

FINAL

REPORT

ZANZIBAR MAPPING



ACKNOWLEDGEMENTS

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INTRODUCTION AND GOALS

The general aim of the Zanzibar Mapping and the Industrial Training of students through the Resilience Academy program is to help the Revolutionary Government of Zanzibar, and the participating local entities, to collect and verify geospatial data by utilizing the rectified UAV imagery and community mapping techniques.

The specific aims of the assignment are to build capacity of the State University of Zanzibar (SUZA) students; train and supervise the digitization of the UAV imagery; and conduct community mapping in Zanzibar City in order to create a series of detailed spatial data layers.

According to the ToR, the overall objectives of the assignment are to:

- Supervise a group of approximately 50 SUZA students as part of their Industrial Training within the framework of the World Bank's Resilience Academy program. During the program, the students will:
 - Create data that visualizes infrastructure across Zanzibar City.
 - Ensure all data is collected to an agreed quality standard.
 - Design and conduct remote mapping/digitization of Zanzibar.
 - Publish data.

Furthermore, this project aims to leverage emerging data communities in Zanzibar through the community mapping methodology. Specifically, this assignment intends to:

- Identify a work space where to conduct the project in the most efficient way and that could provide a good working environment for emerging data and technological communities on Zanzibar for the duration of the assignment.
- Design and implement remote and community mapping of Zanzibar and create an openly licensed dataset.
- Ensure all data is collected to an agreed quality standard; quality should allow for use of the data collected in the Zanzibar OSR system.
- Transfer knowledge and skills to local government officials and university students and staff on the community mapping methodology, building a cadre of students and government staff to implement community mapping.
- Produce final maps and datasets.



WHAT WILL BE CONSIDERED A **SUCCESS?**

A successful completion of the two month long training program where approximately 50 students learn how to plan a mapping project, use open data, OSM, GPS and mobile phones for mapping, and understand basic GIS techniques.

Using these methods, the students will create a generic dataset which will be used by the stakeholders, and design a detailed and open, online and offline, map of public infrastructure in Zanzibar City's center.



TOPICS COVERED

The Resilience Academy's Industrial Training commenced on August 20. During the training, fifty students from the State University learned about community mapping, from project design, budget allocation, equipment set-up, to carrying out independent mapping of communities based on the stakeholders' needs. Specifically, the topics covered were:

- How to design a mapping project.
- How to conduct GPS data collection.
- Introduction to OpenStreetMap.
- How to map drainage.
- How to digitize drone imagery using QuantumGIS.
- How to use mobile phones for data collection.
- How to set up a household survey using KOBO software.

The students then used the newly acquired knowledge and collected about 15,000 GPS points of interest, 35 kilometers of drainage lines, 200 kilometers of roads, digitized approximately 100,000 buildings on Pemba Island, collected 2,000 household surveys, and gathered hundreds of public opinions.



TOPICS SELECTED BY THE STAKEHOLDERS

On August 22, Spatial Collective, Resilience Academy team, and students met with the stakeholders to determine what are some of their key data needs. The stakeholders represented civil society, government, and the private sector. During the workshop, the stakeholders presented their work and discussed how data collection might benefit their day-to-day operations. A couple of topics continuously came up in the conversations, these were:

- A need for a base map of Zanzibar Urban West
- A need for the road network of Zanzibar Urban West
- A need for a drainage map of Zanzibar Urban West
- A household survey of one of the most flood affected areas in Zanzibar Urban West

We felt that the Industrial Training was a great opportunity to teach the students about using drone imagery for mapping. For this reason, once the topics were selected, we added the digitization of drone imagery to the tasks. Our goal was to use the Industrial Training platform to complete the digitization of Pemba Island, finalizing the mapping of buildings on the entire Archipelago in the process.



CREATING A BASE MAP

Geo-services are becoming an essential part of the fabric of common society and geographical information has moved to be interwoven with many aspects of life. Key to that service is accurate, up to date, extensive data collection or base mapping.

Recent laudable efforts to create crowd-sourced open data on Zanzibar have shown that the quality of the data produced by the students and others, using innovative tools and methods, can achieve the quality standards required to fulfill the essential geo-data needs on the Islands.

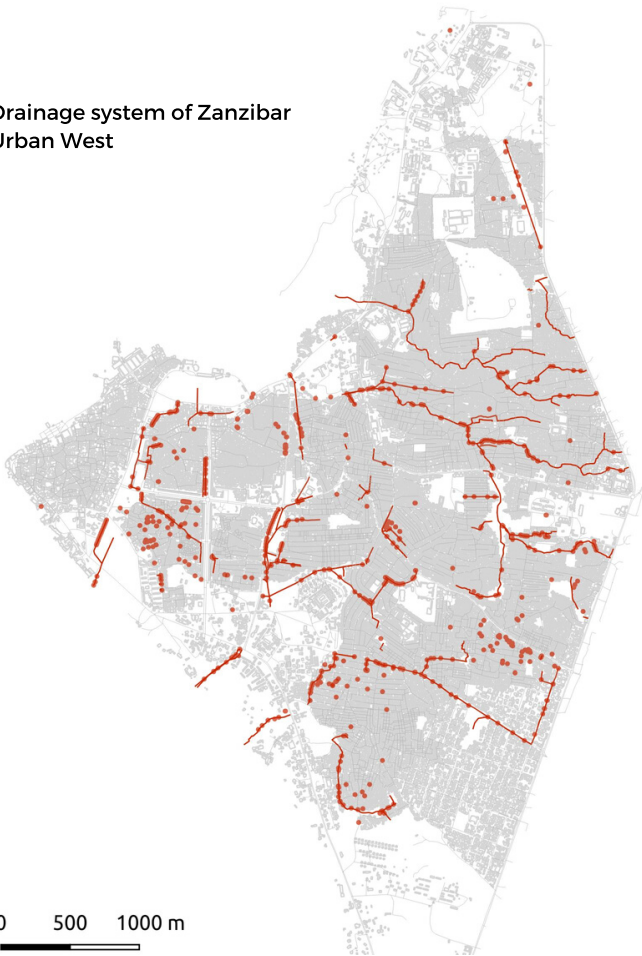
The goal of creating a base map of Zanzibar Urban West was to teach the students about OpenStreetMap, open source software, GPS and mobile data collection, and other technical aspects of mapping, data collection, and open data.

During this effort, the students added almost 15,000 points of interest to the base map of Zanzibar City Urban West.

Several data-sets that were collected during the completion of the base map are displayed on the next page and an excerpt of the data on the page after that.



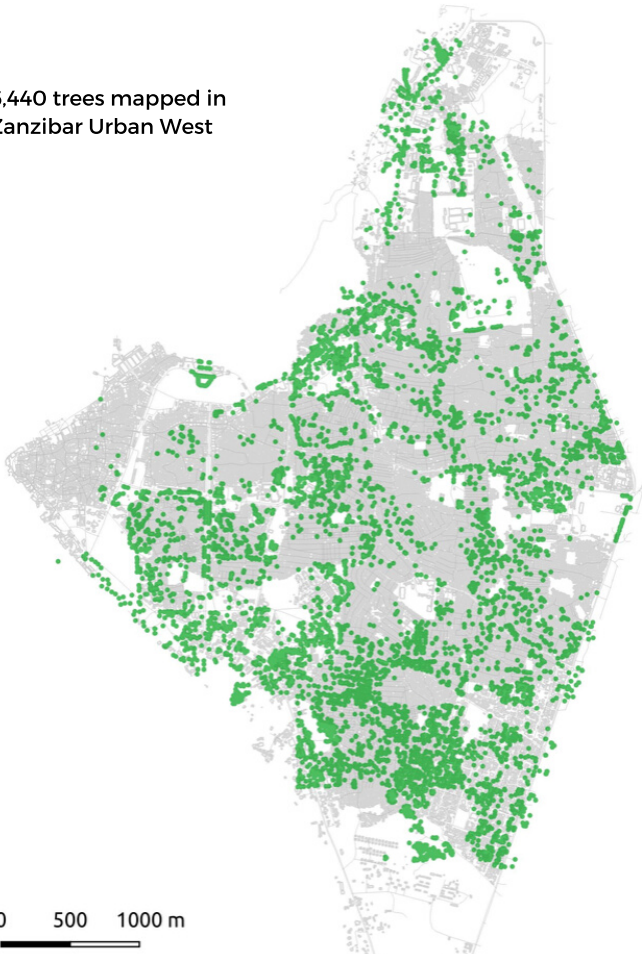
Drainage system of Zanzibar Urban West



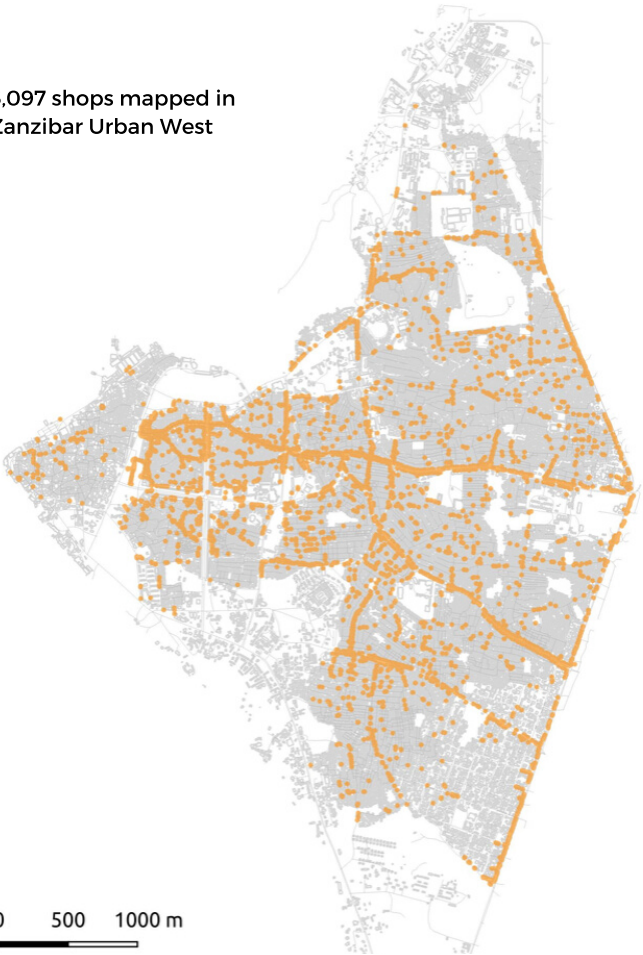
1,500 amenities mapped in Zanzibar Urban West



6,440 trees mapped in Zanzibar Urban West

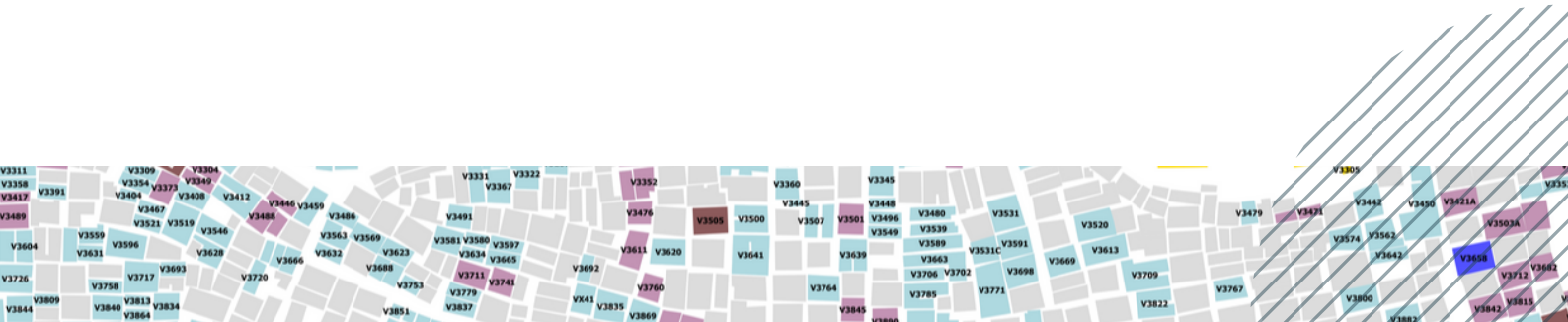


5,097 shops mapped in Zanzibar Urban West



BASE MAP DATA

Shehias mapped	42
Buildings digitized	approx. 100,000
Roads	approx. 200 km
Shops	5097
Trees	6440
Schools	99
Hospitals, clinics, pharmacies	88
Madrasa	161
Place of worship	119
Community centers	157
Workshops	318
Waste disposal points	103
Restaurants and cafes	106
Mobile money agents	113
Colleges	4
Water tanks	85
Water wells	11
Wetlands and water bodies	8
Playgrounds	17



DIGITIZING THE DRONE IMAGERY

Building upon the previous efforts, the main objective of digitizing drone imagery was to finalize the digitization of all the buildings on Pemba Island. For this reason, a digitization work-space and a localized network for accessing and sharing data was established at the State University of Zanzibar.

Digitization started with the introduction to QGIS environment. Computers were set up and QGIS was configured to fit the previous digitization efforts. Quality assurance and quality control rules were introduced.

Initially, all 50 students participated in the digitization. They digitized about 100,000 buildings which were added to the pre-existing data-set of almost 400,000 buildings, completing the digitization of entire Zanzibar Archipelago. The entire data-set was re-checked for errors and building reference numbers were assigned following the nomenclature put forth by the Commission for Lands.

Spatial Collective then secured the agreement with the Commission for Lands, who is the rightful owner of the data, to release it under the Creative Commons License and open it in OpenStreetMap.





This is a representation of Unguja and Pemba Islands only through buildings. There are 499,127 buildings on the Islands.

MAPPING DRAINAGE

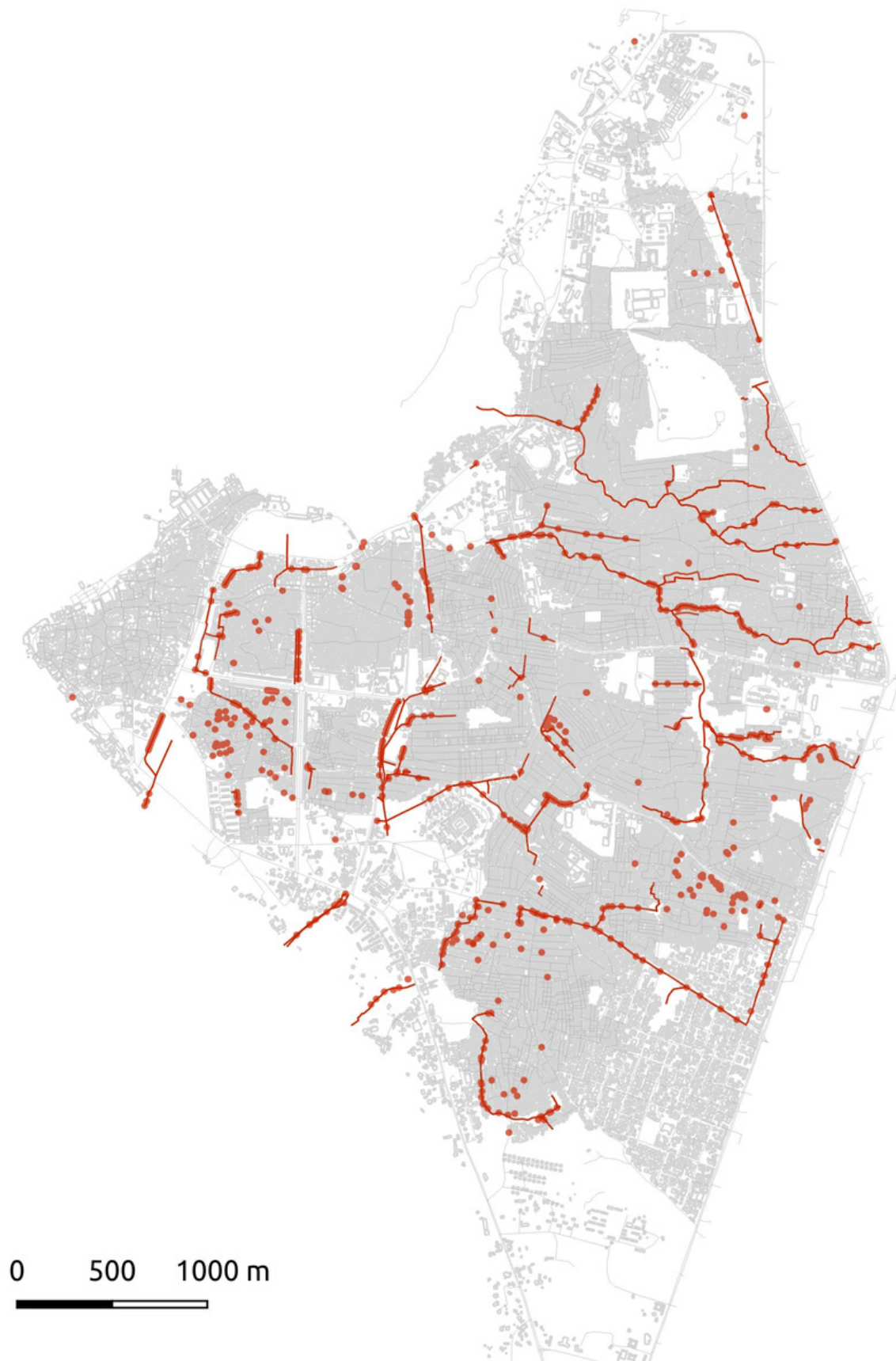
Drainage mapping was likely the most complicated task performed under the Industrial Training. Prior to the data collection and mapping itself, we set up the data collection protocols, bought measuring tapes and other equipment, and carried out several days of hands on mapping with all of the students.

The following attributes were collected:

- type of drainage
- length
- building material
- blockage
- width
- depth
- profile
- manhole
- drainage outlet and inlet
- bridges
- etc.

In less than two weeks, the students collected about 35 kilometers of drainage lines and more than 650 drainage related points of interest. A map can be found on page 12 and some of the data on page 13.





This map represents approximately 35 kilometers of drainage lines
and more than 650 drainage related points of interest

DRAINAGE DATA

Ditch	4.2 km
Drain	16.5 km
Underground drain	13.1 km
Stream	1.7 km
Manholes	162
Pipe inflow	118
Pipe outflow	34
Building drain	36
Culvert entrance	23



HOUSEHOLD SURVEY

The goal of carrying out a household survey was to introduce the students to mobile data collection and to teach them how to interact with community members while conducting a survey.

KOBO software was used for data collection and some of the data collected was:

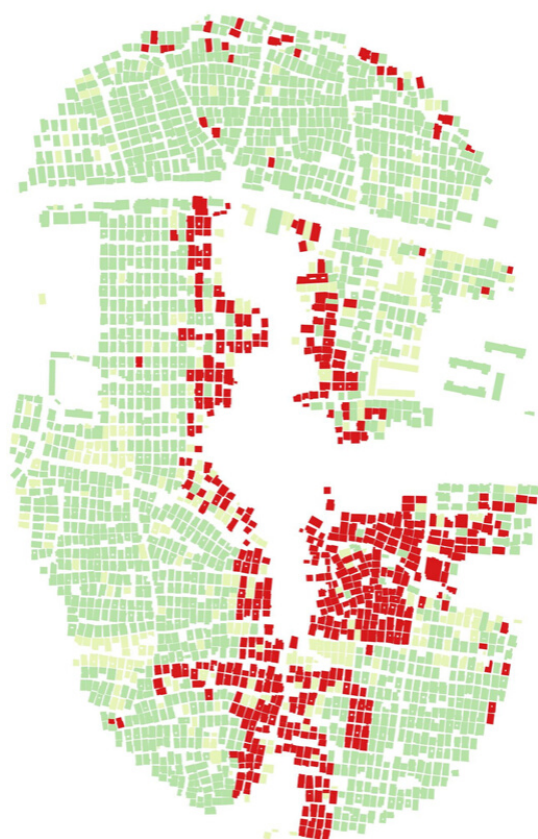
- building type, material, structure, roof, building levels, condition, and age
- how many people - adults and children - live in the household
- does the household have a drainage connection
- does the household have a sanitation connection
- does the household have an electricity
- does the household have a water connection
- how does the household get rid of the waste
- has the community experienced flooding recently
- has the household experience flooding recently
- what were the main causes of flooding

The survey was carried out in one of the most flood affected areas of Zanzibar Urban West. A few visualizations of the 2,300 households surveyed are displayed on the next page.





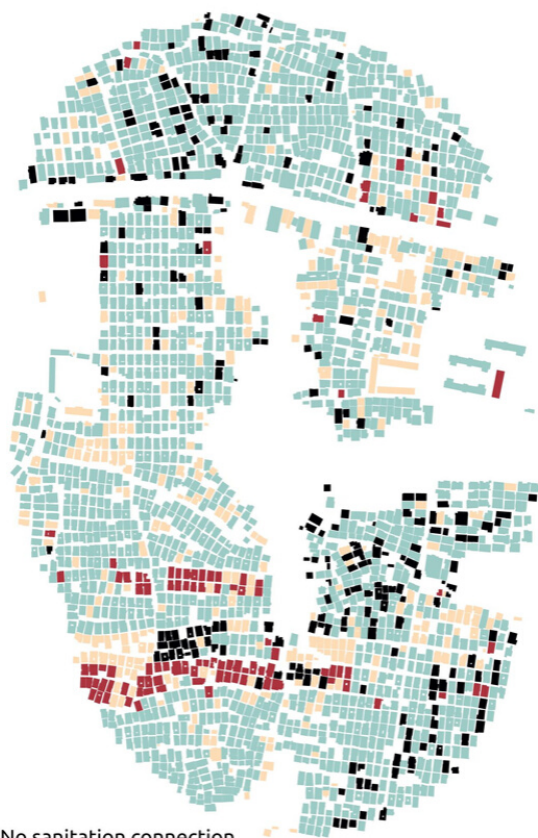
- Community not flooded
- Community flooded
- No data



- House not flooded
- House flooded
- No data



- No water connection
- Water connection
- No data



- No sanitation connection
- Private connection - chemba
- Public connection to municipal line
- No data

THE NEIGHBORHOOD OPINIONS

In our work, we find that many data collection initiatives/tools that exist are extractive and that information collected rarely stays with the people. People are often cut out of the decision-making process, from determining what data points are collected to what happens with the data itself, and because of that, people don't have access to data that is important to them. The failure to include the communities doesn't just impact them negatively; it also reduces the accuracy of the data and knowledge about a place.

At Spatial Collective, we have developed a platform that enables people to express their perceptions about a place through location, topic, and emotion. The spatial location means they can contribute information precisely in the area they are in. The topic section allows them to name or select which issue in particular matters to them. The emotion section allows them to say how they feel about the selected issue using their emotions with provision for further explanation. The platform does not dictate what is important about a place, the people tell us, and through the application the data remains in the communities.

A section of the students, together with the community members, used the platform to gather qualitative perceptions about a place. Below are some preliminary results from Zanzibar Urban West region.





Map of public opinions in the areas of flooding

Descriptio	Longitude	Latitude
too many waste	39.221344...	-6.1618670...
mtaro una taka taka nyingi unanuka hatari	39.215747...	-6.1603221...
dump site in the open	39.217318...	-6.1630855...
open drainage	39.217429...	-6.1629489...
katika mtaro huu wananchi wanasema baadhi ya siku hutokezea ukabaji ikiwemo kuporwa kwa wapita njia	39.218092...	-6.1689366...
ni sehem ambayo wananchi husema siku za mvua husababisha sehem ya njia hii kuchimbika	39.217028...	-6.1693286...
unofficial dump site near with builing and also there is a dum	39.215628...	-6.1704046...
sehemu hii ni hatari sana kwa sababu ni main dump	39.217820...	-6.1709276...
dump chafu sanaa	39.220969...	-6.1685341...
maji inatoka kwa nyumba inamwagika kwa barabara	39.219217...	-6.1678378...
sehem hii ni ya jaa lakini ipo hatarini kwa sababu ipo karibu na mto	39.218890...	-6.1670045...
mtaro chafu	39.219699...	-6.1668250...
no drainage in the area, muddy when rains	39.219521...	-6.1659617...
open drainage	39.220419...	-6.1674224...
eneo la kutupa tala lakin taka zishajaa hazijachukuliwa	39.218958...	-6.1613293...

An excerpt of qualitative data from mapping of public opinions

FUTURE POTENTIAL

Several projects on Zanzibar are taking advantage of the data collected; to name the two most prominent:

- Commission for Lands uses digitized buildings to identify households during the adjudication process and Building Reference Numbers to assign the receipt number to adjudication forms issued.
- Zanzibar Urban Services Project uses digitized buildings in several ways, first, for orientation during field data collection, second, to tie the data collected in the field to particular properties, and third, to assign value to each property.

Furthermore, several other departments in the Government of Zanzibar have expressed the need for the data, especially the buildings data, to be used in their work. To name the two:

- Zanzibar Water Authority would use the data as a baseline for their proposed services feedback and monitoring mechanism.
- The Zanzibar Disaster Management Commission wants to use the data to monitor which households are affected during emergencies.

Most of the data mentioned in this report is openly available in OpenStreetMap and GeoNode. For more information, find the contact information on the next page.



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