# Environmental Data Collection App for Morogoro Region, Tanzania Feasibility Study

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D-Lab Winter 2019 Final Report

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## I. Executive Summary

The Environmental Data Collection App project in Tanzania is the brainchild of Venance Soza Segere, a 2018-19 Humphrey fellow at the University of California, Davis. In response to growing concerns for environmental issues in Tanzania, Segere came up with the idea of an app to help the government learn about and respond quicker to environmental misconduct in addition to gathering data. This will help decrease the environmental harm caused by human behavior and educate citizens on the environment and consequences of environmental misconduct. Segere received his Master's degree in Environmental Science in Australia and is an environmental technical advisor for the Morogoro Regional Secretariat, an office that works directly with the national government. In collaboration with Segere, our team of UC Davis undergraduates comes from backgrounds in computer science, economics and environmental science.

Our project's purpose is to help the environment by streamlining information the government receives on environmental misconduct. Our project will be successful if many citizens are regularly using the app to provide data to the government. Currently, when citizens have environmental or other concerns they want to report, their concerns must be passed through several leaders before reaching the attention of the regional government (clgf.org. 2018). This not only takes a long time, but information is often compromised or forgotten. With our mobile app, Tanzanian citizens can report environmental misconduct to both their peers and the government. This peer-reporting component of our app's "newsfeed," is crucial to the success of our app, because citizens may feel more accountable for their reported environmental misconducts if the government and peers saw their reporting. The sustainability and effectivity of our app will rely on citizens wanting a healthier environment for their community and our app being easy to use. We therefore plan to include educational facts on different types of environmental misconduct, so that more citizens will learn and care about their environment. With an increasing collection of environmental data, the Tanzanian government will know what areas and sectors of the environment need more protection and also be able to write policies to conserve the biodiversity and natural resources the country so heavily depends on.

Our final deliverables for this quarter are this feasibility study and the user interface (UI) for our mobile application. Our UI and feasibility study are the product of our client's vision for the app, researching sectors relevant to our project and studying other apps. Methodologies we used were conducting a SWOT analysis of our app's concept and using three other apps as prior art. Apps that our UI has taken components from include "Snap Send Solve", "Hooked" and "Lake Tahoe Citizen Scientist". Both our feasibility study and UI will let our client show his boss the materialization of his ideas and provide the foundation for the completion of this app.

## II. Intro

Tanzania is a country in Sub-Saharan Africa with a population of 53.7 million. With 70% of its population below the poverty line and a young population structure, one of the country's current concerns is the management and lack of resources that its people depend on (World Bank, 2015). Key natural resources for Tanzania are lumber and water sources which shift attention to the country's environment. This project is important, because the Tanzanian government does not currently have a way to collect environmental data and there has been an increase in depletion of these natural resources. Communication between Tanzanian citizens and the national government is currently very slow, where citizens will relay information to local government authorities who then report to their own superiors and so on. As a result, information is sometimes lost and the government does not know how well it is addressing the needs of its citizens. This makes it difficult to address problems and write policies to protect the environment. This mobile application will help the government better protect the environment in the Morogoro reason and will improve its communication with its citizens.

Our project focuses on the Morogoro region, our client works for the office of the Morogoro Regional Secretariat. Morogoro is in the eastern region of the country and has a population of about 2.2 million. Morogoro has nine districts and about 80% of its population lives in rural areas. Morogoro has nine major cities and eight large national parks, supporting a diverse biodiversity, with forests, water sources and many animal species, all which would be better-protected with improved environmental data collection. With this mobile app, the government can quickly collect data from citizens to not only address environmental misconduct, but also better align policies with the country's needs.

## III. Methodology

### A. SWOT Analysis

Our methodology includes conducting SWOT analysis, researching on three sectors and comparing features three apps. We conducted two SWOT Analysis, including the analysis for the feasibility of Environmental Data Collection App in Tanzania, and the app "Snap Send Solve" (in Appendix 3) that is based in Australia and New Zealand. Doing SWOT analysis for these two apps is helpful to examine the strengths, weaknesses, opportunities, and threats comprehensively and better inform of our user interface design and future implementation.

| Possible Strengths | Possible Weaknesses |
|---|---|
| • Promote environmental misconduct reporting and disclosure among the public<br>• Enhance environmental literacy among the public and citizen science education<br>• Mobile apps are easy and convenient to use. It will improve environmental data collection, analysis, storage and dissemination in a government level<br>• It will help improve the environment<br>• It will enforce public health and social well being | • Potential "Big Brother" paranoia<br>• The government could "greenwash" their work, difficult to monitor<br>• Usage/support of the app is subject to political dynamics<br>• Technology can be difficult, expensive to maintain<br>• Without sufficient staff, the government could be overwhelmed with reports and address them too slowly |
| **Possible Opportunities** | **Possible Threats** |
| • Create Tanzania's first environmental data collection system<br>• Partnership opportunities with local businesses<br>• A platform of civic engagement in environmental issues<br>• A more direct way to hear from the public regarding environmental issues<br>• Create a good image and reputation for the government<br>• Accessible environmental education | • User-submitted data is susceptible to cyber security issues, compromised privacy<br>• Tanzania's citizens generally have limited environmental literacy, may submit inaccurate reports<br>• People may be afraid of reporting their community members, who might be upset or aggressive in response to knowing their actions have been reported |

With a growing number of people in Tanzania using mobile phones, more people in Tanzania will end up using apps. By incorporating peer-reporting with app-technology, the government would collect real-time environmental misconduct data and perform counteractions or remediation plans accordingly. Embedded with columns of related categorical introduction, the Environmental Data Collection App would promote citizen science education and better enhance the environmental literacy among the app users, all of which will enforce public health and social well being (Appendix A-1).

However, creating an app raises cybersecurity concerns. This is a threat, because users who are worried their privacy could be compromised when using this app, will likely be wary of downloading it. Citizens additionally might not feel comfortable knowing misconduct can be reported directly to the government by their peers.

In addition to collecting environmental data, this app can act as a platform to encourage civic engagement for environmental problems in Morogoro Region. The successful operation in Morogoro pilot region in Tanzania would act as a model of a well-established environmental data collection system. The government could also view this opportunity as a way to gain trust, create a good image and reputation.

**B. Prior Art**

The app "Snap Send Solve" is a local issue-reporting platform for Australia and New Zealand. We will use most of this app's feature as our inspiration to build the environmental data collection app. Users of our app will be able to report any environmental misconduct that they come across in Tanzania. Other users are able to view the incident in the app and learn more about the environmental pollution. Our app has tentatively been named "TAZAMA," meaning to "look" or "observe" in Swahili.

The app "Lake Tahoe Citizen Scientist" provides critical scientific information to help understand, restore, and sustain the Lake Tahoe Basin and other systems worldwide. This is done with pictures and a few corresponding sentences educating users on that feature of Lake Tahoe. Segere wants to combine the idea of educating people into the environmental data collection app. For that, we will be providing the information for each different types of educational misconduct. When an incident is clicked, users will see user-submitted details on the incident and educational information on the consequences of that specific type of incident. For example, for every incident related to logging, clicking on the incident will show specific details on the incident and general information on the effects of deforestation. This will give app users a better understanding of various environmental issues.

The "Hooked" app has a live feed features short term deals on food that is updated throughout the day. We will use "Hooked's" live feed feature to build our news feed page. User is able to see what kind of incidents are happening nearby, learn the facts of the pollution, and ultimately promote community awareness in environmental protection. Upon opening the mobile app, users will see a "newsfeed" of environmental incidents submitted by other users. App users can file a new report from the app's homepage (newsfeed). Users title the incident, select the category of incident they are reporting, write more details on the incident, the district in Morogoro for which the incident is in and can upload a picture if they would like. The app will use GPS to pinpoint the location of the incident. Once the user clicks "submit", the report will be added to the app's newsfeed and sent to the government.

## IV. Results and Discussion

### A. Increasing popularity of mobile phones in Tanzania

Throughout the years, mobile phone usage in Tanzania has grown tremendously over the past decade, even in remote areas. This is because mobile phone prices have dropped dramatically. Studies across a range of African countries state that in remote rural areas, many of the young people already have access to a mobile phone, even if they do not own it themselves. In addition, there is an increasing number of these phones are smartphones, particularly in urban centers (Swarts and Wachira 2015). According to the report by the Tanzania Communications Regulatory Authority (TCRA), the number of mobile phone users in Tanzania rose by 16 percent from 2013 to 2014 with 31.86 million users, which it has become one of the fastest expanding market in the communications sector (Ng'wanakilala 2016). Thus, it creates a great opportunity for the government to promote the idea of environmental data collection app.

### B. Environmental Issues in Tanzania: Deforestation

Deforestation is one of Tanzania's biggest environmental threats and is tied to other issues including declining biodiversity, pollution and land degradation (Conference on Biodiversity). Since illegal logging is mostly responsible for Tanzania's severe deforestation problem, citizen reports on this and other issues will help the government in several ways. As of 2012, about 39.9% of mainland Tanzania was covered in forests (URT, 2012a). This massive number of trees has, however, been threatened by rapid deforestation over the past couple of decades.

Trees are being harvested at rapid rates in order to fuel the country's population of over 57 million, but at many costs to the environment. Tanzania relies heavily on its abundant forest cover for energy. According to the Tanzania Forest Services Agency (TFS), "biomass energy provides 92% of [the] energy needs" of the country (Tremblay, Lowry, 2016). About 90% of Tanzania's forest cover is woodlands, a third of which is unprotected and without clear regulations (URT, 2012a). This lack of regulation has resulted in the exploitation of this land by deforestation, most of which is illegal. The Ministry of Natural Resources and Tourism reported a $60 million USD loss in revenue to illegal logging between 2004 and 2005 (TRAFFIC, 2007). According to Tanzanian Professor Jafari Kideghesho, the country lost about 0.97% of its forest cover annually from 1990 to 2010, totalling at a 19.4% total loss in forest cover during this 20 year time period (Kideghesho, 2015). Based on these depletion rates, Professor Kideghesho estimates Tanzania could lose its forests within the next 50 to 80 years if no action is taken. This rapid deforestation also threatens the country's biodiversity.

Tanzania's forests are "home to about 116 known species of amphibians, 1100 birds, 316 mammals and 335 reptiles" and over 10,000 plant species (Kideghesho, 2015). The more land that is cleared by deforestation, the less species that will be able to sustain themselves and reproduce in the forests of Tanzania. Some of these sub-saharan animals at risk include: elephants, cheetahs, lions, wildebeests, about a thousand bird species and more ( Lonely Planet). Deforestation is also closely tied to Tanzania's economy.

Forest products makeup 10% to 15% of Tanzania's export profits and 20.1% of its Gross Domestic Product. Without its forests, Tanzania will suffer greatly economically and will need to import another energy source. Between 6 to 11 million Tanzanians are employed by the forestry industry, so there will be a major loss of income and jobs ( Kideghesho, 2015). About 90% of

Tanzanians are not connected to the national grid, if Tanzania does not begin to address deforestation and alternative energy sources, the majority of the population will suffer (REDD, 2012). With more data on environmental incidents such as illegal logging, the Tanzanian government will know which areas are most at risk and have data to support potential policy initiatives.

### C. Education in Tanzania

Environmental literacy refers to a person's capacity to perceive and interpret the state of the environmental systems and the appropriate action to manage, restore or improve those systems (Sife et al, 2010). Since environmental protection needs efforts from the mass population, individual forming environmental literacy is essential for the environmental protection as a whole.

According to the World Bank (2017), about 30% of Tanzanian receive no or incomplete primary school education, indicating that Tanzania has "a large share of population [lagging] behind in basic literacy and numeracy skills" (para.13). To reduce illiteracy rate, Tanzania has been continuously received support on environmental education from the international society. For example, World Wildlife Fund (WWF) has been supporting and coordinating environmental education programs in the country; NGOs like Wildlife Conservation Society of Tanzania, AGENDA and NEMC have been developing educational materials for biodiversity conservation in Tanzania(WWF Tanzania, n.d). With educational support from these international organizations on a yearly basis, citizens in Tanzania have increased their awarenesses in environmental problems that exist in their country.

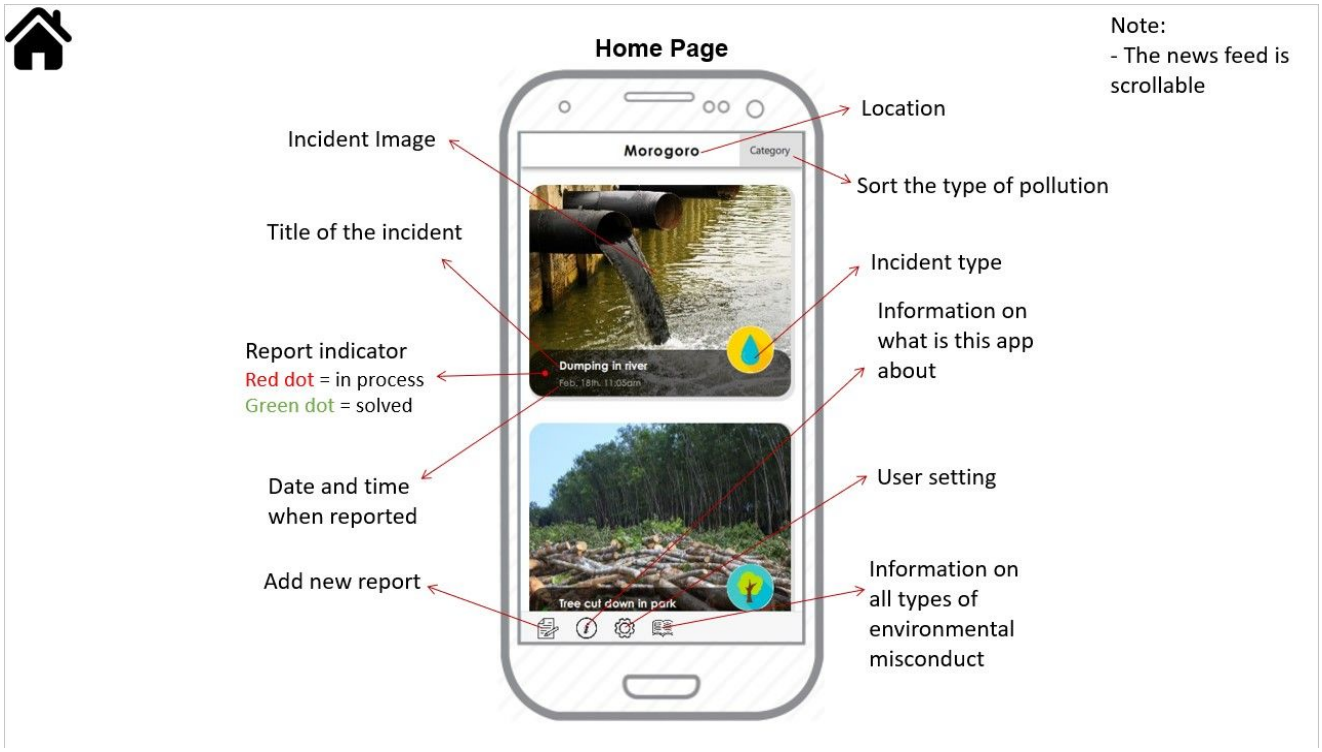
Our Environmental Data Collection App is a digital monitoring strategy that helps the government receive incident reports quickly. It could also play an important role in enforcing environmental literacy by educating citizens with certain basic knowledge. This would better enhance users' experience in reporting environmental issues while enhancing their understanding of the issues related to their reported cases. The News feed will also inform the citizens of a bigger picture of the status quo of the environmental landscape they live in.

## Discussion

The nine categories of environmental incidents on our app are: vegetation, waste, water, livestock, transportation, agriculture, mining, fishery and wildlife. With a peer-reporting app for environmental misconduct, the government will be able to respond quicker to illegal logging and incidents from the other eight categories. Ideally, if environmental misconduct is quickly posted for all app users and the government to see and address, people will be less-likely to engage in these harmful activities. This data will help the government learn where they should increase security and see how much stricter their policies might need to be to better protect the environment. The peer-reporting design and educational aspects of our app will promote users to use the app while simultaneously learning more about the environment and hopefully decrease the prevalence of environmental misconduct over time.

Our deliverable of our app's User Interface is the "front end" of this app. This what that app users will see and tap through on their own devices when using this app to learn about and report incidents. Additional User Interface images can be found in **Appendix 1** of this paper.

User Interface: “Newsfeed”



## V. Recommendations

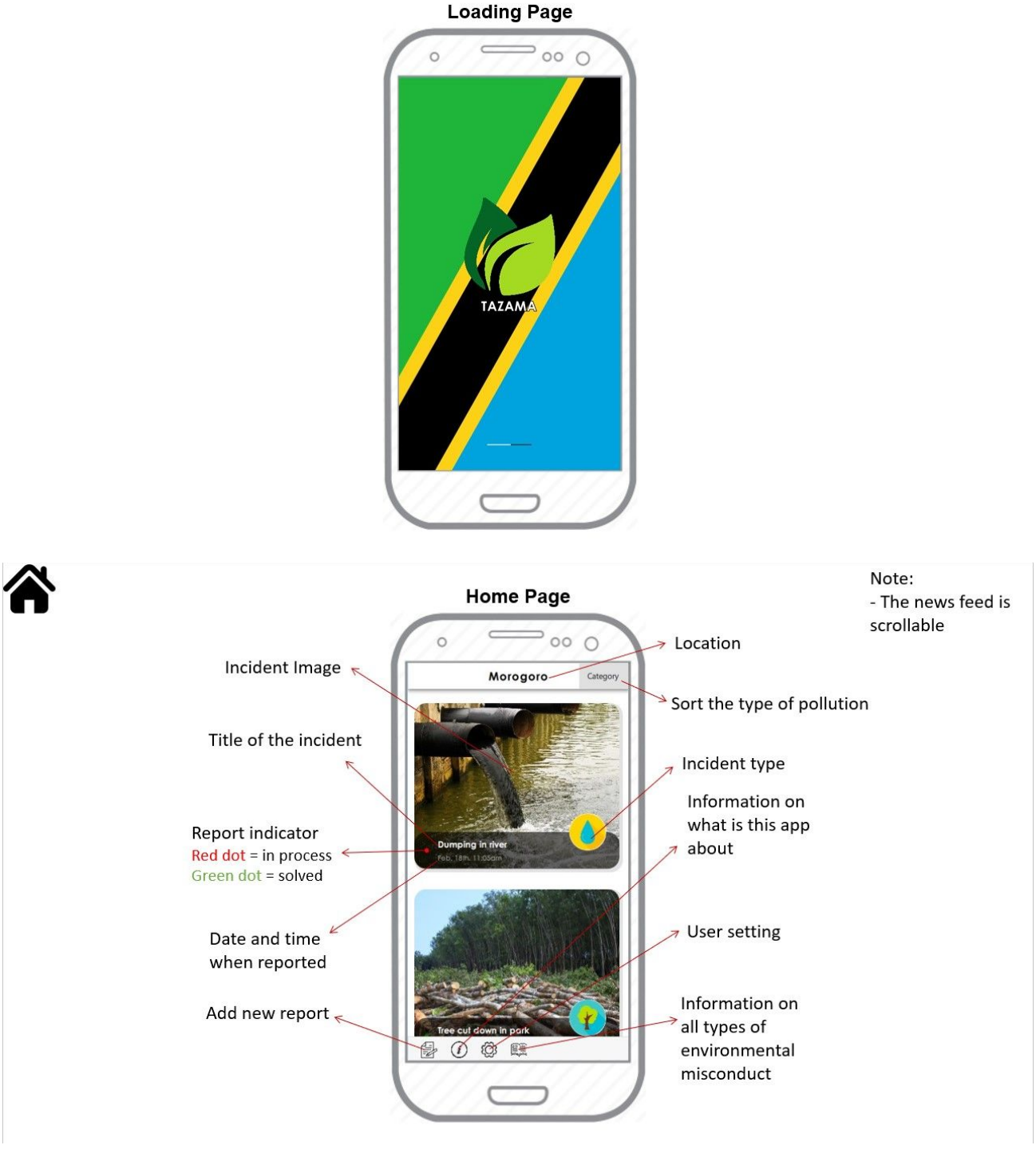
Next quarter, D-Lab 2 will have a team of four Computer Science majors to complete the app's "back end". This includes organizing data receiving and organizing, real-time notifications to users (based on our "settings" page's customization options) and setting up GPS to pinpoint incident locations. In order for the government to continuously collect and analyze environmental data from user reports, user input must be organized and sent to different sections of the government's database. This means all deforestation related events will be grouped together, all trash related events will be grouped together and so on.

After researching and talking to individuals from UC Berkeley's "Mobile Developers of Berkeley" regarding the costs of mobile app development, having student computer scientists continue this project is the best option, given our client's budget constraints. This team will ideally have previous app development experience. Our app's front end was built with the free software "Qt Creator" and the back end can be built on this software as well, or any other software that can develop Android app. "Qt Creator" can be used on both Macs and PCs. Other free softwares we recommend using for the back end include "Flutter" by Google or "React Native". This new team will have full access to documents and coding from this quarter.

It is also important to continue addressing potential challenges to this project. While Segere has assured us that it will not be a problem, it is possible citizens will feel uneasy or paranoid about using our mobile app in fear that the government is invading their privacy. Therefore, we recommend our client reach out to a third-party such as non-governmental organizations (NGOs). By establishing these relationships, our app can gain local trust and assurance. These partnerships can include promoting the app and if applicable, offering discounts to active app users. We are addressing this weakness by assuring app users that their submissions are private by emphasizing user anonymity on the app's "About this App" page and before reports are submitted. We also recommend that the team of computer scientists in D-Lab 2 set up a way to blur out the faces of individuals in user-submitted photographs. This way, app users will know the app is addressing and minimizing environmental misconduct rather than turning in and disciplining those contributing to these issues.

Our app's "About this App" page additionally provides statistics on how many of each of the nine incident types were addressed by the government in the previous month. This will keep users engaged and informed on how their information is being used to help the environment. We also recommend the government increase transparency by releasing regular public reports on type and quantity of environmental incidents it has addressed and how they did so.

## Appendix 1. User Interface Design



## Settings Page


Text explaining push notifications

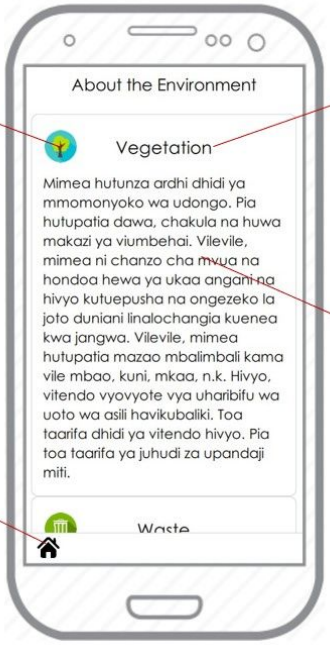
Switch button

Defaults to Morogoro which is the entire region, can choose smaller, sub-regions from drop-down menu

Return to home page

Note:
- Can turn all push notifications on/off, can specify below

## Education Page




Category icon

Category title

Users scroll to read all 9 categories of info

Return to home page

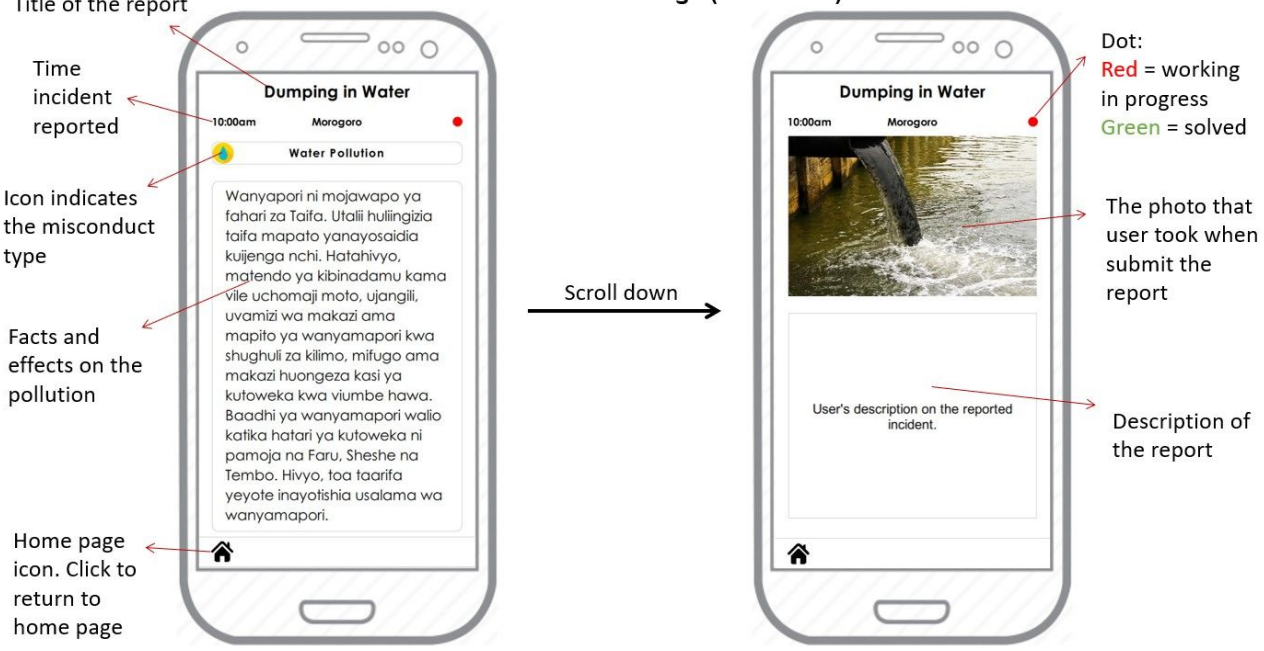
Note:
- There are total of 9 categories

## About This App Page


Once the app is in use, we can upload short statistics on this page

Return to home page

## Incident Information Page (news feed)



## Report Image Page


The five circles represent the five steps to complete the report.
Green = currently on the page
Gray = not yet complete

Note:
- 5 steps to complete the report

Access the front camera of the phone

Press the button to take the picture or hold the button to take the video

Return to home page

Go to next step

NEXT

## Report Location Page


Note:
- Total of 9 locations

Pick the district of the incident.
Able to scroll to select the district

Return to previous page

NEXT

**Report Type Page**

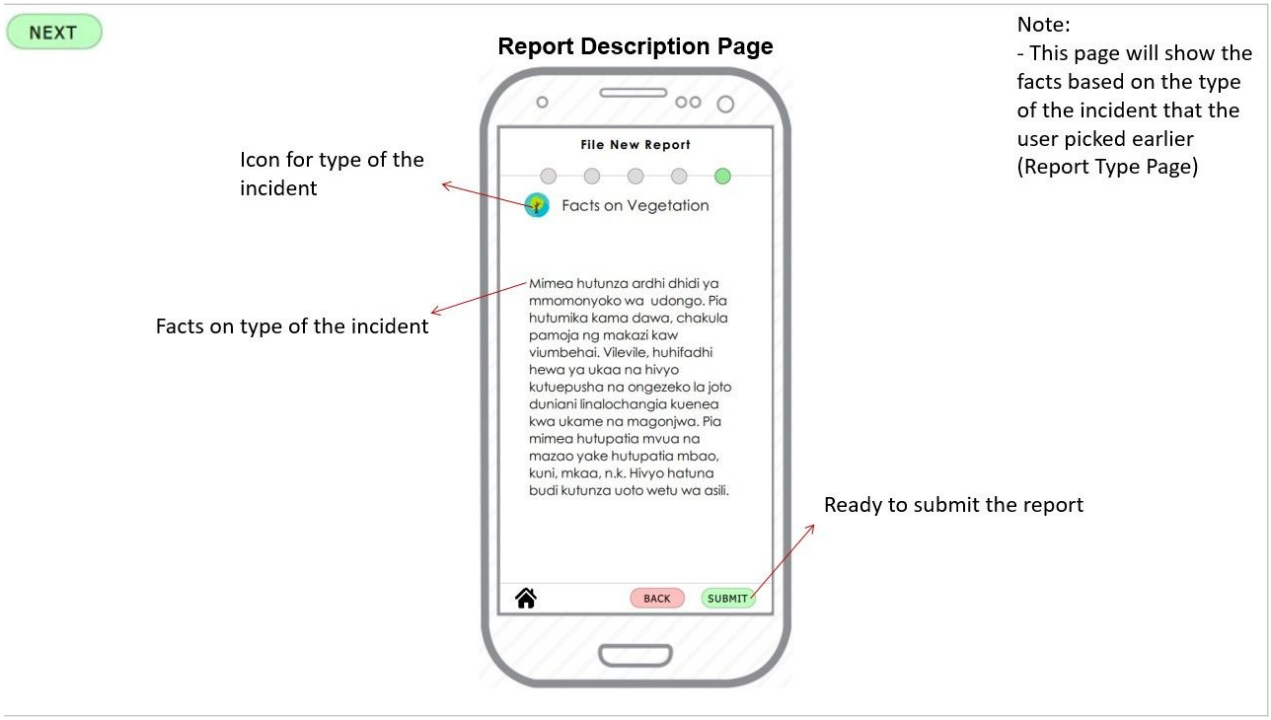

Pick the type of the incident.
Able to scroll to select the type

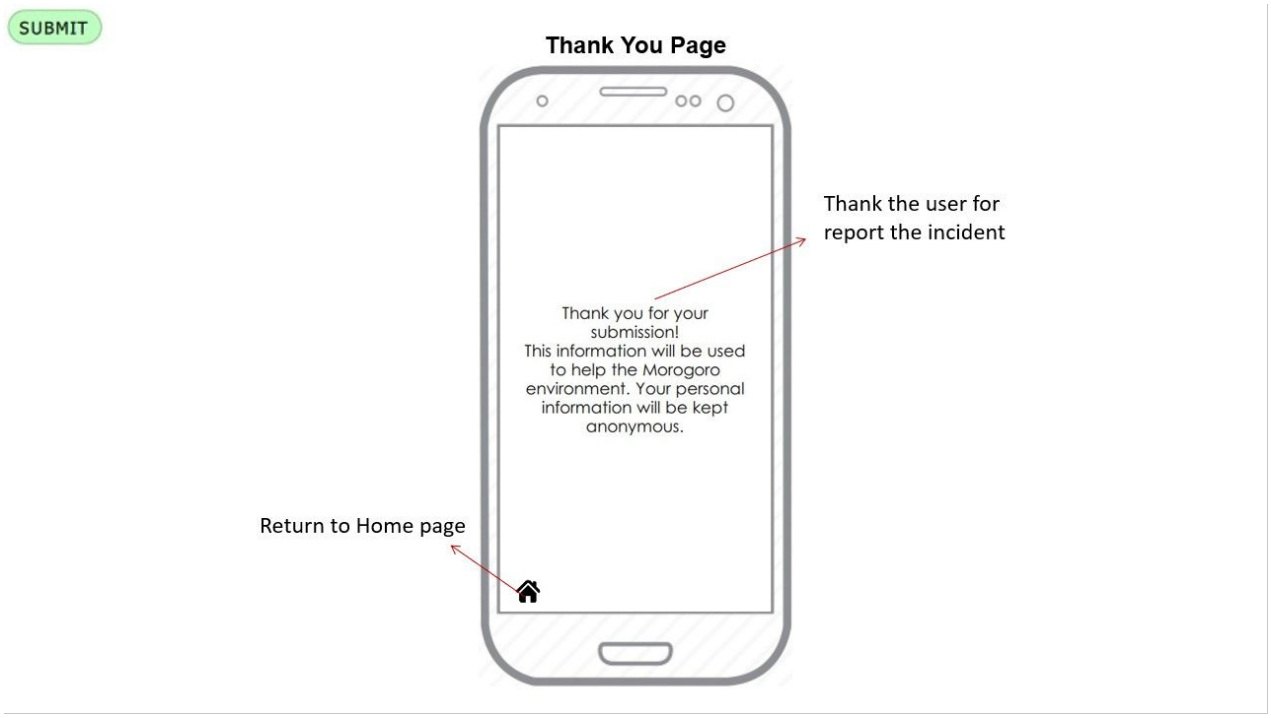
NEXT

**Report Description Page**


Enter the title of the incident

Description of the incident




**Screen capture of tapping through the app**:
https://youtu.be/4n-ffFG9H9w

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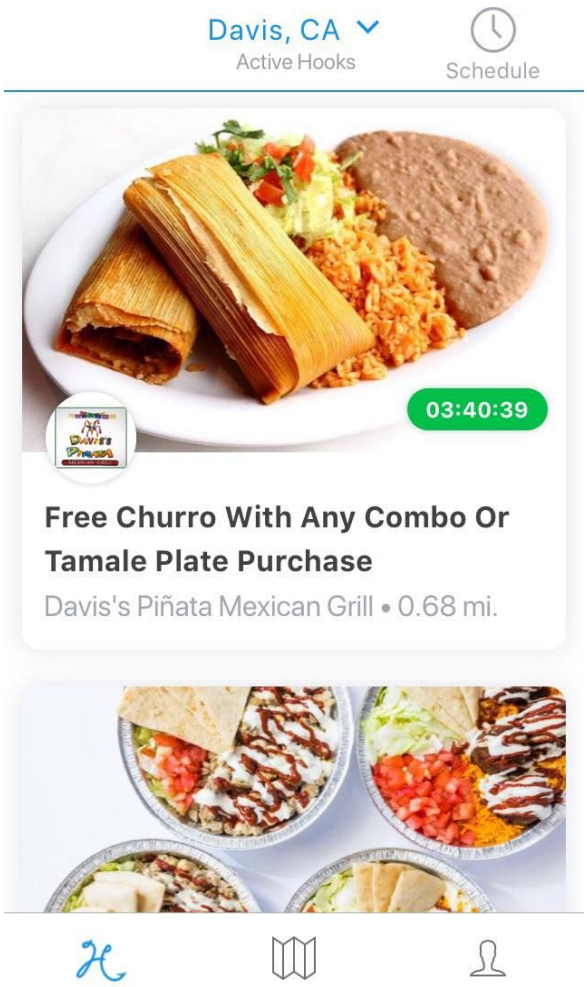
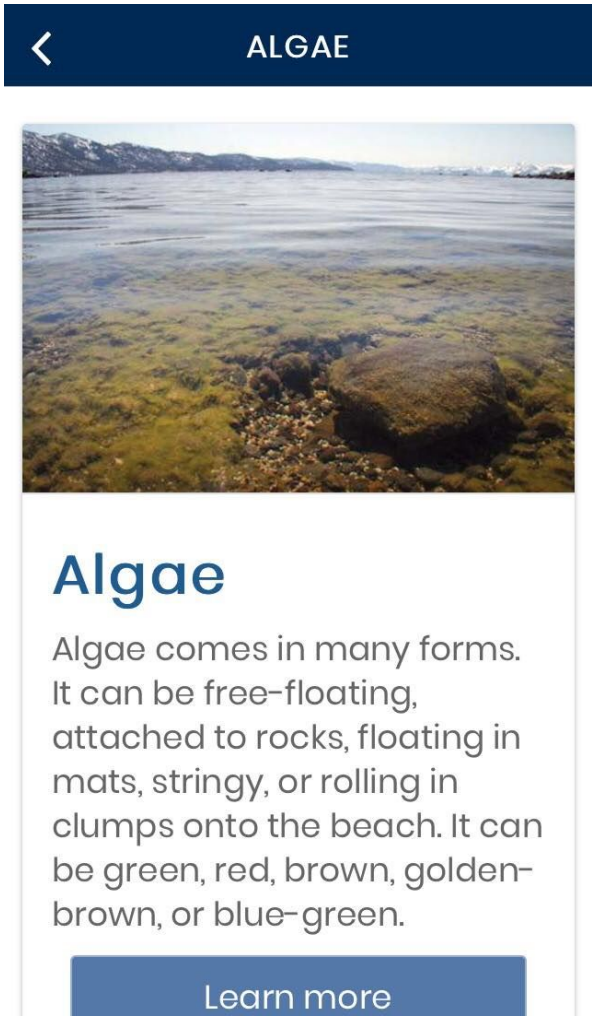
Tremblay, Sophie, and William Lowry. “Despite Conservation Efforts, Tanzania's Forests Still under Pressure.” *Conservation News*, Conservation News, 14 Oct. 2016, news.mongabay.com/2016/10/despite-conservation-efforts-tanzanias-forests-still-under-pressure/.

## Appendix 2

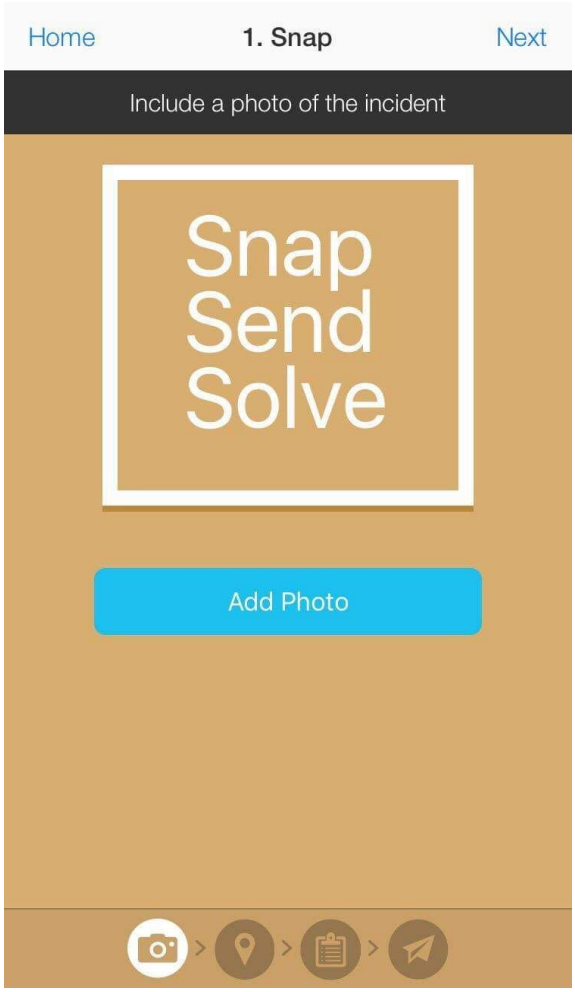
**Prior Art 1:** "Hooked"



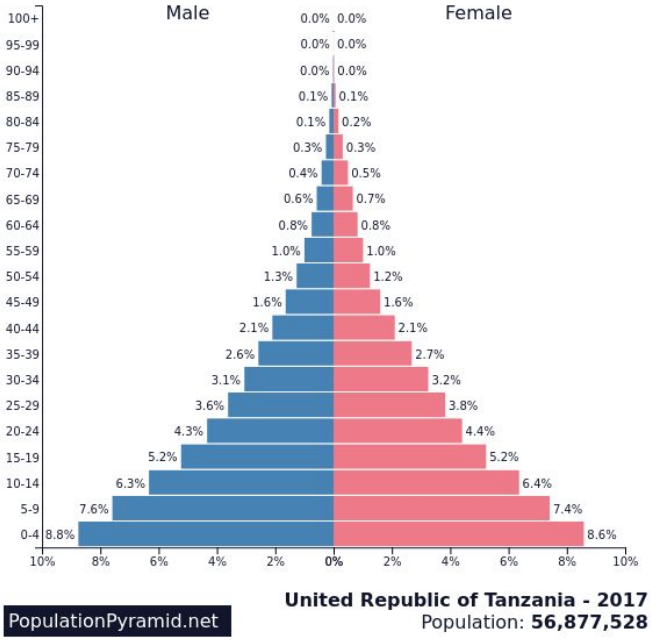
**Prior Art 2:** “Lake Tahoe Citizen Scientist”



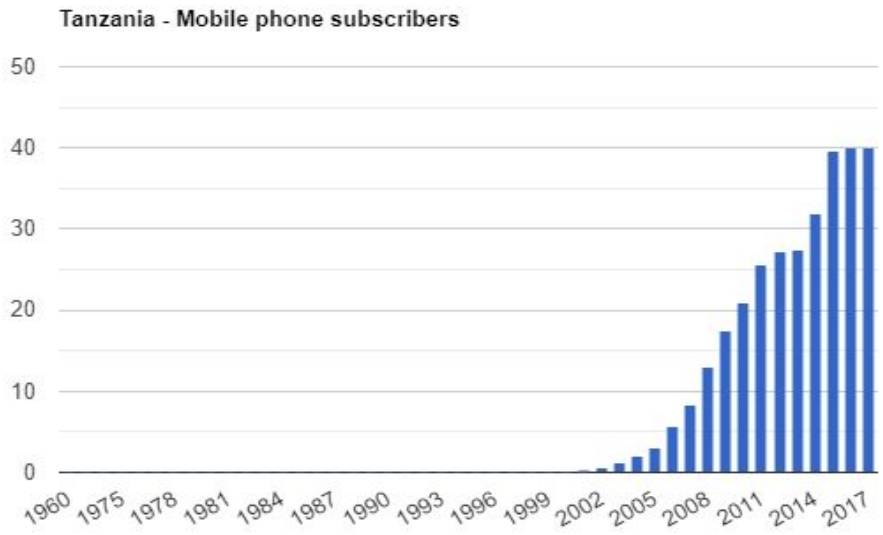
**Prior Art 3**: “Snap Send Solve”



## Tanzania's young population structure




## Growth in mobile phone usage in Tanzania




Source: TheGlobalEconomy.com, The International Telecommunication Union

**Appendix 3:** Yuyou's Work

**SWOT Analysis 2:** Snap Send Solve App

| Strengths | Weaknesses |
|---|---|
| ● The app is easy to use with concise interface<br>● The attributes of the app is clearly organized<br>● It includes reporting history for each device<br>● An easy and convenient way for the public to receive environmental education<br>● Enhance environmental literacy among the public in Australia and New Zealand<br>● Streamlining the communication between the government and<br>● It will enforce public health and social well being<br>● It has a decent loading speed | ● The app is too simple and has two few buttons<br>● It does not provide user with ongoing updates like a newsfeed<br>● Does not include partnership with local businesses<br>● Citizens may fail to provide accurate data due to their illiteracy of environmental science |
| **Opportunities** | **Threats** |
| ● Australia's citizens generally have better environmental literacy<br>● A platform of civic engagement in environmental issues<br>● A more direct way to hear from the public regarding environmental issues<br>● Create a good image and reputation for the Australian government<br>● Inducible to city management | ● Cybersecurity issues<br>Invasion of app users' privacy<br>● The government may "greenwash" their work if without supervision by the third party and the public<br>● The continuation of the implementation of the app is subject to political dynamics<br>● The funding of the app project may be subjected to stop when economic recession takes place (government allocates much more fund to counteract the crisis) |

From SWOT 1:

When users are using the Environmental Data Collection App, their privacy may be invaded, leading them unwilling to register an account or download the app; technical problems, such as slow loading speed and loss of data storage, would also lead to the dysfunction of the app and therefore, loss of users. The funding of the app may be subjected to be shortened or stopped when economic recession and political dynamics takes place.

**From Education in Tanzania:**

Lydia Kimaryo (2011), the educator at the Ministry of Education and Vocational Training in Teachers Colleges in Tanzania, thinks in a pedagogy perspective that having environmental education via countering real environment is crucial to meaningful environmental education. Learners should focus on an issue or problem and engage in problem-solving through seeking information and reporting ideas (Kimaryo, 2011). Both the Snap Send Solve, and Citizen Science App of Lake Tahoe can serve as good examples that expose learners to the real environment and actively engaging in environmental misconduct reporting.

Citizen science apps, such "Citizen Scientist Lake Tahoe" is designed to monitor the environmental condition in Lake Tahoe; "Snap Send Solve", based in Australia and New Zealand, is known for having citizens endeavoring in environmental misconduct disclosure. It is easy and convenient for citizens to report environmental misconduct by simply taking a photo and send to message. The App has access to more than 600 Australian and New Zealand authorities till now, and Sydney has become a "dobber" city, a city with people actively engage in reporting problems, according to New.com.au (2017). TAZAMA, the one we created for Morogoro Region, will combine the peer-reporting mechanism in "Snap Send Solve" and the knowledge education features of Citizen Science Tahoe.

**From Recommendations:**

The continuation of this peer-reporting project relies on involvement from environmentally-conscious citizens, thus exploring ways to enforce environmental education is fundamental for citizens to form environmental literacy. We recommend Morogoro Regional Secretariat, the local government where our client at, to have third parties such as non-governmental organizations (NGOs) to supervise the government if they perform their duties. By establishing these relationships, our app can gain local trust and assurance.

The apps can also attract and retain users by rewarding them intermittently. With local business partners providing discounts to active TAZAMA users, more citizens will be willing to report environmental misconducts when they observed. Engaged users should also be invited to attend auditing or policymaking conferences to give advice and feedback to better enhance the user experience.