Citizen Science & Digitalization for Water

An AGUASAN Learning Journey e-workshop

Thursday 29 June 2023 3pm CEST

AGUASAN Community of Practice

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Swiss Agency for Development and Cooperation SDC

skat Swiss Resource Centre and Consultancies for Development

Citizen Science & Digitalization for Water

This e-workshop will start soon…

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skat Swiss Resource Centre and Consultancies for Development

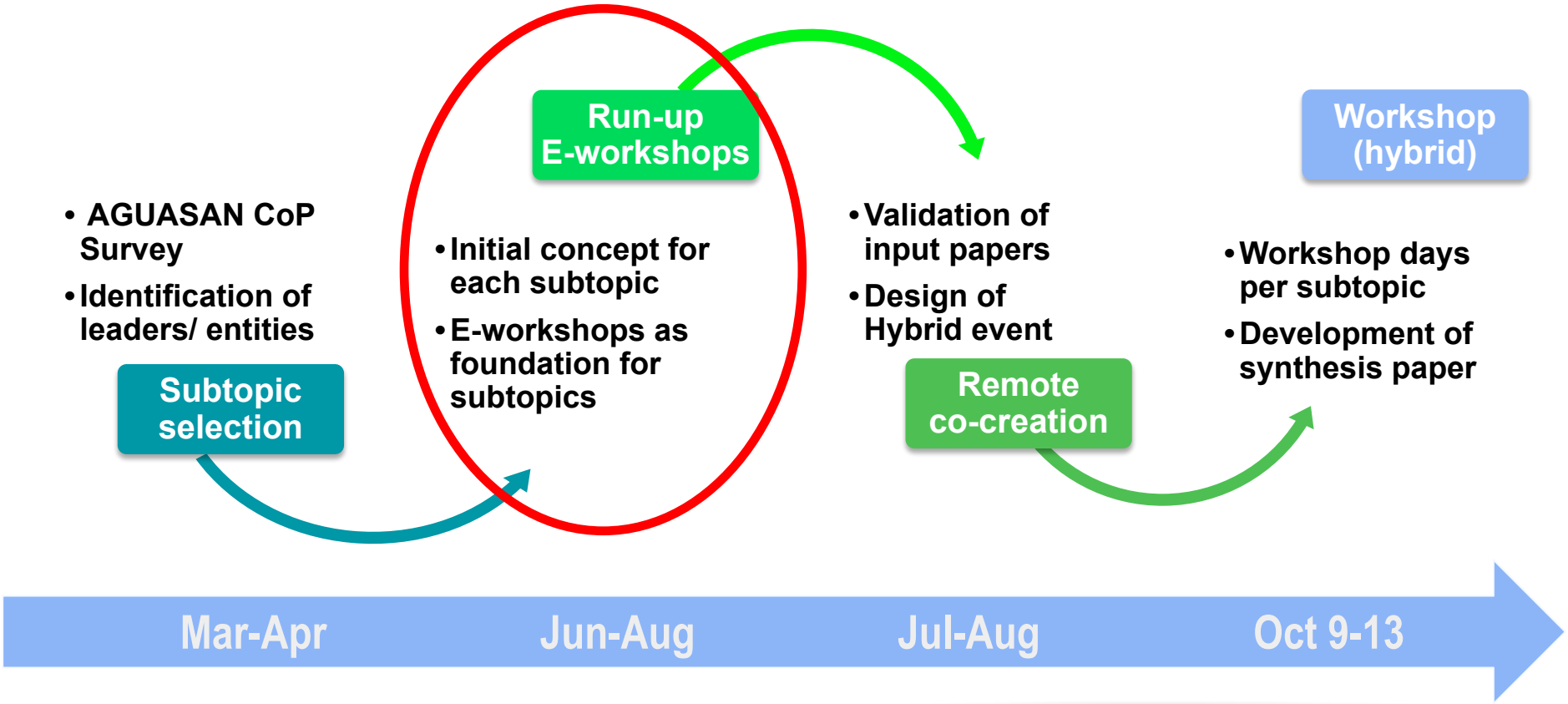
Tech housekeeping

Your microphone is currently off
If you want to speak or have a questions, click on the button at the bottom of the screen to open the mic

This event is being recorded. Plenary sessions may be shared online.

If you can't hear or see: close and restart the meeting, and close other programs

If you have comments or questions during presentations, please post them in the chat, or wait for the Q&A moment


Subtopic selection
• AGUASAN CoP Survey
• Identification of leaders/ entities
Run-up E-workshops
• Initial concept for each subtopic
• E-workshops as foundation for subtopics
Remote co-creation
• Validation of input papers
• Design of Hybrid event
Workshop (hybrid)
• Workshop days per subtopic
• Development of synthesis paper
Mar-Apr
Jun-Aug
Jul-Aug
Oct 9-13

In preparation for this year's AGUASAN Workshop, participate in these three free e-workshops and learning exchanges on:

Digitalisation and Data Management in the Water Sector

1

Citizen Science and Digitalisation for Water Quality

Date: June 29th, 2023
Time: 3 pm CEST

2

Digitalisation in Rural & Small-Town Water Services

Date: July 3rd, 2023
Time: 3 pm CEST

3

Data for Water Disaster Risk Reduction

Date: July 13th, 2023
Time: 3 pm CEST

Find more information on aguasan.ch

Register here

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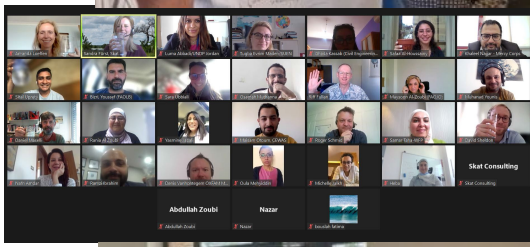
Swiss Agency for Development and Cooperation SDC

AGUASAN Hybrid event 9-13 October 2023

1) Citizen Science & Digitalisation for Water Quality
2) Digitalisation in Rural & Small Town Water Services
3) Data for Water Disaster Risk Reduction

And…

- Artificial Intelligence in Water Resource Mgmt/Services
- Data Mgmt/Security/Misuse
- Digitalised Responses to Disasters/Extreme Events



CITIZEN SCIENCE IN WATER QUALITY MONITORING AND MANAGEMENT

By Simlindile Mahlaba
GroundTruth CC
Environmental Scientist, Social & Stakeholder Engagement Specialist

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Freshwater in crisis: Global and Locally – South Africa

Freshwater: A Global Crisis of Water Security and Basic Water Provision*

Rosalie Gardiner

Freshwater failures: The crises on five continents

Abramovitz, Janet N

ProQuest document link

SPECIALTY GRAND CHALLENGE article

Front. Environ. Sci., 21 March 2016

Sec. Freshwater Science

Volume 4 - 2016 | https://doi.org/10.3389/fenvs.2016.00021

Grand Challenge for the Future of Freshwater Ecosystems

Stuart E. Bunn*

Ambio 2021, 50:85–94

https://doi.org/10.1007/s13280-020-01318-8

KUNGL. VETENSKAPS AKADEMIEN

PERSPECTIVE

Scientists' warning to humanity on the freshwater biodiversity crisis

James S. Albert, Georgia Destouni, Scott M. Duke-Sylvester, Anne E. Magurran, Thierry Oberdorff, Roberto E. Reis, Kirk O. Winemiller, William J. Ripple

institute for FUTURES RESEARCH

Vol 7 No 01 Apr 2009

The state of water in South Africa – are we heading for a crisis?

LAW, CRIMINOLOGY & CRIMINAL JUSTICE | REVIEW ARTICLE

Talking dirty - effluent and sewage irreverence in South Africa: A conservation crime perspective

Friedo J.W. Herbig[1]*

The impact of inadequate wastewater treatment on the receiving water bodies – Case study: Buffalo City and Nkokonbe Municipalities of the Eastern Cape Province

MNB Momba[1]*, AN Osode[2] and M Sibewu[1]

[1] Tshwane University of Technology, Water Care Department, Arcadia Campus, P/Bag x 680 Pretoria 0002, South Africa

[2] Department of Microbiology and Biochemistry, University of Fort Hare, P/Bag X1314, Alice 5700, South Africa

pollutants

MDPI

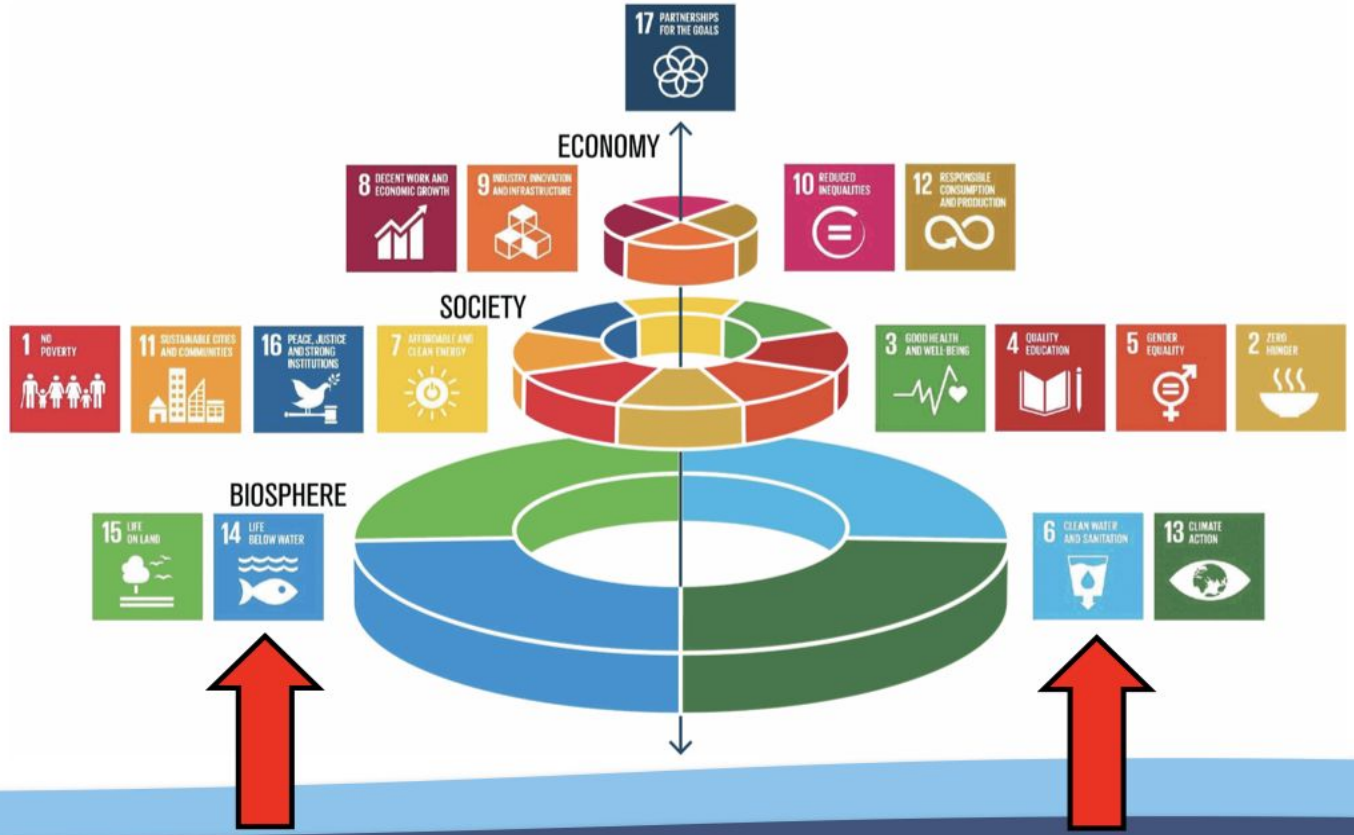
Article

Pollution of Sand River by Wastewater Treatment Works in the Bushbuckridge Local Municipality, South Africa

Thivhonali Kenneth Masindi [1,*], Thomas Gyedu-Ababio [2,*] and Lizzy Mpenyana-Monyatsi [3,*]

Water supply
- Local (drinking, washing)
- Downstream (Midmar for PMB)
Agriculture
- Cannot irrigate
- Cattle grazing and drinking
The importance of community-based monitoring:
Water quality and WWTW issues affect people directly!
Communities
- Health
- Well-being

Combating the freshwater crisis: SDGs



Combating the freshwater crisis: SDGs

SUSTAINABLE DEVELOPMENT GOALS

6 CLEAN WATER AND SANITATION

6 CLEAN WATER AND SANITATION

ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

THE WORLD'S WATER-RELATED **ECOSYSTEMS** ARE BEING DEGRADED AT AN ALARMING RATE

OVER THE PAST 300 YEARS, **OVER 85%** OF THE PLANET'S WETLANDS HAVE BEEN LOST

MEETING DRINKING WATER, SANITATION AND HYGIENE TARGETS BY 2030 REQUIRES A 4X INCREASE IN THE PACE OF PROGRESS

FOR AT LEAST **3 BILLION PEOPLE,** THE QUALITY OF THE WATER THEY DEPEND ON IS UNKNOWN DUE TO A LACK OF MONITORING

733+ MILLION PEOPLE LIVE IN COUNTRIES WITH HIGH AND CRITICAL LEVELS OF WATER STRESS (2019)

TARGET 6.B

SUPPORT LOCAL ENGAGEMENT IN WATER AND SANITATION MANAGEMENT

Citizen Science to the rescue

Traditional monitoring methods:

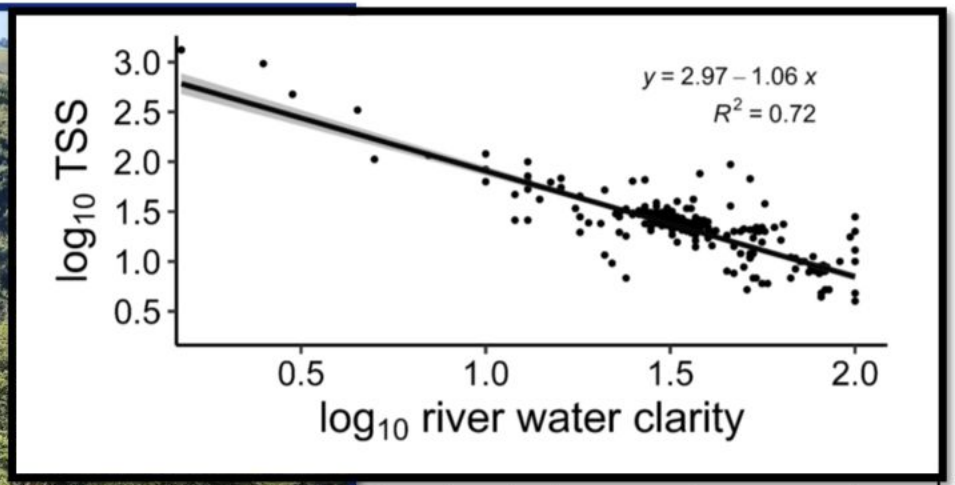
- Expensive, time consuming.
- Require high-capacity laboratories and people (lacking in developing places).
- Low spatial and temporal resolution because of financial and logistic limits.
- Disconnect between data and people.

VS.

Citizen science:

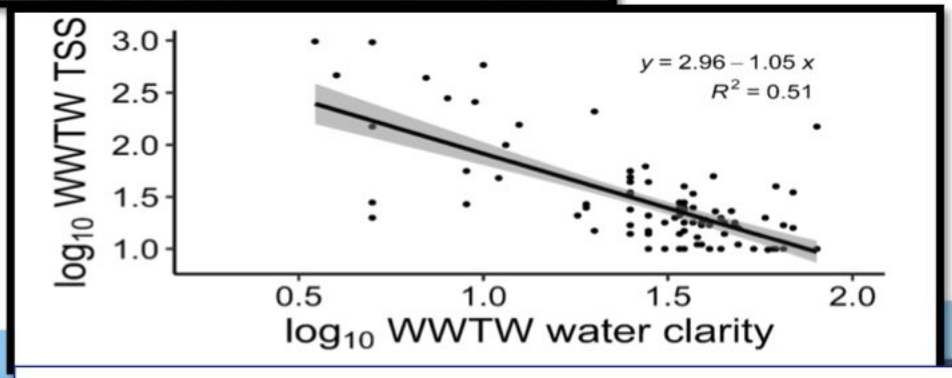
- Everyone can be one! Quick, intuitive, easy.
- Education, exposure, increase scientific literacy.
- Local / indigenous knowledge.
- A voice to disaffected, vulnerable, and marginalized people.
- Low-cost, high spatial and temporal resolution, high volume data.

Citizen Science: Clarity tubes



Use the clarity to estimate total suspended solids for river quality monitoring.

Clarity tubes for WWTW effluent monitoring



amaBhungane | Free State's foul failure: The critical state of SA wastewater plants

Aisha Abdool Karim and Laura López González

Comments Bookmark

The sewage treatment plant section of the Vaal River.

PHOTO: Alaister Russell, Gallo Images, Sunday Time

- 75% of SA's wastewater treatment plants deemed to be in a "critical" state have failed to deliver the recovery plans demanded by government's Green Drop report.
- The bleak situation in the Free State, where only one municipality out of 19 submitted plans, provides a vignette into the crumbling national infrastructure.
- Broken down, abandoned, and vandalised wastewater treatment plants continue to pollute South Africa's major water sources by flooding rivers with raw sewage.

Use the clarity tube to estimate total suspended solids in wastewater treatment works effluent for quality and compliance monitoring.

Citizen Science: Velocity Plank

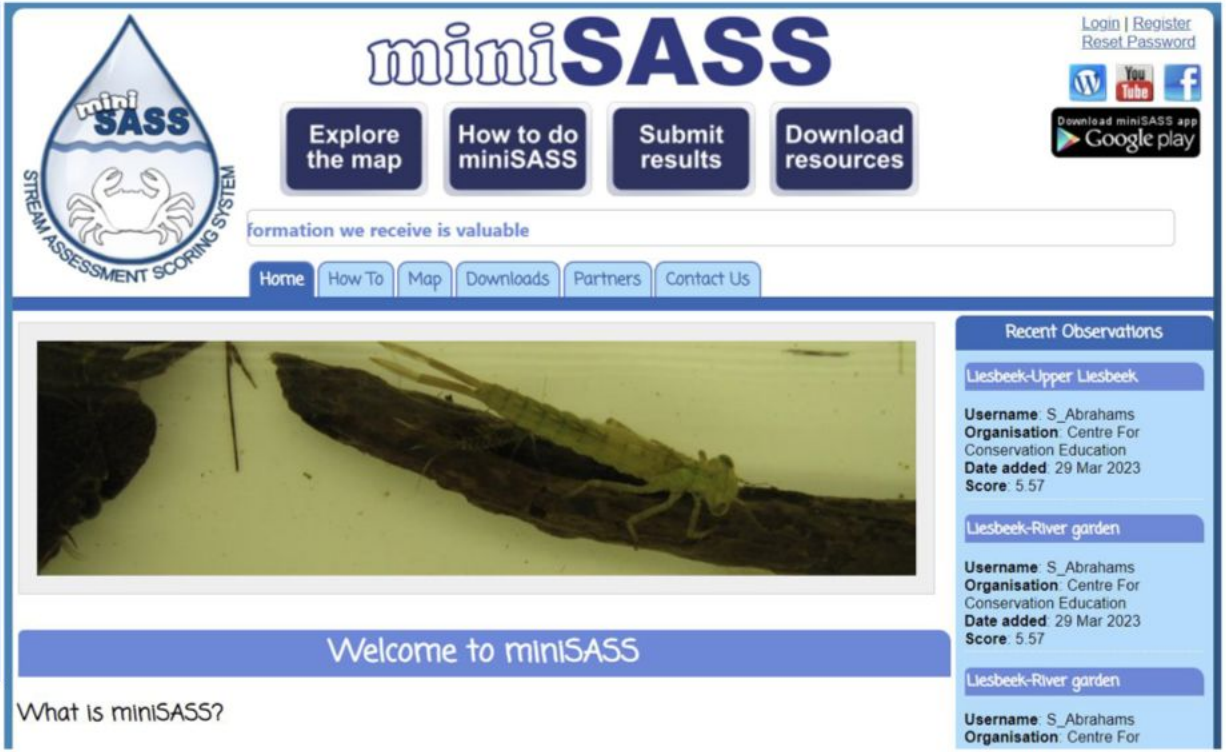
- Depth and the speed of river water flow.
- Observe patterns and changes.

Citizen Science: miniSASS

Aquatic macroinvertebrates each have unique sensitivities.

Highly sensitive species present = high score.
Only pollution tolerant species present = low score.

Easy, intuitive, and engaging biomonitoring tool.



Citizen Science: miniSASS

Citizen Science: The Enviro-Champs

A public and environment-spirited person.

Enviro-Champs provide linkages between communities, authorities, and key issues such as pollution, wasting water, and poor sanitation.

DUTIES

- Communication with ward councillor.
- miniSASS.
- Clarity tubes.
- War on leaks (fixing or reporting).
- Sewer line monitoring.
- Alien vegetation (clearing or monitoring).
- Illegal dump site monitoring.
- Community engagement / education.
- Attending training workshops.

Enviro-Champs: Projects

- Palmiet River Catchmentment Rehab Project
- Mpophomeni Enviro-champs
- Transformative River Management Enviro-Champs
- Amanzi Ethu Nobuntu (AEN) – DSi
- WRC – in Lake Sibaya, links to SANParks, UKZN
- WWQA and HR2W – Community of Practice

Enviro-Champs success

unicef | for every child
South Africa

EXPLORE UNICEF | PRESS CENTRE | DONATE

WHAT WE DO | RESEARCH AND REPORTS | STORIES | TAKE ACTION

Home > Stories > Youth on the frontlines protec...

Article

Youth on the frontlines protecting South Africa's environment

'Enviro-Champs' - helping to create a healthier environment today and building knowledge and skills for tomorrow.

Toby Fricker and Bongeka Ngcobo

Personal | Business | Corporate

Enviro Champs success story

By Heather Dugmore

The WWF-Nedbank Green Trust Enviro Champs Programme has contributed to a growing success story in the mainstreaming of under-resourced and informal communities in the management of freshwater resources.

We now have four thriving Enviro Champ nodes in formal and informal settlements in the Western Cape and KwaZulu-Natal,' says Kholosa Maqudu, engagement leader for

'The Enviro Champs monitor water quality and report

Nedbank Ltd Reg. No 1951/000009/06.
Authorised financial services and registered credit provider (NCRCP16).

About us | Investor rel

Citizen Science: Research on smartphones for monitoring

- Hydrocolor app (reflectance, turbidity)
- Eyeonwater app (reflectance, turbidity)
- Deltares nitrate app (nitrate strip)
- The Nutrient app (nitrate & phosphate strips)
- ODK collect app (Enviro-Champs, clarity tubes, velocity planks, algal blooms, etc.)
- **miniSASS app**

THANK YOU

UN environment programme

GEMS Water

WATER RESEARCH COMMISSION

unicef

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

IWMI International Water Management Institute

CGIAR

DUCT
DUZI UMNGENI CONSERVATION TRUST

Centre for Water Resources Research

UMGENI WATER · AMANZI

GroundTruth
Water, Wetlands and Environmental Engineering

amazon web services

NWU
NORTH-WEST UNIVERSITY
NOORDWES-UNIVERSITEIT
YUNIBESITI YA BOKONE-BOPHIRIMA

LIMCOM
LIMPOPO WATERCOURSE COMMISSION

KARTOZA
OPEN SOURCE GEOSPATIAL SOLUTIONS

FBIS Freshwater Biodiversity Information System

CITIZEN SCIENCE COOPERATION

By Tiyani Chauke

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Citizen Science and Institutional Support

What is Citizen Science,

Oxford dictionary “ the practice of public participation and collaboration in scientific research to increase scientific knowledge”

Collaboration of the public and scientist in scientific and data analysis

California Academy of Sciences

Why Citizen Science ?

Participation of the public in Science

Education /Capacity development

Sharing of knowledge

Science based decision making

Promotion of ownership of resources (Natural, artificial/ infrastructure, projects etc)

Knowledge generation (increase scientific knowledge)

Citizen Science cooperation and Digitisation

Mitigation of duplication work

Amplification of resources

Knowledge and solution sharing

Capacity building (training, tools and Infrastructure)

Digital platforms (ease of data collection and information sharing)- knowledge hubs and living labs

Scientific communication at large scale

WRC Citizen Science tools

- Minisass- River health monitoring
- WET-SERIES-Ground Truth and Rhodes
- Buffer Zone Maintenance and determinisation
- Citizen Science Tools
- Vanishing waters
- River Rehabilitation

CITIZEN SCIENCE PARTNERSHIPS

UNICEF

HR2W

SAHRC

WATERNET

IWRA

UNESCO

PCC

WATERSHARE

Thank you
Enkosi
Ngiyathokoza
Ke a leboha
Ro livhuwa
Dankie
Ngiyabonga
Inkomu
Ke itumetsi
Siyabonga
Re a leboga

Biomonitoring & miniSASS River Health Index

By Jim Taylor
UKZN and GroundTruth

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WWQA
World Water Quality Alliance

REGIONAL CENTRE OF EXPERTISE ON EDUCATION FOR SUSTAINABLE DEVELOPMENT
ACKNOWLEDGED BY
UNITED NATIONS UNIVERSITY

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CARE

WATER RESEARCH COMMISSION

GroundTruth
Water, Wetlands and Environmental Engineering

SDGs

ESD EXPERT NET

Citizen Science through Partnerships

SADC
SOUTHERN AFRICAN DEVELOPMENT COMMUNITY
TOWARDS A COMMON FUTURE

CGIAR/IWMI

AWS

WESSA
PEOPLE CARING FOR THE EARTH

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

Centre for Water Resources Research

United Nations

UN WATER

This is our land – Where we come from!

Citizen Science & Heritage in southern Africa

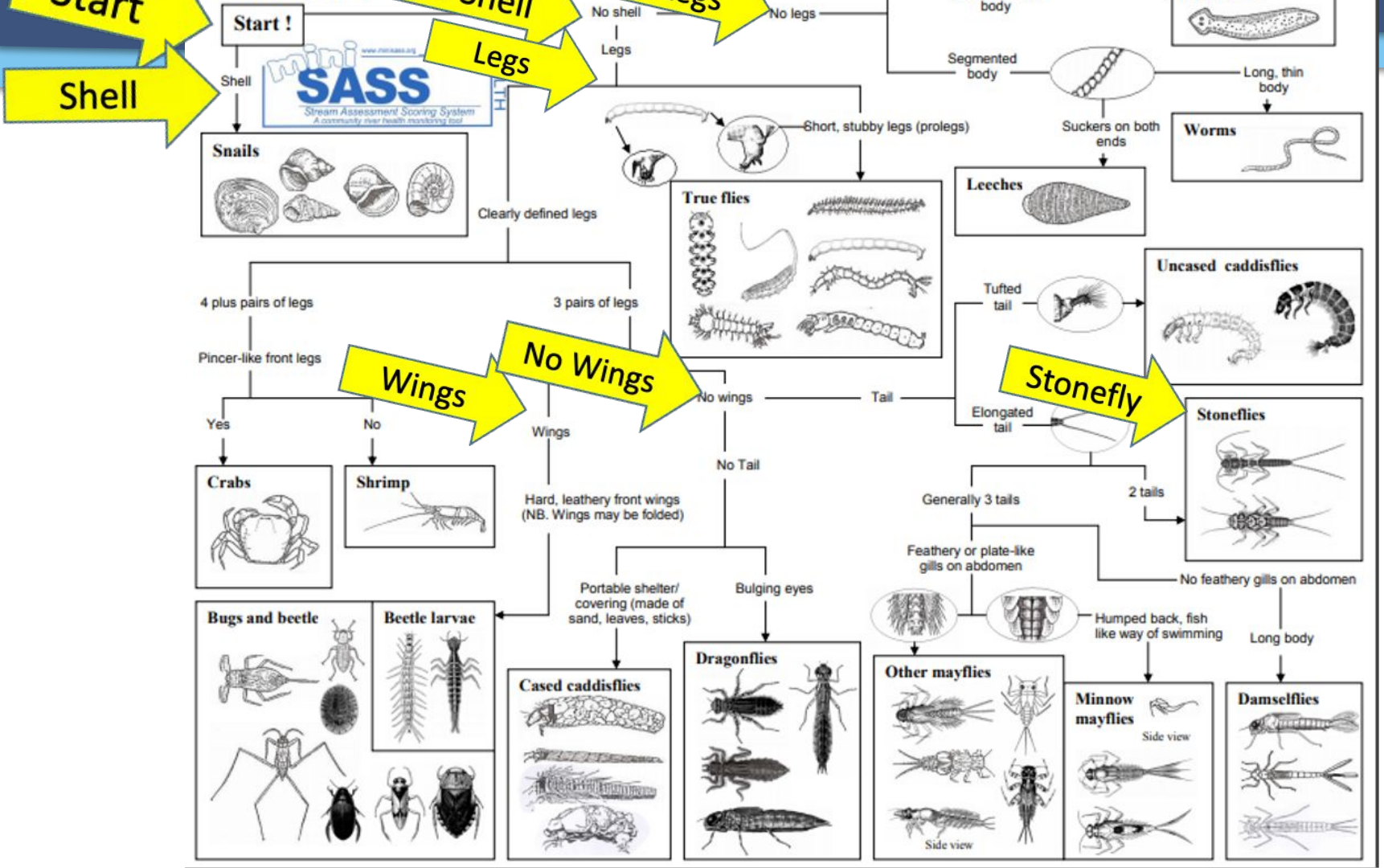
Although it wasn't known as citizen science, in those days, citizen science as indigenous heritage has been practiced for hundreds of years in southern Africa.

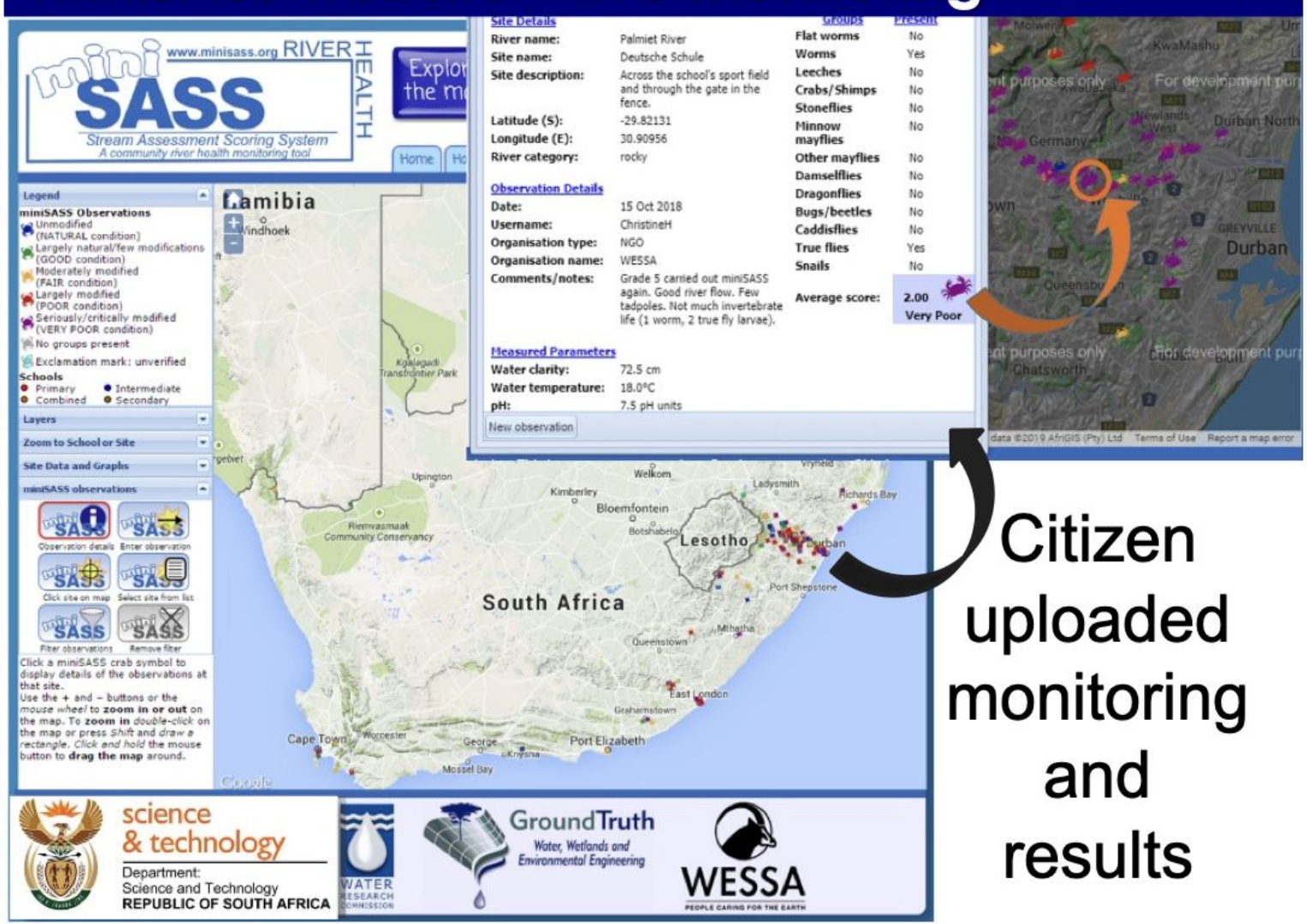
People living in rural villages have been able to 'read the water quality' in their streams and springs so as to collect clean water for their daily use.

One example is how people learnt not to drink the water unless they could hear it!

miniSASS Biomonitoring

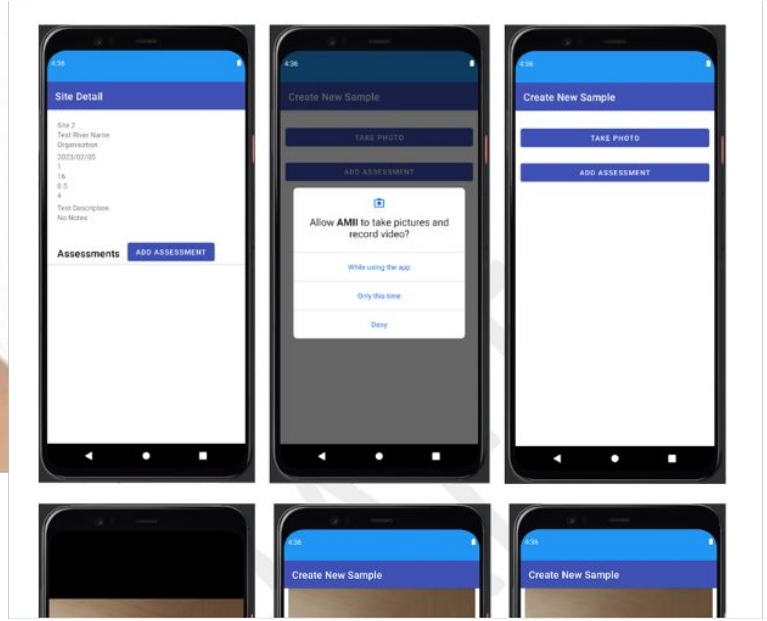
Collect a sample of organisms (macro-invertebrates) from our local stream

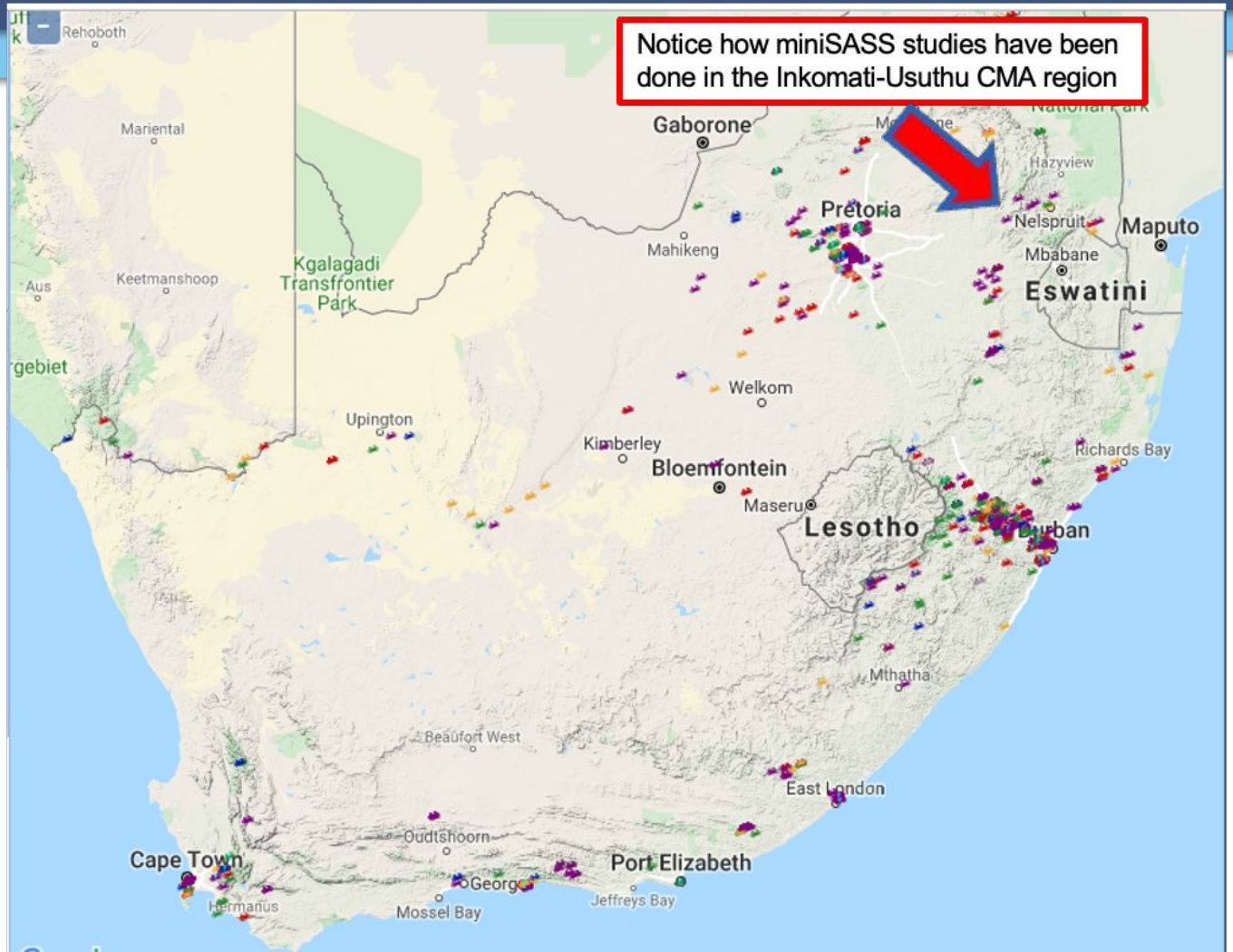

Start
Shell
Legs
Wings
No Wings
Stonefly
Start !
mini SASS
Stream Assessment Scoring System
A community river health monitoring tool
Shell
No shell
Legs
No legs
Segmented body
Long, thin body
Worms
Suckers on both ends
Leeches
Short, stubby legs (prolegs)
Snails
Clearly defined legs
True flies
4 plus pairs of legs
3 pairs of legs
Pincer-like front legs
Yes
No
Crabs
Shrimp
Wings
No wings
Tail
Tufted tail
Uncased caddisflies
Elongated tail
Stoneflies
Generally 3 tails
2 tails
No Tail
Hard, leathery front wings (NB. Wings may be folded)
Portable shelter/ covering (made of sand, leaves, sticks)
Bulging eyes
Feathery or plate-like gills on abdomen
No feathery gills on abdomen
Humped back, fish like way of swimming
Long body
Bugs and beetle
Beetle larvae
Cased caddisflies
Dragonflies
Other mayflies
Side view
Minnow mayflies
Side view
Damselflies

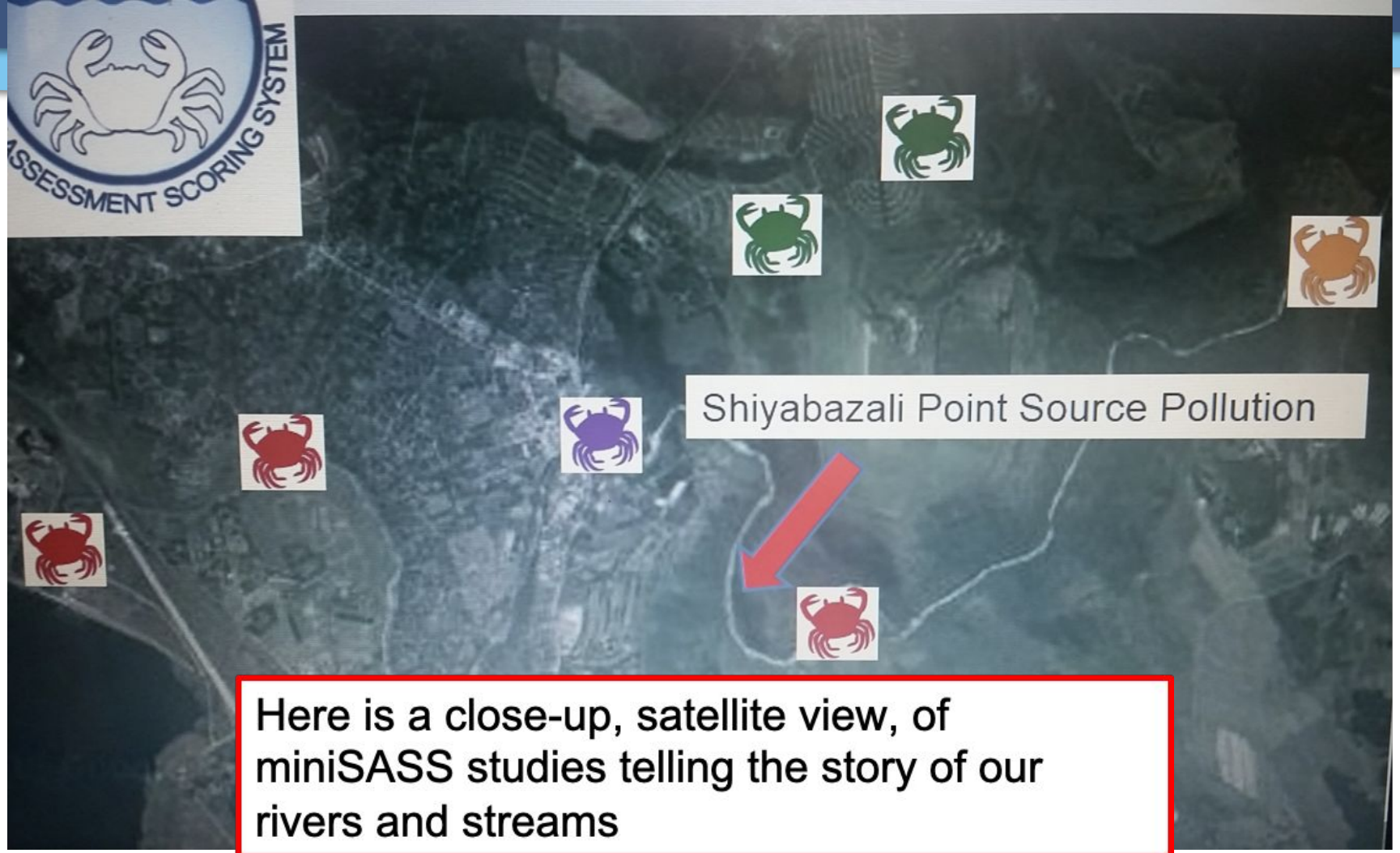


Citizen uploaded monitoring and results

Phone App Interface – with Machine Learning




Notice how miniSASS studies have been done in the Inkomati-Usuthu CMA region
Rehoboth
Mariental
Gaborone
Hazyview
Pretoria
Nelspruit
Maputo
Mahikeng
Mbabane
Kgalagadi Transfrontier Park
Keetmanshoop
Eswatini
Welkom
Upington
Kimberley
Richards Bay
Bloemfontein
Maseru
Lesotho
Durban
Mthatha
Beaufort West
East London
Oudtshoorn
Cape Town
Port Elizabeth
George
Hermanus
Mossel Bay
Jeffreys Bay



Here is a close-up, satellite view, of miniSASS studies telling the story of our rivers and streams

SDG Reporting

Contribute towards the scoring of SDG target 6.3.2 as well as Target 6b.

Andrés Manuel López Obrador

Data collection techniques and tools

Sampling methods, water quality measurements, and technology applications

By Steven Loiselle, Earthwatch

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Sampling, monitoring and technology, experiences from the FreshWater Watch

Sierra Leone

Zambia

Kenya

Tanzania

Malawi

Measurement methods

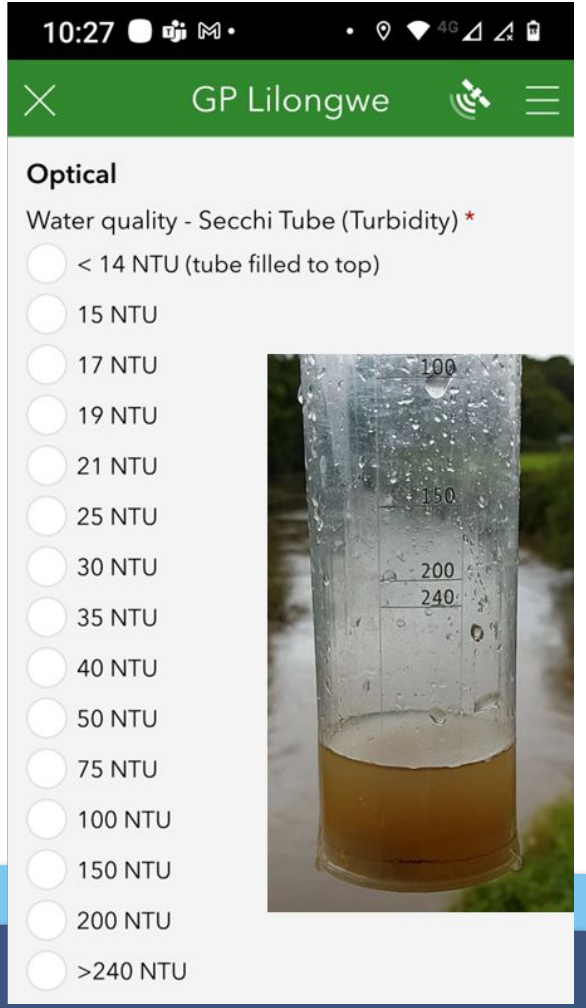
General Information: gives context of the study site

Ecological observations: visual indicators of waterbody health

Hydrological observations: estimates of water level and flow

Chemical tests: for nitrate, phosphate, NH_4^+, metals

Optical test: for turbidity and water colour



Overall approach to citizen scientist water quality monitoring

1. Co-design of monitoring protocol to complement agency monitoring activities and meet SDG 6.3.2 reporting objectives
2. Knowledge exchange and Training of local agency staff for recruitment, training and support of citizen scientists (Train the Trainer)
3. Identification of participating communities and recruitment of citizen scientists from each community
4. Training and knowledge exchange with localcitizen scientists
5. Citizen scientist monitoring and quality control
6. Collaborative data analysis
7. Feedback and consultation with citizen scientists
8. Integration of citizen scientist for SDG 6.3.2 reporting and local river management

NWRMA
NATIONAL WATER RESOURCES MANAGEMENT AGENCY

WARMA
Water Resources Management Authority

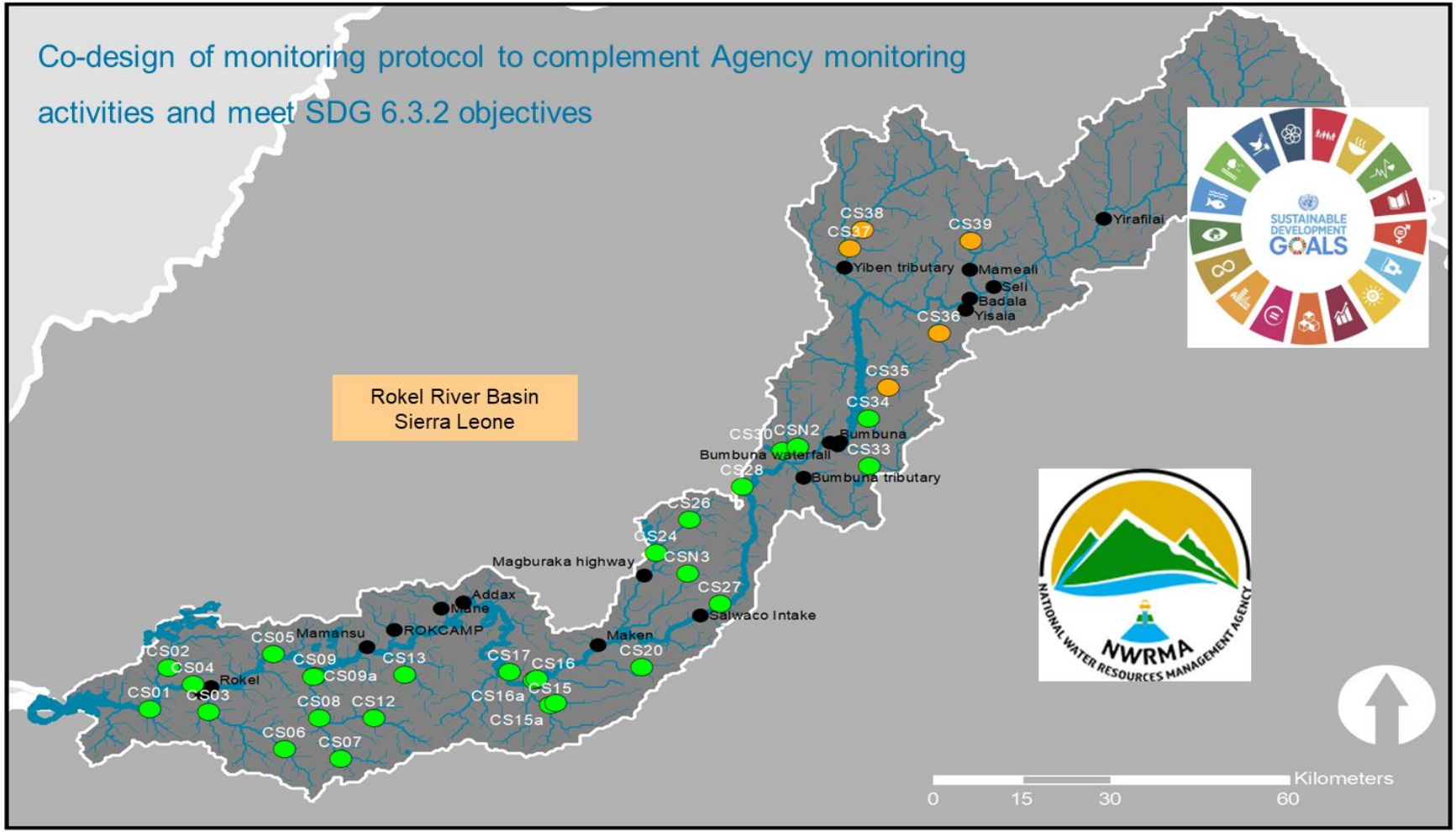
WWF®

UN environment programme
GEMS Water

LWT
LILONGWE WILDLIFE TRUST

WWQA
World Water Quality Alliance

Co-design of monitoring protocol to complement Agency monitoring activities and meet SDG 6.3.2 objectives



Identification of participating communities and recruitment of citizen scientists from each community

NWRMA
NATIONAL WATER RESOURCES MANAGEMENT AGENCY

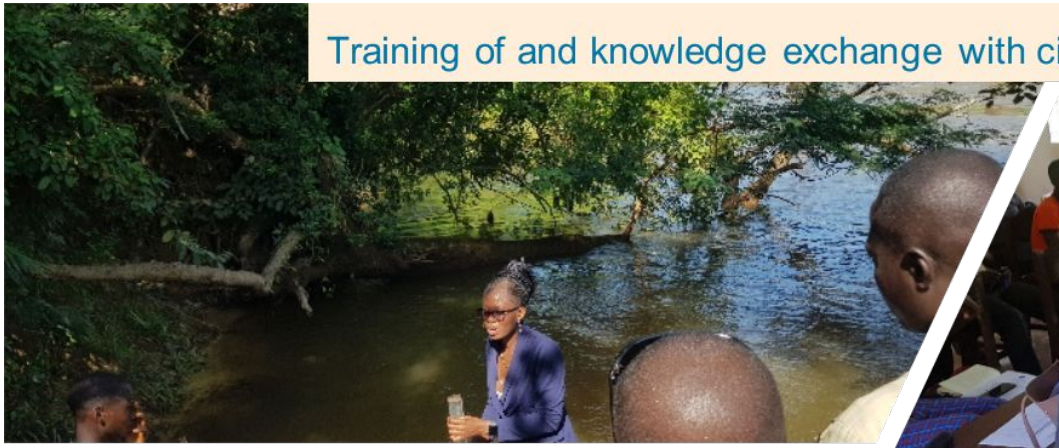
WWF®

LWT
LILONGWE WILDLIFE TRUST

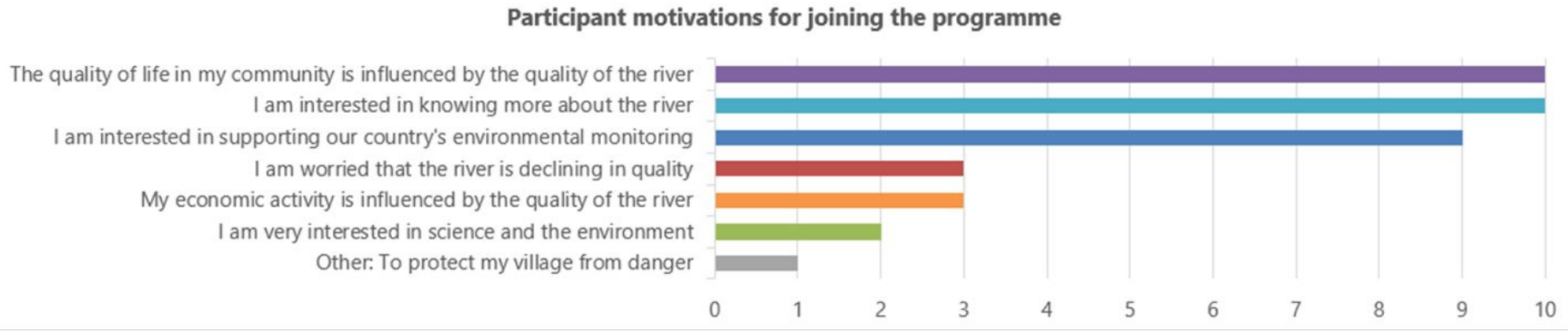
LVBWB

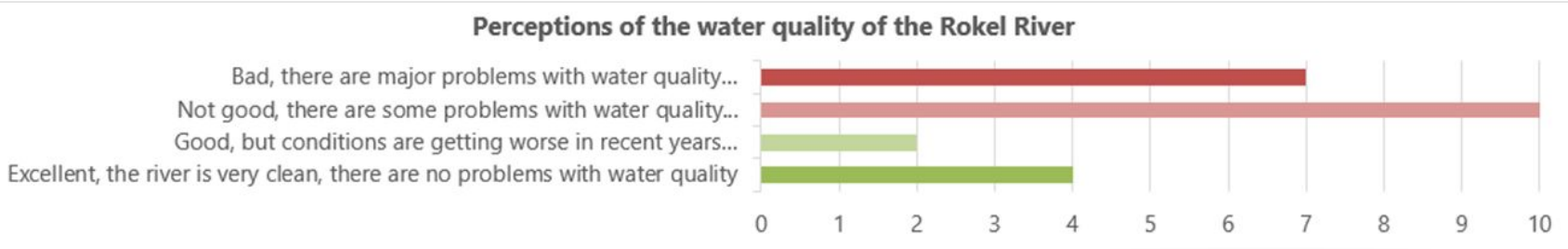
earthwatch
EUROPE

Training of and knowledge exchange with citizen scientists

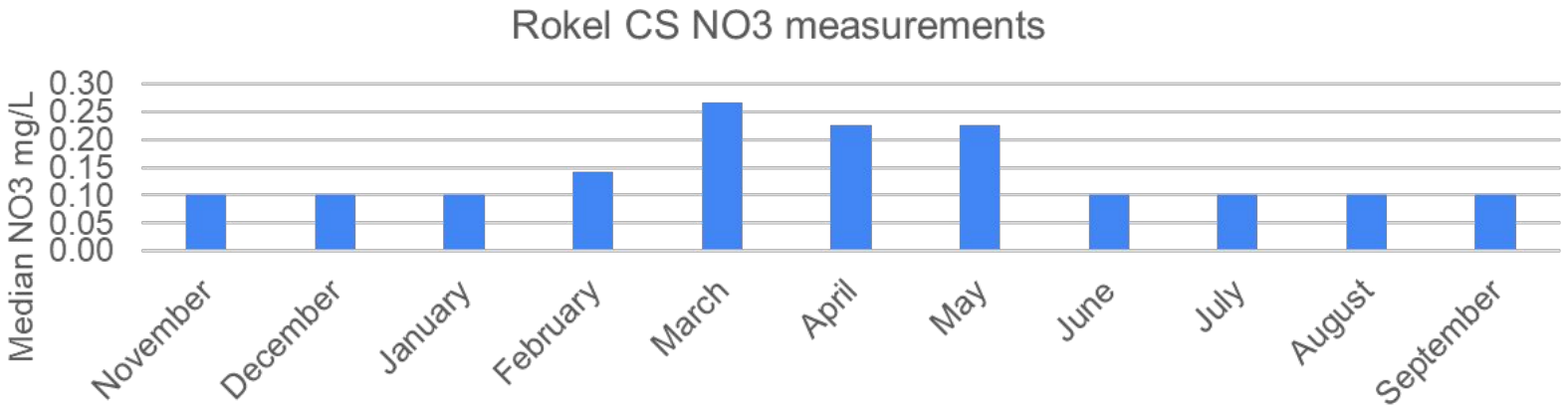


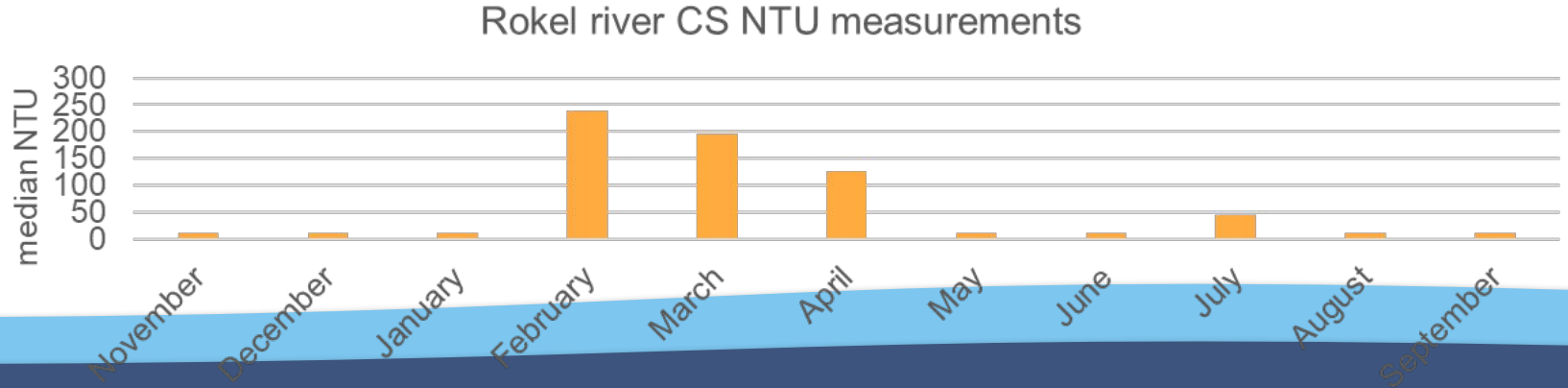
Citizen scientist participation dynamics



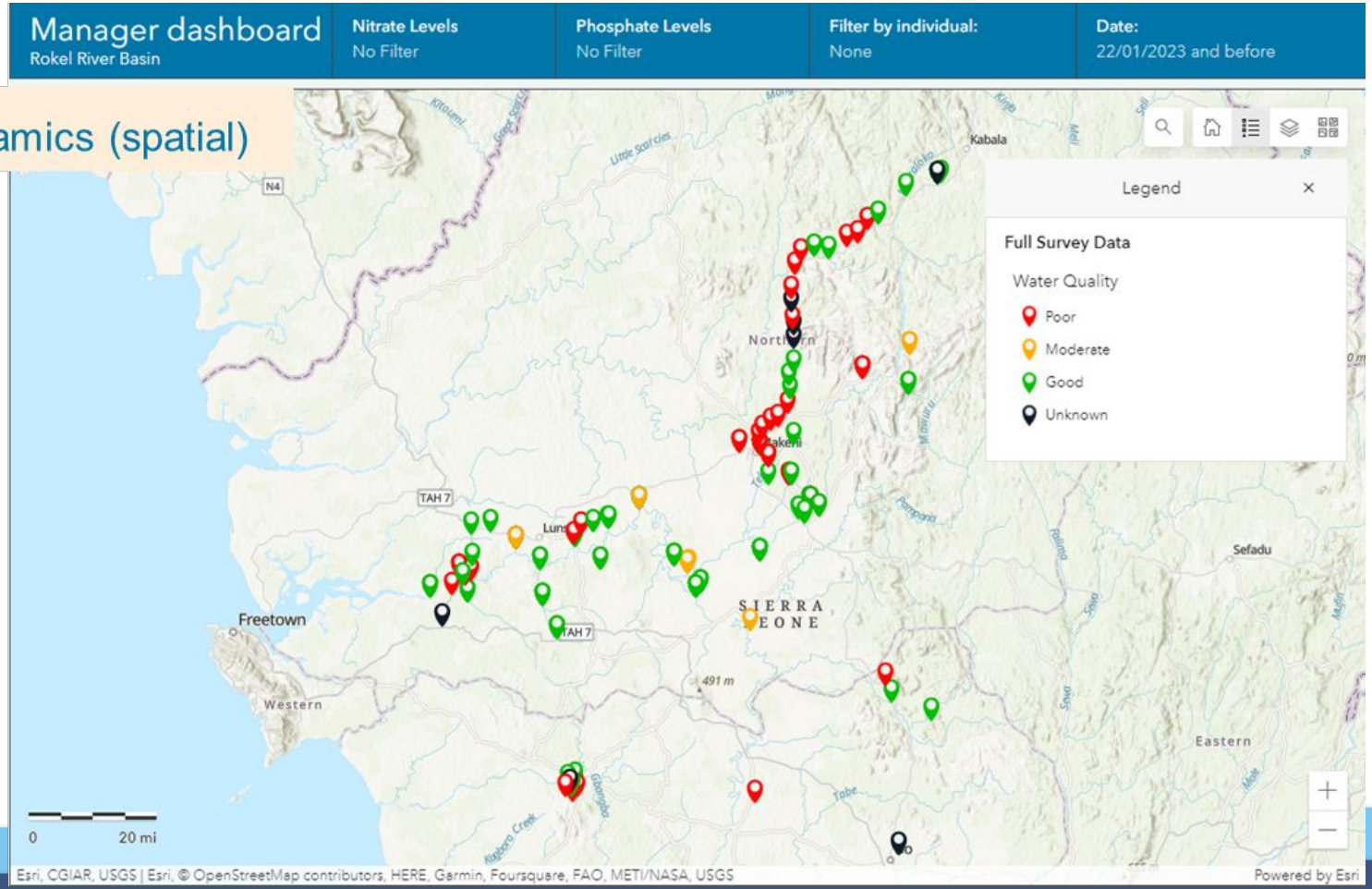


Water quality dynamics (seasonal)





Water quality dynamics (spatial)



From citizen science to action

FRESHWATER Watch

water@earthwatch.org.uk

Rokel River Basin Management Plan

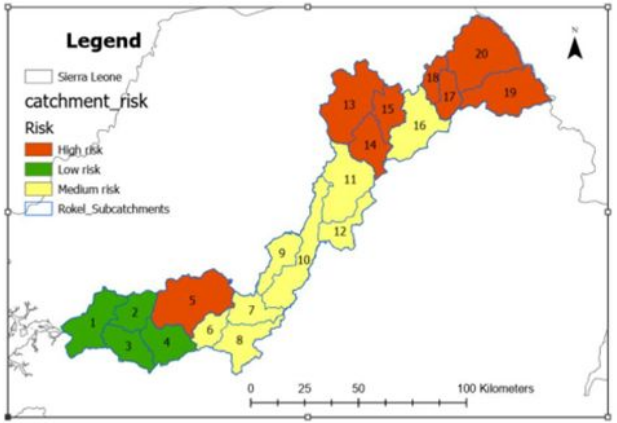


Figure 21 Risk ranking of the sub-catchments in the Rokel River basin

Figure 25 Composition of the Rokel Basin Management Board

Stream type category: water quality observations in the CrowdWater app

Sara Blanco Ramírez*, Ilja van Meerveld*, Jan Seibert*^, Mirjam Scheller* & Rieke Goebel*

* Department of Geography, University of Zurich, Zurich, Switzerland (sara.blanco@geo.uzh.ch)

^Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, Uppsala, Sweden

AGUASAN Community of Practice

eawag aquatic research

Human Right 2 water

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

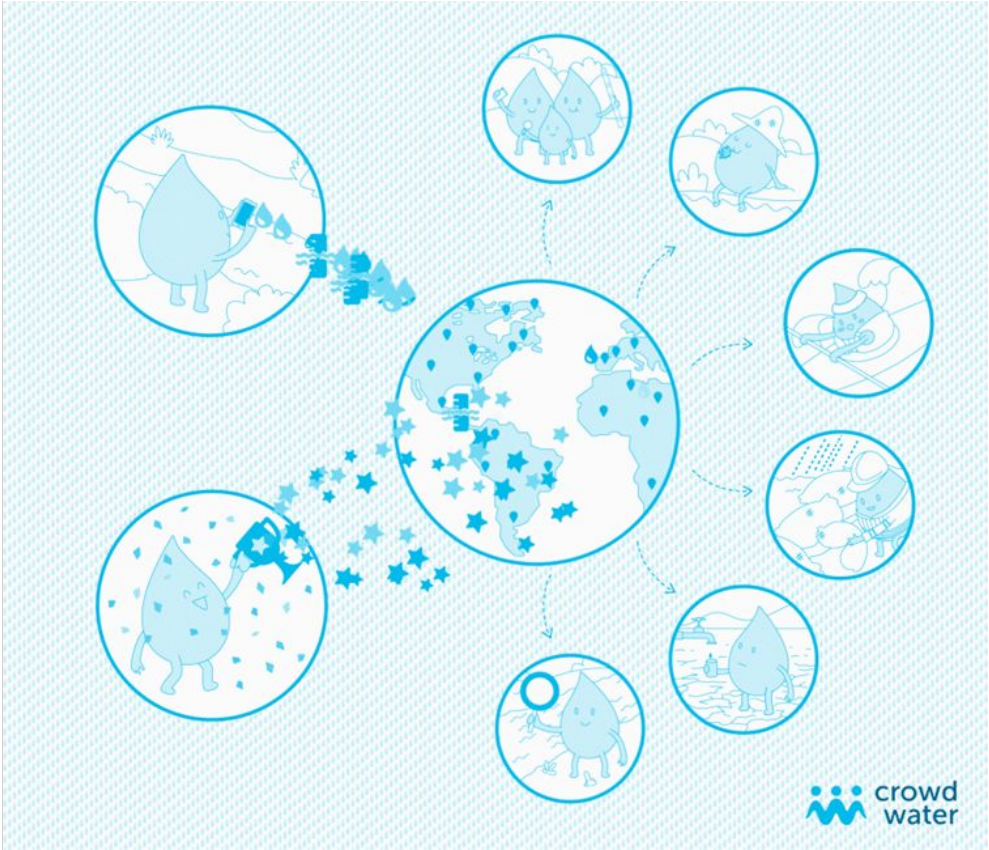
skat Swiss Resource Centre and Consultancies for Development

What is CrowdWater?

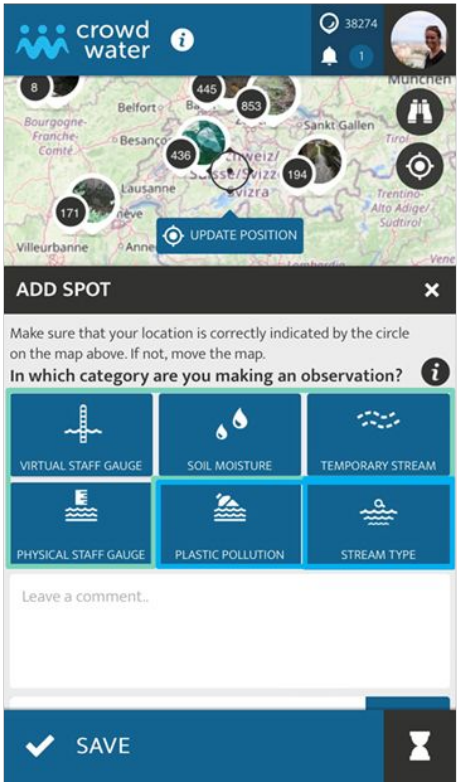
Citizen science project in **Hydrology**, University of Zurich – since **2016**

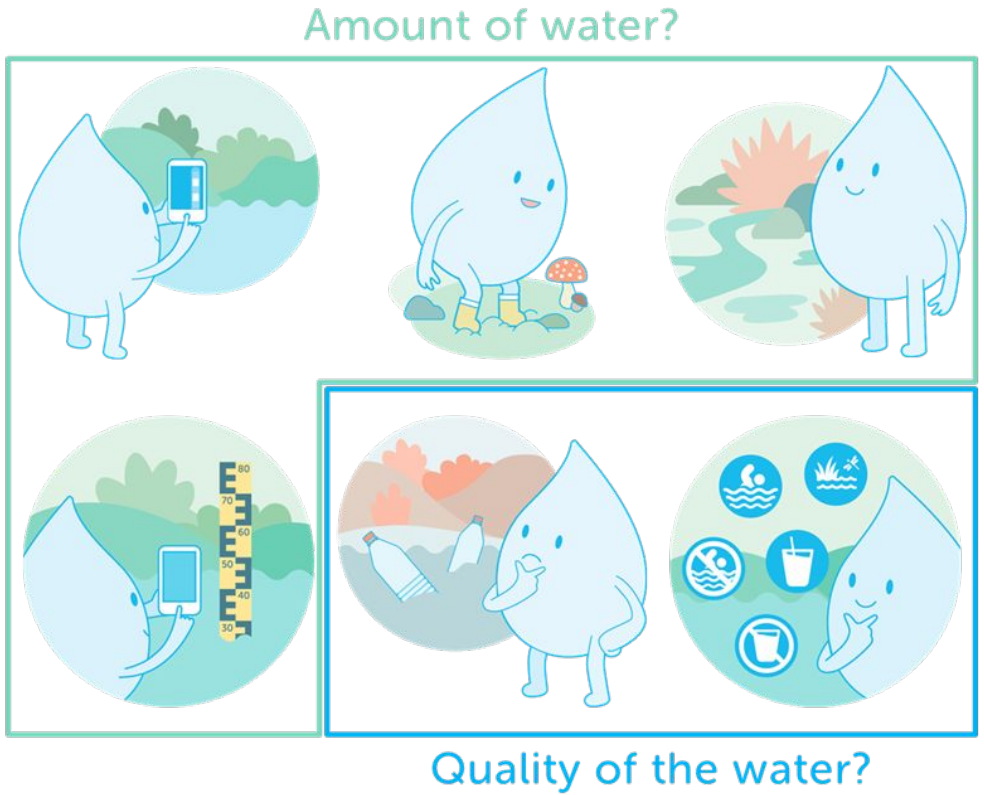
Non-sensor based, **mobile app** for **data collection** and communication

Increase **public interest** for **water topics**

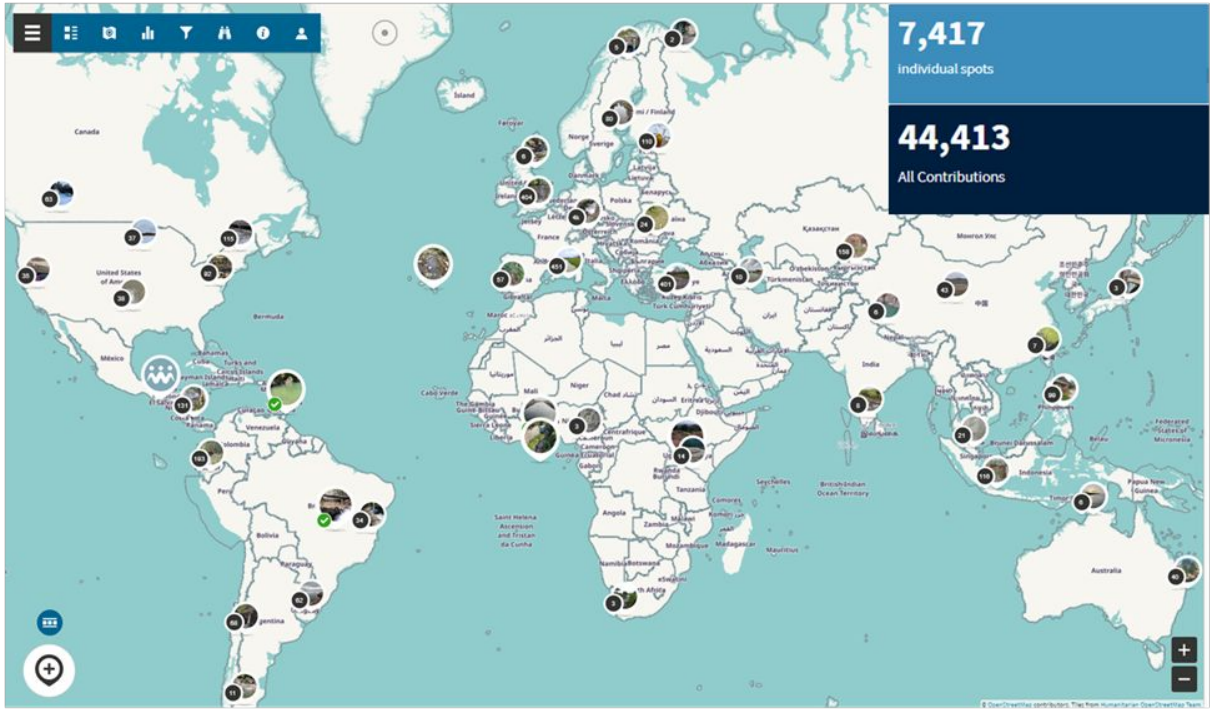


CrowdWater app





Observations with the CrowdWater app

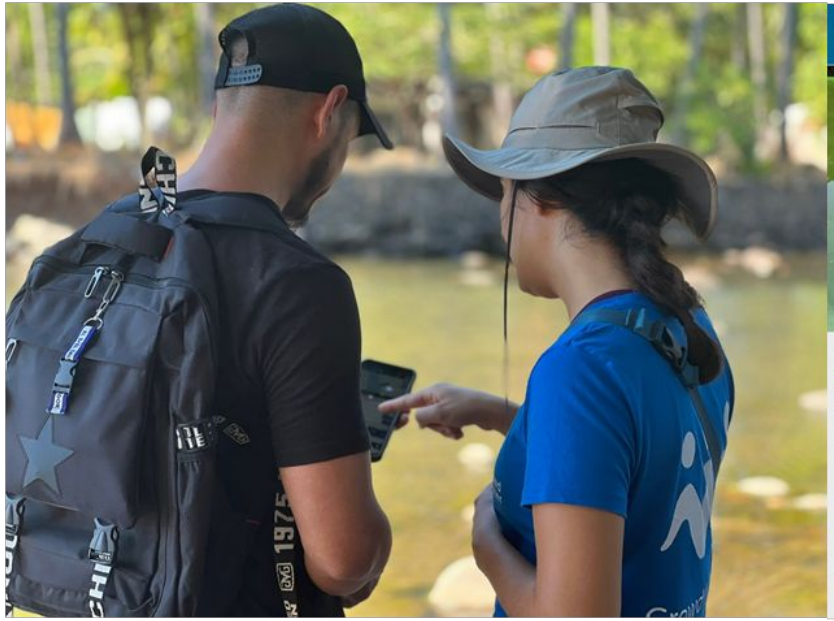


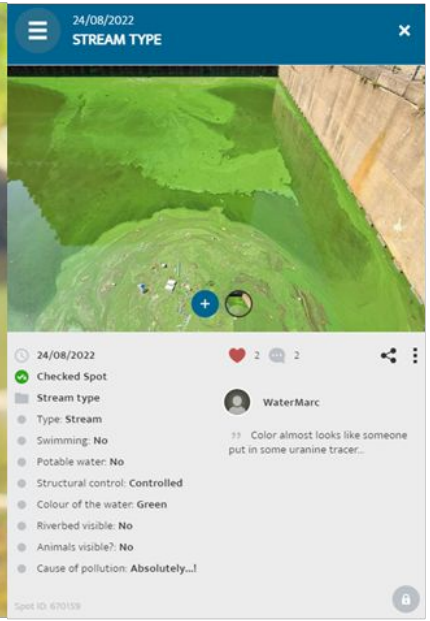
Status june 2023: https://crowdwater.ch/en/dashboard-2/

Kirgystan

El Salvador

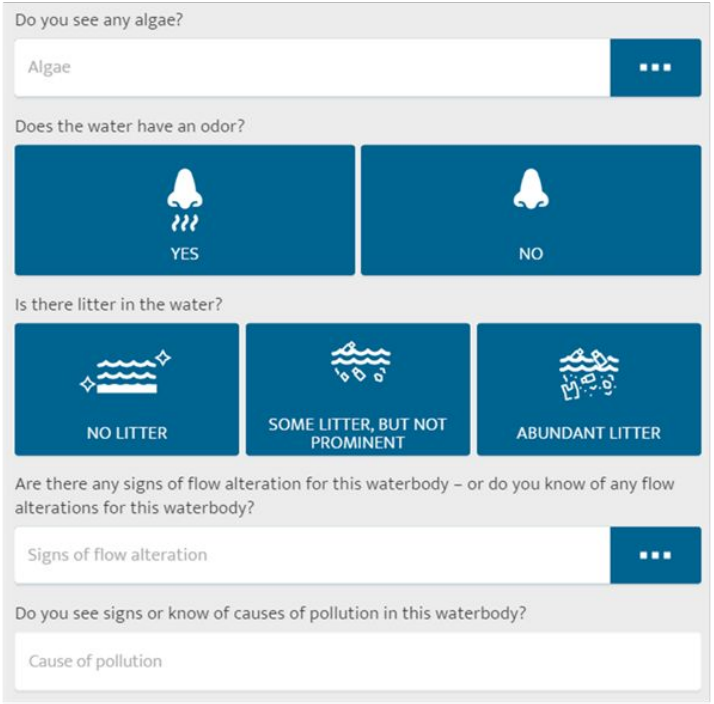
Potential value of different citizen science approaches for water quality measurements





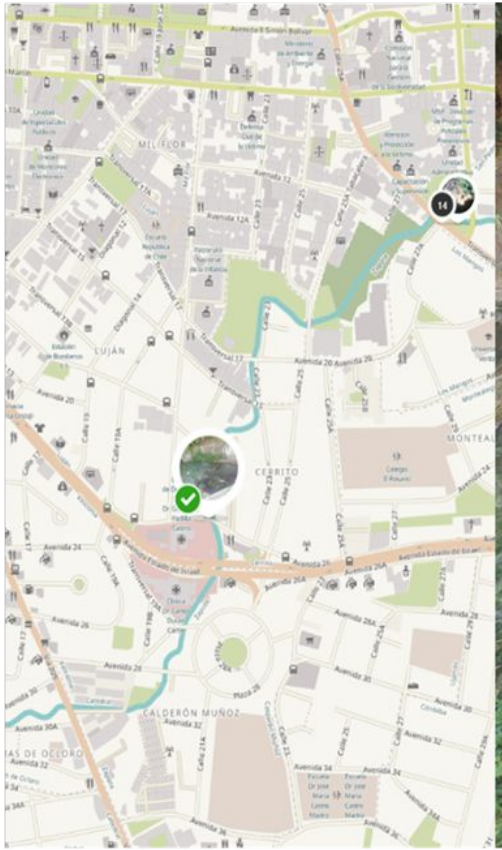
While we can not observe all water quality components, it is possible to quickly obtain some information on stream health

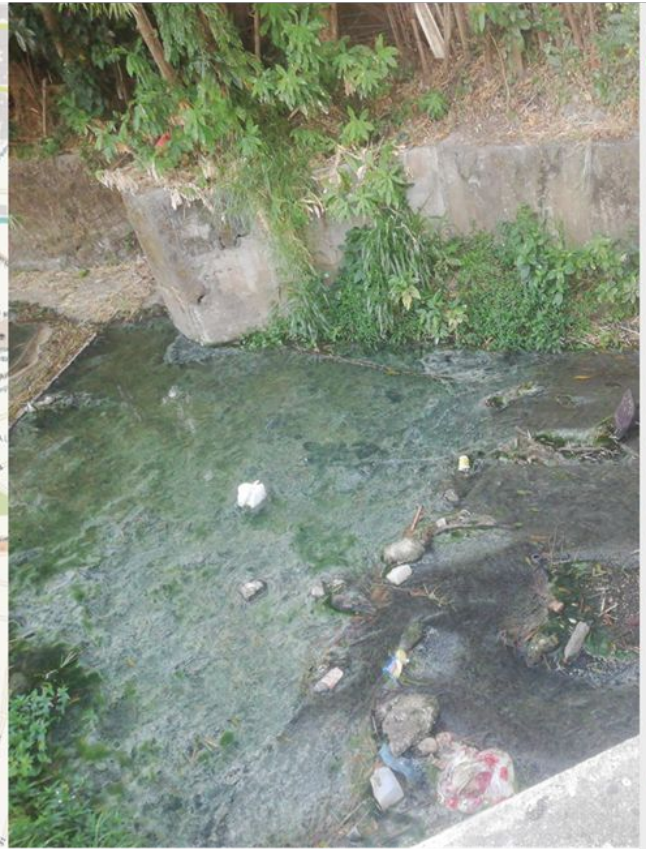
CrowdWater and water quality observations



*We use this information for **everyday decisions***
e.g., whether to swim in the water or not

Stream type category





20/02/2023

Checked Spot

Stream type

- Type: **River**
- Water quality: **Very poor**
- Swimming: **No**
- Potable water: **No**
- Structural control: **Controlled**
- Water clarity: **Very murky**
- Type of river bed material: **Mud**
- Colour of the water: **Grey or milky**
- Typical Colour of the water: **Yes**
- Riverbed visible: **Yes**
- Vegetation: **No**
- Animals visible?: **No**
- Foam: **Yes, a little**
- Algae: **No algae or layer of microalgae**
- Litter in Water: **Some litter, but not prominent**
- Signs of flow alteration: **Stormwater/industrial/household discharge into the waterbody**
- Cause of pollution: **Aguas negras y jablnosas** → Discharge and soapy water
- Name of the water body: **Río ocloro parte sur**

0 0

francisco Chavarría Hernandez

"La construcciónes de apartamentos son lo que puede estar ocacionando estas contaminaciones

Stream type category

04/04/2023
Checked Spot
Stream type
- Type: **Stream**
- Water quality: **Poor**
- Swimming: **No**
- Potable water: **No**
- Structural control: **Natural**
- Water clarity: **Very murky**
- Type of river bed material: **Gravel**
- Colour of the water: **Grey or milky**
- Typical Colour of the water: **Yes**
- Riverbed visible: **No**
- Vegetation: **No**
- Animals visible?: **No**
- Foam: **Yes, a lot**
- Algae: **No algae or layer of microalgae**
- Odor: **Yes**
- Type of odor: **Rotten eggs**
- Litter in Water: **Some litter, but not prominent**
- Signs of flow alteration: **Stormwater/industrial/household discharge into the waterbody** → Industrial wastewater discharge
- Cause of pollution: **Vertido de aguas negras e industriales**
- Name of the water body: **Quebrada Azul**

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Roger Araya

Puente el ahorcado

12/03/2023
Stream type
- Type: **River**
- Water quality: **Poor**
- Swimming: **No**
- Potable water: **No**
- Structural control: **Controlled**
- Water clarity: **Very murky**
- Type of river bed material: **Sand**
- Colour of the water: **Beige (like cappuccino)**
- Typical Colour of the water: **No**
- Riverbed visible: **Vaguely**
- Vegetation: **Yes**
- Animals visible?: **No**
- Foam: **Yes, a little**
- Algae: **Green/brown growth visible**
- Odor: **Yes**
- Type of odor: **Sewage**
- Litter in Water: **Abundant litter**
- Signs of flow alteration: **Stormwater/industrial/household discharge into the waterbody** → A lot of garbage thrown into the river and household waste from the pipes of residents' homes
- Cause of pollution: **Banyak sampah yg dibuang warga ke sungai dan limbah rumah tangga dari pipa-pipa rumah warga**
- Name of the water body: **Sungai Cikapundung**

0 0

Smansa_Bandung

pH Air Titik Sampel 1: 7.6 Titik Sampel 2: 8.2 Titik Sampel 3: 8.4

Traditional/local knowledge, human perception, old memories, narratives…

A visual approach for water quality observations?

- Visual/qualitative water quality observations in scientific literature (e.g. indigenous knowledge, human perception)
- Local people are usually the first noticing environmental changes
- Possible to observe and track changes over time
- Broader perspective and understanding of water quality conditions

Download the CrowdWater app!

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www.crowdwater.ch

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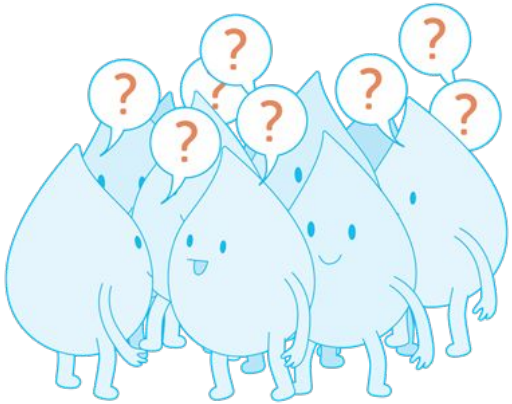
Thanks for your attention!



sara.blanco@geo.uzh.ch
info@crowdwater.ch

www.crowdwater.ch