groundtruth2.0

Environmental knowledge discovery of human sensed data

D 3.4 Exploitation Roadmap

Final Exploitation Strategy

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Author(s)	Nina Costa (NDConsult), Elizabeth Gil-Roldan (Starlab)
Contributors	Uta Wehn (IHE Delft), Joan Maso (CREAF), Hans van der Kwast (IHE Delft), Stijn Vranckx (VITO), Annemarleen Kersbergen (HR), Ellen Pfeiffer (IHE Delft), Thomas Bjelkeman-Pettersson (AKVO)
Internal reviewer(s)	Thomas Bjelkeman-Pettersson (AKVO), Luigi Ceccaroni (CERT-Earthwatch), Sasha Woods (CERT-Earthwatch)
Contact for queries	nina.costa@ndconsult.eu; elizabeth.gil-roldan@starlab.es
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Abstract of deliverable	In this final Exploitation Roadmap report, the key activities to achieve sustainability of the 6 GT2.0 COs is presented as well as their Social Return on Investment (SRoI). Also, initial business plans for the exploitation of the Quality Tool and the Co-design Methodology are described.

Versions and Contribution History

Version	Date	Modified by	Modification details
v0.1	5/12/19	Nina Costa (NDConsult), Elizabeth Gil-Roldan (Starlab) with contributions from all demo teams and other tool leads	First draft version
v0.2	9/12/19	Simon Gathuru (Upande) Thomas Bjelkeman-Pettersson (AKVO), Ana Perez (Starlab)	Final inputs on Kenyan CO Internal reviews
v0.3	16/12/19	Ellen Pfeiffer (IHE)	Final inputs on Zambian CO
V0.4	18/12/19	Luigi Ceccaroni (CERT-Earthwatch), Sasha Woods (CERT-Earthwatch)	Internal review
V0.5	19/12/19	Nina Costa (NDConsult)	Final edits based on reviewer feedback

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List of abbreviations

AQ	Air quality
BMC	business model canvas
CAPEX	Capital Expenditure
CERT	Earthwatch
CO	Citizen Observatory
CRB	Community Resource Board
CBNRM	Community based natural resource management
CS	Citizen Science
CSO	Civil Society Organisation
DC	GT 2.0 Demonstration Case
DCL	GT 2.0 Demonstration Case Leader
EC	European Commission
EQL	Environmental quality of life
GT2.0	Ground Truth 2.0 project
ICT	information and Communications Technology
IPR	Intellectual property rights
LUM	Land Use Mapper
LULC	Land use land cover
NCRBA	National Community Resource Board Association
NGO	Non-governmental organisation
NRM	Natural resource management
OPEX	Operating expenditure
OSM	Open Street Map
QoL	Quality of life
PESTEL	political, economic, social, technological, environmental and legal
SP	Service provider
SRoI	Social Return on Investment
SVA	Social Value Add
SVP	Social value proposition
SWOT	Analysis of supplier strengths and weaknesses, and market opportunities and threats
TAM	Total addressable market
TRL	Technical Readiness Level
tbc	to be confirmed
tbd	to be determined
VA	Value add
VAG	Village Action Group
WB	Water Board
WP	Work package
WTP	willingness to pay

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1 Introduction

The Ground Truth (GT) 2.0 project's vision is to develop Citizen Observatories (COs) tailored to a range of user cases during the project duration, with the goal to expand these geographically (world-wide) and thematically (to cover a wide range of environmental themes).

The GT 2.0 project has delivered six scaled-up citizen observatories with varying degrees of operational conditions. The six are widely distributed geographically, with four being undertaken in Europe (Belgium, Spain, Sweden and the Netherlands) and two in Africa (Kenya and Zambia).

The long-term sustainability of each CO depends on two aspects:

1. the long-term engagement of the community of users (including the contributions from this community in terms of information collection) and
2. the financial sustainability of the information provision via the CO platforms (the CO products and services).

The issue of ensuring continued user engagement is covered in WP1 of GT 2.0, with the Stakeholder Engagement Strategy (D1.3 and D1.4), while the work presented here forms part of the second aspect and concerns the financial sustainability of the COs.

1.1 Objectives of the WP

The objectives of WP3 are:

- To clearly identify the value propostion to customers/users of the CO products and services.
- To understand the markets in which the COs will be operating, in terms of structure, segmentation, size and competition.
- To understand and define business models suitable for COs, taking into account the specific characteristics of each of the stakeholder communities.
- To develop the case for the sustainability for the six GT 2.0 information platforms, in terms of organisational structures and funding (private or public).
- To support the service providers (SPs) for the implementation of measures for long-term sustainability of their platforms, and for the leverage of new market opportunities both inside and outside of Europe.

To achieve these objectives three main tasks were undertaken:

- Market research and analysis,
- Business model analysis,
- Development of an exploitation roadmap.

The outcomes of the market analysis and business model analysis both form key inputs for the development of this sustainability roadmap for each of the CO platforms. The outcomes of these specific analyses are reported in a number of previous deliverables, including D 3.1 and D3.2 – Reports on Market Analysis and Market Update (versions 1 and 2), and D3.3 – Sustainable Business models for the GT 2.0 products/services. Each CO is considered individually since they have very different product/service offerings and target markets. Tools developed under GT 2.0 that potentially have commercial value are also considered, such as the Land Use Mapper, the GT 2.0 Methodology and the Quality Tool.

1.1.1 Purpose and scope of this document

The purpose of this report is to outline the activities or roadmap that are required for the exploitation of the COs and tools developed during the GT 2.0 project. These COs and tools are summarised in the table below:

Table 1. COs and tools developed during the GT 2.0 project.

Name	Type	Topic for data collection	City or location	Country
Meet Mee Mechelen	CO	Air quality (& noise)	Mechelen	Belgium
Klimaatrobuust Sint-Andries	CO	Heat stress	Sint-Andries, Antwerp	
Grip op Water Altena	CO	Pluvial flooding	Altena	The Netherlands
RitmeNatura	CO	Phenological observations	Catalonia	Spain
VattenFokus	CO	Water quality	Lake Dunkern, Södermanland County	Sweden
Maasai Mara	CO	Natural Resource Management	Maasai Mara conservancy area	Kenya
National CBNRM	CO	Natural Resource Management	(national scope)	Zambia
Quality Tool	web tool	Verification of data collected by citizens	n/a	n/a
Co-design Methodology	methodology	For the implementation of co-designed projects	n/a	n/a
OSM LUM	web tool	Land use and land cover mapper	n/a	n/a

By roadmap, we refer to a plan that outlines the short, medium and long-term activities that should be undertaken by each of the community partners or service providers to achieve the goal of exploitation of the COs or tools. This report comprises a dedicated chapter for each of the COs and tools/methodology listed in the table above.

On the topic of exploitation of the COs, we have to admit to naivety at the start of the project for thinking that the COs would attract private investment and revenues through subscriptions, etc. When it became obvious to the team such 'commercial' returns were very unlikely, we changed our approach to put more emphasis on the social value add (from for example environmental benefits) and wider public good aspects of the COs. It became clear that the value of the CO outcomes is significant when considering the social dimension, and thus it made more sense to evaluate the social return on investment (SRoI) of the COs, rather than their potential financial return on investment. Thus we started moving away from thinking about commercial exploitation and towards a search for public funding to sustain the platform and operations of the CO. This is coherent with the approach that public good initiatives should be funded from the public purse, in whatever shape the funding may take.

Besides an analysis of the financial sustainability of the COs, we have also taken into account other activities that are necessary to ensure that the COs are 'kept alive' or sustained. These include sustainability of the data/information platforms that have been developed, continuation of the data collection campaigns by citizens (regular campaigns or on an ad-hoc basis), and the endurance of the CO community or

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group of stakeholders. These aspects have been included in the roadmaps of each of the COs and are discussed more in depth in the sections below.

In contrast, the GT2.0 Co-design methodology and the Quality Tool are products and services that can be commercialised, and we have defined exploitation roadmaps for them with the aim of running a profitable business. These business cases are based on their target markets, their total number of potential customers (total addressable market) and an estimated increase in number of customer year on year (market uptake). Once service pricing and costs are included in the mix, the annual revenues can be estimated.

1.1.2 Links with other WPs

The diagram below illustrates how the four tasks undertaken by WP3 contribute to this final analysis, but also how this strongly relies on inputs from other WPs and tasks, especially WP1 (for stakeholder analysis and stakeholder engagement).

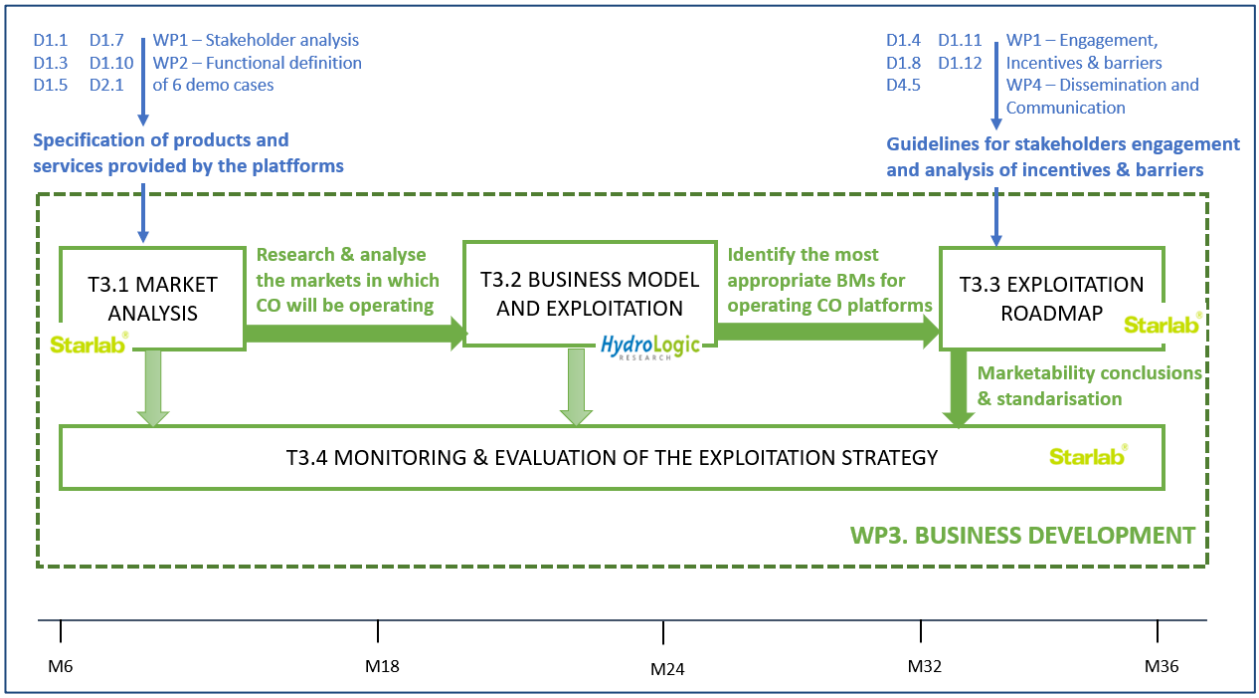

Figure 1. Contribution of the fours tasks to the final analysis and inputs from other WPs and tasks.

1.2 Methodology and activities undertaken

During the initial years of the GT 2.0 project, the focus was on the co-design and specification of the COs with the core stakeholders. Once the functional design of the COs was completed, the products and services offered by the COs were specified and this allowed the WP3 team to start their analyses on the benefits or value-add that these would offer their end-users or customers.

WP3 also built upon the stakeholder analysis and the functional definition of the six citizen observatories (reported in D1.1 and D1.5). The next step was to research and analyse the markets in which the COs operate. The aim was to attain that market size estimates together with information on who would be willing to pay for such products and services. This, together with estimates of the costs and revenues (or funding), would inform the exploitation potential of the COs.

In parallel an investigation was undertaken to identify the most appropriate business models for operating the CO platforms. This was a challenge in light of the fact that COs are relatively new to the realm of environmental information service provision, and that they have strong social value or public good dimension. Thus, WP3 adopted the non-profit business model canvas (which includes social value proposition, indirect beneficiaries and social return on investment (SRoI) aspects), to accommodate the specific characteristics of the COs, e.g. the key partners or core stakeholders are also beneficiaries of the CO. See D3.3 for details.

1.3 Lessons learnt and revision of our approach

Initially WP3 planned to follow a traditional marketing approach to the exploitation of the COs, which is outlined in Annex 1. In practise, we had to adapt this approach significantly during the project as it turned out to be a poor fit. Here we outline the key lessons learnt and the adaptations that we applied during our analysis.

1.3.1 Market analysis and exploitation

Desk research was carried out to analyse the markets for the CO products and services, especially with regard to the market size, e.g. the number of conservancy areas in Zambia and Kenya. The total addressable market (TAM) figures were obtained in this way, but these proved less useful than in a traditional market analysis as the local focus of the COs did not lend itself well to upscaling, but rather to geo-replication, i.e. replication of the CO for another city or region. This information and data on the market opportunities for each of the CO platforms and the GT2.0 Methodology and Quality Tool is presented in deliverable D3.2 – Update report on market analysis and market uptake. Similarly, the SWOT, PESTEL and competitor analyses turned out to be an interesting exercise for an in-depth understanding of the COs, but it did not lend itself to estimation of the market uptake. This is probably due to the fact that market uptake, in its traditional sense, is not really applicable to COs which are principally driven by the communities involved. In retrospect it would have been better to consider the factors that drive community expansion, as this would better reflect the potential growth in size of the CO.

In lieu of market uptake, we did consider two ways in which COs can expand – either **thematically**, to include other environmental thematic areas, or **geographically**, towards other cities, counties or regions. Thematic expansion is possible within the COs as they have been initially developed with a limited number of environmental parameters in mind. Geographic expansion is more challenging for the six COs of GT 2.0, since many have (by design, or by co-design in this case) a local focus which the core stakeholders want to retain (as this is seen as a key advantage of the COs). Thus, rather than geographic expansion of the individual COs, we considered geographic 'replication' of the COs – i.e. a copy of the CO based in another city, region or country. This might not apply to the whole CO platform, but it could apply to the front-end of the CO platform – such that the user 'sees' (through the user interface) only a local system and local data.

On the topic of exploitation, we were initially naive in thinking that the COs would attract significant private investment, as well as accrue revenues from CO subscriptions or for the provision of information services. This approach was however thwarted by a number of factors:

- The communities were strongly against investment by the private sector, as this would undermine the goals of keeping the CO independent and the information impartial.
- The value propositions of the COs have a strong social dimension related to improved environmental stewardship and management.

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- It is mainly citizens and the public sector that will benefit from the information collected and collated on the platforms.
- The non-profit business model canvas was more applicable to the COs.

Over time it become clear to us that true 'exploitation' of the COs – in that the COs would be operated as 'profitable' businesses – was unlikely. Thus, we scaled our expectations back to them being run on a basis more akin to organisations or foundations with charitable or social advocacy /environmental goals. In retrospect this now seems rather obvious. Thus, in this analysis, our focus changed from exploitation to ensuring financial and social sustainability of the COs.

1.3.2 Financial sustainability

It was essential to consider some financial figures, even if they are not part of a business plan per se. It is still essential that the operating costs of the COs are estimated such that it is known what level of funding will be required to sustain the CO – albeit from social enterprises or the public purse. It should be noted that for the COs, their development costs have not been taken into consideration in our analysis. Normally these would be considered under CAPEX or capital costs, but in all cases the development was paid for under the GT2.0 project budget and therefore can be considered as a sunk cost.

Potential business models for each of the COs have been developed, and in all cases a non-profit model was applied, as explained above. This exercise was carried out around six months before the end of the project, and at this stage there were a large number of uncertainties surrounding the future ownership and financial support for the COs. For this reason, a number of options for each CO were presented in D3.3 with a view to a positive outcome for hand-over of each of the information platforms by the demo teams before the end of the project in December 2019. In this next step, and profiting from the progress made in many of the COs, we asked the teams to identify the **most likely scenario** from future ownership of the CO and how its continued operations will be funded. This is reported for each of the COs in Chapters 2-7.

1.3.3 Social sustainability

The social sustainability of the COs is dependent on the benefits or value-add that the stakeholders will accrue from having an on-going and operational CO. The non-profit business model canvas (BMC - elucidated in D3.3 for each CO) includes the social value proposition (SVP) or value-add, but it also considers non-financial outcome streams. This is considered as important as revenues for the standard BMC, as it quantifies, as far as possible, the social value that is delivered. This in turn can be used to justify a request for public support and funding for the continuation of the CO.

To estimate these non-financial outcomes, the team had to apply a new methodology. We considered the Value of Information (VoI) and the contingent valuation methods, but choose the methodology described in 'Measuring Social Value – A social metric primer[1]' with its focus on stakeholders. This seemed to be well aligned with the participatory design principles of the COs and the extensive involvement of the core stakeholders. In addition, it is aimed at organisations that have a triple bottom line in that they blend three different values – economic, social and environmental outcomes, which fits well with the COs developed in this project.

The first step in this approach is to define and identify the stakeholders – an exercise carried out already, with great depth from the beginning in WP1. These key stakeholders are then asked to identify their inputs

[1] B.Bhatt and T. Hubb, Carleton Centre for Community Innovations, Carleton University, Canada, 2013

(or resource contributions) to the CO, the outputs of the CO, the subsequent outcomes (defined as the short to medium term effect of the outputs) and then finally the long-term impacts of the CO. In a final step, financial proxy or contingency values were given to these impacts (as far as possible) to give an indication of the social return on investment (SRoI) of the CO. It should be noted that this SRoI value, is of particular importance when seeking public funding for the COs and for justification of the amount of funding sought.
To this end, WP3 carried out face-to-face interviews with a range of stakeholders from each of the six COs. The aim was to get different views on the potential impact of the CO from the triumvirate of stakeholders (i.e. citizens, policy makers and data aggregators). See Annex 2 for the impact questionnaire that guided these interviews which was based on insights (namely, expected outcomes and impacts of the COs) produced by WP1 and reported in D1.7 Initial report incentives and barriers and D1.11 Initial validation and socio-economic impacts report. The interviewees needed to be strongly involved in the development of the COs, very well informed on the objectives and the outputs, and thus only 2-4 interviews were carried out for each CO. Thus, we have to stress that the outcome of this analysis is purely indicative of the extent of the SRoI rather than attempting to be a definitive estimate.

A minor modification was made to this methodology in that we categorised the outcomes according to those that are knowledge & inspiration outcomes and those that are actionable, in order to be coherent with the reverse impact journey exercise that was carried out by WP1 for all the COs through the co-design methodology developed throughout the project.

The final step is to put a financial 'proxy' value on the long-term impacts of the CO, i.e. to translate the non-monetary value of the impact into monetary value or proxy for the stakeholders. One way of doing this is through contingent valuation or value-based monetarisation. This method links a value to an impact (that does not have a direct market price or cost price) by assessing how people value the solution through their willingness to pay or willingness to accept it.

We have included this analysis in this report – with the principal aim of comparing this value to the estimated costs of keeping the CO operational. Clearly if the social value outweighs the operational costs, then it makes sense to keep the CO sustained.

1.4 Community sustainability

As explained above, the financial support of the CO by the institutions that have agreed to take over ownership of the CO, is key. However, platforms, websites and agreements are not the only thing that keeps a CO running. One of the most critical aspects of keeping the COs 'alive' is the sustainability of the community that took part in the co-design process and that drives the CO. During the project, considerable coordination and dissemination effort was undertaken by the project partners, but the majority of project partners will no longer have a mandate to do so after the project ends. It is critical that it is recognised by the new owners that considerable effort is needed to sustain the CO community and to keep the citizens engaged. This aspect has also been considered and analysed in-depth for each CO under the Stakeholder Engagement task of WP1, and is reported in D4.1 – Updated Engagement Strategy.

1.5 Exploitation of the GT 2.0 tools and methodology

When it comes to the GT2.0 tools (Quality tool and LUM) and Co-design Methodology, here we can talk about exploitation in the traditional sense, and the marketing aspects of product, price and promotion can be defined. Here it also makes sense to consider the total addressable market (TAM), i.e. all potential users of these tools, and to estimate the likely year on year uptake by customers of these tools. For these, the market-based and business case methodologies, detailed in Annex 1, can be applied.

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In D3.3, the standard BMC (business model canvas) was developed for the two tools and the Co-design-Methodology. For all three, there is no product pricing per se, i.e. a standard product will be made available without charge, but the customer is offered consultancy services (at a price) for customisation or for support in applying the tools or Methodology.

In D3.2 (Updated Report on Market Analysis and Market Uptake), an analysis of these tools is presented, (e.g. market segmentation, value-add, SWOT, PESTEL and competitor analyses), allowing us to define the TAM and consultancy pricing. Now in a final step, we have estimated the potential market uptake over the next few years and the promotion activities that are needed to support this. This is presented in Chapters 8-10.

2 Sustainability of Meet Mee Mechelen CO

2.1 Social return on investment

For the analysis of the Meet Mee Mechelen CO we managed to conduct four interviews, three with citizens representing various local community groups and one with an individual from the Mechelen municipality. For the citizens, their inputs mostly concerned their voluntary time dedicated to the measurement campaigns and information meetings. For the municipality, their inputs were more onerous and including staff time of 1-2 days a month and the production of promotion materials of around €1,000 per year.

In the table below, we present a summary of the responses of the interviewees regarding outputs, outcomes and impacts:

Table 2. Summary of the responses of the interviewees regarding outputs, outcomes and impacts.

Outputs	Data on soot/black carbon (BC) levels in the city, showing pollution hotspots Open information events held to inform the wider community on air quality in the city
Knowledge and Inspiration OUTCOMES	Evidence to pressure the municipality to take action regarding pollution hotspots Raise awareness and urgency of air quality problems Open discussions between citizens and the municipality of Mechelen on sustainable mobility in the city centre
Action OUTCOMES	Management plans by the municipality to extend the car-free zones in the city Behaviour change on the part of citizens to use bicycles rather than their cars for trips into the city centre
Long term IMPACTS	Improved air quality in the densely populated city centre. Inspiration for other cities for follow suite.
Quantitative estimate of impacts	5-40% reduction in traffic in the city centre, leading to improved air quality
% attributable to the CO	25% of the reduction in soot levels in the city centre

Note that for this analysis we have assumed that the above-mentioned action outcomes will be undertaken for the impacts to be realised. Consequently, we also recognise that the full extent of the impact

cannot be solely attributed to data/information provided by the CO, but that the can play a significant role in CO contributing to these outcomes and impacts – especially considering that the information provided often forms the starting point for discussions on future management plans. For Meet Mee Mechelen the stakeholders estimated that 25 % of the improvement in air quality in the city centre could be attribute the existence of the CO.

To estimate the 'proxy' value of this extent in air quality improvement, we researched the willingness for people to pay for a reduction in air pollution. The most appropriate estimate we found was from paper by Istamto et al.[2] , where citizens in a number of central European countries[3] were willing to pay around € 100/year/person for a reduction in air pollution of 50%. (A study in Poland indicated €60/year/person[4]). If the former is extrapolated to the city centre of Mechelen with its population of 85,700 (in 2017), the citizens would be willing to pay €8.6 M per year for such a 50% improvement in air quality. Considering that only an 18% improvement on air quality is envisaged for Mechelen (taken from the 5-40% estimate above), this reduces this overall value to around €3M per year, of which 25% or €771,000/year can be attributed to the CO. Thus, we estimate that the SRoI of the Meet Mee Mechelen is around €0.8 M per year for the city of Mechelen. This 'theoretical' estimate of the public good for the CO, exceeds the amount of funding that will be sought from the City of Mechelen to continue the air quality monitoring campaigns (of €5,000 to €7,500 biannually – see section below), by more than a factor of 10.

2.2 Most likely sustainability scenario

The sustainability of the Meet Mee Mechelen CO and platform has been agreed, in that it will be handed over to Klimaan – klimaan.be . Klimaan is a broader citizen initiative run by a Flemish group of volunteers that are concerned with 'common goods' such as (healthy) air, (clean) water, land, renewable energy, (local) healthy food, open data, information, knowledge, etc. Management of these are carried out by citizens who are supported by the community.

Meet Mee Mechelen becomes a working group on Air Quality within Klimaan, thereby strengthening Klimaan but still keeping the CO citizen driven – representing a win-win situation for both parties. An agreement was reached in Klimaan in October 2019, but the physical migration of the data and content of the CO to Klimaan remains to be carried out. In the hand-over, the main change concerns the role of the experts from the GT2.0 team and the role of city of Mechelen. The team aims for a smooth continuation with keeping up frequent contacts with the municipality of Mechelen.

It is likely that the air quality (AQ) monitoring campaigns will continue in order to monitor the impact of new implemented policies. Klimaan will request funding for this from the municipality and VITO will organise these campaigns with funding from the Flemish Government (Science and Innovation Department) on a project by project basis. It is estimated that the AQ campaigns will take place every second year, and that in 2022, heat stress monitoring will also start in Mechelen. These activities are summarised in the table below.

[2] Multi-country willingness to pay study on road-traffic environmental health effects: are people willing and able to provide a number?, Istamto et al, Environmental Health 2014 **13**:35

[3] UK, Finland, Germany, The Netherlands and Spain

[4] Measuring the Willingness to Pay for Improved Air Quality: A Contingent Valuation Survey, Magdalena Ligus, Pol. J. Environ. Stud. Vol. 27, No. 2 (2018), 763-771

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Table 3. Summary of the sustainability outlook for the most important responsibilities of the CO.

Key activities	Responsible entities	Associated costs	Sources of funding
Handover of Meet Mee Mechelen data and information to the Klimaan platform	VITO and Klimaan	n/a	GT2.0 project budget
Hosting, operations and maintenance of the platform	Klimaan	-	RESCOOP[5] Europe
Leasing of sensors for AQ and noise (from VITO)	Mechelen municipality	(included in campaign costs)	(see below)
Air Quality monitoring campaigns every two years in Mechelen	Klimaan and VITO	€10,000 – 15,000/campaign	50% funded by Mechelen city and 50% by Flemish gov.
Heat stress campaigns in Mechelen every two years, starting in 2022	Klimaan and VITO	€10,000 – 15,000/campaign	50% city funding (from Mechelen city), 50% funding by Flemish gov.

Thus, VITO foresees their continued involvement and an increase in their project business by €5,000 – 7,500 € every year from the Science and Innovation Department of the Flemish Government.

2.3 Market expansion

In D3.2 – Updated Report on market analysis and market uptake, we reported on the thematic and geographic expansion opportunities for Meet Mee Mechelen. At this point in time, geographic and thematic expansion had already been realised, in that VITO set up a CO concerning heat stress in a suburb of Antwerp, Sint-Andries.

Mechelen is also interested in the monitoring of temperatures and heat stress in the most densely populated areas and it is estimated that this could start as early as 2022. The monitoring of noise pollution, which was planned for inclusion under the original Belgium demo case, has not yet been realised but neither has this idea been scrapped by the Mechelen municipality as it is an important aspect of their city mobility initiative. It is thus highly likely this topic will be introduced under Klimaan. However, thematic expansion to mapping of green areas in Mechelen is unlikely since the municipality of Mechelen is already doing this under another initiative.

There is a likelihood of geographic expansion to other Belgian cities, albeit not high, since many other cities are developing climate adaptation plans, and also due to the fact that air quality is increasingly moving higher on the agenda of policy makers as well as citizens. Geo-replication to another city in a neighbouring country, such as Amsterdam is also thought likely, as the local government there is already considering plans for city mobility and improving routes for urban cycling and walking paths.

Klimaatrobuust Sint-Andries

The demand/request for a CO to monitor extreme heat events in urban areas came to the attention of VITO from a very active citizen group in the Sint-Andries quarter of Antwerp. Due to the lessons learned in setting up the Meet Mee Mechelen CO, the team could compress the process for Sint-Andries into a shorter time scale and the Klimaatrobuust Sint-Andries CO was realised in 2019. In this way, these two COs have been developed synergistically over the last year of the GT2.0 project. The VITO team foresees

[5] Rescoop.eu

the continuation of this CO through embedding the CO into the citizen organization Klimaatrobuust Sint-Andries, partly with funding support from the Stadslab2050 initiative of the City of Antwerp. The local community have happily taken responsibility for 'maintaining' the CO under the auspices of the Stadslab 2050 web site - https://stadslab2050.be/klimaatadaptatie/klimaatrobuust-sint-andries.

Active members from the local community carried out temperature monitoring campaigns in Sint-Andries during the summers of 2018 and 2019, using advanced digital thermometers[6]. It is expected that from 2021, such campaigns will be rolled out to other quarters of Antwerp (45 in total). It is expected that similar campaigns, not only for heat stress, but also for water resilience and greening of gardens (green/blue measures), will be undertaken. Such campaigns will be undertaken every year at a cost of around €10,000 to 15,000, with 50% of the funding coming from StadsLab Antwerp and 50% from the Flemish government through project work by VITO.

Table 4. Summary of campaigns that will be undertaken.

Key activities	Responsible entities	Associated costs	Sources of funding
Hosting of the data	Stadslab2050 (short-term) Klimaatrobust Sint-Andries (longer term)	€20-30/year	Stadslab2050 existing budget for their web-site
Leasing of sensors from VITO	Antwerp City	(included in campaign costs)	(see below)
Implementation of early warning system for heat stress (Hitteverk-likker)	Klimaatrobust Sint-Andries and Antwerp City	around €30,000	Antwerp City
Heat stress and other CS campaigns in Antwerp every year	Local community (Sint-Andries) and VITO	€10,000 – 15,000 /campaign	50% city funding (from Burger-begroting[7] Antwerp), 50% funding by Flem-ish gov

Once again VITO will benefit from this CO by receiving additional funding from the Flemish government for projects related to heat stress.

2.4 Roadmap for sustainability

Meet Mee Mechelen CO shows a strong social/public good value, and this strongly justifies its public support. However, the biggest challenge for Meet Mee Mechelen lies in the competition for government funding from many other 'green' initiatives. On the positive side, the Flemish Department of Environment (LNE) is looking to support local initiatives that will improve the EQL (environmental quality of life) for citizens in Flanders, and once the Meet Mee Mechelen and Sint Andries COs are sustainable, they will show convincing outcomes to gain funding from the public sector.

[6] Wet bulb globe temperature sensor

[7] Budget set aside for citizen initiatives

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Klimaan has agreed to owning and hosting the platform, and the municipality is likely to fund around 50% of the future measurement campaigns (with the other 50% coming from the Flemish Department of Science and Innovation). VITO will stay involved through project budgets from the Flemish government for organising the campaigns and providing their tools and apps.

Here we present the various actions that need to be undertaken to ensure the sustainability of the Meet Mee Mechelen, in light of it being subsumed into the Klimaan sphere.

Table 5. Actions that need to be undertaken to ensure the sustainability of the Meet Mee Mechelen CO.

Actions to sustain	CO platform	Data collection	CO community
Short-term (until end of project)	Transfer of data and content to the Klimaan platform		Organise and info event regarding the hand-over to Klimaan
Medium-term (next 1-2 years)	Find a 'home' or location on the Klimaan web site for reporting on noise 'pollution' or disturbance	Leasing of sensors by city of Mechelen from VITO for Air Quality Run an air quality monitoring campaign every two years VITO to support with organisation of monitoring campaigns and obtaining funding of up to 50%) from the LNE (Flemish gov) Run the first noise monitoring campaign in Mechelen	Ensure that Mechelen municipality remains involved through the city's Environment Advisory Board project-based meetings Continuation of the constructive relationship with the city of Mechelen Organise regular information events (on AQ and noise) to ensure that citizens remain actively involved Citizens to lobby city of Mechelen and follow political advancements Citizens to promote CO on social media
Long-term (2022 onwards)		Organise heat stress monitoring campaigns every two years	Propose heat stress monitoring, or of other topics, to citizen groups in Mechelen Verify the impact of changes in implemented policies on mobility in Mechelen

Here we present the various actions that need to be undertaken to ensure the sustainability of the Klimaatrobuust Sint-Andries CO. As mentioned before, sustainability of this CO is very likely due to hosting by the citizen organization and partial funding from Antwerp's Stadslab 2050 initiative, and continued support from VITO through projects funded by the Flemish government.

Table 6. Actions that need to be undertaken to ensure the sustainability of the Klimaatrobuust Sint-Andries CO.

Actions to sustain	CO platform	Data collection	CO community
Short-term (until end of project)	Finalise discussion on sustainability of data and information	Local community members with support from VITO	Find a sustainable working relationship between the Sint-Andries community, the city of Antwerp and VITO
Medium-term (next 1-2 years)	Find a 'home' for reporting on heat stress monitoring campaigns Transfer of data and information to Stadslab 2050 web site, or other city, open access web site Create communication and promotional materials (Klimaatrobust Sint-Andries)	Local community members with support from VITO Leasing of specialised sensors by Antwerp City or citizens Annual data collection campaigns in Sint-Andries	Explore the possibility of including other possible partners if need be Actively lobby city of Antwerp and follow political advancements Organisation of meetings to plan campaigns and inform citizens
Long-term (2022 onwards)	Maintain data and information Expand data and information repository with data from other areas of Antwerp	Run data collection campaigns in other quarters of Antwerp	Involve local communities from the other quarters of Antwerp Verify the impact of changes in implemented policies on green/blue measures in the quarters of Antwerp

3 Sustainability of Grip op Water Altena, Netherlands

3.1 Social return on investment

For the Dutch CO, three interviews were undertaken, one with a concerned citizen, one each with the representatives of the municipality and the Waterboard. In the table below, we present a summary of the responses of the interviewees regarding outputs, outcomes and impacts:

Table 7. Summary of the responses of the interviewees regarding outputs, outcomes and impacts.

Outputs	Observations during heavy rainfall events Information on measures citizens can take to minimise flooding Data and information on projects from the Waterboard and municipality (e.g. wetlands outside of the urban areas)
Knowledge and Inspiration OUTCOMES	Understanding the situation in the event of heavy rainfall Evidence – showing an example of regional based work Awareness of local measures that can reduce pluvial flooding, e.g. through collaboration with local specialists in garden design Awareness – improvement in the image/visibility of the work done by the Waterboard and municipality re mitigation of flooding

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Action OUTCOMES	Improved decision making and management plans by the municipality and WB Behaviour change on the part of citizens, inspire them to take their measured on their own properties Community action – creation of a network of professionals/local specialist and citizens
Long term IMPACTS	The area is better prepared for heavy rains and thus less damage caused by pluvial flooding Gardens will be 'greener' (reduction in sealed surfaces) and more rain resistant
Quantitative estimate of impacts	Flood event in 2014/2015 damaged 100 properties with an average overall cost around €500,000 €20 M has been invested by municipality of Altena on measures to reduce the damage caused by pluvial flooding (including enlargement of sewer systems, dredging water cannels to improve discharge, creation of wetland outside urban areas)
% attributable to the CO	5%

We estimated that the economic loss of around €500,000 in damage was caused by the last pluvial flooding in Altena. If a CO can reduce this even by a small amount (e.g. €25,000), this still compares favourably with the associated costs of hosting the website – see below (€20-30/year). Efforts to improve the management of the risk of pluvial flooding should be undertaken by the Water Boards, municipalities and citizens alike.

3.2 Most likely sustainability scenario

At the time of writing the different scenarios of continuing Grip op Water Altena (Deliverable 3.3), it was not yet clear how the CO would be sustainable after the project. In the summer of 2019 the conversations with the CO member on this topic continued, and fortunately a framework for continuation emerged.

Grip op Water will continue as a working group under the Agrarische Natuurvereniging Altena (ANV - Agricultural Nature Organization). It will be an umbrella platform for all the different organizations and citizens within Altena that deal with water and climate. The principal activity of the platform would be to discuss and align goals & activities.

The municipality and the water board will still be involved in Grip op Water. For the municipality Grip op Water is a good channel to communicate with the citizens. For the Waterboard, Grip op Water is a useful network to keep in contact with the Land of Heusden en Altena. They are keen on making their data and information available to the public. This will benefit them in a number of ways: they will save staff time in responding to citizens' questions and complaints and they see Grip op Water Altena as a means to reach out to and involve more citizens (coherent with the Dutch government's new policy). At this stage, citizens are less interested in monitoring water levels or water on the streets, but they are keen on taking preventative actions in their own gardens. This is also due to the fact that heavy rains which cause floods have not occurred in the past few years.

The plan is to organize two group meetings per year (organized by the water board and ANV). The website and communication channels will be maintained by enthusiastic volunteers, with support from ANV, the

municipality and the water board. A commitment has been expressed for a period of two years, after which the CO and its sustainability will be evaluated.

Because the Grip op Water platform is using existing licenses (from the water board) for HydroNET and ESRI storymaps, the only cost to be financed by Grip op Water, is the hosting of the website.
At the moment the ANV is taking lead in organizing a meeting in January 2020 with all stakeholders to discuss the next steps.

Table 8. Summary of the sustainability outlook for the most important responsibilities of the CO.

Key activities	Responsible entities	Associated costs	Sources of funding
Hosting and maintaining the platform (website + Storymaps)	Volunteering citizens	€20-€30 per year (hosting service) licences of HydroNET and ESRI storymaps are available from Waterboard	Municipality/ANV and Waterboard
Organizing Grip op Water meetings	ANV and Water board	-	-
Promotion of Grip op Water and events	working group	Depending on means of promotion (e.g. social media, flyers, etc.)	Municipality/ANV

3.3 Market expansion

The geographical coverage of the focus region within the Rivierenland area includes the municipalities Aalburg, Werkendam and Woudrichem, which merged from January 2019 to form the Altena municipality. Besides these 3 municipalities, the Rivierenland WB includes a large area of another 29 municipalities, which could be a possibility for expansion. This would imply geo-replication of the platform (or at least replication of the front end), such that the local focus of Grip op Water **Altena** is not lost.

Further expansion to other water boards is possible in light of the fact that between 1986 and 2009 the total damage from pluvial flooding was €674 million[8] in the Netherlands.

In D3.2 – Updated Report on market analysis and market uptake, we considered the option of expanding the thematic topics of Grip op Water Altena to water quality and river flooding but this depends on the level of interest in these topics by the citizens.

3.4 Roadmap for sustainability

Here we present the various actions that need to be undertaken to ensure the sustainability of Grip op Water Altena. The planning of these actions is already taking place.

[8] https://ore.exeter.ac.uk/repository/bitstream/handle/10871/17835/J%20Susnik%20et%20al%20Eindhoven_revised_1.pdf;sequence=1

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Table 9. Actions that need to be undertaken to ensure the sustainability of Grip of Water Altena.

Actions to sustain	CO platform	Data collection	CO community
Short-term (until end of project)	Transfer of the platform from HR to Grip op Water HR to organise a workshop on the platform to train the new staff on how to use and maintain the platform		ANV to host the new planning meeting Hand over of all promotion materials from GroundTruth/Grip op Water to working group ANV
Medium-term (next 1-2 years)	Maintain platform, by volunteers Write news stories for web page Grip op Water Keep available information on pluvial flooding and the measures people can take up to date (possibly with help from local entrepreneurs)	In case of a heavy rainfall event; organize data collection campaign with photos of flooding. Update information on measures taken by municipality and Waterboard Encourage citizens to fill in the measures they took on their own property	Organise events to keep the group engaged by working group of ANV Post on social media by volunteers Attend events (like Molendag or Boerenerfdag) Regular planning meetings with working group, municipality and water board. Continuation of the constructive relationship between citizens, municipality and waterboard
Long-term (2022 onwards)	Dependent on year 2 evaluation: maintain platform, by volunteers Write news stories for web page Grip op Water Keep available information on pluvial flooding and the measures people can take up to date (possibly with help from local entrepreneurs) Give the platform an update (if needed)	Dependent on year 2 evaluation: In case of a heavy rainfall event; organize data collection campaign with photos of flooding. Update information on measures taken by municipality and Waterboard. Encourage citizens to fill in the measures they took on their own property.	Dependent on year 2 evaluation: Organise events to keep the group engaged by working group of ANV Activities to reach a larger group of citizens in Altena Post on social media by volunteers Attend events (like Molendag or Boerenerfdag) Regular planning meetings with working group, municipality and water board. Continuation of the constructive relationship between citizens, municipality and waterboard

4 Sustainability of RitmeNatura, Spain

In this CO, it is important to note that no additional effort will be required to maintain the CO, as RitmeNatura will be maintained by CREAF with its own funds in virtue of the multi-year agreement signed with Meteocat.

4.1 Social return on investment

In the table below, we present a summary of the responses of the two key interviewees (C. Dammases from the Diputació de Barcelona and M. Busto from Meteocat) regarding outputs, outcomes and impacts:

Table 10. Summary of the responses of the interviewees regarding outputs, outcomes and impacts.

Outputs	New data and new information on phenology observations A website and a project and community within an already existing app (Natusfera) to collect data that was previously not possible to be recorded.
Knowledge and Inspiration OUTCOMES	Trusted data and information that has been validated by scientists. Raise awareness of changes in phenology due to climate change and raise this as a new topic of interest within the sphere of climate change
Action OUTCOMES	Resource optimisation by the Catalonian administration Improved management plans for the Biodiversity Strategy in Catalonia, based on a biodiversity observatory that maximises data collection and the development of improved information (2nd level products) Tool for environmental awareness and education – for citizens in general, but also for school children
Long term IMPACTS	Influencing the institutional policies related to mitigation of climate change in the region Improvement of biodiversity conservation by the Diputació de Barcelona (DIBA)
Quantitative estimate of impacts	Cost savings of 2% (on the province's budget of €80,000) for continuous monitoring of natural protected areas/phenology observations
% attributable to the CO	80%

The budget for the management of nature areas in the Diputació de Barcelona is €4 million per annum. We are assuming improvements in biodiversity conservation management will take place in the long term by taking the additional phenological data into account (i.e. for planning reforestation areas, optimising species choice, better decisions on which water courses to apply conservation efforts for protected species). Better allocation of resources could also mean cost avoidance. According to the interview conducted with Carles Dalmases (Head of management of protected areas of DIBA), most of the province's protected areas need new management master plans to be drawn up in the coming years, and these will take phenology data into account. These plans will also need continuous data observations for the monitoring of their implementation. With RitmeNatura, the DIBAs workers have a monitoring scheme set up ready to be used and can reduce their observations to around a shorter 10-minute activity in their day-to-day work.

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This will save them around €1,600/year, of which just under €1,300/year can be attributed to RitmeNatura. Even this small annual cost savings is welcome considering that the Diputació de Barcelona will not be faced with any additional costs from the CO.

4.1 Most likely sustainability scenario

The RitmeNatura.cat CO has taken benefit of the existing communities and included data from these which could lead to an opportunity to attract more users, improve functionalities of existing platforms and increase visibility of involved organizations. Ritmenatura is a CO with its own website (www.ritmenatura.cat) for information purposes, which directs potential observers to the specific Ritmnatura projects on Natusfera (natusfera.gbif.es). Natusfera is an umbrella platform for general biodiversity monitoring) that is an adaptation of the more international platform iNaturalist. Natusfera is financed by FECYT (Spanish fund for science and technology), Obra Social "La Caixa", the Spanish node for Biodiversity (GBIF.ES) and the Instituto de Ciencias del Mar (www.icm.csic.es).

At the time of writing D3.3 for the RitmeNatura CO there were three possible options defined for the way that the CO could be continued after the project ended. These scenarios were a little different to those of other COs in the sense that they didn't exclude each other and were more of the incremental type, in the sense that they were added functions or basement for the CO to continue into the future. Fortunately, the sustainability options mapped out as possibilities in that deliverable have partially been materialised in the last months of the GT2.0 project.

One of the main critical points that was necessary to take place, was for CREAF and Servei Meteologic of Catalonia (also known as SMC or Meteocat) to sign a collaboration agreement on the subject of phenology to continue working in the future. This agreement has been signed in November 2019 and signifies that the CO will be sustained by two public institutions with a common interest in making phenology accessible to the general public and allowing citizen science to provide new data to the already existing initiatives (mainly the network of Fenocat observers managed by Meteocat). In addition to this, CREAF has been awarded a project by the CSEOL initiative funded by ESA that builds on the Ritmenatura observatory. The Phenotandem project will aim to combine EO data with CS data on phenology and will therefore draw on the RitmeNatura community and technological assets to continue forwards. Phenotandem will run for 18 months (from approximately December 2019 to May 2021).

In addition to this as a collateral consequence or happenstance of the co-design process, Meteocat started working together with the senior technical personnel of the Diputación de Barcelona (DIBA). They recognised that it would be interesting for this institution to also include phenological monitoring in the nature reserves that DIBA manages. So, an additional agreement has been signed between DIBA and Meteocat to realise this collaboration, which will also base itself on the technological assets developed in Ritmenatura. At the moment the agreement has setup a monitoring activity for the forestry agents of DIBA to report phenological observations as part of their daily operations. However, in the future, this agreement could include the creation of phenological nature paths and other similar activities aimed at the general public. DIBA is an institution that puts great effort into environmental education and is willing to innovate in how these natural protected areas are used by visitors.

As explained above, the long-lasting support and funding of RitmeNatura by these institutions ~~that are~~ is guaranteed. However, platforms, websites and agreements are not the only thing that keeps a CO sustainable. During the GT2.0 project, RitmeNatura was kept alive and traction has been maintained with considerable coordination and dissemination effort by the project partners, which no longer have a mandate to do so after the project ends. Therefore, sustainability will be in the hands of CREAF and Meteocat,

and they will need to maintain the coordination and dissemination effort by participating in relevant events with workshops, presentation, giving talks at schools, and in definitive keeping the community engagement activities alive. The following table therefore summarizes the sustainability outlook for each of the most important responsibilities of the CO.

Table 11. Summary of the sustainability outlook for the most important responsibilities of the CO.

Key activities	Responsible entities	Associated costs	Sources of funding
Maintaining Ritmenatura website and managing Ritmenatura project on Natusfera (minimal) (hosting)	CREAF (via Meteocat CREAF agreement)	n/a	CREAF as part of Phenotandem in short term but as part of multiannual agreement with Meteocat in the long term)
Recruiting observers/organizing engagement activities	CREAF (through its regular dissemination activities and Phenotandem specific activities) Meteocat (through its agreement with DIBA)	n/a	CREAF as part of Phenotandem in short term but as part of multiannual agreement with SMC in long term
Dissemination of the CO and its activities	CREAF while the Phenotandem project lasts	n/a	CREAF as part of Phenotandem in short term but as part of multiannual agreement with SMC in long term
Organize and attend activities (events, conferences, meetings of the citizen science office of Barcelona	CREAF while the Phenotandem project lasts	n/a	Phenotandem project. After Phenotandem, alternative funding would have to be sought.
Exploitation of data and data sharing	CREAF and Meteocat (as part of their agreement)	n/a	Own resources of CREAF and Meteocat
Adaptive management of the CO purpose & resulting activities	CREAF and Meteocat	n/a	Own resources of CREAF and Meteocat

4.2 Market expansion

No geographical expansion of RitmeNatura is expected at this stage, since this CO is an initiative of the Catalonian region and is confined here in principle also because of the jurisdiction of its main actors, CREAF and SMC. However, the CO could be replicated in other regions of Spain, since there are no other citizen science based initiatives like this. During some of the interviews conducted for the Incentives and barriers analysis under WP1, key contributors to Natusfera who are not involved in Ritmenatura were interviewed and some of them conveyed that Ritmenatura was very interesting to replicate in other regions. Thus, replication of the same concept in other areas is a real possibility if the right stakeholders were willing to take it on board. which has a high level of autonomy (low level of collaboration) compared to the other regions in Spain. Having said that, Catalonia itself comprises 7.523 million (2016) citizens and so had considerable outreach already.

FENOCAT (under Meteocat) closely focusses on phenology whereas the more general topic of biodiversity is addressed by a number of organisations in Catalonia (e.g. like ICO, ICHN and CBMS) already. However,

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there are plans to establish a Catalan biodiversity monitoring agency within the next few years. The expectation is that this agency will need new reliable streams of data to plan adaptation policies to climate change. The phenology data produced by RitmeNatura could be one of these streams. Thus, this agency could potentially finance, or at least contribute to the maintenance of RitmeNatura's activities.

4.3 Roadmap for sustainability

The RitmeNatura website is currently hosted on CREAF's servers. The RitmeNatura projects are hosted in the Natusfera platform which is sustained by its own funds.

Table 12. Actions that need to be undertaken to ensure the sustainability of RitmeNatura.

Actions to sustain	CO platform	Data collection	CO community
Short-term (until end of project)	Merging of occasional and recurrent observations Continued hosting by Natusfera platform or alternative		Investigate possibility to merge with school activities done by Meteocat to give continuation to Ritmenatura
Medium-term (next 1-2 years)	Continued hosting by Natusfera platform or alternative Development of app for Fenocat observers to send observations back to SMC (currently still using excel sheets) in virtue of SMC-CREAF agreement. With the aim to merge Fenocat and Ritmentura observations soon after.	Data collection campaigns will continue through Phenotandem by volunteer observers Continuous observations throughout the school year by school children covering the most relevant phenological moments (spring and summer).	Ensure continued community engagement and coordination activities (newsletter, twitter feed, meetings of co-design group) Organize coordination meeting/s to discuss governance and community engagement after Phenotandem Continue engagement activities in schools and inclusion in curriculum for science-courses
Long-term (2022 onwards)	Continued service by Natusfera platform or alternative	Aim to be included as a source of data for the Biodiversity monitoring agency to be set up by Generalitat (regional government of Catalonia).	Gain sustained funding to cover engagement activities (assistance to events, workshops, keeping social networks alive, etc). Aim to be like the NPN (National Phenology Network) in the US.

5 Sustainability of VattenFokus, Sweden

5.1 Social return on investment

Two interviews were undertaken in Sweden, one with a representative of the regional water authority, Nyköpingåarnas Vattenvårdsförbund, and one with the leader of the citizen observatory of Dunkern, who has been very active in the community around the lake of Dunkern.

In the table below, we present a summary of the responses of the interviewees re outputs, outcomes and impacts:

Table 13. Summary of the responses of the interviewees regarding outputs, outcomes and impacts.

Outputs	New data on nitrate and phosphate levels in Dunkern lake (national register only includes a few old data points) A digital platform where water quality information is presented in a simple way, and which can be used for outreach, engagement of citizens and education
Knowledge and Inspiration OUTCOMES	Evidence of eutrophication of Lake Dunkern due to excess runoff from cattle farmers Raise awareness among local community of the water quality in the lake
Action OUTCOMES	Community action – meetings held with local politicians and the farmers Education of school children on water quality issues Management plans – action to improve the water quality and fish pathways (e.g. plans for a wetland to form a natural filtration zone between the farmers and the lake)
Long term IMPACTS	Improved water quality of Lake Dunkern which is extensively used for swimming and recreation.
Quantitative estimate of impacts	Lowering of nitrate and phosphate levels by 10% in two years and 50% in 5 years (from both agriculture and urban sources)
% attributable to the CO	20-80% (the latter since VattenFokus initiated the entire investigation)

The Water Council of Nyköpingåarnas estimated that water restoration actions will cost around €5 M (50 M SEK) to achieve across the region, while it is estimated that to establish a wetland at the entry to Lake Dunkern, it will cost around €100,000 (€1 M SEK).

According to a European study from 2018[9], households in Denmark and Norway are willing to pay €14-71/year and €100-198/year respectively for their lake water (so called non-use water) to reach a good status. This study also analysed the willingness to pay (WTP) in the UK, Ireland, Germany and France, but we choose to focus on the WTP in Scandinavian countries and this should best reflect the situation in Sweden and a 50% reduction in nitrates and phosphates. Here our calculations are based on an average WTP between these two countries of 97€/year/household. Dunker and the town of Malmköping are parts of the community of Flen. Dunker comprises around 300 households (750 inhabitants), while we estimate Malmköping (15 km away) with its 4,000 inhabitants, comprises roughly 1,600 households. There are also around 200 summer house and two large villas on the lake of Dunkern. Thus, if we consider the total number of households, the village of Dunker and the 200 summer houses, would be prepared to pay just

[9] https://ec.europa.eu/environment/blue2_study/pdf/BLUE2%20Task%20A2%20Final%20Report_CLEAN.pdf.

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under €49,000/year for improved water quality in Lake Dunkern, while households in Malmköping, would value this at €155,000/year. If we just consider these three groups in Flen, then the cost of the proposed wetland is around half of the amount that citizens would be prepared to pay in just one year (€204,000). In reality, the benefits of improved water quality resulting from the wetland will accrue over tens of years, if not more. In terms of the VattenFokus CO, the SRoI of can be estimated as 50% of this figure, i.e. just over €100,000/year.

The strengths of VattenFokus is that it is led by a small group of citizens that are extremely concerned about the water quality in Lake Dunker, and that it is part of CERT-Earthwatch's global citizen science initiative on freshwater monitoring.

Its social return on investment or social value is strong and this easily justifies the cost of the proposed wetland, even in the short-term.

Recently, the Nyköping municipality water authority (Nyköpingåarnas Vattenvårdsförbund), which includes the Dunkern Lake region[10] has become aware of VattenFokus and is interested in the data collected by citizens in the region. Although these measurements are not as accurate or detailed as their official measurements (for the national implementation of the WFD), they are, and will be, more numerous in number and locations. As such, they could be used to substantiate their smaller number of measurements and to identify pollution hotspots that they might have missed in their sparser measurement campaigns[11]. The support and/or adoption by this local/regional water authority will go a long way towards persuading other local/regional authorities, and perhaps even the national authorities, of the value of VattenFokus' crowdsourced data.

5.2 Most likely sustainability scenario

The most likely sustainability scenario is that the Lake Dunkern group, in collaboration with the Nyköpingsåarnas Vattenvårdsförbund (Water Council of Nyköpingåarna) continues to support the citizen observatory, VattenFokus. A meeting is planned between the Water Council and the local citizen group around Dunkern in February-March 2020, to investigate the possibilities of sustaining the CO.

Thomas Bjelkeman-Pettersson, who has been the Swedish contact from Akvo in the Ground Truth project, has committed to work on a voluntary basis with the Dunkern group to help grow the observatory.

Table 14. Summary of the sustainability outlook for the most important responsibilities of the CO.

Key activities	Responsible entities	Associated costs	Sources of funding
Keeping the local citizen group Dunkern informed and interested.	Dunkern group	n/a	n/a
Meetings between the local Water Council and the citizen group Dunkern.	Dunkern group	n/a	n/a (voluntary basis)
Keeping VattenFokus.se web site up and running	Dunkern group, with support from volunteers	1000 SEK (€100) / year	Remainder of GT2.0 funding (Gavagai) for 2020. For 2021 and

[10] Nyköpingsåarnas Vattenvårdsförbunds area of coverage: https://www.vattenorganisationer.se/nvvf/modules.php?name=Content&op=showcontent&id=1942

[11] Water control programme, tests 2009-2022. Page 26: https://www.vattenorganisationer.se/nvvf/downloads/25/arsrapport2019.pdf

Key activities	Responsible entities	Associated costs	Sources of funding
			further, grants or donations.
Water quality tests	Dunkern group	N/A (2020), TBD (2021 and further).	CERT-Earthwatch is sponsoring test equipment for 2020. For 2021 and further, grants or donations. CERT-Earthwatch is sponsoring the use of Freshwater Watch for several years going forward.

5.3 Recommendations on market expansion

Thematic market expansion to microplastics, pharmaceutical residues and micopollutants are all possible but are considered unlikely in the near future since the detection of these are expensive and not yet available as kits. Sampling of fish in Lake Dunkern has already been undertaken in 2019 to determine the fish population in the lake (as an indirect indicator of water quality) – which already represents a kind of thematic expansion.

Although VattenFokus started with a local focus (Dunkern lake in Södermanland county), as part of Freshwater Watch it potentially has a much wider geographic scope. Simple geographic expansion of the data collection area to other communities and even regions in Sweden would be relatively easy if a budget could be found. This is also the vision of the leaders of the Dunkern citizen observatory group. Geo-expansion of the CO to other communities in the Mälarendalen region is very likely as they have already shown an interest in water quality monitoring. Further expansion to communities/municipalities in Stockholm region (e.g. the island borough of Södermalm) will take more work, as the region of Stockholm is busy with many other sustainability initiatives efforts and it may be hard for VattenFokus to get the right attention.

In addition, VattenFokus has always had the support of CERT-Earthwatch[12] (an international non-profit environmental organisation) and has been part of their Freshwater Watch[13] programme. In fact, the measurement kits used by VattenFokus were those of Freshwater Watch and the VattenFokus results are also reported on the world-wide data repository on the Freshwater Watch website.

[12] https://earthwatch.org/

[13] https://freshwaterwatch.thewaterhub.org/

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5.4 Roadmap for sustainability

Table 15. Actions that need to be undertaken to ensure the sustainability of VattenFokus.

Actions to sustain	CO platform	Data collection	CO community
Short-term (until end of project)	Wrapping up Ground Truth project. Keeping the Dunkern group informed.	On-going water quality testing by the Dunkern group, as before.	Keep the community up to date on current status and progress through information events and meetings.
Medium-term (next 1-2 years)	February – March 2020: Meeting with the local Water Council and the Dunkern group to investigate future collaboration Investigate if neighbouring areas want to participate in VattenFokus	Expand the number of tests and the area tested by the Dunkern group Keep regular measurement campaigns going for the local Dunkern group (Water Blitzes) Investigate the continuation of the sampling of fish that has been done in 2019 in Dunkern Investigate what further tests can be performed, including comparison with laboratory tests. Find a sponsor for Water Blitzes in the region.	Establish the anchoring of the platform in the local community for the longer term
Long-term (2022 onwards)	Establish further engagements with regional Water Councils.	Expand water testing to the region of Mälardalen	Grow the community to the region of Mälardalen

6 Sustainability of Maasai Mara CO, Kenya

6.1 Social return on investment

Five interviews were carried out in Kenya during the Plenary meeting in Tarok County in May 2018, with one representative of the FMM (Friends of the Maasai Mara), one pastoralist and leader of the Olderkersi community, and with three representatives from the Maasai Mara University (MMU). On the one hand, the FMM saw the MMCO as saving them the cost of purchasing a database for event records but they foresaw an effort from their side of one day per week to raise awareness of the MMCO. The pastoralists and community also faced staff and travel costs of one day/week to travel to the site of incidents and the cost of GMS calls and data downloads. In addition, local citizens would require training on the reporting of wildlife locations and incidents. The MMU are prepared to make in-kind contributions and to utilise projects and their students for data collection.

In the table below, we present a summary of the responses of the interviewees regarding outputs, outcomes and impacts:

Table 16. Summary of the responses of the interviewees regarding outputs, outcomes and impacts.

Outputs	Reports on human/wildlife conflicts for the KWS and Narok county A central repository of records concerning wildlife locations and numbers, wildlife corridors and injured animals A channel for complaints and praise Training for trackers and data collectors
Knowledge and Inspiration OUTCOMES	Evidence to feed discussions with KWS and Narok county Information to inform decision making Improved understanding by gov. bodies to what is actually happening on the ground Improved well-being for pastoralists Motivation for Maasai Mara University to gain funding as custodians of this data
Action OUTCOMES	Management plans – improved decision making by gov. bodies based on analysis of past events Action – dangerous animals are returned back to the park Action – pastoralists obtain compensation (as is their due) from the Mara Conservancy Program Community action – communities and leaders will make better decisions on movement of their livestock Training – citizens are trained to report incidents through the use of mobile technologies
Long term IMPACTS	Improved natural resource management by KWS and Narok county Reduction in human/wildlife conflicts Pastoralists also benefit from having wildlife on their grazing areas Narrowing of the digital divide
Quantitative estimate of impacts	Average number of incidents could be reduced from 1340/year to under 1,000/year through the CO and government action
% attributable to the CO	30%

Thus, the value of the Maasai Mara CO to the pastoralists in and near the Maasai Mara conservation area is a reduction of around 300 incidents. Of course, this assumes that the Narok county will take action on reports of human wildlife conflicts. This reduction can be equated to 300 fewer cows been killed or injured, and with a value of around €355 - 620 (40,000 – 70,000 Kenyan shillings) per cow, the overall value could be as high as €186,000.

The CO will also financially benefit the Narok county administration through more efficient working practices (e.g. through lower data collection costs by using the app), and possibly from tourists representing an important source of national income. However, at this stage it is difficult to quantify these impacts. From a social perspective, it will also benefit from improved government accountability and transparency, and the involvement of citizens in wildlife conservation. In addition, the local communities will benefit from an improvement in their access to technology and information.

Another way of estimating the impact of the Maasai Mara CO would be to do a top down assessment of to what extent the CO will support improved natural resource management by Narok county and the KWS,

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thereby leading to an increase in tourism. The value of wildlife tourism in Africa is reported in the UN World Tourism Organisation Briefing Paper of 2015[14]. In a case study of the Kichwa Tambo Maasai Mara Tented Camp (categorised as luxury accommodation), it was found that around of which €1.4 million of the camp's overall revenues is paid directly to local communities for the lease fee, salaries and purchases of local products. Overall, Kenya's gross income from tourism was worth about US$ 500 million in 1995 of which approximately 70% or US$ 350 million - can be attributed to wildlife tourism, representing about 5% of GDP[15]. Although this data is not recent, it does illustrate the value of wildlife tourism in Kenya and thus an even small increase in tourism, could be significant for the local communities as well as the country as a whole.

6.2 Most likely sustainability scenario

Recently, a major obstacle to the continuation of the Maasai Mara CO has been overcome. Narok county's initial concerns about data sharing practices of the CO (regarding wildlife sightings being abused by poachers), have been addressed. A data sharing policy was developed and has been agreed with all stakeholders at a meeting in November 2019. This includes clauses that sensitive information (e.g. location of endangered wildlife) included in the CO has to be validated and only shared with the appropriate stakeholders.

The most likely sustainability scenario is that the Maasai Mara University (MMU) will take ownership of the CO, and Upande will be contracted to host and maintain the platform. Narok county and the Wildlife conservation organization, MMWCA, will help to financially support the CO and thereby gain access to the data and information held on the platform. MMU will be responsible for training the staff of Narok county and the rangers from KWS and the MMWCA. In addition, students can carry out observations as part of their course work or projects.

The team have also received interest from the Mara Serena Lodge for the purposes of supporting ecosystem conservation, and for their guests to view the data collected and to report wildlife sightings in the area. This is in return for security that they provide for some water sensors.

Upande is currently hosting the platform and maintaining the app, but at a meeting on 18 Nov 2019, there was a symbolic hand-over of this to the MMU. It is expected that the ownership will be transferred to MMU in early 2020, and Upande will continue hosting the platform and app under contract. All stakeholders - Narok County, KWS, MMWCA, MMU, WRA, ACC – all pledged to support the continuation of the CO through in-kind contributions.

Table 17. Summary of the sustainability outlook for the most important responsibilities of the CO.

Key activities	Responsible entities	Associated costs	Sources of funding
Hosting of app and web platform (GeoNode) and maintenance	Upande	€2,000/year	Under contract (funding sources tbd)
Data processing and analysis, quality control	Upande		Under contract (funding sources tbd)

[14] Towards Measuring the Economic Value of Wildlife Watching Tourism in Africa, UNWTO Briefing Report, 2015

[15] https://www.awf.org/sites/default/files/media/Resources/Books%20and%20Papers/ACE-DP-4_economics_tourism.pdf

Key activities	Responsible entities	Associated costs	Sources of funding
Wildlife observations	Staff of Narok county Rangers from KWS and MMWCA MM University students Local communities (pastoralists)	- - - -	County data collection budgets Data collection budgets of KWS and MMWCA University project budgets
Maintaining low cost weather and river-level stations	Upande	€2000 €/year	(tbd)
TAMHO weather data	TAMHO	No additional cost	TAMHO
Giving access to web platform and app to lodges	Upande	-	In-kind support from lodges e.g. Mara Serena Lodge
Training on use of platform (data collection, access, analysis, etc.) of 'trainers'	Upande	€ 100-1000 /year	Grant funding

6.3 Recommendations for market expansion

The Maasai Mara CO has already expanded thematically by incorporating the information collection systems from the MaMaSe project, and thereby also offers weather information, livestock prices, grazing availability and water level and resource information. This offers significant added value to the local pastoralists and farmers.

The market expansion opportunities for a CO (or any similar initiatives) that supports sustainable livelihoods and biodiversity management are vast in Africa, and geographical expansion of the platform to include data and information from other counties in Kenya, such as the Amboseli NP in Kajiado county and the Samburu NP in Samburu county, would be relatively easy from a technical perspective. Furthermore, the African Conservation Centre in Nairobi have expressed an interested in hosting the CO platform if and when the CO will expand its coverage to national level.

6.4 Roadmap for sustainability

Table 18. Actions that need to be undertaken to ensure the sustainability of Maasai Mara.

Actions to sustain	CO platform	Data collection	CO community
Short-term (until end of project)	Hosting of app and web platform by Upande Upande to train 'trainers' on use of the platform and app, data processing, analysis	Upande to promote CO to more lodges (e.g. Governor's Camp) such that their guests can submit observations	Agreement on a data sharing policy (completed in Nov 2019)

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Actions to sustain	CO platform	Data collection	CO community
	and quality control (conservancy rangers and community mobilisers)		
Medium-term (next 1-2 years)	Upande to apply for grants for hosting and maintenance of the web site and app Upande to apply for grants for data processing, analysis and quality control Transfer of platform and maintenance to MM University Upande to train the 'trainers' on use of the platform and app, data processing, analysis and quality control (conservancy rangers and community mobilisers) - subject to budget availability	Move to digital data submission by Narok county staff, KWS, MMWCA rangers and community mobilisers for their routine observations Data collection by students via the app on a project basis	Raise awareness of the MM CO and app by all stakeholders Attend 2-4 stakeholder meetings/year (Narok, KWS, MMWCA, ACC, Friends of the Maasai Mara) to ensure a strong and sustainable community Actions to be taken and feedback to reports on human-biodiversity conflicts by Narok country Promote the MM CO to Kajiado and Samburu counties - subject to budget availability
Long-term (2022 onwards)	African Conservation Centre to fund hosting and maintenance of national CO	Continuous data collection by Narok county staff, KWS, MMWCA rangers, and community mobilisers Project based data collection by students	Expansion of CO to cover other counties, communities and NPs (taking the MM CO to national level) Attend 2-4 stakeholder meetings/year (Narok, KWS, MMWCA, ACC, Friends of the Maasai Mara) to ensure a strong and sustainable community

7 Sustainability of National CBNRM CO, Zambia

To recap, the Zambian demo case started with pilot activities in Western Province alone (originally known as the NitiLuli CO). These activities highlighted the potential of the CO for CBNRM in general, as core challenges are relevant to many CRBs in Zambia. As a result, the General Assembly of the Zambia National Community Resources Board Association (ZNCRBA), in December 2018 in Lusaka mandated that the possibility of a citizen observatory at the national level should be explored. The co-design process for a national platform was formally started in March 2019. At the current state, the NCRBA is preparing to request a formal mandate from the collaborating government departments to facilitate the observatory going forward, and broker formal agreements from departments to participate in the collective effort.

7.1 Social return on investment

Six interviews were carried out in Zambia on the occasion of a stakeholder workshop in Lusaka in March 2019, with representatives of the Dept. of Forestry and Fisheries, the Assistant Director of the DNPW, the chairman of the Zambian National CRBA, the Constituency Office for the MP of Shesheke, and Coordinator of the Western Region CRB.

In the table below, we present a summary of the responses of the interviewees re outputs, outcomes and impacts:

Table 19. Summary of the responses of the interviewees regarding outputs, outcomes and impacts.

Outputs	Data on illegal activities (land degradation, fishing, logging and encroachment on protected areas) Digital data that has is geo-located, validated and authenticated (through photos and GPS positioning) Information on human/wildlife conflicts, land resource availability, deforested areas Data collection made easier for communities and rangers Increased amount of data and greater diversity of data on a single platform
Knowledge and Inspiration OUTCOMES	Better traceability of incidents Evidence of illegal activities Motivation to improve coordination between various gov. departments Awareness of CRB concerns by gov. departments, and can be used to request extra support for CRB Secretariat from gov.
Action OUTCOMES	Targeted actions against illegal activities Enhanced coordination between gov. departments due to data sharing Improved management plans for natural resources by Dept. of Forestry, Fisheries and the DNPW Behaviour change on the part of communities for better compliance to policies (wildlife/fisheries/forestry), and vigilance Quicker response by DNPW (Dept of National Parks and Wildlife) to incidents, and apprehension of poachers Actions to reduce wildlife conflicts and illegal activities
Long term IMPACTS	More sustainable management of natural resources (wildlife, forests, fish)

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	Community ownership of natural resources, and improvements in their livelihoods (through fewer conflicts and less crop damage, improved tenure rights) Increased wildlife numbers and tourism Job opportunities in the broader community Better efficiency in the DNPW
Quantitative estimate of impacts	Operational cost savings of around 5% for the CRB Association (on operational costs of ZMK 600-700 K/year) Reduced costs for DNPW for scouting of 30-40% (of ZMK 22.5 M/year) 5-10% increase in fish production (on an annual production of 70-80 metric tons @ ZMK 24/kilo 5% increase in forestry which contributes $1.3 M/year to the GDP of Zambia
% attributable to the CO	3-4% increase in fish production 5% of operation costs savings for CRB association 1% increase in forestry products 35% of scouting costs

DNWP's Assistant Director foresees a revolutionary change in the way they operate due to the CO, leading to an increase in wildlife and thus tourism. It was a challenge to get a handle on the value of improved natural resource management for Zambia, except for the bottom-up estimates given to us by the interviewees. The latter gave us values of €9,000 /year for fisheries, €4,200/year for forestry and a cost savings of around €552,000/year for the CRB association and the DNPW – given a total value of just over €565,000 /year.

Unfortunately, little research has been done on the value of natural resource management in Zambia, but one interesting paper[16] does consider the qualitative benefits of NRM around the National Parks of Zambia[17]. Another way of estimating a contingent value for the impact of the Zambian CO, is to analyse the potential impact of the CO on wildlife tourism in Zambia. According to a recent study[18], Zambia's direct earnings from tourism grew from ZMK 2,271 million (roughly €150 M) in 2012 to ZMK 4,408 million (roughly €300 M) in 2015, and that the direct contribution that these earnings make to the Zambian GDP has grown from 2.4% in 2012 to 3.1% in 2015. However, this type of contingency estimation would be 'a long shot' and would only consider the value of one of Zambia's natural resources, albeit an important one.

The Zambian government is trying to devolve decision-making and giving villagers and the CRBs (community resource boards) more say in the management of their land and wildlife resources, with the goal that the local communities will benefit from an increased share of wildlife revenues coming from the DNPW. Recent laws are mandating more responsibilities to the CRB, from the current one on wildlife management, to forestry, water and possibly agriculture. Citizen participation was high in the NitiLuli CO (the original local CO in the Western Province) and, if this is the case for the other CRBs in Zambia, the national CBNRM CO could have a positive impact on hundreds of thousands of villagers. Besides, improved revenues reaching the poorest of villages, the social value-add of better coordination between the different community levels and improved transparency of decision-making will be significant.

[16] https://www.tandfonline.com/doi/full/10.1080/19390450903350838

[17] Household Consumption and Natural Resource Management around the National Parks in Zambia, S. Bandyopadhuay and G. Tembo, Journal of Natural Resources Policy Research, Vol. 2 Issue 1, 2010.

[18] Analysis of the Tourism Value Chain in Zambia, Final Report, Nov 2018,

7.2 Most likely sustainability scenario

The most likely scenario for Zambia involves technical hosting of the platform by a government agency (SMART Zambia) and oversight of operation by a Steering Committee consisting of all involved government agencies. Administration and operation, as well as content management is the responsibility of the Secretariat of the National Community Resource Board Association (NCRBA), a membership based CSO (civil society organisation) with a formal mandate to support and represent the interests of the elected Community Resource Boards. Data collection and information distribution is a formal responsibility of community-based organizations, with Regional CRB Associations providing training and on-the-ground support to community groups. Operation of the National Observatory, as well as the role and responsibilities of the different actors is enshrined in the upcoming national CBNRM policy, as well as in the constitutions and by laws of CRBs and other community-based committees.

However, as a result of the very limited capacity of the community-based institutions and their associations for implementation, they require assistance by conservation CSOs (e.g. WWF, The Nature Conservancy, African Parks, or Game Rangers International) for fundraising, planning and administrative tasks, as well as stakeholder engagement and roll-out of the platforms to new areas in Zambia. Initially this assistance will take the form of funding through donor grants, but this level of funding could be reduced after 2-3 years, with the CRB Association covering the cost of CO operations from their annual budget.

Table 20. Summary of the sustainability outlook for the most important responsibilities of the CO.

Key activities	Responsible entities	Associated costs	Sources of funding
Setting up of National CO, expansion to one additional CRB area Expansion to 4 other regional CRBs	NCRBA, with collaborating departments and supporting NGO	Operating costs of €40,000 in year 1 Operating costs of €80,000 in year 2	Donor grants
Technical hosting of the data and maintenance of platform	Zambia National Data Center	€20,000 per year	In-kind contribution from SMART Zambia
User administration and content management	NCRBA Secretariat		
Training and programming of additional platform functionality (and eventual training of trainers)	Private companies (e.g. Upande)	(included in annual operating costs)	Donor grants
Purchase of phones/tablets for VAGs	tbd	tbd	Donor grants or projects
Monitoring and tracking of licenses and concessions	Departments hosting NRM policies and affiliated community committees	-	Existing department budgets
Co-design workshops for expansion to other communities	tbd	€7,000 -10,000 per community	Small CSO conservation grants
Co-design workshops for expansion of CO to new topics or functions	tbd	€12,000-20,000 per project	Fundraising

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7.3 Recommendations for market expansion

Geo-expansion of the initial NitiLuli CO for Shesheke West in the Silowana Complex (a National Park and surrounding buffer area of together 9000 km² in the Western Province of Zambia) to the national level, through the establishment of the National CBNRM, has already taken place during the lifetime of the GT2.0 project - making the Zambian CO the most successful of the GT2.0 demo cases with regards to upscaling, but it also led to an extended timeline for launch and operation.

As far as thematic expansion, there is a strong possibility that Agriculture and the Ministry of Agriculture could join the National CO, as the role of the CRB are likely to include decision making on farming issues as well, and current data collection lacks geolocation Another option would be to include the information on land use by involving the Ministry of Lands and Natural Resources, but the likelihood of this is currently unclear.

The National CBNRM CO includes many conservation areas, some of which are part of a growing programme of Trans Frontier Conservation Areas[19] in Southern Africa with significant resources. However, many of Zambia's conservation areas are threatened by a general lack of local resources and infrastructure (GSM coverage) in the area, and some local opposition.

7.4 Roadmap for sustainability

Table 21. Actions that need to be undertaken to ensure the sustainability of CBNRM.

Actions to sustain	CO platform	Data collection	CO community
Short-term (until end of project)	Development of manuals, roadmap for roll-out and operation, and marketing materials	Continued field tests of data collection, completion of a full data model for integrated data collection serving multiple departments and purposes	Support to NCRBA Secretariat for the preparation of grant applications for development of the CO, training of community resource persons
Medium-term (next 1-2 years)	Setup of GeoNode server, technical administration and platform maintenance (at the Zambia National Data Centre) Training on platform utilization and maintenance, user administration and content management. Creation of central information repositories (policy documents, training materials, mapping of boundaries	Training of VAGs on data collection (using the app on mobile phones/tablets) Regular data collection by VAGs and other community level committees Creating of reporting structures for digital collection and aggregation of activity information from CRBs Community mapping	Regular meetings of district council, BRE, and NGOs Steering committee meetings Development of policies, guidelines and materials for the national upscaling Training of trainers Explore the integration of Fisheries and Forestry

[19] https://www.sadc.int/themes/natural-resources/transfrontier-conservation-areas/

Actions to sustain	CO platform	Data collection	CO community
	for government units (constituencies, wards) and CBNRM units (GMAs, community forests, wildlife corridors)		
Long-term (2022 onwards)	Further platform development (to include new topics and functionality) Use of platform to offer customized data collections to projects and government agencies Integration of functionality for access to public services (e.g. health care)	Regular operation at community level - data plan, maintenance of phones, transport of moderators Offer use of platform as a data collection service to projects Use of integrated data for planning purposes (local councils) Use of integrates data for evidence-based advocacy	Regular meetings of district council, BRE, and NGOs in each area that has customized the CO for local purposes Steering committee meetings at the national level Explore integration of Agricultural services and possibly Land services Exploration of application of CO in transfrontier KAZA[20] area

[20] Kavango-Zambezi Transfrontier Conservation Area, which includes the Silowana Complex

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8 Exploitation of the Quality Tool

8.1 Recap

The USP (unique selling point) of the Quality control tool is that it can analyse any data coming from any interoperable CS project, i.e. that use SOS and WFS standards. The tool is open source and available free of charge. However, revenues can be accrued by customisation of the tool and for consultancy by CREAF on how to set up an OGC SOS for their clients. The MiraMon software[21] is free of charge, but a MiraMon server costs around €2,200 to install on the clients' platform.

It is estimated from trial runs that clients will require three hours of consultancy for installation of the Quality tool, and 25 hours for customisation. In addition, clients will face five hours per year in operating costs which include updating and debugging of the software. A CREAF is a non-profit organisation, their consultancy rate is €50/hr.

The number of potential customers for the Quality tool has been estimated from the ECSA (European Citizen Science Association) membership - as this reflects the number of organisations that are interested in implementing CS projects and campaigns.

Table 22. Number of potential customers.

Customers	Number of potential customers	
	Europe	World-wide
Citizen science campaigns, project organizers and data aggregators	≅ 100	≅ 500[22]

The toughest competition faced by the Quality Tool is that of the incumbent, which is manual checking of the data quality. Even though manual checking is more time consuming and costly than it would be with the Quality Tool, customers are likely to be resistant to change initially. A second factor that will limit the market uptake of this tool is the low current use of OGC's interoperable Sensor Observation Services (SOS). Few potential customers are aware that such a tool exists since it has only just been developed. However, it is estimated[23] that the uptake of SOS standards/servers will increase rapidly (exponentially) over the next five years as this tool becomes more widely known.

To overcome the lack of awareness of SOS, CREAF needs to publicise this tool as widely as possible in the CS fora of GEOSS and OGC. Consequently, only a small number of early adopters of this new technology are expected, with exponential market growth over the next five years. Furthermore, CREAF could boost their number of clients by an offering of a single bundled product comprising the SOS and the Quality tool in one package.

8.2 Potential market uptake

Based on the above reasoning, CREAF has estimated that the number of clients/customers world-wide for their Quality tool will start off with very few (three in total) in their first year of operation, increasing to 90 by the end of year five. If we consider three hours consultancy for installation and 25 hrs for customisation for new clients, the annual revenues can be seen in the figure below. The estimated annual running

[21] http://www.miramon.cat/USA/Prod-NavegadorServidor.htm

[22] Mostly in USA, Australia and Africa

[23] Personal communication, J. Maso, CREAF

or operational costs (OPEX) of the Quality Tool is €250/year based on around 5 hours of software programming, and a software update of €750 in year three (capital cost or CAPEX). Thus, even at the low number of three clients in the first year of operations, breakeven will be achieved and after that the revenues will increase exponentially. Note that the revenues are indicated on the left-hand axis.

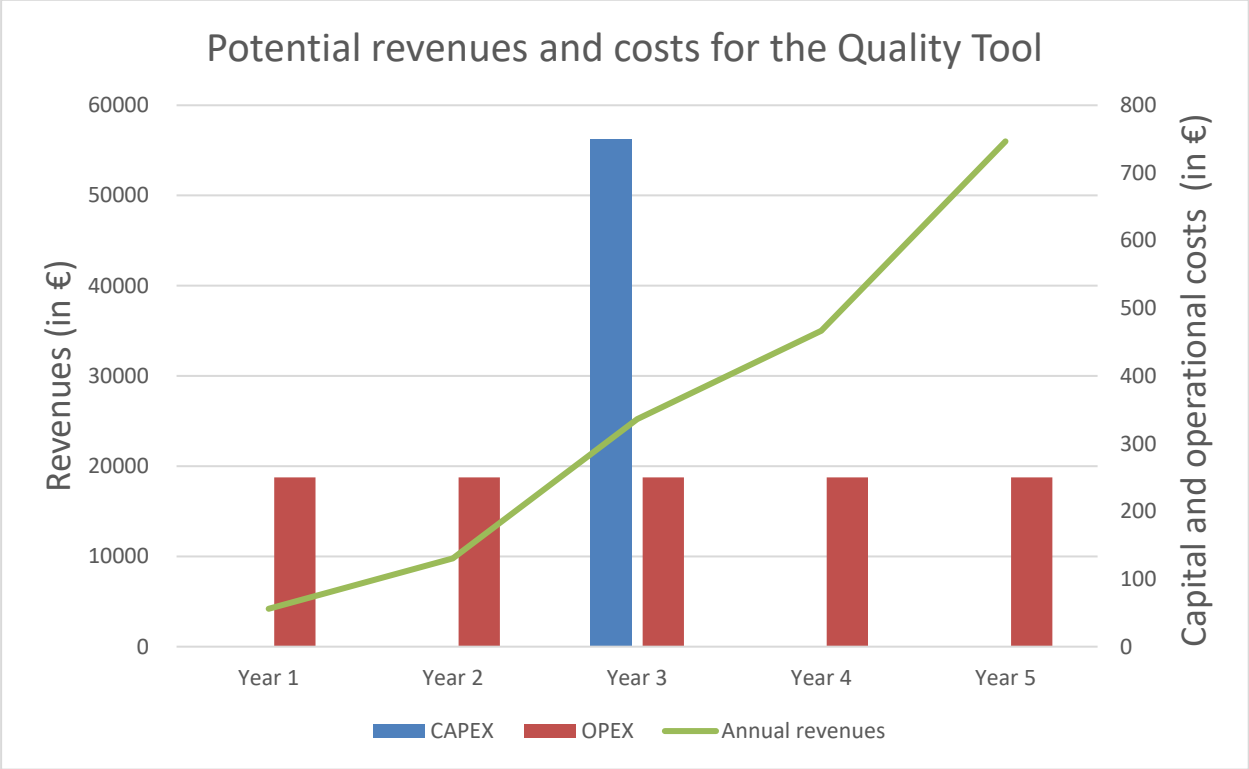

Figure 2. Potential revenues and costs for the quality Tool.

8.3 Exploitation roadmap

Table 23. Actions that need to be undertaken to ensure the sustainability.

Actions to sustain	Technical activities/ product development	Promotional activities	Continuation through other projects
Short-term (until end of project)		Actively promote the Quality Tool and SOS to GEOSS and ECSA	
Medium-term (next 1-2 years)	Create a manual on how to use the tool Test the tool in different conditions and fix issues Apply the tool to the current COs	Actively promote the Quality Tool and SOS to CSA (USA) and ACSA (Australia) Make the Quality Tool available on web sites such as GITYHUB, Gitlab and Bit bucket	Use it in Phenotandem and COS4Clould

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Actions to sustain	Technical activities/ product development	Promotional activities	Continuation through other projects
Long-term (2022 onwards)	Extend the number of quality indicators to other present in qualityML Allow a user to send a quality report to the Geospatial User Feedback System Align with the new revision of the ISO 19157 foreseen for 2021	Keep Quality Tool updated on web sites (GITYHUB, Gitlab and Bit bucket)	Include the module in new projects related to data capture (beyond CS) as CREAF contribution

9 Exploitation of the GT2.0 Co-design Methodology

9.1 Recap

The USP of the GT2.0 Co-design methodology is that it is a methodology for the setup of Citizen Observatories or other complex projects that involve multiple & diverse stakeholders. It offers the following advantages:

- A methodology for social value creation related to complex processes and the creation/strengthening of local relationships.
- Provides credibility to participatory processes and community-based data collection.
- Adaptable to different geographic contexts, socio-economic & political settings and thematic issues.
- Flexible while maintaining quality control and providing detailed guidance.
- Provides a higher chance of success of the envisaged change and higher impact.

In essence, it offers a common global methodology that can be applied to local environmental concerns. The customer groups of donors/funding bodies and public authorities have similar requirements for the Methodology, and thus no market segmentation (based on user requirements) is required for the moment. In particular, the target is change or process managers within these organisations, or consultants to such organisations, who are specifically interested in delivering value from research projects.
The total addressable market for the Methodology is substantial, given its wide applicability for setting up complex projects in the context of developing social innovations (addressing societal needs involving society), in international cooperation and for developing sustainable solutions more generally.

We have approached the analysis of the TAM from a number of angles. The number of citizen science campaigns has been estimated from the ECSA (European Citizen Science Association) membership and world-wide. We have also considered the membership of ICLEI[24] (Local Governments for Sustainability) to reflect the potential interest from local public authorities with a strong urban environmental agenda. We have also included NGO/CSO numbers since a subgroup of these organisations will be interested in local environmental stewardship activities and require a clear demonstration of impact and social return on investment for the projects that they support/fund.

We recognise that there are some overlaps in our customer groups (leading to double counting), but this is compensated by the underestimation that comes from counting organisations rather than the number of projects they might manage.

[24] www.iclei.org

Table 24. Number of potential customers.

Customer groups	Number of potential customers	
	Europe	World-wide
Citizen science campaigns, project organizers and CO	≅ 100	≅ 500[25]
ICLEI members	≅ 160	≅ 1,750[26]
CSO/NGO	≅ 2,120	≅ 11,690[27]

9.2 Potential market uptake

The GT2.0 Co-design methodology is complex to apply but offers projects, with a strong social perspective, and their funding bodies significant benefits regarding sustainable outcomes and impacts, societal value, as well as citizen buy-in and participation. The Co-design methodology clearly has the advantage of having a large potential market, and thus market uptake could be significant and grow rapidly. The challenge is for IHE to raise awareness of this new methodology and to clearly demonstrate such benefits to a broad range of potential customers. Initially this can be done by publicising the successful application of the methodology in the GT2.0 project. This message should be targeted at funding bodies, public authorities and CSOs through academic conferences and citizen science fora.

An initial idea for the business model for the GT2.0 methodology is that it will be made available free-of-charge under some kind of copyright, for example, a Creative Commons licence[28] held by IHE. However, financial revenues can be obtained from consultancy services towards complex project implementation to support the implementation of the GT2.0 methodology. Such consultancy is not essential for the application of the co-design methodology, but we foresee that many users will require such support, at least initially. A typical hourly rate of IHE for such consultancy services is 100 €/hr and it is estimated that around 225 hours (30 days) will be required per implementation. The total amount of for each client will be €22,500, which will need to be included in their calculation of the overall costs of setting up a co-design project. Ideally, this 'other cost' should be included upfront in future project proposals – with justification to convince the funding organisations of the substantial advantages offered by this Co-design methodology.

A website will be created with the aim of publicising the Methodology, and where the methodology guidelines will be made available as a public report (D1.13- Guidelines for Citizen Observatories and Future Recommendations). It is estimated that the cost of such a website, together with the production of promotional materials (printed brochures and social media posts) will cost around €10,000 in the first year, and then it will reduce to €5,000 for updates and website maintenance in the second year. IHE foresee five clients for their methodology in 2020, followed by ten more in 2021.

In year three (or 2023) IHE intends to change their marketing approach and business model, in that they will move to training 'facilitators' who will then interact directly with the clients and implement the methodology. Thus, they will be faced with a CAPEX cost developing the training material (one person-month)

[25] Mostly in USA, Australia and Africa

[26] http://www.iclei-europe.org/

[27] https://esango.un.org/civilsociety/

[28] https://creativecommons.org/

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in this third year, but this will reduce to half a person month/year for material updates in the subsequent years four and five. They predict 25 trainees in 2023, increasing to 75 in 2024 and 175 in 2025. Considering the vast potential market for this Methodology (see table above), these are conservative estimates. The current thinking is that such a course will comprise 1-2 weeks of training in groups of 10-15 trainees. The courses will be held at IHE and thus the travels costs to IHE will be covered by the trainee organisations. Each trainee will be charged €10,000 to attend this course. After completion of the course, IHE will offer on-site mentoring at the premises of the trainees – this will comprise 2-3 trips per client of 1-2 days at an estimated additional cost of €7,500 (this includes IHE's travel costs).

Based on these assumptions, the potential revenues and costs for the Co-design Methodology is shown in the graph below. Please note that the capital costs (CAPEX) are considerably lower than the other two amounts and thus are shown separately on the right-hand vertical axis.

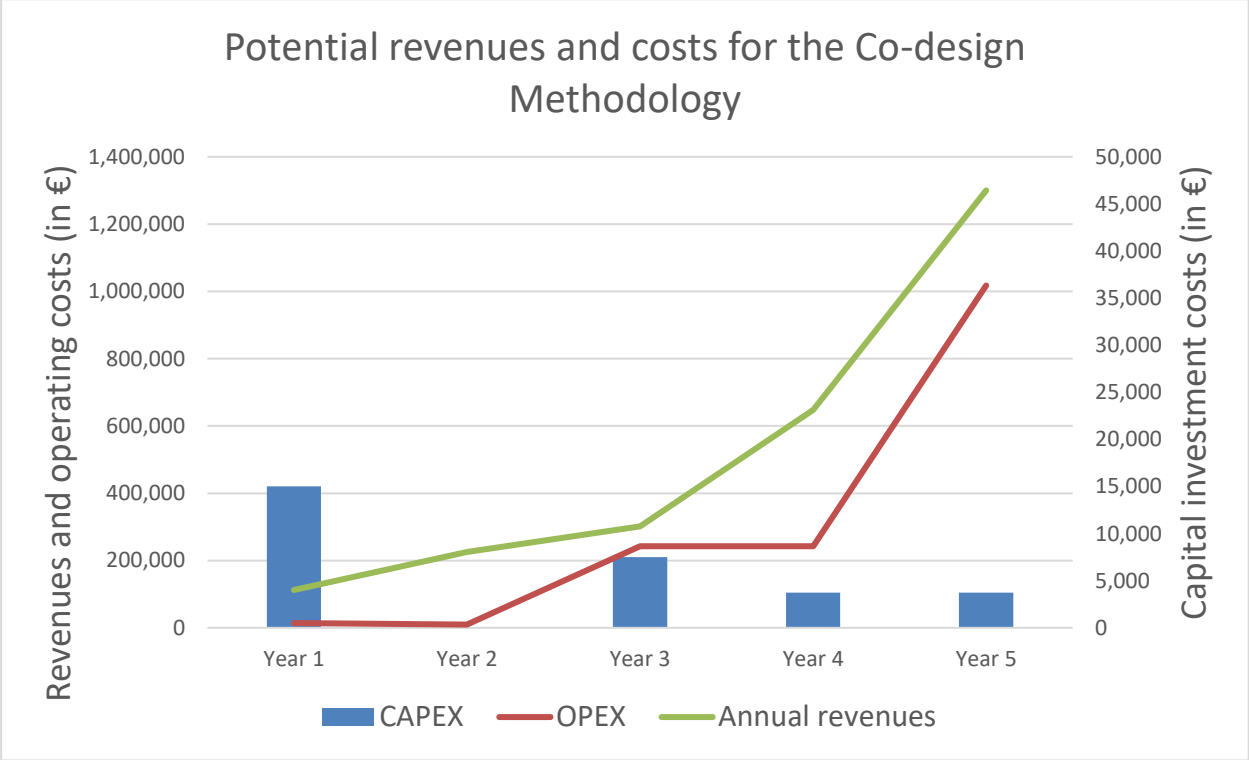

Figure 3. Potential revenues and costs for the Co-design Methodology.

For all years the revenues exceed the capital and operating cost and thus breakeven is attained even in year 1. This indicates that marketing of the Co-design methodology service represents a lucrative business for IHE (under the assumptions detailed above). The inflection in the graphs at year three, is the result of the change of marketing approach by IHE – moving from training clients to training of trainers or facilitators.

9.3 Exploitation roadmap

Table 25. Actions that need to be undertaken to ensure the sustainability.

Actions to sustain	Technical activities/ product development	Promotional activities	Continuation through other projects
Short-term (until end of project)	Initial preparation of Methodology guidelines	Apply Common Creative licence (and copyright assignments)	A 'light' version is developed in the MICS project[29], which started in 2019
Medium-term (next 1-2 years)	Finalisation of Co-design Methodology guide and facilitator's handbook Development of training for project managers Offer consultancy service of 30 days for each client for Methodology implementation	Design and printing of brochure Creation of new website for the Co-design methodology and social media channels (Twitter, LinkedIn, etc.) Active posts on social media Updating of brochure, web sites and social media channels in 2nd year	Implementation of Methodology in projects that are awarded funding (this Methodology has already been included in a few project proposals) IHE offers a short course on Co-design Methodology for project managers as part of their MSc programs
Long-term (2022 onwards)	Development of training for 'facilitators' Delivery of 1-2 week Co-design Methodology courses for facilitators On-site mentoring for facilitators (2-3 trips per client)	Promotion of training opportunities (new brochure, update of web site and social media channels)	Implementation of Methodology in projects that are awarded funding

[29] https://mics.tools/

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10 The OSM LULC Mapper

10.1 Recap

The initial idea was to derive a Land Use Mapper from the vector data available from OpenStreetMap. The context of this proposal has changed since the start of the project, while researching current initiatives and the state-of-the-art in this field. The first conclusion was the existence of two main similar initiatives developed by the Heidelberg University (UHEI) and the University of Coïmbra. After analysing both initiatives, the conclusion was that it is more convenient to join forces with both universities for further development on top of their current progresses. Thus, the approach for this task was completely rewritten and a new description of activities was made, considering not only GT2.0 contributions, but also those coming from the universities. It was agreed by GT2.0, LandSense, University of Heidelberg and University of Coïmbra that they would join forces for the implementation of the concept of the Global LULC Map. [30]

The OSM (Open Street Map) Land Use Land Cover Mapper (LULC Mapper) web service is intended to be a standard web service to enable worldwide mapping and improve accessibility to land-use mapping and consistency of time-series of land use maps. It is targeted at urban planners, policy makers, private sector land investors, scientists, research institutes, and other research projects.

The unique selling point (USP) of the OSM LULC (Land Use Land Cover) mapper is that it provides easy access to LULC maps for any place in the world. The maps are consistent in number of classes and definitions and a quality layer will be provided. The map is a product of multiple available data sources so gaps caused by data poor areas and clouds can be filled. This standard mapping service will be made available free of charge – following the encouraged-to-contribute, free-for-citizens philosophy of OSM. As such, it does not face significant competition – the other research-based, publicly funded global land map GIS systems (e.g. CORINE, Copernicus Global Land Service, Global Land Cover USGS) are not updated that frequently and are limited in the flexibility of their nomenclatures (thematic categories).

It is unlikely that policy makers and spatial planners in Europe will use the OSM LULC mapper extensively, as they have access to up-to-date cadastral maps provided by national or private mapping agencies. However, in Africa for example, the public or governmental maps have not been updated for many years, and most governments are lagging far behind Europe in moving to digital GIS maps as well as digitising the geo- information they collect. Thus, such a freely-available OSM LULC map is of great value to policy makers and spatial planners in many African countries.

The total addressable market (number of potential customers) for the LULC map is based on OpenStreetMap (OSM) user statistics. We have assumed that these communities, since they are already familiar with OSM and using it for navigation purposes, that they could also make use the OSM LULC mapper to give them a richer mapping environment (in terms of information layers).

Table 26. Number of potential customers.

Customers	Number of potential customers	
	Africa	World-wide
Policy makers, planners, researchers, citizens	≅ 600[31]	≅ 5,000,000[32]

[30] Taken from D2.14 – Land Use Mapper web service (April 2018)

[31] https://www.openstreetmap.org/stats/data_stats.html

[32] https://osmstats.neis-one.org/?item=countries

10.2 Exploitation of LUM

The idea is that the basic/standard OSM LULC mapping functionality will be made available free of charge. However, additional customisation & consultancy will be offered as a paid service. The latter could include different spatial, temporal and thematic resolutions, or different thematic categorisations (nomenclature). The charge for customisation could be around 500 € per product, while the consultancy that goes hand-in-hand with this customisation might be charged at 850 € per day. At this stage it is unclear which organisations or companies would be interested in offering such services.

Unfortunately, the OSM LULC mapper is still at the stage of being an 'excellent concept' and an early prototype with low TRL. Because of the complexity of linking the different components and lack of verification data, and recent lack of progress by the third-parties involved, there is unfortunately no current working prototype (which includes all components envisaged by the Ground Truth 2.0 project). In addition, the parties involved have not yet considered that a business might arise from marketing of the OSM LULC Mapper. Thus, it cannot be considered a marketable product at this stage and we have therefore not been able to include either potential market uptake or an exploitation roadmap for the LULC Mapper in this report.

11 Overall Recommendations

Not surprisingly, the various COs turned out to all be very different in many respects, but in particular in their upscaling potential. For Meet Mee Mechelen, by happenstance the CO was 'duplicated' in a suburb of Antwerp, called Sint-Andries, albeit for the thematic topic of heat stress. In the case of the NitiLuli CO for the Shesheke West region of Zambia, this CO received national support even before it was launched and now it has already evolved into the National CBNRM CO in support of all the regional CBNRM associations. These two COs represent the opposite sides of the expansion spectrum, with the others falling in between. Overall, the local focus of many of the COs means that extensive expansion possibilities are not that likely, except for the ones where expansion up to national level (NitiLuli, VattenFokus and to a lesser extent Maasai Mara) is/was possible. In fact, in some cases, the communities strongly wanted to protect the local, and independent, nature of the COs, and are not interested in growing it geographically - but are keen on thematic expansion. However, it has also become clear that for COs, 'growing the market' is not as important as it is in a traditional marketing approach, but rather that the goal of achieving sustainability is key (and more challenging than expected).

In retrospect it is now blatantly obvious that the social value-add, and the environmental and socio-economic impacts far outweigh any financial or 'profit' objectives. This is clearly illustrated in the first forays that the team made into analysing the social return on investment of the COs. The latter turned out to be an extremely interesting way of assessing the COs, but as it was not included in the original DoW, we were only able to just touch upon this analysis. Our recommendation would be to investigate this aspect of the COs in considerably more depth.

As highlighted in this report and flagged in D3.3 (Business models), exploitation of the COs turned out to be a wrong expectation. It soon became clear that a non-profit business model was a better fit, but even this had to be further adapted to the particular characteristics of the COs (such as the fact that the partners/core stakeholders are often the beneficiaries too). Again, we learnt a valuable lesson here and have developed a new business model that can be applied to CO, and possibly more broadly to citizen science (CS) initiatives as well.

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Furthermore, our expectation for private investment and/or subscription revenues was not realistic, but it was nevertheless worth investigating for future knowledge. Our recommendation would be to include this option in the analysis, but not to rely on it. For example, there is still a chance that the Maasai Mara CO will accrue revenues from private lodges for their branding on the app and for their clients to be involved in data collection. But this is the only example we have encountered across all seven COs (Klimaatrobust Sint-Andries included). For the other COs, public funding turned out to be the only option for sustainability, which is strongly underpinned by the public good impacts and their considerable socio-economic and environmental value. However, one consequence of this government-based funding is that the annual costs have to be kept as low was possible. This, in-turn, means that free and open-source tools are preferred over proprietary tools that have licensing costs attached.

It was recognised, even at proposal stage of the GT 2.0 project, that sustainability of the CO communities was key, and this turned out to be a major challenge for the demo case teams in that they had to expend considerable effort to keep the stakeholders engaged and to build a sustainable community. The more enthusiastic the local community was, there more successful the demo case proved to be, especially with respect to data collection campaigns, but also with respect to continuation of the CO beyond the end of the project. The most valuable lesson learnt was that the key to sustainability is the have a champion organisation onboard, where the CO fits their interests and needs closely. Furthermore, it is expedient to find an existing organisation or institution with a specific interest in the subject of the CO, thereby increasing the likelihood that they will take over the ownership of the CO platform and data repositories. For some COs such organisations were onboard from the start (e.g. for RitmeNatura and Grip op Water Altena) but for others, this happened organically during the project and platform development.

Turning to the GT2.0 tools and co-design Methodology, these are project outcomes that can be exploited commercially. Our initial, 'back of an envelope', business case analysis shows that the Quality tool and the Methodology could offer lucrative opportunities, especially since the operational costs are limited and the capital investment is low. It is a real accomplishment for the GT2.0 project to have produced two exploitable outcomes that can be realised by willing parties.

Out of the six (plus one[33]) COs, it is highly likely that three will continue and likely that two will be sustained, with the future of only two hanging in the balance.

[33] Klimaatrobust Sint-Andries

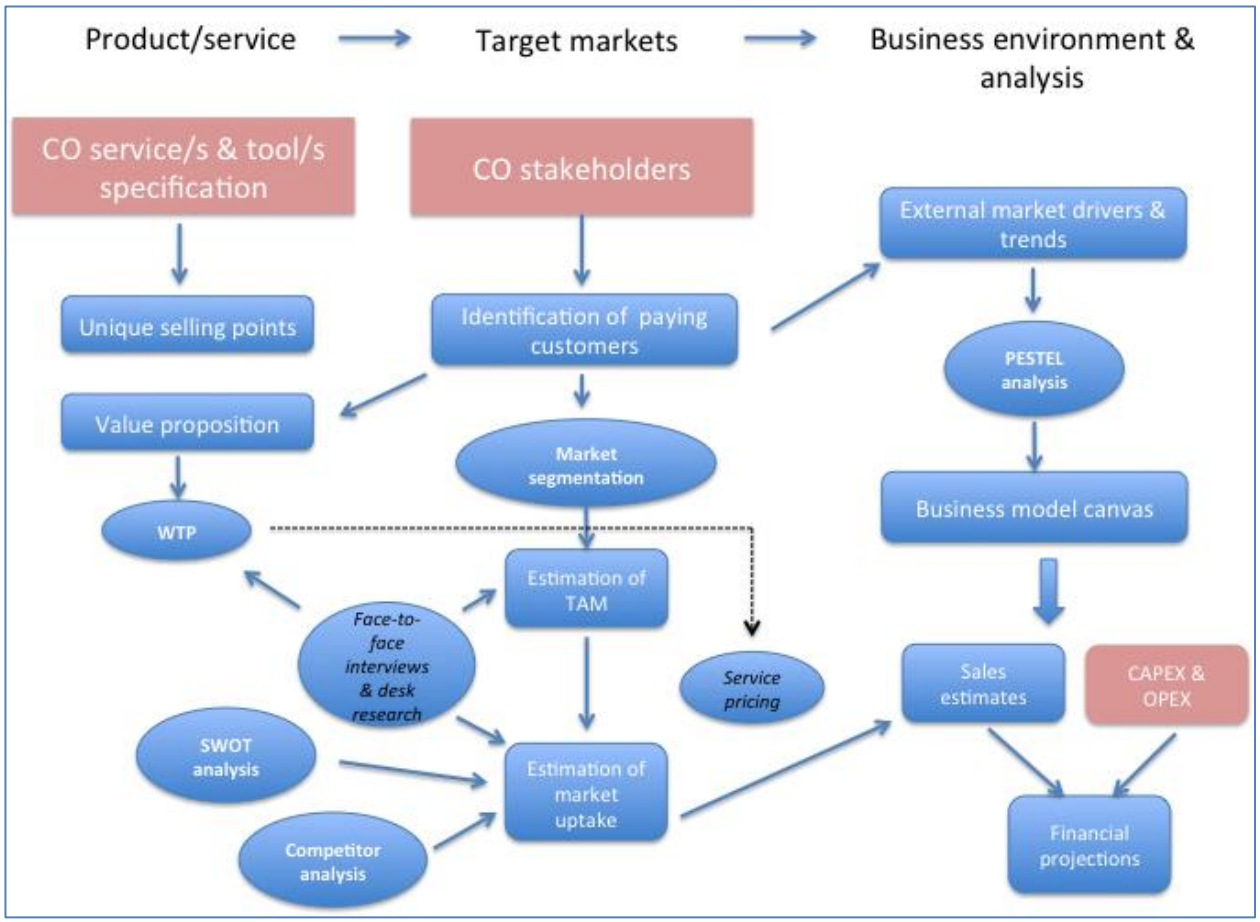
Annex 1: Initial Methodology

Overview of the market and business analyses

Here we present a schematic overview of the tasks that will be undertaken for the market and the business analysis.

We plan to take a conservative bottom-up approach for exploitation, starting with an investigation into potential paying customers, estimation of the size of the addressable market and market penetration, the potential market expansion (geographically and thematically), and finally the estimated costs and revenues for the platforms. The latter will lead into the business case analysis and identification of possible business models.

The diagram below shows how all the elements interlink to produce the final exploitation recommendations.



The starting point (in the upper left-hand side of the diagram) is the detailed specification of the information products or services that will be offered by the CO platforms. The ultimate aim is to collect enough market and business intelligence to get us to the lower, right hand part of the diagram - the best prospects for financial sustainability of the CO service provision. However, this complex overall process can also be broken down into a number of closely related tasks, which are further explained in the sections below.

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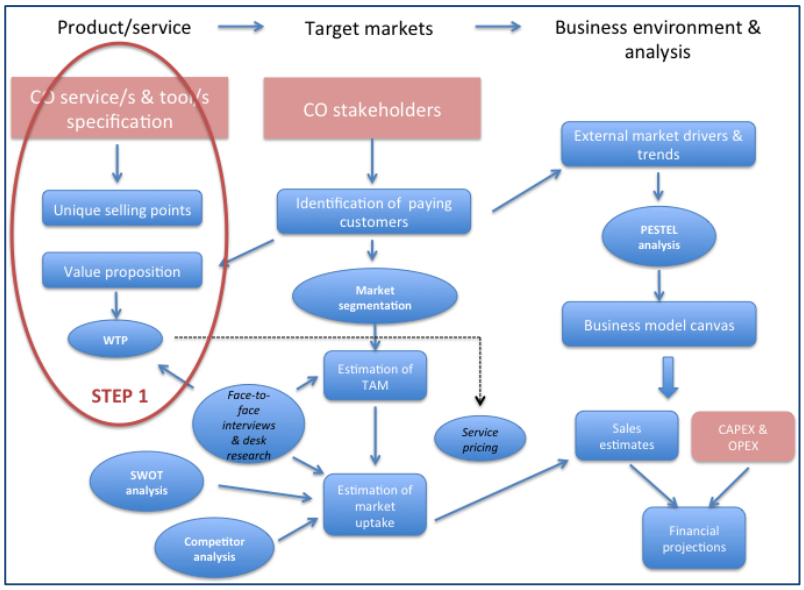
Market analysis

Product/service specification and value-add

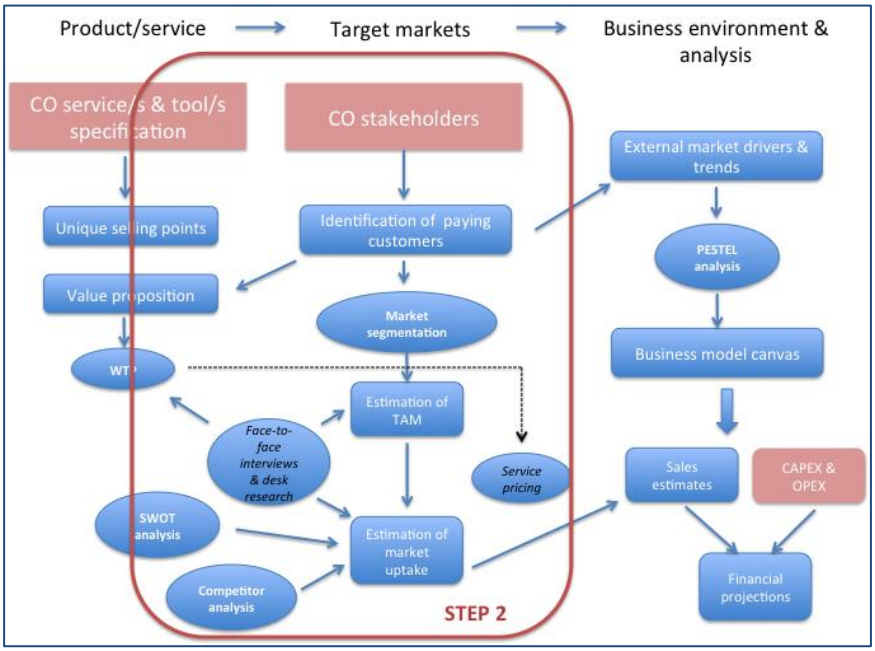
The first step toward the market analysis is the comprehensive identification of all the products and services offered by the CO platforms.



Once each of the CO products and services are defined, it facilitates the elaboration of the USPs (unique selling points) of the CO services. This together with a value proposition assessment, will highlight the value-add that the CO services will afford stakeholders.

For this assessment, we will make use of the Strategyzer Value Proposition Canvas methodology to develop these concepts (see the next chapter for more information). The value proposition canvas will be developed in collaboration with the demo teams, and will be complemented by information gathered when interviewing stakeholders.

Target markets and sizing



The next step in our methodology is to revisit the stakeholder groups or community for each of the COs, and to identify the target markets for the products and services. In addition, we will need to undertake and initial identification of the potential customer groups, i.e. an entity or entities that could possibly fund or pay for such services. This will depend on the extent to which they will benefit (directly or indirectly) from paying for such a service.

We will also investigate segmenting the market according to stakeholders' needs. Meeting the customers demands with the best product/service offering is the fundamental principal of marketing success, and this is best achieved when the market is divided into customer groups having very similar requirements

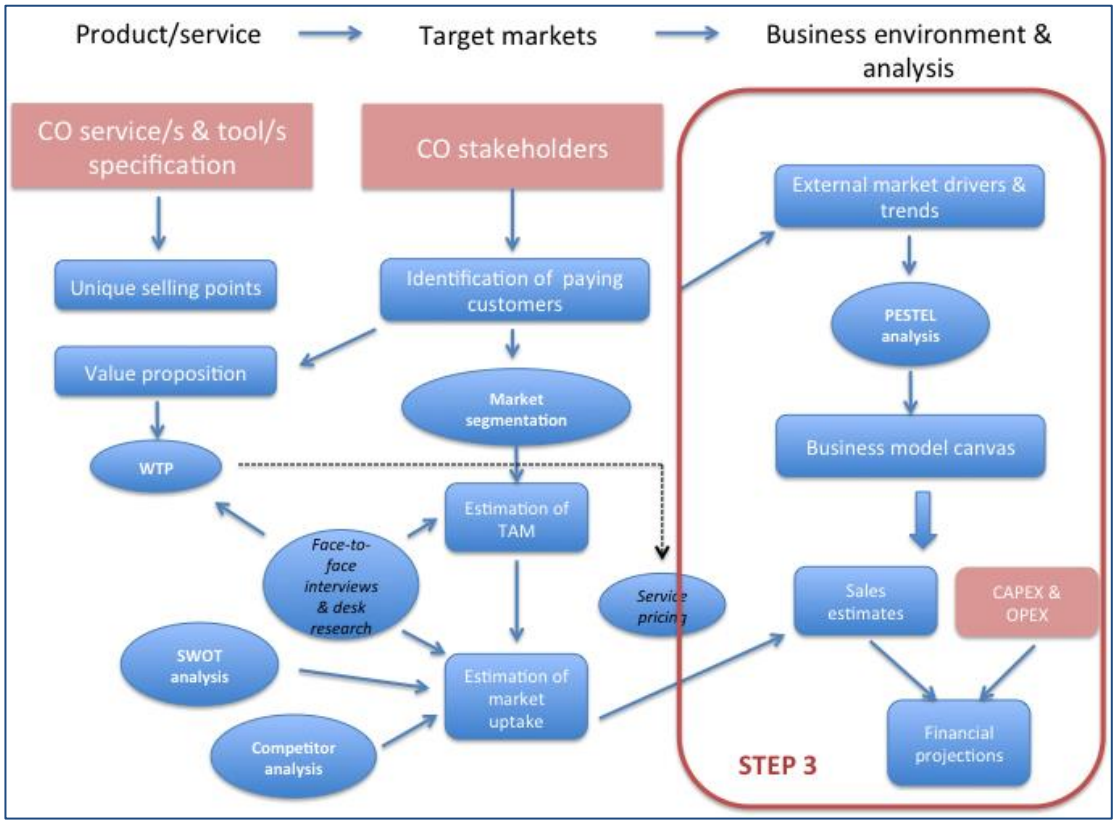
(e.g. information on ppms of specific air pollutants such as NOx versus an air quality rating of good, medium, or bad). This will be done by closely analysing the user requirements across all the types stakeholders.

Through desk research and the information gathered from face-to-face interviews with stakeholders, we estimate the total number of potential customers that could benefit from this type of environmental information, the so-called total addressable market (TAM). For this we will start extrapolating from the regional demo cases, to potential countrywide usage, then pan-continental (Europe and Africa) and, if applicable, the global market as well. These TAM estimates together with inputs from market experts will facilitate a forecast of the likely market uptake of the CO information services, i.e. the market penetration figures or the number of customers that are foreseen to buy such services.

It is expected that the market uptake will grow year on year as new customers are attracted to the services (through promotion, marketing, demonstrations, etc.), and thus we will forecast the market uptake over the next 1 to 5 years. We will also take into consideration that market growth can be achieved through geographical expansion, but also through thematic expansion, i.e. other, possibly, unrelated market sectors that could also benefit from the same information services.

Having said that, market growth can be constrained or threatened by competitive services. This and other market factors will be taken into consideration through an analysis of the strengths, weaknesses, opportunities and threats faced by the SPs – a SWOT analysis. This will serve to inform the most likely market uptake forecasts.

Business case and business model analysis



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We also need to consider external market drivers and trends that the SPs will be facing. For this, we will undertake a PESTEL analysis, which looks at the political, economic, social, technological, environmental and legal factors that may impact the market uptake and 'sales' of the CO products and services.
In parallel, we need to investigate the business model/s that will be most applicable to operating each of the COs, e.g. a free basic service with annual subscriptions for additional, customised information, or licensing, or a flat fee per access, publicly funded, etc., or even a non-profit model. This will be elaborated for each CO in a business model canvas (explained in detail in the next chapter). This will determine the likely revenue sources and streams, or even wider social outcomes, for the CO platforms. These business models will also outline the organisational structures, partnerships or agreements that need to be put in place to operate the CO platforms and provide the services in the long term.

With all this information in mind, the next step will be to estimate revenue figures for the potentially profitable business models. Annual sales can be deduced from year on year market uptake estimates, including repeat sales and sales to new customers. This together with the servicing pricing, will give us potential revenue figures. And finally, these together with the capital expenditure (CAPEX) and operating costs (OPEX), we will be able to calculate the breakeven point and give an overview of the business case or financial projections for the CO platform. This will also highlight any key issues, such as opportunities or threats to the financial sustainability of the platforms for the SPs.

To facilitate the collection of all this market and business information, we have prepared a template that is presented in the next chapter. This template was devised to ensure that similar information is collected across all the demo cases, and that sufficient information on each is amassed to be able to develop well-informed recommendations on their financial sustainability.

Annex 2: Impact Questionnaire for SRoI

1. General Information

Name and affiliation:

Public, private or research organisation?

Which of the following stakeholder groups do you represent?

☐ Citizen	☐ Scientist	☐ Decision-maker	☐ Policy-maker	☐ Expert Advisor
☐ Supplier	☐ Data aggregator	☐ Customer/buyer	☐ Shareholder	☐ Investor

Which of the COs are you involved in?

☐ Meet Mee Mechelen	☐ RitmeNatura	☐ Grip op Water Altena
☐ Vatten Fokus	☐ Zambian National CBNRM CO	☐ Maasai Mara

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Please explain how you are involved in the CO

What are your inputs to the CO ?

What are the costs to you of these inputs to the CO ?

2. OUPUTS of the CO

☐	'New' data sets
☐	New information
☐	Others (e.g. MoU, training)

What are for you the key outputs of (directly produced or supplied by) the operational CO?

3. OUTCOMES of the CO

What key outcomes (short term changes in the situation) will these outputs have? Outcomes can be positive or negative – please indicate which.

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4. IMPACTS of the CO

Which of the following impacts (long term) of the CO would you say are key?	
☐	Raising awareness and urgency of CO topic
☐	Improved reliability/trustworthiness of information
☐	Improved information re timeliness and accuracy
☐	Improved community cohesion
☐	Improved communication with regulators
☐	Improved skills and competences
☐	Participation in decision making
☐	Improved distribution of resources
☐	Narrowing of digital divide
☐	Improved environment and local environment (Quality of Life)
☐	Cost savings
☐	Reduction in staff effort
☐	Others?

Which of these impacts are the most important for you? Please list in descending order of importance. Impacts can be positive or negative – please indicate which.

5. Value of the impacts

What value do these impacts have for you/your organisation in terms of time/money or other?

What % of this impact would you estimate could be facilitated by the CO, i.e. what % can be attributed to the CO?

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