

The Enviro-Champs: Establishing a framework for a technologically upgraded environmental monitoring network at community scale

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ABSTRACT

The Enviro-Champs initiative was developed as a community driven, citizen science initiative in Mpophomeni township in Kwa-Zulu Natal (KZN), South Africa. Over time, the scope of work done and data collected by the Enviro-Champs has expanded. There is now recognition both locally and globally that the Enviro-Champs initiative shows great promise for national and global upscaling. However, several areas within the initiative remain where it could be improved, especially technologically. GroundTruth, in conjunction with technical and funding support from CGIAR Research Initiative on Digital Innovation and the International Water Management Institute (IWMI), engaged in a project which aimed to i) establish recruitment, training, and education tools to support establishment of a technologically integrated and upgraded Enviro-Champs initiative, ii) develop an outline for a training and education workshop for Enviro-Champs once they are hired, iii) improve data collection and reporting capacity and efficiency with a sustainable system (in collaboration with CGIAR and FormShare), and iv) pilot test technological improvements to the Enviro-Champs initiative within the Mpophomeni Enviro-Champs in conjunction with the South African National Biodiversity Institute (SANBI), and Umgeni Water. The overarching aim was to develop a technologically innovative and upgraded best-practice framework for the Enviro-Champs, from recruitment, through training and data collection, to data management and reporting. The primary outcome was to have a fully functional, digitally improved Enviro-Champs system in Mpophomeni, that could serve as a working template for upscaling the Enviro-Champs initiative elsewhere in Southern Africa or the world. This report reflects the process and outcomes of this project to date.

1. Introduction

1.1 Background

The Enviro-Champs initiative was developed as a community driven, citizen science initiative in Mpopomeni township in Kwa-Zulu Natal (KZN), South Africa. Initially, this initiative trained community members to monitor and report sewage leaks within the township to assist in municipal management of the water use and waste disposal (Taylor and Taylor 2016). After resounding success, it was upgraded to include training on and implementation of a) data collection and reporting regarding potable water leaks and sewage issues, b) community engagement and awareness building regarding waste and wastewater management, and c) community engagement and emergency response assistance regarding flood preparedness (i.e., a community-driven early warning system for floods), flood risk, and evacuation prior to flooding. This broader scope was expanded to more areas in KZN beside the initial Mpophomeni community and was flagged as a promising

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initiative for national upscaling and a model which could benefit greatly from technological improvement (Lepheana et al. 2021). To-date, the Enviro-Champs initiative has been successfully implemented in several regions across South Africa (Schachtschneider 2016; Taylor and Taylor 2016; Lepheana et al. 2021).

Over time, the Enviro-Champs initiative evolved to introduce some technological aspects to the monitoring and training processes (Lepheana et al. 2021). These included group text messaging platforms to share information (including training information), and data collation in excel (from paper forms submitted on a weekly basis) by a manager. However, several areas remained where the initiative could be improved, throughout its process but especially technologically, including the recruitment and hiring process, the technical capacity of the Enviro-Champs (e.g., technical skills and scope of data capture, reporting, or management actions), the agency of the Enviro-Champs (i.e., accessing real-time information and data outcomes which can empower and inform Enviro-Champ and Community action), and ultimately the relaying of information to agencies (government or nongovernment) that can take action on the information and data gathered by the Enviro-Champs.

1.2. Mobile Data Collection App

Enviro-Champs, along with most people globally, even in rural places, generally have access to smartphones. These can be effectively used for data collection, boasting a host of advantages over traditional data collection techniques, including mobility, processing power independent of a power source (as opposed to desktops), connection to the internet, interactive and customisable user interfaces, and all-round accessibility (Hartung et al. 2010; E. A. Graham et al. 2011; Njue et al. 2019). Therefore, smartphones were targeted as an efficient means to improve the quality and quantity of data collection, while simultaneously building digital capacity with the Enviro-Champs. Through collaboration with CGIAR and previous experience collaborating on previous projects, the Open Data Kit (ODK, 2023) (Hartung et al. 2010) data collection mobile application (app) ODK Collect was selected as the ideal candidate to explore in terms of its abilities to meet all the requirements of the data collection side of the Enviro-Champs initiative. The ODK Collect app interfaces with the data capture and management platform FormShare (https://formshare.org), a CGIAR product.

ODK is one of the most renowned, globally employed data collection and management services available (Brunette et al. 2013; Ouma et al. 2019). It has been successfully employed in

both rural and urban settings, in both on- and offline situations, ranging from tracking tuberculosis (Ali et al. 2016), gathering data on childhood pneumonia (Ginsburg et al. 2016), through to use in farming (Ouma et al. 2019) and utilisation in disaster response (see case studies discussed in Brunette et al. 2013). ODK offers ODK Collect, a mobile app not only suitable for collecting the types of geo-referenced, photographic or text data typically collected by the Enviro-Champs, but capable of far more than previous data collection tools regarding data collection, curation, visualization, management, and reporting (specifically improving automation and reducing manual input and reliance on manual data handling for data management) (Ouma et al. 2019; Hartung et al. 2010; Loola Bokonda et al. 2020). ODK was also initially designed with the goal of providing a data collection and management solution that worked for rural and developing areas (Hartung et al. 2010), therefore building on an ideal ethos and outset mentality for use in citizen science in a developing or rural area as is the case with the Enviro-Champs initiative. Overall, ODK Collect, working in conjunction with Formshare to collate and handle the data, was chosen to implement for the Enviro-Champs initiative.

1.3. Objectives

GroundTruth, in conjunction with technical and funding support from CGIAR and IWMI, engaged in a project which aimed to i) establish recruitment, training, and education tools to support establishment of a technologically integrated and upgraded Enviro-Champs initiative, ii) develop an outline for a training and education workshop for Enviro-Champs once they are hired, iii) improve data collection and reporting capacity and efficiency with a sustainable system (in collaboration with CGIAR, ODK, and Formshare), and iv) pilot test technological improvements to the Enviro-Champs initiative within the Mpophomeni Enviro-Champs in conjunction with the South African National Biodiversity Institute (SANBI), and Umgeni Water.

The overarching aim was to develop a technologically innovated and upgraded best-practice framework for the Enviro-Champs, from recruitment, through training and data collection, to data management and reporting. By working with SANBI and Umgeni Water, who currently fund the Enviro-Champs and gather their data for reporting, testing of technological improvements to data collection and reporting are planned om pilot tests in Mpophomeni.

1.4. Cautionary Note

Going forward with technological developments, especially



regarding citizen science engagement, it is important to acknowledge the tenets of action-learning, and avoid past failures when implementing technological innovations (Rogers 2002). Issues relating to technical innovations and supposed transfers of technology to communities or other institutional settings are important for all Work Packages (WP) of the CGIAR Initiative on Digital Innovation, or indeed any sphere of work seeking to integrate digital innovation and technology with pre-existing work frames. The literature is littered with failed technology transfer projects, not only in Africa, but world-wide (Rogers 2002; Jalbert and Kinchy 2016; Trouille et al. 2019). In a wide-ranging review of such projects, Rahnema (2020) identifies the underlying technicist assumptions and associated modernist ideology as the key weakness or stumbling block. As early as the 1980s, scientists were warning of this phenomenon, "There is today an increasing consciousness that our technology has, in enough cases to worry us, out-stripped the ability of many organizations and individuals to make productive use of it" -Eveland, J. D. (p 303, 1987). With rapid technological innovation and increasing complexity, this concept is even more threatening in the present day. To avoid replicating past failures we suggest that such issues are carefully addressed through throughout work in the arena of digital innovation.

2. The Enviro-Champs Initiative

2.1. A Recruitment Protocol for Enviro-Champs

The initial aim of this work was to put together a research synthesis on the best practices for community engagement and Enviro-Champ recruitment, including broader education regarding the Enviro-Champ initiative. This initial aim culminated in the research and development of an education and recruitment framework for finding and hiring proficient Enviro-Champs. The framework is based on prior experience and a synthesis of what has thus far defined successful Enviro-Champs, and outlined best practice advice, from a situational analysis through to appointing successful candidates.

Building on the experience of establishing the initiative in the Mpophomeni township in Kwa-Zulu Natal (KZN) and in the Palmiet catchment in Durban, KZN, we have refined a 7-step process for selecting and recruiting Enviro-Champs suitable for implementation in the Limpopo and Inkomati basins (See Appendix 1).

2.2. Enviro-Champs training and capacity building workshop research and design

The second aim was the research and development of a

framework for workshops to orientate, educate, and train newly recruited Enviro-Champs. The framework details bestpractice advice on the structure of a workshop that will be best suited to efficient education and training. The framework includes key topics to cover, such as all the duties of data collection, methods for community engagement, environmental awareness and safety, and in-depth training using the multi-media data and information systems associated with data collection and reporting:

Several days of training workshops are required, especially considering that Enviro-Champs may have limited formal education and require baseline education and training in ecological principles, as well as the importance of water, sanitation, and hygiene. One option is to offer a training course or programme once a week on a suitable day, or alternatively to hold several days of education and training consecutively. Generally, for the first month or several months, there will be a requirement for follow-up training and education sessions to solidify the lessons learned and data collection protocols. Therefore, it is good to plan ahead accordingly, with particular attention on adaptive management and training in the early stages. The aims of these workshops are the following:

- 1) Formally welcome and congratulate the new Enviro-Champs on appointment, explaining the necessity and importance of their roles.
- 2) Facilitate a 'meet-and-greet' between all the Enviro-Champs working in the focal area and the management team. This will enable them to begin developing a support and working network between the each other, and between them and the implementing organization. It is important that all parties are acquainted and acknowledge their roles so as to improve sustainable communication and foster good working relationships.
- Once the general introductions are completed, the capacity building can commence. In terms of a training methodology, "The 5 T's of Action Learning" (UNESCO 2018; Figure 1) has been found to be really useful (O'Donoghue, Taylor, and Venter 2018). Workshops comprise a series of multi-media lectures and interactive working-group discussions covering details on standard operations and data collection related to:
 - a. The "War on Leaks", including measuring, reporting and fixing water leaks.
 - b. Pollution monitoring and WTWW effluent compliance monitoring using clarity tubes (Graham et al. 2024).







- c. Sewer line monitoring.
- d. Alien vegetation monitoring.
- e. Illegal dump site monitoring and clearing.
- f. Use of the mini Stream Assessment Scoring System (miniSASS) assessment (Graham et al. 2004). Training for this can be done through use of the online miniSASS training course.
- g. Monitoring total suspended solids (via water clarity) in streams and rivers using clarity tubes (Graham and Taylor 2018).
- 4) For data collection on each of the areas of interest, there should be accompanying demonstrations to explain using data capture software, such as the ODK Collect app on their smartphones, to collect and report data. At the end of the workshop, all Enviro-Champs should have full capacity for all aspects of data collection and reporting. Consequently, it is recommended that ample time is dedicated to training and practice in data collection. Spending time practicing with real examples for every aspect will allow for quick, real-time troubleshooting that is the most expedient way to ensure data are collected



efficiently and correctly. It is recommended that data collection protocols are kept up to date, and that refresher courses on all aspects are held regularly after the initial training.

Finally, following training on the standard data collection 5) methods, more in-depth training should be offered on more complex social engagement tasks. This involves interactive lectures on methods for community environmental education and engagement, social awareness raising, and flood risk management. Part of this training focuses on capacity building and learning, where the Enviro-Champs are taught how to improve and refine their skills, and to provide feedback to the implementing organization, as well as local Ward Counsellors and community leaders. A critical component of this section of the training focuses specifically on the functionality of the Enviro-Champs as a communitybased, social-engagement driven early-warning system for flooding.

Considering it is important for training workshops to include simulated data collection related to each aspect of the work of the Enviro-Champs, it is recommended that the workshops are held in convenient locations in the focal area. This means that the training will happen in a comfortable, familiar location to the trainees (which is conducive to a good learning environment and easy for the trainees logistically), and that infield training can be carried out in the system where the Enviro-Champs will be deployed, maximizing the utility and real-life relevance of the training. One the initial orientation is complete, the Enviro-Champs can be deployed.

Following the initial workshops, the skills and capacity of the Enviro-Champs are continually built upon through online feedback and occasional (quarterly at a minimum) follow-up in-person refresher, short workshops, to refine skills and act on adaptive feedback and training needs. After the initial establishment of the Enviro-Champs, their roles can be upgraded as appropriate and possible. For example, the Enviro -Champs can undergo formal basic training in skills useful for their data collection or even on-the-ground action for community improvement. Possible additional training can be offered according to the local needs and requirements. This could include, for example, alien invasive plant clearing, the use of chainsaws, basic plumbing, and first aid.

It is important to note that the deployment and training of the Enviro-Champs is an adaptive and reflexive process that is ongoing post the initial training workshops. Feedback, support, and action-learning principles need to be continuously followed to ensure the Enviro-Champs are efficient, supported, well-equipped for their duties, and safe in carrying them out. Some of the potential duties of the Enviro-Champs, such as miniSASS assessments, clarity tube use, and fixing leaks, may require further training sessions over several weeks.

3. Technologically upgrading Enviro-Champs data collection and management with ODK Collect and FormShare

Collaboration with CGIAR led to a thorough investigation of the use of ODK Collect as a data collection and management platform (in conjunction with a compatible data management and visualization platform FormShare). Overall, the ODK Collect app, in conjunction with FormShare, were identified as the ideal partners for the Enviro-Champs initiative for efficient, powerful, and customizable, mobile data-light, data collection, storage, and management. Critically, using ODK Collect is available via FormShare, making it accessible and maintained in terms of privacy and security requirements. It also means that the app will be supported on the front and back end by the FormShare developers. Keeping up-to-date with security and privacy requirements, and maintaining a data collection and reporting platform, can be prohibitively difficult if taken on without support from the developers. This can lead to project failure in the long-term, which using ODK Collect will mitigate.

3.1. Data Collection with ODK Collect

The data collection capabilities of ODK Collect include (Hartung et al. 2010; Brunette et al. 2013; Brunette et al. 2017; Ouma et al. 2019), but are not limited to (should more needs arise):

- Auto-generated quick response (QR) code that links a unique user profile to a specific project. This streamlines adding app users (in-field Enviro-Champs) to the project, and auto-generates a user profile for each individual which can be customized for access to certain features, including geographic areas or sites, among others.
- Customizable data collection forms. Any data that the managers need to be collected can be included in the forms, including precise locations, photos, videos, voice recordings, or virtually any form of quantitative or qualitative form-based information.
- Visualizing geographic areas of interest (e.g., Wards) in which to collect data, on mapping software for Enviro-



Champs in-field to navigate by. Assistance navigating to points of interest is also built in;

- Collection and real-time submission of geo-referenced image and text data covering all aspects of the data Enviro-Champs are required to gather, including leaks, clarity tube data, miniSASS assessment scores, various sources of pollution, sewer infrastructure damage, alien vegetation, and dump sites;
- Collection of more complex geographical data. Global positioning system (GPS) data can be collected in lines or shapes, allowing for submission of more holistic visualizations of potential issues. For example, GPS data could be collected showing the distribution of a stand of alien plants, the path of illegal water connections, or the size of a dump site, rather than simply submitting a single point;
- It is possible to collect background data continuously. For example, ODK Collect could be programmed to collect a GPS co-ordinate every ten minutes through a working day to develop a map of movement. This may prove useful, for instance, in visualizing coverage of a Ward or area of interest by Enviro-Champs, and isolating areas not yet or seldom visited that might need increased attention;
- Minimizing mobile data use requirements. All data uploaded are G-zipped, minimizing data transfer requirements. It is also possible to predetermine the image quality of any images to be uploaded during submission. For example, images can be compressed to the lowest resolution that serves the data collection needs, and then zipped with all the other data collected, before submission. Ultimately, this process can reduce the data required for a submission by up to 90%, compared to submitting raw, unprocessed data;
- Visualizing data collection points. App users can view both all points already submitted;
- Data collection using the ODK Collect app can all be done offline, with options for submission either using mobile data when it is available, or solely a Wi-Fi connection when one is available. Powerful, designed offline data collection maximizes the geographic coverage of data collection (by allowing for a full suite of data collection in remote places), and works towards minimizing data costs by affording the opportunity to upload data at convenient times (optimized if data can be uploaded using freely available WIFI where possible,

reducing expensive mobile data consumption to zero or close to zero) (Brunette et al. 2017). Importantly, ODK Collect is supported on over 21 000 devices, and has been developed to function in over 60 languages, maximizing accessibility (ODK, 2023: https://getodk.org).

A custom ODK Collect form collection interface has been designed and launched for the Enviro-Champs (See Appendix 2 for screen shots of the data collection interface for the Enviro-Champs within ODK Collect), which is available via the FormShare webpage dedicated to the Enviro-Champs (Figure 2).

3.2. Data Management with FormShare

ODK Collect uploads data to a FormShare server, which securely stores the data in a cloud-based format, making the data available online anywhere in the world. Through this process, one can create an end-to-end data management stream: Data are collected in ODK Collect in-field \rightarrow data are uploaded and securely stored on the FormShare server \rightarrow those data are auto-assimilated into a managed, live-updated database in FormShare, without the need for tedious manual data handling through transcribing paper-based forms into digital spreadsheets. The data are available for management (review, editing, and cleaning) on the FormShare platform, or they can be easily downloaded in a format suitable for management (i.e., the data are stored and can be downloaded or transferred in a variety of ways, whichever the data manager finds more suitable, e.g., .csv, .json, or .xls). All changes made to data can be logged and can be flagged for later approval or rejection. This allows for data to be updated / edited post collection should there be any errors or changes needed. Moreover, each data point submitted can be easily and quickly reviewed.

3.3. Summary of ODK for the Enviro-Champs

Switching to ODK Collect and FormShare creates room for improving the Enviro-Champs' technical skill, building the capacity of the Enviro-Champs for collecting and visualizing data, and for processing and managing the data real-time through a primarily automated process. Switching to ODK Collect will also provide a partial (but best-case) solution to the limitations imposed by mobile data requirements for information data handling (e.g., uploading large data files and images). The ODK Collect app is designed for offline use, where the data can be stored and uploaded at a later stage once an appropriate internet connection is available. Therefore, some of the significant issues with internet connectivity in rural areas can be solved by using the ODK platform.







Become an Enviro-Champ

Note: If you have ODK Collect in your phone please uninstall it and use the link below.

Download ODK Collect for Enviro-Champs

Figure 2 The landing page for the Enviro-Champs Initiative, hosted by FormShare (https://formshare.cgfes.org).

Unfortunately, there are currently no sustainable possibilities for 'mobile data free' use of the ODK Collect app (which would remove any constraints Enviro-Champs might have with mobile data restrictions or expenses, which can be significant for people living in rural or disaffected locations). However, to fully overcome the bottleneck in data collection associated with mobile data constraints. UNICEF-South Africa in collaboration with GroundTruth, will explore options to fund mobile data use for data collection via the Youth Agency Marketplace (YOMA). The YOMA platform will ideally allow the entity managing and employing the Enviro-Champs to purchase data packages (via vouchers, which need to be redeemed for mobile data), modulated via blockchain technology, for the Enviro-Champs. This system will allow specific data challenges to be overcome in an efficient, accessible fashion, while minimizing the chance for abuse or dangers associated with direct cash transfers. Work on the applicability and potential of YOMA and blockchain technology in this manner is ongoing.

3.4. Recommendations on Technicist Assumptions and Action-learning

At the introduction to this report we noted that there are challenges and assumptions that must be addressed as digital innovations, such as those relating to the Enviro-Champs and their work with ODK Collect and FormShare, must be understood and engaged with. In particular, issues related to technicism and technicist assumptions can have a marked debilitating effect on efforts to communicate, mobilize and implement such innovations.

Research reveals how one can't simply discover the best possible digital innovations, such as the integration with and application of ODK Collect, and then communicate it to the Enviro-Champs, with the assumption that they will effectively apply the technology (Popkewitz 1984; Jalbert and Kinchy 2016; Walker et al. 2020). People and social change processes are much more subtle and unpredictable than this and one needs careful learning pathways that support the application of



the innovations if these are to be effectively integrated with the work of the Enviro-Champs and the catchment management processes. This work resonates with Beck's concept of a 'risk society' (1992) an orientation which signals a transition from modernity to reflexive modernization (Giddens 1982). The research also engages with the technicist assumptions that are made in such arenas.

As stated by Rogers (2002), "...technology transfer is essentially a communication process through which the results of scientific research are put into use. As such, technology transfer is a unique type of science communication, one that is often frustratingly difficult. Many technologists believe that advantageous technologies will diffuse spontaneously, so technology transfer activities are unimportant and unnecessary. But this is not the case. For example, when technology transfer occurs too slowly, it is thought to be the fault of the receptors."

It is important to acknowledge that the receptors are often not at fault. Rather, there is a requirement to engage in actionlearning to facilitate technology transfer, and the onus rests on developers and educators to ensure successful implementation of technological advances (Rahnema 2020). This is especially the case within unskilled, developing, and traditionally technologically limited settings (Walker et al. 2020; Weingart and Meyer 2021).

Technicism is a dominating feature of modernist thinking. Technicism comes from a preoccupation with technique and technology, and also has a dominating linear and causal belief structure. Technicism is more than an obsession with technology and 'techno-fix'. It supports a belief structure that sees the world, and how people relate to it, as involving rational processes that can be addressed in a mechanistic manner (Lyotard 1993). Manifesting within modernism and techno-science, technicism has been supported by its research complement scientometrics, a positivistic research style that has dominated the social sciences until quite recently. Interventionist ideologies, especially as these relate to digital innovations, often have a technicist orientation that may be linked to positivistic research perspectives where social change becomes a matter of technical and administrative reform (Popkewitz 1984).

For effective social change processes to be achieved, especially as these relate to the digital innovations we are developing with the Enviro-Champs, a close connection with the world-view or the social reality of the Enviro-Champs must be engaged with (Weingart and Meyer 2021; Hulbert 2016; Hulbert et al. 2019; Schachtschneider 2016; Taylor and Taylor 2016). In the Action Learning literature (e.g., O'Donoghue et al. 2018) we recommend 'tuning-in' processes that are crucial to help participants make the connections and engage with the complex social reality that involves water quality monitoring and catchment management. Such 'tuning in' processes also resonate with indigenous knowledge practices and the histories and cultures that have shaped how people live and relate to water and catchment management (UNESCO 2018). These approaches to social change, which are now being adopted by UNESCO, continue to define the further 5 T's of Action Learning, namely Talk, Touch, Tune-In, Think and Take Action.

This thinking is not new. The ideology and importance of action-learning, although not so termed, was even reflected on by Xun Kuang, a prolific Chinese Confucian philosopher in 312-230 BC, whose philosophies were collected and published as the Xunzi by Liu Xiang in c 818 AD:

"Not having heard something is not as good as having heard it; having heard it is not as good as having seen it; having seen it is not as good as knowing it; knowing it is not as good as putting it into practice."

— Chapter 11, Book 8: Ruxiao ("The Teachings of the Ru"), in the Xunzi (circa 818 AD), translated by Dubs, H. H. (1928).

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Appendix 1. Recruitment Protocol for Enviro-Champs

Step 1. Who to Work With? Situational Analysis and Partner Identification

At the outset of attempting to establish an Enviro-Champs initiative, it is crucial to engage with key stakeholders in the region. A situational analysis is a useful strategy because it will establish who all the role players and stakeholders are in a particular area, including Government Departments, Local Government, Non-Government Agencies and Community Based Organizations (CBOs). From the situational analysis, the project team can begin to identify partners suitable for working with the Enviro-Champs. The nature of these potential partners varies; they can range from well-situated, strong church groups, to NGO's such as the World Wildlife Fund (WWF).

Step 2. Liaise with Relevant Authorities and Partners

The next step is to engage with the agencies and communities identified in the situational analysis and partner identification. It is crucial to work with elected Councilors or Ward Representatives, whomever is directed with the charge of environmental regulation and service delivery in the region. There may also be traditional authorities with influence, engaging them, as well as with local municipalities and South African Local Government Association (SALGA) representatives, can be really helpful in ensuring the project is well received and gets the kind of support it needs. Other NGO's and CBO's from the region as identified in Step 1 should also be engaged with to establish whether they may be prepared to help host Enviro-Champs.

Step 3. Develop Criteria for Selection

Once partners have been identified who will take charge of funding and managing the team of Enviro-Champs, selection of Enviro-Champs can begin. The selection process for Enviro -Champs has been partially developed and refined since the inception of the first Enviro-Champs initiative, but never refined and formalized. Our aim was to synthesize a selection process that provides an objective and unbiased method for selecting Enviro-Champs who represent the focal area well, and who will effectively and passionately form environmental and community stewards. The approach for selection of Enviro-Champs, from spatial delineation of the catchment through to outlining the requirements for skills and traits of the selected personnel, and has two parts: The first part of developing the criteria for selection is developing a Decision Support Tool for establishing the geographic location from which the Enviro-Champs will be selected. To begin, a geographic information system (GIS) is used to spatially map and priorities informal settlements to objectively select communities from the Wards which comprise the focal catchment. The GIS mapping and prioritization is done according to the following process:

- The wards, or relevant government district units (hereafter 'Wards' is used), that are within the entire focal area are identified. The relative area of each of these Wards within the entire focal area is calculated.
- 2) The relative area each informal settlement within the focal area, as well as the area of each informal settlement (considering Enviro-Champs initiatives are usually set up in rural areas, or areas with large informal settlements – the strategy can be adjusted accordingly for local relevance) within the focal area, as mapped by the relevant local municipality, is calculated.
- 3) For initiatives focused on stream and river monitoring, variable buffer scores, extending outwards from the mainstem catchment river/s in graduations (i.e. 100m, 500m, 1.5km, 3.0km) are used to establish the proximity of informal settlements to the river. Informal settlements occurring close to the river would have greater access in terms of ongoing monitoring. A buffer score is applied to each informal settlement where those occurring within 100m of the river are given a high score (buffer score = 4), whereas those occurring beyond 1.5km, but within 3.0km, are given a low score (buffer score = 1). An extent score (small = 1; medium = 2; large = 3) is also applied to the size of informal settlements, based on the assumption that larger communities will have a greater number of potential Enviro-Champs for the selection process. Guidelines for the delineation of these areas are: small (<1ha), medium (1 to 10ha), large (>10ha). Buffer scores (1 to 4) are multiplied by extent scores (1 to 3) to develop values that reflect access to the river and potential number of Enviro-Champs. Overall scores range from zero (0) to eight (8), where a low overall score indicates poor access to the river for a small number of potential Enviro-Champs, while a high score indicates good access by a large number of potential Enviro-Champs. Informal settlements with high scores are selected as suitable commu-



nities for Enviro-Champs training. Within the informal settlements with high scores, there needs to be equal and fair appointment of candidates (focusing on equality in gender appointment and female empowerment). It is recommended (based on the size and coverage of each Ward) that enough Enviro-Champs be appointed to cover the key nodes in the relevant part of the focal area.

4) If the focus of the monitoring program is not stream or river monitoring, the same scoring system can be applied to the variables of interest. Essentially, a score can be developed which accounts for the proximity to the variables needing to be monitored or managed, as well as the number of people who have close access to engage in that monitoring and management. Through this process, one can establish what areas should be targeted for recruiting Enviro-Champs, and how many Enviro-Champs would be suitable for that area. It is useful to keep in mind that citizen science achieves heightened efficacy and engagement the easier it is to engage. Therefore, focusing on proximity, ease of access, and minimizing costs, are critical to successful implementation.

The second part of developing the criteria for selection is then to define the required and / or desirable qualifications, character, and traits of the potential Enviro-Champs applicants from the selected informal settlements. Within the selected geographic locations, the Enviro-Champs need to meet a set of criteria. Here, we provide a guide for selectors based on previous experience with what has defined successful and effective Enviro-Champs:

- Firstly, an Enviro-Champ should be a public-spirited per-1) son who cares about local people and the environment around where they live. Enviro-Champs need to provide linkages between the issues they and their community face, which are often about water, sanitation and waste, and the authorities who are situated to do something about those issues. While Enviro-Champs can be primarily focussed on environmental monitoring and management, they also play an integral role in strengthening social fabric. Enviro-Champs need to be willing environmental and community stewards who can respond when things go wrong, or even when things appear to be going right. Enviro-Champs need to be strong communicators, willing to engage with their community, educating them, congratulating them on what is going right, and challenging them on what is going wrong.
- 2) To be effective the Enviro-Champs must be capable of conducting the following activities:

- a. Measuring, reporting and in some cases even fixing (if minor) water leaks, both of potable water in supply lines, but also of sewage leaks in the wastewater reticulation network.
- b. Industrial pollution monitoring and wastewater treatment works (WTWW) monitoring using the transparent clarity tubes (Graham et al. 2024).
- c. Sewer line monitoring and patrolling designated routes and points to ensure that the sewage net-work is operational.
- d. Alien vegetation monitoring and eradication. Eradication can include both physical (e.g., removal with saws and spades), and chemical (e.g., with herbicides) methods.
- e. Community environmental education. This is one of the most crucial tasks of the Enviro-Champs, and typically includes door-to-door education and attending and participating in community meetings (such as war-room discussions).
- f. Illegal dump site monitoring and clearing. This involves repeatedly monitoring known illegal dump sites, as well as patrolling for new ones. Often, Enviro-Champs are encouraged to engage with community members dumping illegally, to find out why they do it, encourage them to stop, and challenge them on their behaviors where it could be rectified.
- g. Attending capacity building training. Ongoing learning, as part of the work of Enviro-Champs, is crucial for motivation, understanding and a sustained commitment.
- 3) Experience: No prior specific qualifications or experience is required. Any concerned community resident should be able to contribute.
- 4) Eligibility:
 - c. Reside within the focal area in which the project is to be implemented (this is essential for streamlining logistics, access, familiarity with the area, and building day to day relationship with the community members).
 - d. Be available to work on the dates as required by the project.
 - e. Be in good physical health because of regular



physical work.

- f. Have Grade 10 as the minimum requirement. This is a guideline, since people without formal educations can still contribute meaningfully to environmental and community stewardship. However, at least a basic education is very helpful for carrying out all the tasks required of an Enviro-Champ, especially in terms of the digital literacy required to capture and report monitoring data.
- g. Be a South African citizen (for initiatives in South Africa). This can be adjusted as required for the region. The local citizenship is aimed at bolstering local employment and affording opportunities to local nationals in regions characterized by extremely high unemployment and disenfranchisement.
- 5) Interests: Applicants should be passionate about the environment and their community and should have an active interest in outdoor pursuits. Applicants should be committed to public service and to the health and development of the communities in the catchment in which they will be working.
- 6) Skills & Traits: It is recommended that recruitment focus on people with the following skills and strengths:
 - a. Organizational skills. Enviro-Champs need to be able to manage their time and show strong personal time management skills.
 - b. Proactive and positive outlook. Enviro-Champs are 'change-makers'. As a result, the attitude towards the work is critical. People simply seeking easy employment without a positive work ethic and desire to bring positive change to their environment and community will not be suitable.
 - c. Ability to work with people / good interpersonal skills.
 - d. Strong work ethic and good self-motivation.
 - e. Determination and persistence. Many issues that Enviro-Champs face are persistent and difficult to remedy over short time scales. Therefore, it is important to persevere and remain proactive and positive in the face of adversity.
 - f. Networking and communication skills. Enviro-Champs are often relied on as conduits of com-

munication and networking between communities and local authorities. Consequently, they must show an ability and interest in forming and fostering those connections.

- g. Team building / capacity building skills.
- h. An understanding of community and social issues. Enviro-Champs often experience most of the issues they deal with first-hand. However, they need to show concern for their community issues, and a willingness to listen and communicate with community members to understand their grievances.
- i. An interest in research and data gathering skills.

Step 4. Advertise

An advertisement for the Enviro-Champ's positions should be shared with the managing and funding partners, for input and editing. It is also a good idea to include local leadership, such as Ward Counsellors and Traditional Leaders, in the process before advertising to ensure that the new role of community members is transparent and welcomed. Following this consultation, the final advert for positions for the Enviro-Champs can be sent out by the key managing and funding partners in the best mechanisms they choose. At this stage, it is important to consider the best methods for reaching the target citizens. In some cases, digital access to conventional platforms may be limited, requiring alternative approaches such as open days in the community advertising the positions, or printing flyers to be distributed within the target communities.

Based on the mutually agreed Decision Support Tool and selection criteria, the managing authority are then required to select and review the curricula vitae (CV's) of people who might be suitable and eligible Enviro-Champs. Notably, this step has proven a significant challenge in the past – collecting CV's for the positions can take a long time. Facilitating easy submission of CV's is vital, either via an online means (email or a submission portal), or through facilitating manual submission by providing a time and place, with printing services supplied, where CV's can be submitted. In addition to working through local authorities it is advisable to circulate job description advertisements in communities where the Enviro-Champs will be operating (e.g., pamphlets, educational / recruitment video; https://www.youtube.com/watch? <u>v=VkSm4VDYY</u> Q) explaining the Enviro-Champs initiative and encouraging people to forward CV's to the appropriate Counsellors for consideration, increasing the uptake from the community side. A shortcoming of other projects has been a



low number of potentially suitable candidates to select from. This can potentially be overcome by extending advertising to the communities themselves in an engaging fashion.

Step 5: Short-List Candidates

This step simply requires verifying that the submitted candidates meet the selection criteria. Maximizing the number of CV's submitted increases the chances of having a strong pool of candidates to select from. Where there are enough applications, they can be narrowed down to those best suited to move on to interviews.

Step 6: Interviews

Once short-listing is completed, the remaining candidates are invited to interviews. The number of candidates interviewed will depend on the application pool, resources for interviewing, and the rate of successful appointment. The interview should attempt to establish how well the candidate fits the recommended skills and traits listed in Step 3. The most critical aspect of the interview process is to attempt to establish the participant's commitment to public-spirited or communitydevelopment work. As mentioned above, being an effective Enviro-Champ requires more than someone simply seeking employment and an easy paycheck. They must show genuine desire to be active within their community and to undertake a meaningful role in environmental stewardship. To this end, interviewees are invited to describe any community work they have undertaken, or the visions they may have for activities or practices which could lead to community improvement.

Step 7. Appointing Successful Candidates

Once suitable candidates are selected based on the interview performances, they should be required to undergo two final assessments of their physical health:

- Medical screening: Candidates are requested to submit medical screening reports from clinics and doctors. Medical screening includes blood pressure and glucose levels. This is a low resolution, minimally-invasive screening to ensure a suitable level of baseline health. The medical screening can also help to identify potential issues, such as diabetes, that may be treatable before they become serious health risks.
- Physical test: To work as an Enviro-Champ requires a certain level of basic fitness. This necessitates a physical test. It is suggested that candidates be invited to a walk of approximately 5 km in the focal area to establish if their fitness levels are adequate for the required work.

Table A1. The number of selected for appointment of Enviro-Champs and the number of Enviro-Champs expected to be, compared to the actual number, eventually appointed in five informal settlements in the Palmiet catchment, Kwa-Zulu Natal

Informal Settlement	No. of Enviro- Champs Expected	No. of Enviro- Champs Finally Selected
Rainbow Ridge	4	2
Quarry Road West	4	6
Zamokuhle	2	2
Dukezwe	2	1
Ezinyosini	3	1
TOTAL	15	12

It should be noted that candidates with disabilities should, nonetheless, be encouraged to apply to be Enviro-Champs. In the past several disabled persons have functioned effectively as Enviro-Champs, although the level and focus of work may need to be adapted to accommodate the skillsets of disabled persons.

Once the host partner has established the list of successful candidates, the participants are informed if they were successful or not. The ideal number of candidates eventually appointed will depend on the size of the communities, Wards, and focal area, as well as the number of eligible applicants. The outcome of the Enviro-Champ appointment process is included here for the eThekwini Palmiet catchment Enviro-Champ initiative as an example that can be adapted for future use (Table A1).

The process of appointment needs to be adaptive and reflexive. Local issues and challenges may affect the appointment process. Examples from the Palmiet project are noted here to illustrate how challenges could be overcome:

- The number of Enviro-Champs selected per settlement was affected by not receiving adequate strong candidates from some settlements. For example, two more Enviro-Champs were added in Quarry Road West, while in Rainbow Ridge the number of Enviro-Champs was reduced by two.
- Due to various delays, which were unavoidable and unforeseeable, there remained a need to repeat the selection process for Enviro-Champs positions in Dukezwe and Ezinyosini, where only two were selected instead of five. This illustrates how the process of appointment may be ongoing, until the requirements for Enviro-Champ presence in the catchment are met.





Appendix 2. Screenshots of ODK Collect Data Collection Forms for the Enviro-Champs

















