviewees mentioned that although there has been open communication about data

analysis, they did not participate in this process themselves. These interviewees described the data processing as 'very technical' and mentioned that they do not have the required technical expertise to be involved in this process. They believed that this expertise lies with the GT2.0 local partner (VITO), but they highlighted that they trust VITO with this process. Nevertheless, a few interviewees suggested that processing the data can be very political and specific stakeholders, such as the city authority, may want to block certain information.

Authority & power

'Authority and power' refers to the actual level of impact of different stakeholders on decision making processes. Participants in the interviews in this Demo Case were asked to about the extent to which their influence in decision making processes regarding air quality and noise pollution in Mechelen has changed because of their participation in Meet Mee Mechelen.

Representatives of the city did not perceive any change in their level of authority and power, as a result of participation in Meet Mee Mechelen, because they believed they have already been involved in policy and decision-making regarding air quality and noise pollution in Mechelen via their job and mandate. On the contrary, the majority of other interviewees[10] believed that their participation in Meet Mee Mechelen has provided them with new possibilities for influencing policy and decision making processes. These changes can be categorized into three distinct categories.

(1) A number of interviewees mentioned that Meet Mee Mechelen has increased attention of policy and decision makers to these topics and the fact that a group of citizens are concerned about this. One of the interviewees provided tangible examples with this regard. He mentioned that "the influence is there; almost all political parties know me by my first name. I also work politically neutral, so in that sense I do have influence. The urban environmental council is going to change its concept: working more on a project basis. Now the environmental council is working on the climate plan, in January we should be able to say we are making a project to work on air and noise".

(2) Possibility of influencing public opinion was another identified change. Interviewees mentioned that via Meet Mee Mechelen, they have had the possibility of disseminating the results of their efforts and communicate their concerns to the general public. For example, they mentioned that they had the opportunity of presenting a list of possible actions (based on among others on MMM results) to elected officials of the municipality. Moreover, it was mentioned that the activities of this CO have raised media interest and via interviews and published material in the media, Meet Mee Mechelen could influence public opinion.

(3) The third change was using the produced data as evidence and as a bargaining chip to convey a message to decision makers. In this regard, one of the participants mentioned that "you have taken measurements, and those measurements remain an argument and scientific proof of what the situation is like; that's something you have".

[10] i.e. members of environmental NGO such as Leefmilieugroep Mechelen-Zuid, Fietsersbond Mechelen, Natuurpunt, Fietsersbond and Klimaan

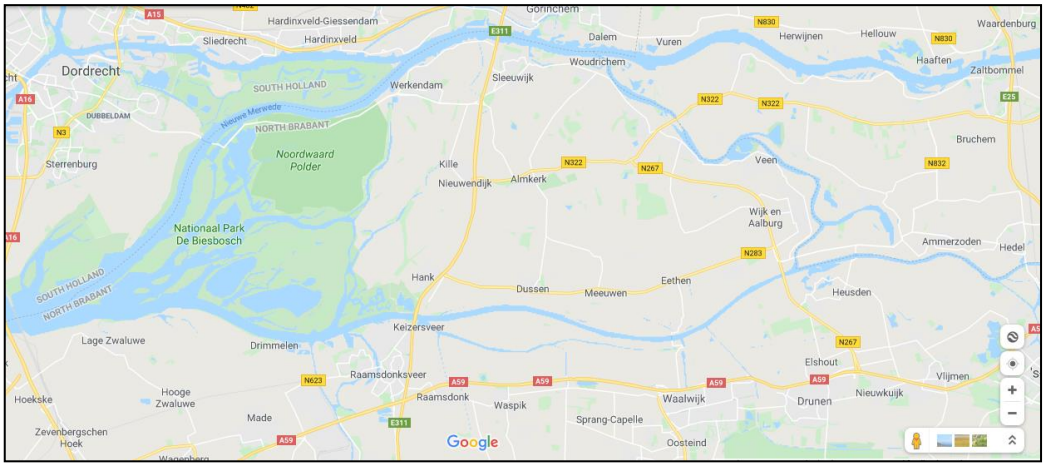
A1.2 Dutch Demo Case

Section 4.2 and Annex 3 of D1.11, provided an overview of the baseline situation of the GT2.0 Dutch Demo Case. In order to understand the institutional impacts of Grip op Water Altena, 12 in-depth interviews were conducted with nine member of the co-design group, the Demo Case lead, and two team members of this GT2.0 Demo Case. The members of Grip op Water Altena who participated in the interviews included two representatives of the water authority Rivierenland, one representative of the municipality of Altena, and six community members. In some cases, interviewees from the community members also represented an NGO (e.g. Altenatuur). In order to analyse the (expected) changes, the results of these interviews where compared against the baseline situation in this case and are elaborated according to the conceptual framework for analysis institutional impacts of COs presented in D1.10.

Participation

Geographic scope

As described in the baseline analysis of this Demo Case, Grip op Water Altena is located in 'Land van Heudsen en Altena'. This is a river island located in the estuary of the rivers Rhine and Meuse. It is enclosed by the rivers Boven Merwede (north), Afgedamde Maas (east) and Oude Maasje/Bergse Maas (south) and by the region of De Biesbosch (west). Land van Heudsen en Altena is located at the municipality of Altena, with a total population of 55840 inhabitants[11]. As indicated in the baseline analysis of this case, in terms of water management this area is under the jurisdiction of the water authority Rivierenland. At the start of the GT2.0 project, this study the area consisted of the three municipalities of Werkendam, Woudrichem and Aalburg. On 1st of January 2019, these municipalities were merged to form the new municipality of 'Altena'.



Map of Land van Heudsen en Altena[12]

[11] Source: CBS Statline (in Dutch). Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/?fromstatweb, 05 November 2019

[12] Source: Google Maps

Participant groups

In the baseline analysis of this Demo Case, the water authority (waterschap), union of Water Boards (Unie van Waterschappen), municipalities, the Association of Dutch municipalities (Vereniging van Nederlandse Gemeenten or VNG), Rijkswaterstaat, Provinces, Rioned Foundation (the umbrella organization for urban water management and sewerage in the Netherlands), the Southern Agriculture and Horticulture Organization or ZLTO (i.e. a farmers' association) were identified as the main organizations involved in making decisions regarding management of pluvial flooding in Land van Heudsen en Altena. Moreover, some examples of companies from the private sector (e.g. Royal HaskoningDHV, HydroLogic and Witteveen & Bosch) were also identified as the stakeholders who are currently involved in the decision making and policy making processes for managing pluvial floods in the Netherlands. Citizens influence on decision making processes was mainly indirect and via electing officials in the national elections and the elections of the board members of the regional Water Boards.

The majority of the participants in the co-design workshops of Grip op Water Altena were members of the local community, many of whom also represented environment-related NGOs. Moreover, representatives from the water authority Rivierenland and the three municipalities of Werkendam, Woudrichem and Aalburg (and at later stages representative of the merged municipality of Altena) participated in almost all co-design workshops. KNMI, amateur weather networks, farmers association (ZLTO), Housing association (Meander), and local business owner were also among the participants in the co-design workshops in this case; however, their participation was either occasional or discontinued after a while. Overall, the participants in the co-design workshops were mainly senior citizens and the majority of community members who participated in the workshops were male.

All three interviewees from the GT2.0 team identified local community members (especially those with an interest in gardening, weather or water), the municipality and the water authority as the end-users of the tools developed in Grip op Water Altena. However, the interviewees did not expect citizens living in apartments and the rural community (e.g. farmers) to use the Grip op Water Altena tools.

Efforts required to participate in Grip op Water Altena

The effort required to participate refers to different types of investments and requirements that are necessary from participation of different stakeholder groups, e.g. the time or monetary investments required for participation, or the need to gain expertise on a topic. For a citizen observatory to be able to function and produce results, its members need to be willing to invest these efforts. Both, the GT2.0 team members and the CO members who participated in the interviews indicated that participation in Grip op Water Altena can be both online and offline.

Online participation mostly requires access to internet, as well as a phone or computer. Participants need to take the time to post information (e.g. about measures taken in their garden), read the available information online, or promote the activities of the CO via social media.

Offline participation relates to participation in meetings, outreach event or campaigns, assistant with organizing such events, and efforts needed for contacting and recruiting more members. This form of participation also requires time commitment, as well as travel expenses (if any), however, it was mentioned that in the future the venue and other expenses can be covered by the water authorities and the municipality.

In addition, interviewees from the authorities also mentioned that they then need to provide technical expertise regarding the topic of water management, and also convert the decisions made in the participatory meetings into resources and actions needed. Moreover, they might need to communicate about these efforts and related challenges within their organization, or externally with other organizations.

Support offered for participation in Grip op Water Altena

Support offered for participation by Grip op Water can be divided into two broad categories; organizational support and the technical support required for developing the tools in this CO.

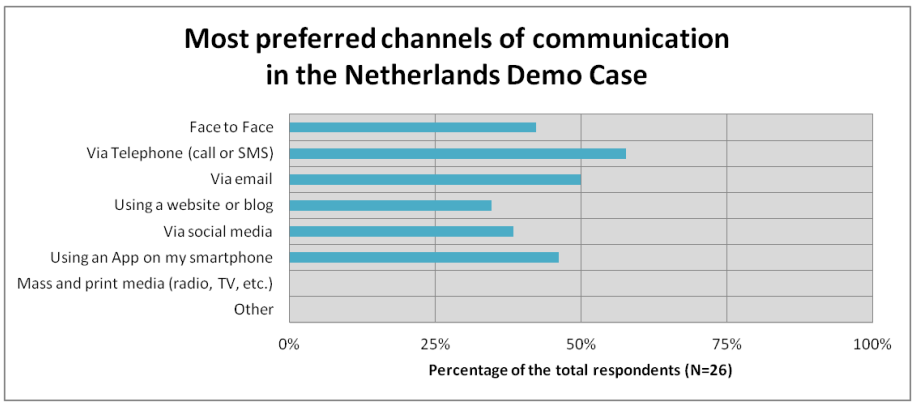
Organizational support include scheduling, setting up, hosting and moderating the participatory meetings and outreach events, as well as setting up and maintaining social media accounts. The costs of organizational support were covered by the Ground Truth 2.0 project, and from 2020 the municipality of Altena and the water authority Rivierenland will provide contributions to cover these costs. Managing the social media accounts (e.g. the Facebook and twitter account) was done by the Ground Truth 2.0 project partners, but this was handed over to the community members in late 2019.

Tools in this CO include development of the web-platform and integrating the data, maps and information available on the platform, as well as development of two surveys for collecting information about the gardens and past floods (2014 and 2015). A lot of the data and information available on the web-platform was provided by the stakeholders and especially the Rivierenland water authorities and the municipality. Moreover, the required technical support for linking databases was provided by the GT2.0 partner organizations and the Rivierenland water authorities.

Communication paradigm

During the baseline interviews in this Demo Case, the interviewees were asked to indicate their preferred channels for communicating about pluvial flooding in Land van Heudsen en Altena. This question was designed to help prioritize the preferred communication channels from the users' point of view. The following bar chart summarizes the answer to this question. One of the findings from the baseline assessment was that unless there is an actual problem or an emergency situation, there is little or no communication with municipalities and the water authority. Moreover, community members mostly discuss about this topic in informal settings and face to face. Using phone call or SMS and emails the most frequently preferred communication channels and these were mostly used to communicate with the authorities in case there is a problem or complaint.

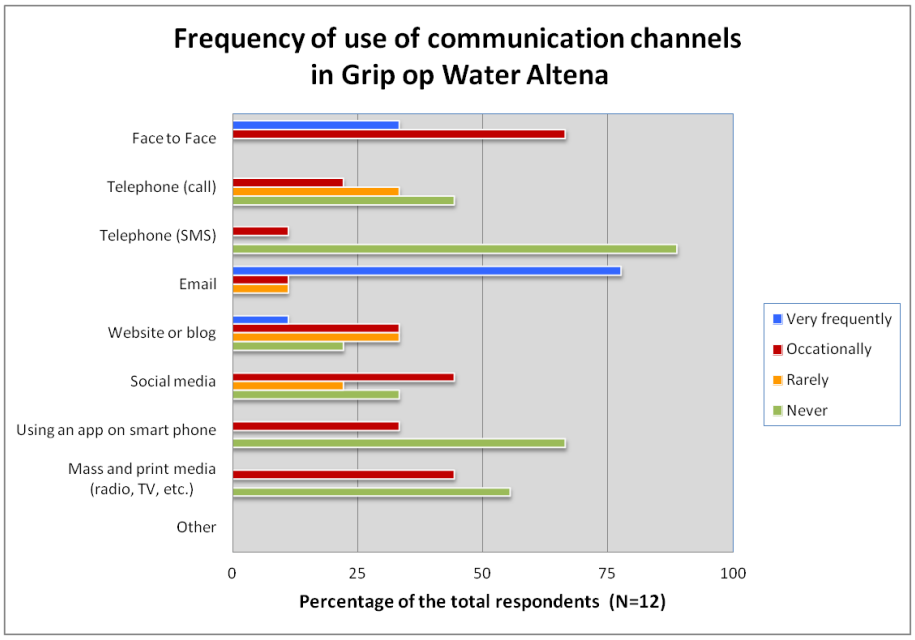
Most preferred channels of communication in the Dutch Demo Case



In the current phase, interviewees were asked to identify the communication channels, which they have actually used to participate in different activities of Grip op Water Altena, and the extent of use of each channel. The following figure summarizes the results of this inquiry. Several channels were used for communication in Grip op Water Altena; however, emails and face to face communications were identified as the most frequent channels of communication in this DC.

Interviewees were also asked to indicate for what purpose they have used each communication channel. Emails were mostly used for coordination purposes (e.g. invitation to participatory meetings, setting up appointments), for exchanging information and also for sharing feedbacks and results of the CO activities. Face to face communication channel corresponds to the participatory and bilateral meetings and also outreach events that meant to promote Grip op Water activities and recruit members. Telephone calls were mainly used for short bilateral discussions between members. Moreover, the CO members used the Grip op Water website for sharing and viewing information e.g. about the measures taken in the area by different stakeholders, or information about water levels in the area. Other less frequently used channels included the Facebook and Twitter accounts that were mainly used for promoting the CO activities and results and a WhatsApp group that was mainly used for coordination among the members. Lastly, print material, flyers and banners were also used in the participatory meetings and outreach events.

Frequency of use of different communication channels in Grip op Water Altena



Communication & decision mode

The majority of the interviewees believed that Grip op Water Altena has provided an alternative way of communicating about pluvial flooding between the members of the local community, the municipality and the water authority that did not exist before. These communications happened both offline (e.g. during the participatory meetings), and online via the Grip op Water web-platform. Interviewees from the local community believed that the offline and online interaction via Grip op Water has provided them with the opportunity to better understand the measures taken by the municipality and the water authority. Interviewees from the municipality and water authority saw this CO as an opportunity to communicate about the measures that they have taken for reducing problems with pluvial flooding in the area, and also ask for collaboration of community members (e.g. by taking measures in their own gardens). Both interviewees from the water authority believed that there were many more offline interactions in the beginning and this decreased towards the end of the GT2.0 project. Lastly, an interviewee from the municipality considered the two surveys that were conducted as a part of this CO as a complementary form of communication and information sharing between citizens and the authorities.

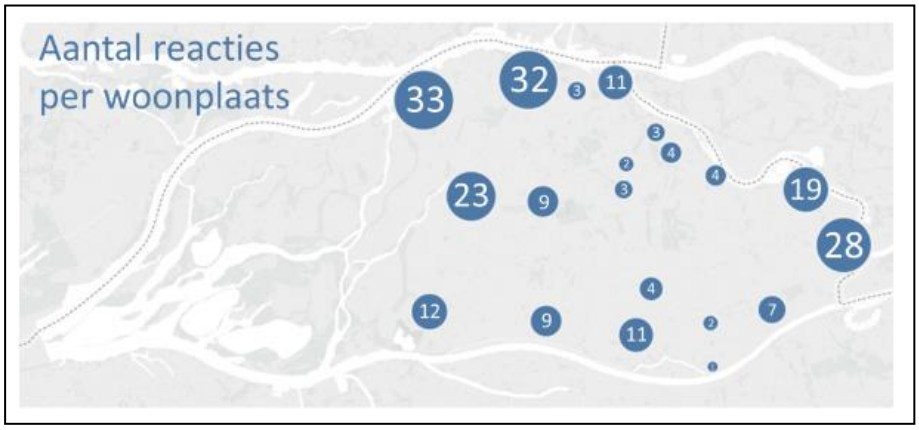
Nevertheless, none of the interviewees from the community members could identify an example of a mechanism by which Grip op Water has enabled them to take part in decision making processes related the management of pluvial floods. Moreover, interviewees from the municipality and the water authority indicated that they have already been involved in making decisions about this issue and believed that Grip op Water did not change anything in that regard.

Power Dynamics

Access to & control over data

The website of Grip op Water Altena integrates weather and water information from various sources. Available information on this website includes physical characteristics of the case study area, precipitation information (including both rainfall data and forecasts), pluvial flooding observations by citizens, information about past flood events of 2014 and 2015 and risk of flooding in different areas, as well as measures taken by residents of Altena, the Rivierenland water authorities and the municipality of Altena and to limit the damage from pluvial flooding in Altena. Information on the Grip op Water Altena website is mainly provided by the Rivierenland water authorities, HydroNET (a decision support system developed by Hydrologic), and a few other sources. However, citizens also contribute to the information on this website. More specifically, citizens contribute to observations of pluvial flooding (submitted using a form that can also include a picture), measures taken to limit the damage from pluvial flooding (i.e. also submitted through a form) as well as memories from past flood events.

In addition to the above mentioned information, two surveys were designed and conducted as a part of activities in this CO. The first one was a 'garden survey' conducted in October 2018, with the aim of gaining more insights into the extent to which and reasons why residents of Altena have a green or paved garden. This survey was completed by 232 respondents and provided valuable information about the status of gardens across the geographical area of the CO. The following figure provides the geographic distribution of the respondents in this survey[13]. The second survey aimed at collecting memories and information about the floods that happened in July 2014 and August 2015. In total, 30 respondents participated in this survey. The analysis of the results showed that people from Woudrichem expect more nuisances from pluvial flooding than people from other towns. Moreover, measures that are taken by the municipality and the water authority Rivierenland are not always noticed by citizens.



Geographic location of respondents to the garden survey in Grip op Water Altena

[13] For more information see: http://altena.gripopwater.nl/oudere-inwoners-van-altena-hebben-de-groenste-tuinen/ (in Dutch)

The results of interviews demonstrate that change in access to data because of Grip op Water Altena is perceived differently by the interviewees from the GT2.0 team and from the local stakeholders.

The GT2.0 team members believed that the Grip op Water website integrates quite some information from different sources and also provides valuable information about what measures have been taken by which stakeholder. It also provides information about the history of flooding in the area and an easy way of finding the areas of high pluvial flooding risk.

Interviewees from the local community, the municipality and the water authority unanimously believed that Grip op Water Altena has created little or no change in their access to and control over data and information. Interviewees from the water authorities and the municipality believed that the available data on the website of Grip op Water Altena is mainly provided by the water authority Rivierenland and therefore, it has not changed their access to, and control over, data and information. In this regard, one of the interviewees from the water authority Rivierenland mentioned that if new data would be generated by citizens in this CO, they would use that data; however, in his view, this has barely happened. The majority of the interviewees from the local community indicated that their access to data and information has not changed because of their participation in this CO and the available information could have been accessed from other sources. They also mentioned that they have not used the data and information available on Grip op Water Altena website. The only exception was one interviewee who mentioned she has used the CO website to see what measures have been taken to prevent flooding.

Authority & power

'Authority and power' refers to the actual level of impact of different stakeholders on the decision making processes. Interviewees in this Demo Case were asked to what extent, if any, they think their influence in decision making processes regarding management of pluvial floods in Land van Heudsen en Altena has changed because of their participation in Grip op Water Altena.

Interviewees from the GT2.0 team members believed that Grip op Water has provided them with an opportunity to raise awareness within the municipality and among the community members on how they can reduce the risk of pluvial flooding using a collaborate approach and with the help of all involved stakeholders. However, it was also mentioned that there has been a broader movement about the topic of pluvial flooding in the Netherlands and more people are aware of this issue, but that is not only because of Grip op Water.

Interviewees from the municipality and water authority indicate that they were already a part of decision making processes, related to their role and function at their respective organization and Grip op Water Altena did not change this. The majority of the CO members did not perceive a major change in their influence on decision making processes. However, they mentioned that participation in Grip op Water Altena has provided them with an opportunity to learn about the topic of pluvial flooding and has raised their awareness about measures taken by different stakeholders for reducing the risk of pluvial flooding. The only exception was one interviewee who believed because of the enthusiasm that he has for Grip op Water Altena, he may be able to communicate about it and influence the opinion of other community members.

A1.3 Spanish Demo Case

Section 5.2 and Annex 4 of D1.11, provided an overview of the baseline situation of the GT2.0 Spanish Demo Case. In order to understand the institutional impacts of RitmeNatura, 8 in-depth interviews were conducted with seven active participants of the co-design group and the Demo Case lead of this GT2.0 Demo Case. The members of RitmeNatura who participated in the interviews included biodiversity enthusiasts and researchers from FEDAC Sant Andreu, CREAF and Institut de Ciències del Mar (ICM) - CSIC, as well as representative of government organizations such as Diputació de Barcelona and Meteocat. In order to analyse the (expected) changes, the results of these interviews where compared against the baseline situation in this case and are elaborated according to the conceptual framework for analysis institutional impacts of COs presented in D1.10.

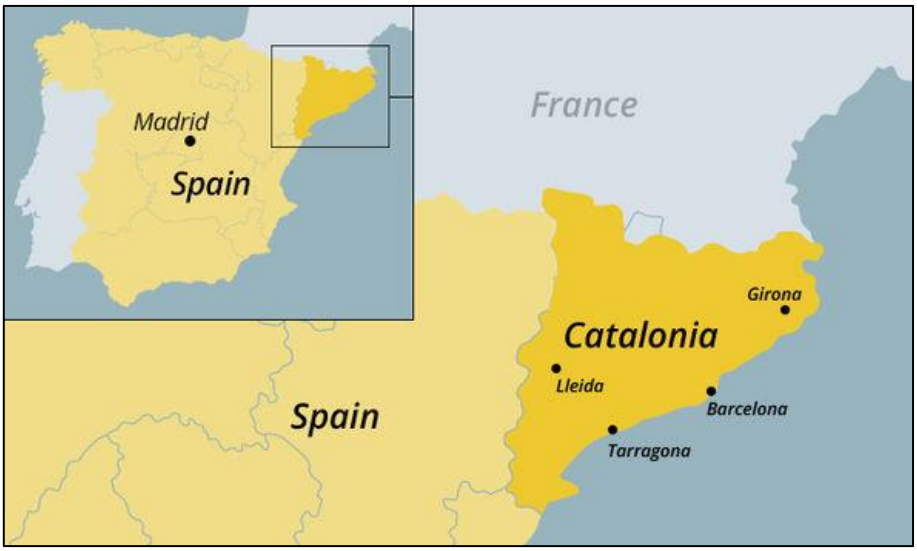
Participation

Geographic scope

As described in the baseline analysis of this Demo Case, the GT2.0 Spanish Demo Case is located in Catalonia that is an autonomous region located in the north-eastern of Spain, and has a population of roughly 7.5 million inhabitants[14]. Noticeable increase in the temperature and decrease of rainfall has started to affect the natural systems in this region. Analyzing phenological changes can serve as a proxy of monitoring climate change. This is due to the fact that even small variations in the climate may have severe effects on plant and animal life cycle. Although several instances of collecting phenological records exist, these efforts are isolated, disconnected, very specific and generally speaking, incomplete. A long-term observation that results in a complete set of phenological records requires collaboration of a significant number of participants and thus, citizens and biodiversity enthusiasts are uniquely placed to carry out this task. The aim of the RitmeNatura is to establish an integrated system of phenological observations and link this system with various sources of meteorological data in order to have a Near Real Time observation network. The phenological observations of RitmeNatura are compiled in Natusfera[15]. Natusfera is a citizen science platform that is used for registering, validating and providing access to phenological observations shared by citizens. The Natusfera's project "RitmeNatura" is divided into two sub-projects: 'Occasional Observations' and 'Repeated Observations'.

[14] Based on the 2017 official statistics provided by The Statistical Institute of Catalonia (Idescat): https://www.idescat.cat/pub/?id=aec&n=249&lang=en

[15] https://natusfera.gbif.es/



The location of Catalonia in Spain[16]

Participant groups

In the baseline analysis of this Demo Case, the EU, National government of Spain (and its ministries), the Generalitat de Catalunya (the autonomous government of Catalonia), and its relevant departments such as 'the Meteorological Service of Catalonia' (Meteocat), 'Catalan Office of the Climatic Change' and the 'Department of Territory and Sustainability and Housing Agency of Catalonia', the Barcelona Provincial Council (BPC)[17], the Barcelona Metropolitan Area (AMB), Diputacio de Barcelona, and the municipalities in Catalonia were identified as the main organizations involved in making decisions regarding climate change adaptation in Catalonia. Moreover, nature associations, research institutions, and other existing Citizen Observatories (e.g. Natusfera) were also identified as stakeholders who have an influence especially for collecting and sharing phenological data in Catalonia.

Participants in the co-design process in this case were mostly professionals and phenology or biodiversity enthusiasts, including representatives of Natusfera and MeteoCat, butterfly and bird enthusiasts, decision makers (Diputacion de Barcelona and the regional government), NGOs and research organizations (e.g. CREAF). The age range was mostly between 35 to 55 years old. Connecting RitmeNatura with Natusfera has created the possibility for participation of interested individuals from all age and gender strata. It is expected that the majority of the participants in RitmeNatura are individual citizens or professionals with an interest in nature or phenological observations.

Efforts required to participate in RitmeNatura

The effort required to participate refers to different types of investments and requirements that are necessary from participation of different stakeholder groups, e.g. the time or monetary investments required for participation, or the need to gain expertise on a topic. For a citizen observatory to be able to function and produce results, its members need to be willing to invest these efforts.

In case of RitmeNatura, the most frequently mentioned factor by the interviewees was time. It was mentioned that especially for recurrent observations, participants need to take the time to go to a specific

[16] Source: https://www.express.co.uk/news/world/861739/catalonia-map-where-is-catalan-referendum-independence-spain

[17] A local government institution that provides technical, economic and strategic support for the 311 municipalities of the province of Barcelona

observation location and fill in the details. It was also mentioned that observers need to have the enthusiasm to spend the time on making the observations; however, not much expertise is required, because experts in Natusfera will help with identifying the species.

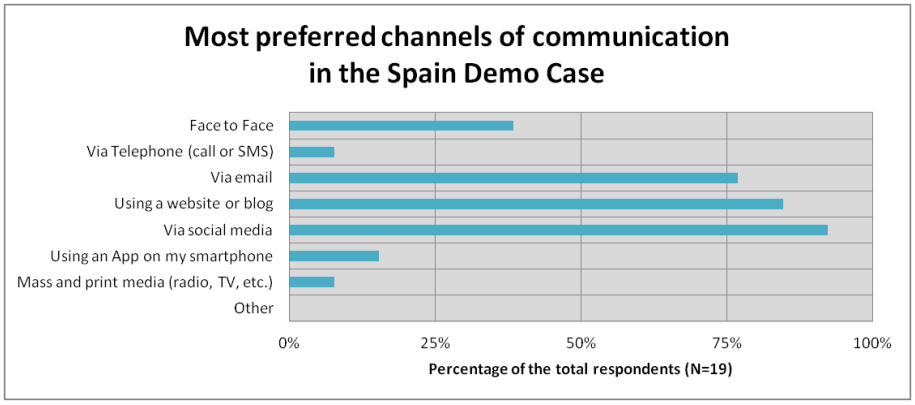
Support offered for participation in in RitmeNatura

Organizational, technical and communicative support required for setting up RitmeNatura was provided by the GT2.0 project partners. Moreover, the majority of interviewees mentioned that Natusfera community helps with identifying and validating the observations. This support by the expert community in Natusfera was evaluated very positively and interviewees considered this as a vital support that is required constantly for continuation of activities in RitmeNatura. Some interviewees also believed that more support from the expert community would be desirable and especially will be needed if the uptake of the initiative increases and more observations are submitted. In addition, the available manuals (e.g. species identification manuals) on the RitmeNatura website were considered as a form of support that can facilitate participation of observer and validators in this initiative.

Communication paradigm

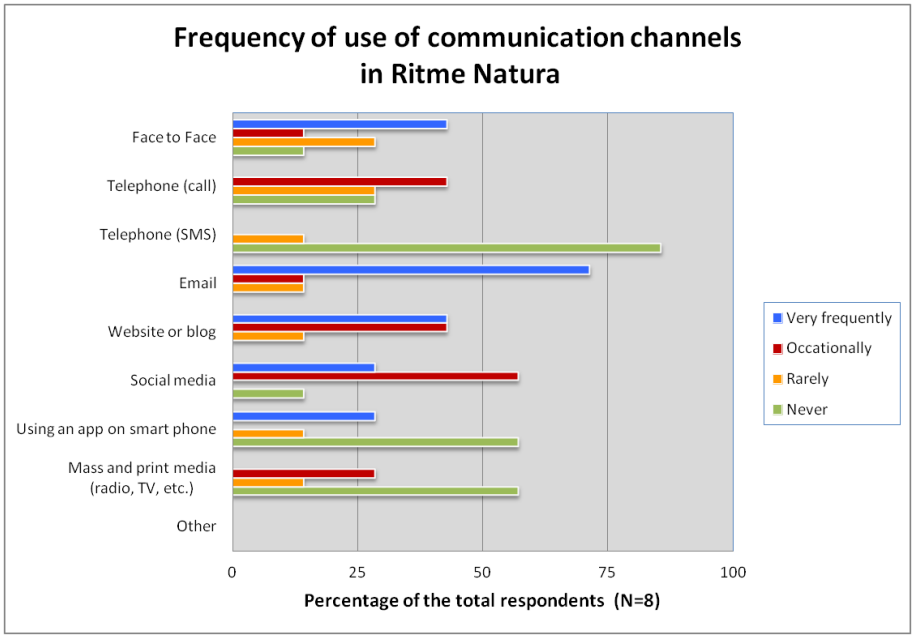
During the baseline interviews in this Demo Case, the interviewees were asked to indicate their preferred channels for communicating about phenology and/or climate change adaptation related issues in Catalonia. This question was designed to help prioritize the preferred communication channels from the users' point of view. The following bar chart summarizes the answer to this question. Based on this figure the three most dominant preferred channel of communication among the interviewees were social media, websites or blogs, and email. In addition, quite a few interviewees also mentioned that they prefer to communicate about these topics face to face.

Most preferred channels of communication in the Spain Demo Case



The results of the impact assessment interviews show a good match between the preferred communication channels and the actual channels used for communication purposes in RitmeNatura. In practice, most of the coordination efforts (e.g. for organizing the collaborative workshops, requesting information and doubt resolutions) was done via emails. The RitmeNatura and Natusfera websites were used for entering and viewing observations, as well as searching for relevant information. Several interviewees also mentioned that they used social media (e.g. Twitter) to share and follow the news about the observatory. Moreover, several face to face collaborative and bilateral meetings took place in this case; therefore, interviewees identified this communication channel as one of the most frequently used forms of communication in this initiative.

Frequency of use of different communication channels in Meet Mee Mechelen



Communication & decision mode

The majority of the interviewees believed that RitmeNatura has allowed for a new way of communication about the topic of climate change in Catalonia. This was made possible by providing a different point of view about this topic, and not only e.g. from the perspective of the number of cars in the cities, but by showing the effect of climate change on different species. Interviewees believed that RitmeNatura, along with other similar initiatives, has contributed to attracting more media attention to the topic of climate change. Moreover, volunteers who participated in the collaborative workshops received valuable information about this topic and created a community of enthusiasts with shared interests and concerns. Interviewees expected that the data produced in RitmeNatura will create a new way of 'being heard' by the decision makers, however, it was mentioned that at the moment the amount of produced data is limited. Moreover the produced data is not yet being used in decision making processes at the regional and national levels. Therefore, none of the interviewees believed that RitmeNatura has (yet) enabled them to take part in actual decision making processes regarding climate change adaptation in Catalonia.

Power Dynamics

Access to & control over data

In terms of change in the level of access to data, all interviewees believed that the amount of data produced so far in RitmeNatura is not enough for creating a meaningful change in their access to data. It was mentioned that at this stage, RitmeNatura has only contributed to awareness raising about the fact that this type of data can be an indicator for climate change monitoring. Interviewees mentioned that for this data to become useful there is a need for several years of continuous monitoring. Several interviewees indicated that are interested in using this data, if the monitoring activities RitmeNatura continues. For example, a respondent from Diputació of Barcelona mentioned that may be able to use this data as an indicator for change in phenological trends in the biodiversity of parks.

Interviewees believed that the level of control over data, by design depends on your role in RitmeNatura. If you are one of the observers, you can view the data submitted by yourself and others, but you are not

able to validate, filter or quality control the data. As a validator, you are able to control the quality of the observations and validate them, but you cannot delete the data or information. The highest level of control remains with Natusfera that hosts RitmeNatura.

Authority & power

'Authority and power' refers to the actual level of impact of different stakeholders on the decision making processes. Participants in the interviews in this Demo Case were asked to what extent, if any, they think their influence in decision making processes regarding climate change adaptation in Catalonia has changed because of their participation in RitmeNatura.

The majority of the interviewees believed that their level of influence on decision making processes have not changed much, because this requires access to long-term time series and it is still impossible to extract fast conclusions from collected observations in RitmeNatura. However, it was mentioned that RitmeNatura has contributed to raising awareness among a community of biodiversity and phenology and enthusiasts, researchers with a focus on climate change, and maybe the general public to increased attention of the media to the topic of climate change.

A1.4 Swedish Demo Case

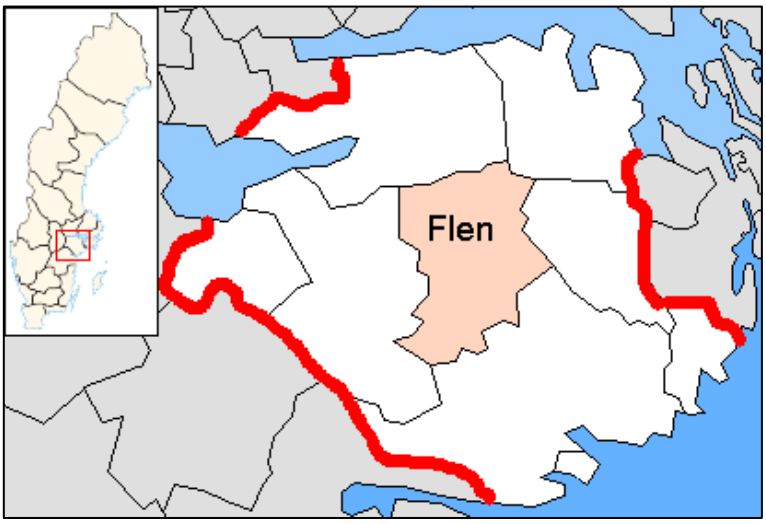
Section 6.2 and Annex 5 of D1.11, provided an overview of the baseline situation of the GT2.0 Swedish Demo Case. In order to understand the institutional impacts of VattenFokus, 3 in-depth interviews were conducted with 2 active participants of the co-design group and the Demo Case lead of this GT2.0 Demo Case. The interviewees from VattenFokus were both active community members; however, the results presented here are mainly based on their perception about this CO. In order to analyse the (expected) changes, the results of these interviews where compared against the baseline situation in this case and are elaborated according to the conceptual framework for analysis institutional impacts of COs presented in D1.10.

Participation

Geographic scope

The Swedish Demo Case has focused primarily on the region of Södermanland, a region about 100 km south west of Stockholm. Flen is a town and a municipality in this region. Flen is where the first water quality testing campaign (water blitz) was held in 2017. In 2018, the geographic focus of the Swedish DC expanded across the region. This included forming the CO Grupp Dunkern (Group Dunkern), who been performing water quality tests continuously from 2017 to 2019 in and around the lake Dunkern, which is located in the Flen municipality.

The location of Flen in Sweden[18]



Participant groups

In the baseline analysis of this Demo Case, the interviewees from the regulatory entities and expert advisors were asked to identify the stakeholders who are currently involved in the decision making and policy making processes regarding water (quality) management in the Stockholm and Flen. Identified stakeholders included EU at the international level; national level organizations such as the Ministry of the Environment and Energy (Miljö- och energidepartementet), the Swedish Agency for Marine and Water Management (Havs- och vattenmyndigheten), the Geological Survey of Sweden (SGU), the Swedish Environmental

[18] Source: https://en.wikipedia.org/wiki/Flen_Municipality

Protection Agency (Naturvårdsverket), the National Food Administration[19] (Livsmedelsverket), the National Board of Housing, Building and Planning (Boverket), the Public Health Agency of Sweden (Folkhälsomyndigheten); regional authorities including River Basin District Authorities, and the County Administration Boards (länsstyrelser); and local authorities such as municipalities (municipal environmental committees), water councils and environmental courts.

Participants of the co-design meetings of this CO were community members and representatives from the water boards. Svenks Vaten was also consulted in the process, but this consultation happened bilaterally between them and the GT2.0 team. Interviewees believed that the end users of the tools developed in this CO are the local community members from the Donken community and the Eco Village; however, at the moment this is limited to a few champions from these communities.

Efforts required to participate in VattenFokus

The efforts required to participate refer to different types of investments and requirements that are necessary from the participation of different stakeholder groups, e.g. the time or monetary investments required for participation, or the need to gain expertise on a topic. For a citizen observatory to be able to function and produce results, its members need to be willing to invest these efforts. In the case of VattenFokus, interviewees identified time and financial resources as the two main categories of efforts that they need to invest, in order to be able to participate in this CO.

The interviewees mentioned that travelling to the sampling locations takes a long time and people may need to drive for a few hours (or more than 100 kilometres) to get to the sampling location. Taking the samples and entering the data in the App also requires time. Furthermore, they often need to coordinate about this over the phone. All these efforts also have financial implications such as fuel costs and the cost of phone calls.

Support offered for participation in VattenFokus

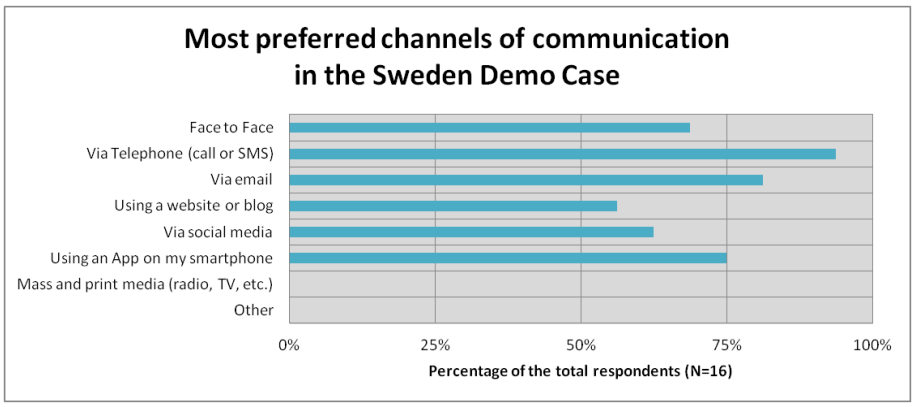
Organizational, technical and financial support required for setting up VattenFokus was provided by the GT2.0 project. Organizational support included scheduling, setting up, hosting and moderating the co-design meetings and inviting different stakeholders to participate in these meetings. Moreover, the GT2.0 team also supported the planning and implementation of data collection campaigns (Blitzes). Technical support and trainings were provided for the participants in these campaigns and volunteers were provided with water quality test kits and also instructions on how to use the kits and upload the data using the App. Nevertheless, one of the interviewees expressed that, in order to participate, he will need this type of support to be provided in the future.

Communication paradigm

During the baseline interviews in this Demo Case, the interviewees were asked to indicate their preferred channels for communicating about water quality. This question was designed to help prioritize the preferred communication channels from the users' point of view. The following bar chart summarizes the answer to this question. Based on this figure at least 75% of the interviewees indicated they prefer to use phone (call or SMS), emails, or an App on their Smartphone to communicate on water (quality) management.

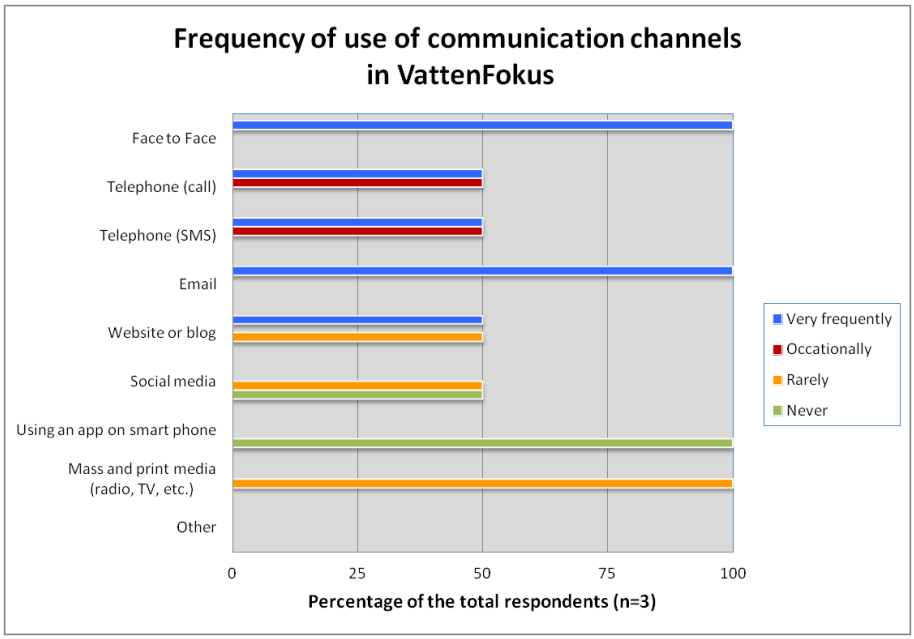
[19] The National Food Administration is a Swedish government agency that answers to the Ministry of Agriculture, Food and Consumer Affairs and is the central supervisory authority for matters relating to food and drinking water.

Most preferred channels of communication in the Sweden Demo Case



The results of the impact assessment interviews indicate a good match between the preferred communication channels and the actual channels used for communication purposes in VattenFokus. In practice emails and face to face VattenFokus. Face to face communications mostly happened during the collaborative meetings and for discussing different issues and agreeing on the way forward. Emails and phone calls were used as the main channels for coordination about the events and keeping the members informed about upcoming activities and sharing results or feedbacks from past campaigns.

Frequency of use of different communication channels in VattenFokus



Communication & decision mode

The interviewees believed that their participation in VattenFokus has resulted in learning more about water quality and became interested to learn more about the scientific aspects of water quality monitoring and management. In addition, they indicated that this CO has enabled the participants to communicate about this topic with others. After seeing the results of the water quality analysis, people living in the area started to question their own practices.

Moreover, it was mentioned that the activities of VattenFokus has resulted in an increased interest from authorities and municipalities. In this regard, one of the interviewees mentioned that "the water board in Nykoping is very interested in what we have done. They contacted us because they heard that we were doing some tests in the region. They have done an eDNA test, informed us about it, and we are waiting for the results. The local and regional government has started to show interest in our doing as well. Some things are happening thanks to VattenFokus".

Power Dynamics

Access to & control over data

Overall, the results of impact assessment interviews in the case of VattenFokus shows an increased access to data and information for participants in this initiative and others who have heard about its results through various channels e.g. the website or casual conversations with members of VattenFokus. The interviewees in this case mentioned that via their participation in VattenFokus, they have access to information about Nitrate and Phosphate for the lakes, information that did not exist before. In this regard one of the interviewees mentioned that before the start of VattenFokus, only out-of-date information from 2008 was available for the location for which VattenFokus did the water quality tests. The information produced in VattenFokus is used by this CO member to raise awareness among neighbors and residents of this area. Regarding control over data, the interviewees mentioned that beyond sharing and viewing the data, they do not have much more control over the data.

Authority & power

'Authority and power' refers to the actual level of impact of different stakeholders on the decision making processes. The interviewees in this Demo Case were asked to what extent, if any, they think their influence in decision making processes regarding water quality region of Södermanland has changed because of their participation in VattenFokus.

Both interviewees from the community members mentioned that they were concerned about the quality of the water in the lakes (e.g. the Dunkern Lake) and they wanted the authorities to pay more attention to this issue. They believed participation in this CO provided them with an opportunity to test the water quality themselves and communicate about this issue with the authorities. They also hopped that through these test they can show the authorities that a closer water quality monitoring is required and will be able to find out if there is a source of pollution at the upstream of the lake.

A1.5 Kenya Demo Case

Section 7.2 and Annex 6 of D1.11, provided an overview of the baseline situation of the GT2.0 Kenyan Demo Case. In order to understand the institutional impacts of Maasai Mara Citizen Observatory, 20 in-depth interviews were conducted with 17 active participants of the co-design group, the Demo Case lead, and two GT2.0 team members of this Demo Case. The members of Maasai Mara Citizen Observatory who participated in the interviews included local citizens, members of conservancies, and representatives from the Maasai Mara University, the Narok County Government, Kenya Wildlife Service, Kenya Forest Service, Kenya Meteorological Department and the Oli Tipis High School. In order to analyse the (expected) changes, the results of these interviews where compared against the baseline situation in this case and are elaborated according to the conceptual framework for analysis institutional impacts of COs presented in D1.10.

Participation

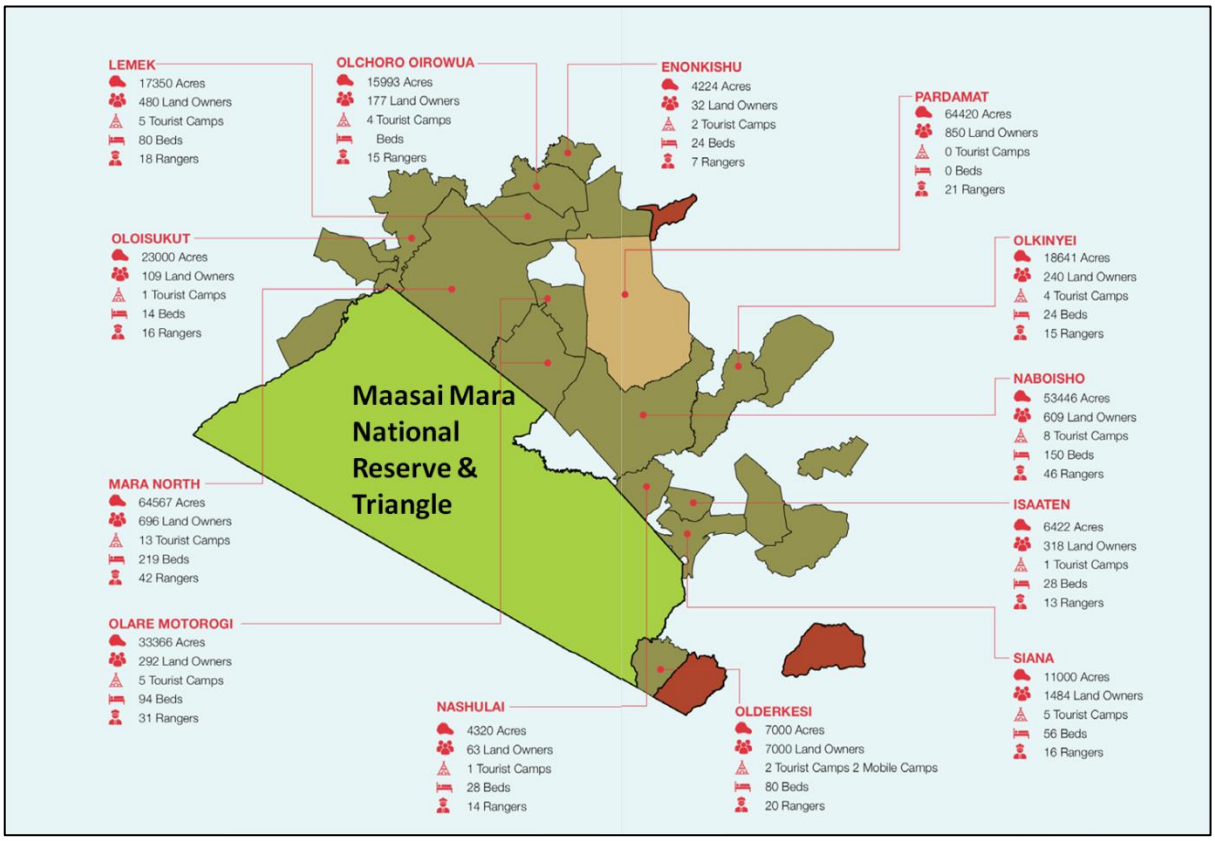
Geographic scope

The Kenya case study is located in Narok County in southwestern Kenya, close to the Tanzanian border. This area includes the Maasai Mara National Reserve, the Mara Triangle and conservancies around the national reserve. This is a part of the wider Mara ecosystem on the Kenyan side that is being managed by the Narok County government. Narok County has a total surface area of 17,921.2 km^2 and a population of 850920[20] inhabitants. The majority of the inhabitants of this area are Maasai pastoralists and it is one of the most famous touristic destinations in Kenya. The human-wildlife conflict is a prominent issue in this area and practices such as overstocking, overgrazing and fencing alongside droughts have put a lot of pressure on biodiversity and people's livelihoods.

The state of the conservancies in the Mara is constantly changing, including the surface area of the land under conservation, number of hotels and lodges, as well as the number of landowner and rangers in different conservancies. Figure 5.6 provides a map of the Maasai Mara National Reserve, the Mara Triangle and the conservancies surrounding the reserve as well as the most recent statistics on the state of the conservancies. This map was published in July 2019 by MMWCA i.e. the umbrella organization of the conservancies in the Mara region. Based on the information on this map, the conservancies in the Mara include 12350 landowners, 274 rangers and 51 lodges.

[20] Based on the 2010 census provided by the Kenya National Bureau of Statistics; retrieved from: https://www.knbs.or.ke/overview-of-census-2009/

Location of the Maasai Mara National Reserve and conservancies Mara region[21]



Participant groups

In the baseline analysis of this Demo Case, the Parliament of Kenya was identified as the main body of policy making at the national level. Cabinet secretaries especially those who head the ministries involved in managing biodiversity and livelihoods (e.g. are 'Environment and Natural resources', 'Agriculture, Livestock and Fisheries', 'Water & Irrigation ' and 'Tourism'); relevant wings of ministries such as Kenya Wildlife Service (KWS), Kenya Forest Service (KFS), Kenya Water Resources Management Authority (WRMA); as well as the National Museums of Kenya, and also the Kenya Water Tower Agency (KWTA) were also identified as very influential actors at the national level. The Narok County Government was identified as the most important stakeholders at the local level. Conservancies and NGOs (e.g. WWF) were also among the elicited stakeholders at the local level.

Representatives of several local and national level organizations were present in the co-design workshops, in which the functionalities of MMCO were defined. This includes representatives from different departments of the Narok County Government, KWS, KFS, Kenya Meteorological Department, National Museums of Kenya, the Water Resources Management Authority (WARMA). The two universities represented were Egerton University and Maasai Mara University. Moreover, NGOs such as the African Conservation Centre, Friends of Maasai Mara and Maasai Mara Wildlife Conservancies Association (MMWCA), and a number of individual community members who often represented organized community groups such as WRUAs and conservancies were also present.

Although Narok County Government always participated in the co-design workshops, their representation was often at junior level; internal communication at Narok County Government appeared to affect the

[21] Source: Maasai Mara Wildlife Conservancies Association (2019), Voice of the Mara (Fifth Edition); retrieved from www.maraconservancies.org/

engagement of higher level decision makers at the county with the project. Moreover, due to the fact that community members live in geographically dispersed locations, local pastoralists, chiefs and the private tourism sector (e.g. lodges and hotels) had variable representation in the meetings; an issue that affected the broader uptake of the initiative by local community members.

Efforts required to participate in Maasai Mara Citizen Observatory

The efforts required to participate in MMCO refers to the requirements and investments that are needed from the participants' side in order to be able to use the MMCO tools or attend the participatory meetings of this citizen observatory.

The need to have access to a smartphone, the time people need to spend on data collection and sharing, and a number of financial implications for participation were among the most frequently mentioned efforts. The need to pay for data bundles, commuting costs (e.g. fuel) and costs of participating in meetings (e.g. accommodation and food) were among the identified financial burdens. For example, a KWS officer mentioned that if a ranger wants to respond to a reported human-wildlife conflict, he needs to use a data bundle and may require extra fuel to travel to more places than his usual posts, resources that are often not compensated or may not be readily available at his disposal.

Several interviewees also mentioned that using the MMCO tools requires a short training. This training can via participation in training sessions, learning from others who have previously used the tools, or by using available manuals.

Support offered for participation in Maasai Mara Citizen Observatory

Support offered by MMCO can be divided into two broad categories; the tools developed as a part of MMCO tools, and the awareness raising and training that was provided by the Ground Truth 2.0 partner organizations.

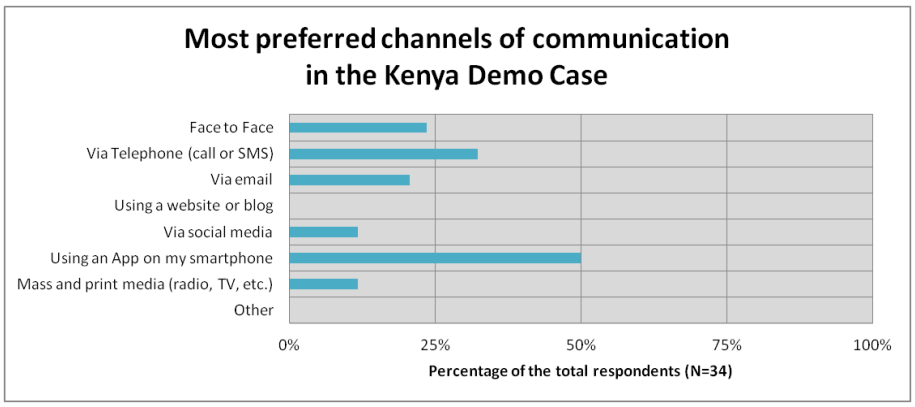
MMCO tools include the MMCO and Mara Collect Apps, the websites, physical sensors (weather stations and water level sensors) and four screens that are installed for displaying the data in different locations. Screens are installed in the KWS office in Narok, in two conservancies (i.e. the Mara Triangle conservancy and the Oloisukut conservancy), and at the G&G Hotel in Talek.

The second category relates to training for using the MMCO tools and raising awareness especially within the communities about how they can contribute to conservation through making, sharing and using environmental observations. This includes training of participants in the meetings, training of trainers, and the available manuals for using the tools. The MMCO website provided a link to a number of teaching materials from the TAHMO School 2 School Initiative, which is meant to be used by teachers to familiarize students with weather data. In addition, a manual for participation in mapathons was shared with the Maasai Mara University and a number of lecturers were trained on how to conduct mapathons, however this manual was not available on the MMCO website. No manual was available for using the MMCO app. Face-to-face trainings included the instructions sessions during the co-design workshops, as well as two dedicated training sessions that were organized for using the MMCO tools. The two training sessions were organized in Talek and Oloisukut conservancy. During these trainings, 70 community members, KWS rangers and conservancy rangers were trained on using the MMCO Apps. In addition, a few staff members of the Maasai Mara University were trained on conducting mapathons. Furthermore, during the Ground Truth 2.0 project, the costs of holding the co-design meetings and training, including the costs of accommodation, transport and food for the participants was covered by the project.

Communication paradigm

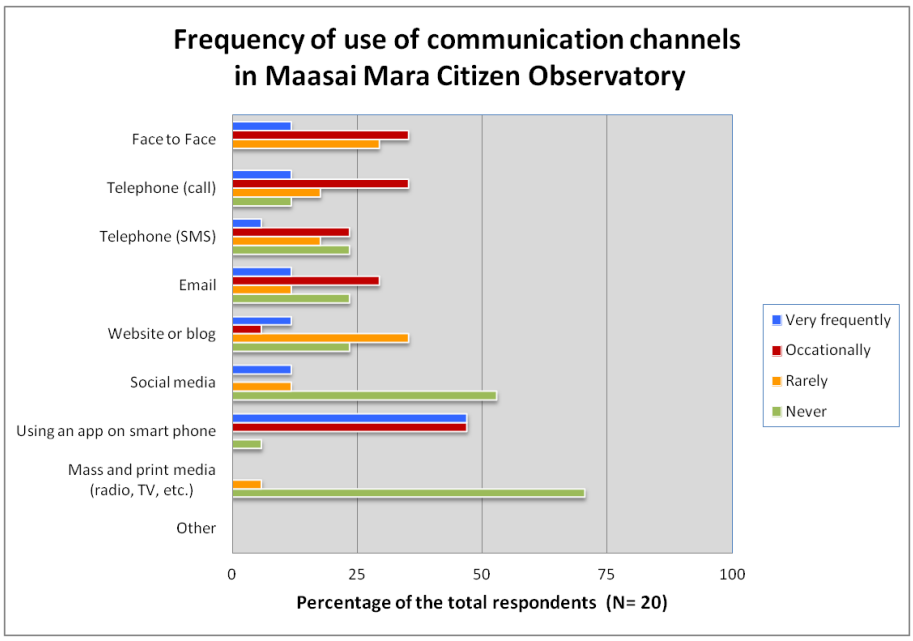
During the baseline interviews in this Demo Case, the interviewees were asked to indicate their preferred channels for communicating about biodiversity conservation and livelihood management in the Mara region. This question was designed to help prioritize the preferred communication channels from the users' point of view. The following bar chart summarizes the answer to this question. Based on this figure using smart phone Apps (predominantly WhatsApp), telephone calls, face-to-face communications and using emails were the most frequently preferred communication channels.

Most preferred channels of communication in the Kenya Demo Case



The results of the impact assessment interviews show a good match between the preferred communication channels and the actual channels used for communication purposes in Maasai Mara Citizen Observatory (see the following bar chart). Interviewees were also asked to indicate for what purpose they have used each communication channel. The most frequently mentioned use for the MMCO WhatsApp group was coordination amongst the CO members, as well as sharing and receiving data and information related to the issues in focus of the initiative (e.g. pictures and videos of biodiversity sighting and incidents or extreme weather information). Face to face meetings were the place for discussions about the co-design process and different issues related to the citizen observatory activities, meeting and discussing with representatives of different organizations and individuals, as well as receiving training on using the MMCO tools. Email was used for coordination purposes mostly with organizations e.g. invitation to meetings. Only a few interviewees mentioned that they are using the MMCO App and website for sharing and receiving information.

Frequency of use of different communication channels in Maasai Mara Citizen Observatory



Communication & decision mode

Only a few interviewees believed that they were at the receiving end of communications during the co-design sessions and MMCO planning meetings; others mentioned that they had a chance to express their ideas during the participatory meetings. Several interviewees described MMCO as platform that is designed for data collection and sharing; a platform that has the potential to help them better understand their living environment, or issues related to their official mandate (e.g. conservation). Furthermore, MMCO was described as instrumental to open conversation with some key stakeholders; a platform that enabled different stakeholders to meet and open critical conversations, and also as a channel for establishing connections that can be used in the future. MMCO was also perceived as an educational tool. A school teacher mentioned that they use the example of MMCO in their lectures with students, talk about the types of data that is generated in the initiative and discuss how this is beneficiary for the local communities that live with the wildlife in the Mara. He mentioned that this will help the students to develop ideas and communicate the issues with their friends and family members.

Nevertheless, almost none of the interviewees from this case study could identify an example of a mechanism by which MMCO has enabled them to (better) take part in decision making processes related to balancing biodiversity management and sustainable livelihoods. Interviewees often referred to the limited amount of data and information produced in MMCO as the reason for their answer. The only exception was the Meteorological Department of the Narok County that integrated the data from the TAHMO weather stations for improving their own forecasts and warnings.

A number of interviewees also believed that if the information produced in MMCO keeps accumulating, they will have a better understanding of their environment and, through that, they may be able to make better decisions within their organization on their community. An example of this situation was mentioned by a participant from one of the conservancies. He believed that the weather data and the information that is generated in the MMCO App has the potential to provide their conservancy with a better picture of existing problems and helps them to develop solutions for those problems. He also mentioned that this will be very useful as it helps them to make better decisions within their conservancy, but also

communicate the common issues with the neighboring conservancies and KWS.

Power Dynamics

Access to & control over data

Overall, the results of impact assessment interviews in the case of Maasai Mara Citizen Observatory shows a moderate increase in access to data and information for participants in this initiative and others who have heard about its results through various channels e.g. the website and casual conversations with members of this initiative.

The MMCO platform provides access to data from 13 TAHMO weather stations, four of which are installed as a part of the Ground Truth 2.0 project. In addition, weather and water level data from a number of low cost weather stations and water level sensors, which were installed as a part of the MaMaSe project, are also integrated into the MMCO platform. Moreover, by the end of November 2019, 232 observations were submitted using the Mara Collect App. Observations on biodiversity and scenery formed more than 85% of the total observations, while observations on topics such as pollution, natural hazards, incidents and emergency situations were less frequently submitted. In addition, mapathons (i.e. coordinated mapping events) were used as a participatory approach for generating data as well as increasing access to and control over data. The following table summarizes the information about a number of mapathons that took place during the lifetime of the Ground truth 2.0, with the aim of improving coverage of the maps in vulnerable places.

Overview of Ground Truth 2.0 Mapathons

Date	Location	Details
13 February 2017	IHE Delft, Wageningen University & Research, UT-ITC, Upande, various locations: IHE Delft alumni	200 participants
15 November 2018	Maasai Mara University, Upande, Map-Kibera, Youth Mappers, IHE Delft	2413 edits: 2061 buildings, 138 km roads
28 November 2018	IHE Delft and alumni in Uganda	150 participants
13 March 2019	Arusha (Tanzania)	Mini mapathon at the community of practice workshop Open Water Network event
28 March 2019	IHE Delft and Maasai Mara University	Online mapping for Cyclone Idai
18 November 2019	Maasai Mara University	30 participants
11 December 2019	IHE Delft	Land use and land cover (LULC) mapping

Most of the participants in the interviews mentioned that they have not so far used the data/information produced in MMCO. The majority of MMCO members highlighted that the available data/information is very limited and therefore perceived little or no change in access to data/information. The only exception was the weather data that was used by some stakeholders, including lecturers and students at the Maasai Mara University who used it for education and research purposes, and the Meteorological Department of the Narok County that used this data for producing forecasts and alerts. Nevertheless, some interviewees mentioned that there is potential for change in access to data and information, if the actual use and uptake of the App increases in the future.

The sensitivity of the data and information generated in MMCO was a concern for a number of stakeholders and therefore, a decision was made for producing a data sharing policy for MMCO. The need for this data sharing policy was realized half way through setting up this CO and the participatory process for

drafting, discussing and agreeing on took considerable amount of time and resources. However, agreement on this data sharing policy was critical for defining the level of access to raw/live data, as well as quality control or data sharing processes. This final draft data sharing policy was agreed upon in November 2019.

The majority of MMCO members did not perceive any change in their control over data/information. The only example was access to raw weather data from the weather stations that was only provided to some stakeholders, e.g. a few lecturers at the Maasai Mara University. Moreover, despite lengthy discussions on the data policy, there were opposing views on principle issue related to control over data. A respondent from the university believed that MMCO is an open system, and if needed, all members should be able to can access data and process the data. On the contrary, a respondent from KWS argued that control over data should be centralized within a relevant organization and this organization should be in charge of quality control and filtering of the data. Interestingly, none of the MMCO members referred to the data sharing policy as a determining factor for defining the level of control over data for different stakeholder.

Authority & power

'Authority and power' refers to the actual level of impact of different stakeholders on the decision making processes. Participants in the interviews in this Demo Case were asked to about the extent to which their influence in decision making processes regarding biodiversity conservation and livelihood management in the Mara region has changed because of their participation in the Maasai Mara Citizen Observatory.

The Ground Truth 2.0 partner organizations provided examples of changes in their authority and power, which based on Fung (2006) includes 'personal benefit', 'communicative influence' and 'advice and consult' modes. For example, the representative of one of the partner organizations mentioned that they are now "on everybody's radar", and as a result, their organisation has been invited to a number of meetings to discuss the Spatial Plan and the Integrated Development Plan of the Narok County. Another respondent from a different GT2.0 partner organization mentioned that they have been successful in communicating the value of data for decision making processes to a number of local and national organizations and they believe that if those stakeholders want advice or consultation with this regard, they will consult them.

Compared to the Ground Truth 2.0 partner organizations, this change was much less evident for the MMCO members. The majority of interviewees from this group did not perceive any change in their level of authority and power as result of their participation in this initiative. Those interviewees who already had a mandate for making decisions (e.g. interviewees from the Narok County, KWS, or KFS), believed that regardless of MMCO, they have a role in, and a mandate for, making decisions regarding biodiversity conservation and/or livelihood management. In addition, approximately half of interviewees who did not have any expectation to influence policy and decision making processes believed that MMCO has not helped with changing their influence. Nevertheless, the other half perceived a change in authority and power for influencing decisions. Some of these interviewees mentioned that through participation in the meetings and by using the MMCO tools, their knowledge has increased and they are now aware of the fact that they can contribute to observations and use this information for their own purposes. Some interviewees also mentioned that due to this increased knowledge and awareness, they are now better placed to influence public opinion and educate other community members. Comparing these finding with the baseline situation that was presented in D1.11, demonstrates that MMCO has not created new ways for exerting influence on decision making processes; rather it has reinforced the already existing modes by increasing participants' knowledge and awareness.

Annex 2 Methodology for assessing economic impacts of CO data for in-situ networks

The overall methodology for evaluating the value of CS observations with respect to in-situ networks consists of two main parts, namely the data perspective and the costs perspective. The former aims to qualify the degree of complementarity that the data collected by citizens offers to in-situ networks. The latter aims to qualify the relation between the investments required to set up a citizen observatory and the actual amount of data collected.

Therefore, the value of a citizen observation with respect to in-situ monitoring networks is a function of complementarity and costs, which, builds on the cost-benefit analysis approach presented in D.11. A data record is to be considered of maximum value if its complementarity is the maximum and if the cost to produce it is the minimum. On the contrary, it has little value if its complementarity is the minimum and its cost is high.

A2.1 Estimation of complementarity

Complementarity is defined as the degree in which existing data gaps coming from in-situ networks or models are filled in space and time by citizen-based monitoring. Spatial complementarity occurs if citizens provide observations in places that are unreachable by in-situ networks, whereas temporal complementarity occurs if citizens provide observations at times for which the in-situ network is unable to provide data. By definition, complementarity is scale dependent, and therefore initiative-dependent. Based on the concepts of spatial and temporal complementarity proposed by Hadj-Hammou et al. (2017), we propose the Complementarity Index (CI) as in Eq (1):

$$CI = w_s * SC + w_t * TC \qquad \text{Eq (1)}$$

where w_s and w_t are weights, between 0 and 1, that define the relative importance of space and time, respectively, according to the needs in each Demo Case; SC is Spatial Complementarity, TC is Temporal Complementarity, defined in the following sections.

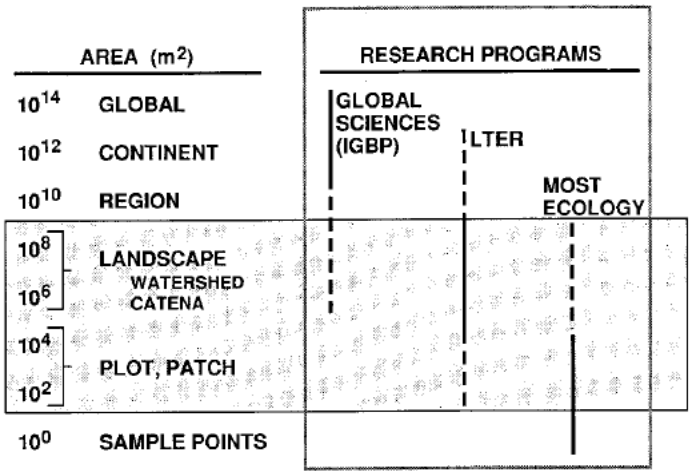
A2.3.1 Spatial Complementarity (SC)

Spatial Complementarity (SC) estimates the degree in which the spatial citizen observations complement the spatial observations of the existing in-situ network, by Eq (2):

$$SC = \frac{\sum_{cell=1}^{C}(cell_{citizen}\ AND\ NOT cell\ _{insitu})}{C} \qquad \text{Eq (2)}$$

where $cell$ refers to the unit of discretization of the area under study, according to spatial scales of the observed variables. The numerator in Eq (2) counts the number of times that cells are observed by citizens ($cell_{citizen}$) and, simultaneously, are not observed by in-situ sensors ($cell_{insitu}$); C is the total number of cells in which the area is discretised. SC ranges from 0, –when all the cells that are observed by the citizens have already been observed by the existing in-situ network, to 1, when all the cells are only observed by citizens (there is no in-situ network).

Spatial Complementarity is sensitive to the size of the cell, so it must be defined carefully. In principle, it can be defined by establishing the relevant scale of a variable, with the help of existing charts. An example of this chart is provided by Swanson and Sparks (1990) to specify the relevancy of spatial scales in research programmes (see Figure).



Spatial scales of ecology research. Shadow shows scales of Long Tern Ecological Research (LTER) concentration. Source: Swanson and Sparks (1990)

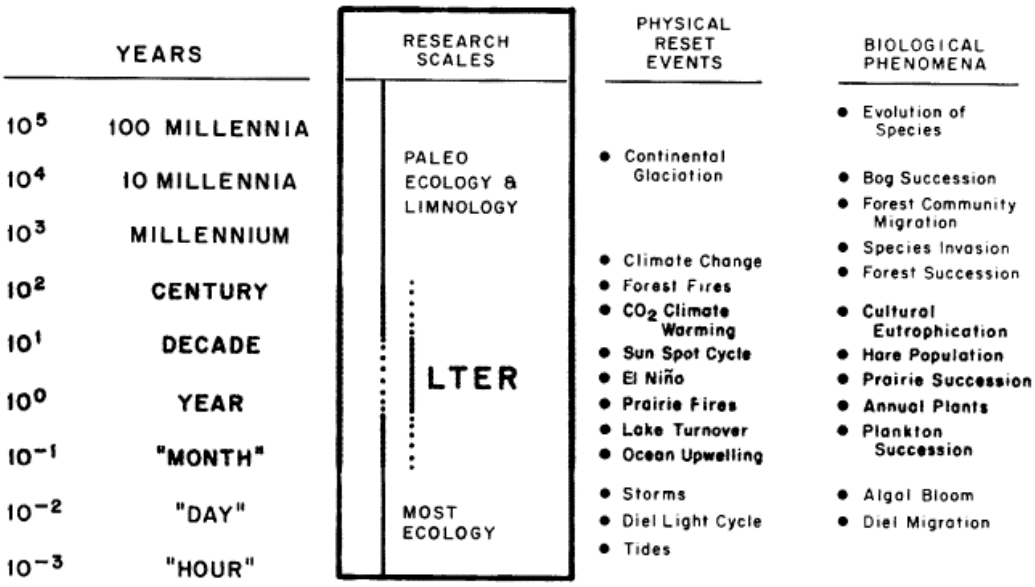
A2.3.2 Temporal Complementarity (TC)

Temporal Complementarity (TC) estimates the degree in which the temporal citizen observations complement the temporal observations of the existing in-situ network, by Eq (3):

$$TC = \frac{\sum_{season=1}^{S}(season_{citizen}\ AND\ NOT season_{\ insitu})}{S} \qquad \text{Eq (3)}$$

where $season$ refers to the unit of discretization time, according to the temporal scales of the observed variables. The numerator in Eq (2) estimates the number of times that seasons are observed by citizens ($season_{citizen}$) and, simultaneously, are not observed by in-situ sensors ($season_{insitu}$); S is the total number of seasons in which the time is discretised.

Similarly to SC, the unit of discretization in time for $season$ can be extracted from existing charts. For example, Magnusson (1990) offers the following chart:



Time scales relevant to various physical events and biological phenomena. Source: Magnusson (1990).

A2.2 Evolution of CO data cost in time

This section presents the approach to define the value of citizen data from the point of view of the costs of applying the CO and its evolution in time. As previously mentioned, this recalls a cost-benefit analysis, in which the costs of setting the CO are compared with the costs of collecting information via the existing in-situ monitoring networks. One of the most informative outcomes of this analysis is the estimation of the monetary value of one data record collected via the citizen observatory. This information is useful for prospective projects that are considering to set up a citizen observatory with the aim of collecting data.

The cost of a single CO data observation or record (CDR) since the beginning of the CO until any time T is estimated as:

$$CDR_T = \frac{\sum_{t=0}^{T} C_b}{\sum_{t=0}^{T} N_o} \qquad \text{Eq (4)}$$

where C_b is the cost of building a CO and N_o is the number of collected observations of a particular variable of interest. C_b takes into account the contributions of *applying* the GroundTruth2.0 methodology, and exclude the costs of *developing* the methodology. Although making a clean separation of these two costs is difficult, a valid approximation is to consider that the tasks related to research, project management, business development and dissemination are not related to *building* the observatory. An estimation of this cost for IHE Delft yields that approximately 38% of its total expenditures were dedicated to activities that support the application in all citizen observatories of the project. We use this conservative figure as a reference for the rest of the partners.

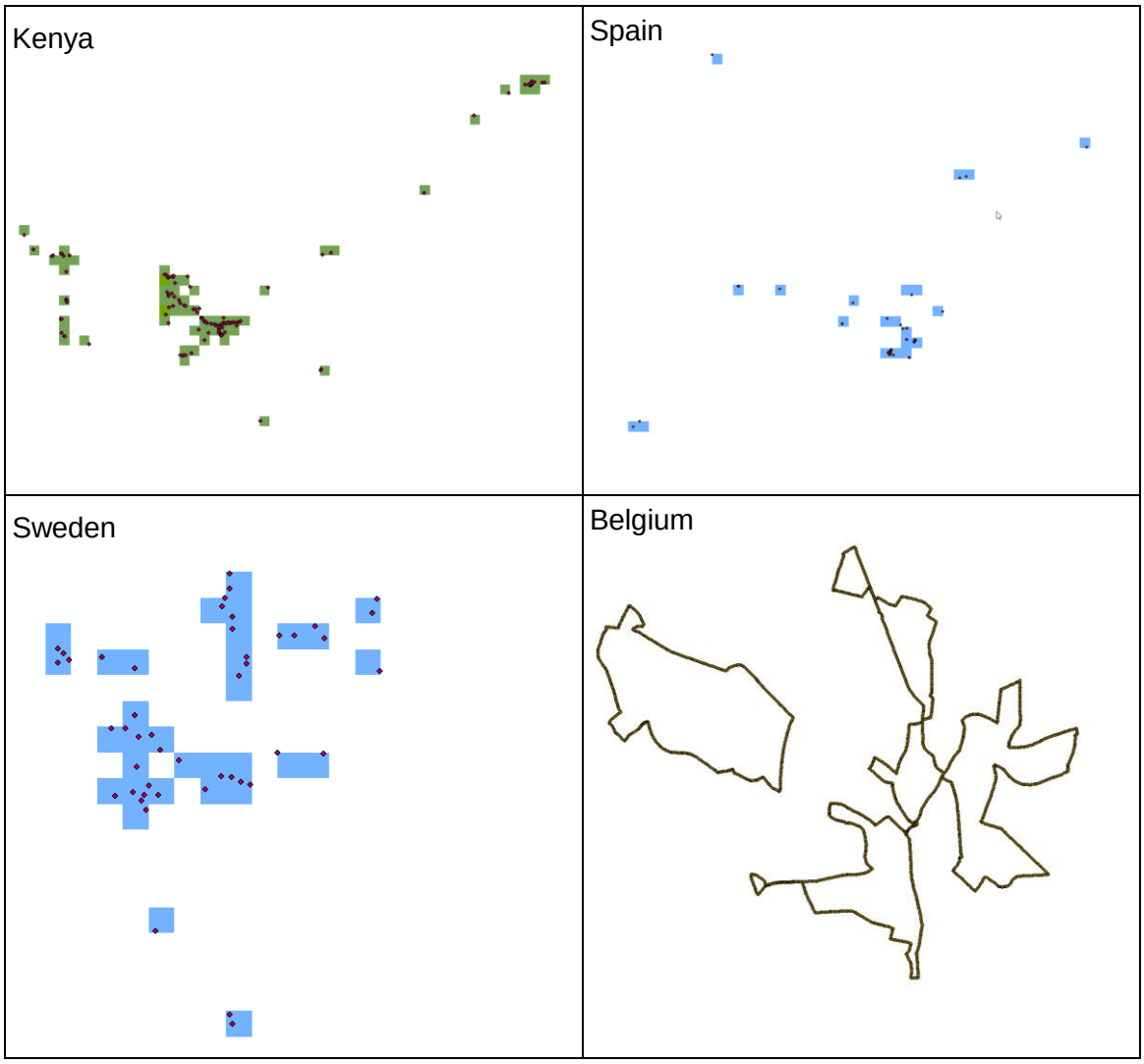
A2.2.1 Temporal analysis of CO costs

As we previously shown in D.11, the temporal analysis of this costs is of our interest, because it allows to understand how the progress in the application of the CO affects the CDR. As it was hypostatised in D.11, it is expected that the CDR lowers in time due to the decrease in effort in applying the methodology and, simultaneously, the increase in the number of observations.

This temporal analysis implies the estimation of the effort of each partner in each of the Demo Cases during the execution of the project, which is very demanding from the point of view of data availability. In this regard, the most trustful and accurate source of data was found to be the so-called Periodic Activity Sheets (PAS), an online tool that was used by the Project Coordinator to keep track of the progress of each Demo Case. Each PAS, which was updated every month, comprehensively reported the current and planned activities from January 2017 to March 2019 (25 months in total). We extracted the names of each involved partner (or the names of the personnel attached to each partner) and evaluated the amount of times their names were mentioned. Based on this data, the Table shows the proportion of participation of each partner in each Demo Case during the considered period.

Proportion of participation of each partner in each Demo Case during the period Jan 2017 – March 2019

Partner	*Belgium*	*Sweden*	*Spain*	*Netherlands*	*Kenya*	*Zambia*
IHE	16.0%	11.5%	8.4%	26.2%	21.9%	16.0%
HR	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
UPANDE	0.0%	4.4%	0.0%	4.4%	84.4%	6.7%
GAVAGAI	38.7%	8.0%	6.7%	37.3%	9.3%	0.0%
VITO	95.6%	0.0%	0.0%	3.7%	0.0%	0.7%
AKVO	27.0%	30.3%	0.0%	13.0%	21.6%	8.1%
STARLAB	2.0%	25.8%	39.1%	18.1%	3.2%	11.7%
ALTRAN	20.3%	0.8%	54.2%	18.6%	0.8%	5.1%
CREAF	0.0%	0.9%	99.1%	0.0%	0.0%	0.0%
SUNIV	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
EARTHWATCH	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
TAHMO	0.0%	0.0%	0.0%	0.0%	60.7%	39.3%
WWF	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
TYGRON	40.0%	60.0%	0.0%	0.0%	0.0%	0.0%



Distribution of observations (dots) and cell sizes in the considered Demo Cases.

Annex 3 Upscaling of Belgian Demo Case to Antwerp

After the successful organization of a CO in Mechelen VITO looked to other cities to upscale the Belgian Demo Case, using replication as a means for upscaling. VITO contacted other cities with whom they had cooperated before. The city of Antwerp was one of them and VITO contacted the environmental department in early 2018 and then VITO and IHE presented the Meet Mee Mechelen as well as the Ground Truth 2.0 project at large.

Co-design of the citizen observatory in Antwerp

The city of Antwerp was very enthusiastic as they had already experimented in the past with co-creation processes related to climate adaptation in selected neighbourhoods of the city. They were looking for ways to make these efforts more sustainable. It was decided to propose the Ground Truth 2.0 approach to citizens in the neighborhood St-Andries who have a very active citizen organization to render the neighborhood climate resilient. For several climate-related issues, actions were already ongoing, so the topic heat stress was identified as salient but as of yet unaddressed. Also, there were plans to develop an early warning system that would help health care workers to prepare vulnerable elderly people for a heat wave. Involvement of this stakeholder group was therefor also important.

Given the heatwave of summer 2018, a first citizen measurement campaign was organized measuring the Wet Bulb Globe Temperature (WBGT) temperature at 16 spots in the neighborhood. This measurement campaign served to train citizens to work with the specific temperature sensor and the Akvo flow app on smartphone and created awareness about the start and urgency of a CO on this topic.

After the summer, the regular Ground Truth 2.0 co-design steps were followed and a stakeholder analysis undertaken together with the City. Citizens and other stakeholders were invited to the co-design workshops. Due to the lessons learned in setting up the Meet Mee Mechelen CO, the GT2.0 team could compress the process for Sint-Andries into a shorter time scale and the Klimaatrobuust Sint-Andries CO was realised in 2019.

During the first co-design workshop, the causal analysis was produced, leverages and barriers were identified and a vision and mission were developed. In a next step, user stories were gathered and, based on those, objectives were formulated in the second co-design workshop. In the third co-design workshop, the functional design was validated. At the end of this co-design workshop, the stakeholders indicated to wish to find a better balance between the more abstract level of co-designing the citizen observatory and planning actions. Therefore, the 4th co-design meeting linked objectives to concrete actions.

Among other activities, in order to engage citizens, the co-design workshops were promoted through the city's website with articles and invitations for interested citizens. Working groups were created to locate cool indoor and outdoor places where vulnerable people can go during a heat wave. During summer 2019, a large measuring campaign was set up. Temperatures were measured during hot days (>25°C) with a WBGT sensor. Akvo flow technology was used to submit the measured temperatures via the app, along with additional observations about wind, shade and sun radiation. A short training was provided to citizens on how to use both tools.

The results of the measurement campaign were presented during an information evening on 30 September 2019, visualized using Akvo Lumen. Moreover, the results of the working groups for locating cool places were incorporated in the demo early warning system for heat waves. This is a website where heat waves are predicted and tips for preventing heat stress are provided.

Next steps and sustainability

The continuation of this CO is foreseen by embedding it in the civil society organization 'Klimaatrobuust Sint-Andries', partly supported by funding from the Stadslab 2050[22] initiative of the City of Antwerp. The translation of the functional design into the technical design for a digital platform has not yet taken place. The local community has happily taken responsibility for 'maintaining' the CO under the auspices of the Stadslab 2050 web site -(https://stadslab2050.be/klimaatadaptatie/stedelijke-hittestress). Later, it will be moved to the website to be developed by the citizen organization Klimaatrobuust ST-Andries.

This CO brings together stakeholders in the neighborhood of St-Andries Antwerp around climate resilience of the neighborhood. It is expected that similar campaigns, i.e. not only on heat stress but also on water resilience and green in gardens, will be undertaken. Decisions will be taken by the citizens with some involvement of the city of Antwerp. The data is owned by all stakeholders in this CO.

CO identity and location	*Core stakeholders/ owners*	*Result: Vision and Mission of the CO*
Name: Klimaatrobuust St-Andries ***Location and scale:*** *St-Andries, quarter of the city of Antwerp* ***Issue addressed:*** *Climate adaptation in general, heat stress in particular*	Citizen organization Klimaatrobuust St-Andries Environmental and health department of the city of Antwerp Elderly care institutes Thomas More graduate school Youth organization Habbekrats Beweging.net Research institutes VITO, IMEC…	Vision: St-Andries is a resilient and heat-resistant neighborhood where different stakeholders such as residents, healthcare workers, scientists, administration and politicians ... work together on a sustainable and constructively way to deal with causes and consequences of heat stress. Mission: The citizen observatory is a physical and online meeting place where citizens, policy makers and scientists gather information and knowledge about heat stress , make this accessible for everyone and actively spread the information in order to influence the policy agenda and start and maintain initiatives to reduce heat stress.
Process indicators	*4 co-design sessions and meetings (incl. some bilateral/split groups),* *2 measurement campaigns,* *2 public outreach campaigns,* *2 information session to discuss results with the public* *4 working group meetings*	

[22] https://stadslab2050.be/

Issue, Vision and Mission of Klimaat Robuust St. Andries		Objectives
Issue addressed: Because of climate change, the heat island effect in cities becomes more prominent. As a consequence heat stress is becoming a main challenge in Antwerp. Because of a large part of the population of St-Andries is quit vulnerable to heat stress, finding solutions for it is very important for the quarter. **Vision**: St-Andries is a resilient and heat-resistant neighbourhood where different stakeholders such as residents, healthcare workers, scientists, administration and politicians ... work together on a sustainable and constructively way to deal with causes and consequences of heat stress. **Mission**: The citizen observatory is a physical and online meeting place where citizens, policy makers and scientists gather information and knowledge about heat stress , make this accessible for everyone and actively spread the information in order to influence the policy agenda and start and maintain initiatives to reduce heat stress.		Gathering existing data and information on heat stress both indoors and outdoors, cool places and possible measures in St-Andries to map gaps and set up measurement campaigns to fill these gaps. Visualize own measurement results together with public data and information about campaigns, cool places, measures to be taken and make them available as open data for joint analysis and informing the wider community. 3. Increasing the scope of the civilian observatory so that we can bring together ideas that are already alive among different actors and turn them into new initiatives. 4. Support a continuous open and constructive dialogue between politicians, administration, local residents and scientists from the start and expand the network of stakeholders to a real community. 5. Facilitate concrete actions on prevention, behavioural change and infrastructure measures in function of different target groups in the neighbourhood
CO core members		**Participants**
Citizens/civil society organisations	Klimaatrobuust St-Andries, beweging.net, Habbekrats (youth), Elderly care homes, Thomas More Graduate school,	*Active*: • 20 volunteers for data collection campaigns • 30 participants best attended public event *Reach*: • 60 via CO email list • 100 via City email list • More via website Stadslab2050 • More via newspapers and radio
Scientists/data aggregators	Research Institute VITO, IMEC, Geosolutions	
Decision/policy makers	City of Antwerp (City administration) and District Antwerp	
Key activities		**Summary of outputs**
• CO activity planning meetings • Data collection campaigns & data analysis		**Online platform & tools**: *no specific online platform yet* . For now on city website: https://stadslab2050.be/klimaatadaptatie/stedelijke-hittestress Wet bulb Globe temperature measurement instruments together with a Akvo flow app - sends the data entered through the app to a server and database in AKVO to process
		Data & information: Wet bulb Globe temperature observations on 16 points in the quarter, summers of 2018 and 2019, scientific analysis resulting in graphs and recommendations.
		Communication & interaction practices: *progress towards cooperative planning* – citizens communicating with policy and decision makers, via CO and based on data and results