

# A Review on Community Gauges: Citizen Science for Water Level Data

A Preliminary Draft of the Method by HKC, HMS and WRC

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## Abstract

Water bodies in Accra, Ghana, are studied frequently to enable the live of the societies living next to them. Characteristics of rivers, channels or creeks constantly evolve and are evolved. Data and information are needed for to quantify observation, model and manage water bodies, but measurements are not in place and data are not sufficiently available. The challenge is to obtain and provide data for a wide network of users, such as researchers and public authorities, without major investment in technology and manpower, as the resources simply do not exist. The solution is to involve citizens in a citizen science project. Many Ghanaians take photos or videos of floods with their mobile phones to post on social media. The planned *Community Gauges*, supply a structure that utilizes these types of pictures of water gauges to obtain information about water levels for a longer time period. They are stored in an easily accessible database.



## 1. Introduction - Motivation - Objective

The PARADeS project - like many other projects in water management - had a great need for field specific data, e.g. precipitation amount and distribution, concentration times, water levels and flow velocities, which are very difficult, to obtain in data scarce environment. Many projects face this problem at their beginning, which requires resources every time. Thus, the desire arose for an accessible database that would incur as little cost as possible and yet be able to grow continuously. Water levels are elementary for the work in the PARADeS project. Research shows that many pictures of floods taken with mobile phones are posted by the population<sup>1</sup>. On these pictures, the time, place and approximate extent are recognisable, but not for certain places continuously and well scalable. However, it is suggested to take these pictures at specific, frequently affected locations, preferably every time an event occurs, from which the water levels can be easily derived. Another requirement is to collect and make available the results easily. The challenge is to activate citizens to take pictures from specific locations on a reoccurring basis. The challenge is to set up the necessary structure and to convince the relevant communities to participate.



Figure 1: Snapshot of a facebook posts including pictures of floods (facebook.com 2023).

Several successful Citizen Science projects have already been carried out in the field of water, but with a different focus. The *CrowdWater* (CH) project created a platform to store geo-located photos from all over the world<sup>2</sup>. The *Coast Snap* (AUS) application uses mobile snapshots to monitor beaches<sup>3</sup>. Other applications such as the *Mobile Water Management* application (NL & MY) used the potential of mobile phone images to measure water levels<sup>4</sup>. But also, scientific publications are focusing on community mapping for urban flooding<sup>5</sup>.

In consultation with the Water Resources Commission Ghana, the project's executing agency, the pilot project *Community Gauges* was tested in Accra. Three locations were selected according to different criteria and gauges were installed. The gauges consisted of a scale reaching into the water body and posters (see the pictures of case studies in chapter 3). These posters asked citizens to take pictures of the water body in normal or flood conditions and then upload them to a prepared database. Following advantages and challenges for the stakeholders were identified involving citizens as data providers:

<sup>1</sup> <https://www.floodtags.com>

<sup>2</sup> [https://crowdwater.shinyapps.io/CW\\_Dashboard\\_2/](https://crowdwater.shinyapps.io/CW_Dashboard_2/)

<sup>3</sup> <https://www.coastsnap.com/>

<sup>4</sup> <https://www.tudelft.nl/myanmar/innovations/mobile-water-management/>

<sup>5</sup> <https://www.frontiersin.org/articles/10.3389/feart.2020.00304/full>

## Advantages

### Citizens:

- Encouragement to become pro-active about flooding.
- Problems in flood risk situation can be pointed out.
- Link between management organisation and citizens - exchange of further information on objectives and background

### Institutions / researchers:

- Low tech solution requiring little maintenance.
- Receive data and indications of the extent of inundation and water levels in flood hotspots.
- Possibility to validate potential model results.
- Indications of unknown problems (unexpectedly high water levels due to clogging)
- Information on the temporal development of water levels
- Does not require large resources for the initialisation.
- Involvement of communities and awareness of flooding issues

## Challenges

### Citizens:

- Investment in terms of time, data volume and interest is required
- Ensure that citizens are not taking risks to take pictures.

### Institutions / researchers:

- Limited precision in terms of the water level information.
- No homogeneous chronological coverage of data series.
- Functionality of gauges must be checked regularly.
- Depends on willingness of communities and citizens.

## 2. Method

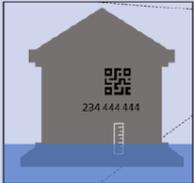
### 2.1. Work steps

The different steps and the respective persons responsible are shown in Table 1. The first step, site selection, is critical to success. The site needs to have sufficient flood events (extent and frequency) whilst at the same time safety must be ensured for the set up and usage of the community gauge site. The selection should therefore consider scientific and practical interest, long-term experience at the location, possible future planning and safety aspects. In addition, the level gauge should have the best possible durability, i.e. construction and materials should be carefully chosen. The information and motivation of the citizens should be tailored to the participants, both in terms of content and manner, and the timing should be coordinated with the installation (and the attention that goes with it). For the next step 2, the citizens are motivated and have received the necessary information to take photos



with the required information content. Step 3 is to send the pictures together with the other data (coordinates, date, time). Consequentially in step 4 the data is saved and evaluated by the involved institutions.

Table 1: Work steps Community Gauges

Step	1	2	3	4
Task	Definition of location and Installing of gauge	Taking picture of gauge during flooding	Mailing to specified address using explanations served by qr-code	Saving and evaluating
Actor	Institutions together with Citizens	Citizens	Citizens	Institutions
				

## 2.2. Setup of the Gauges

The selection of the location should therefore take into account scientific and practical interest, long-term experience on site, possible future planning and safety aspects. In addition, the gauge should have the best possible durability, i.e. construction and materials must be carefully chosen. At the same time, it is important to prove whether a permission is necessary from the infrastructure owner, operator or community leader. Other relevant points are:

- Criteria location
- Frequent flooding
- Sufficient passers-by
- Safe operation possible (installation and photography)
- Durable underground construction (bridge/building)
- Highly visible and durable colour
- Accurate scale
- Ends at characteristic part of the supporting construction (top of wall)

The details of the pilot gauges in Accra are summarised in Table 2.

Table 2: Details setup CGs Ghana/Accra

	Community Gauge 1	Community Gauge 2	Community Gauge 3
Local name / nickname	Haaloo Bridge	Dome Foot Bridge	Algozoshie Foot Bridge
Location	Ni Amah Sogbla Avenue, Accra, Haaloo Near Matrix Innovation Opposite Covenant House Chapel	Parakoo Boundary Rd, Talls	Coff Hills St. Algozoshie – Accra opposite Eagle House Chapel Opposite Jesus Outreach Church
GPS coordinates	0°40'11.17N 0°12'16.57W	0°38'50.37N 0°14'07.77W	0°37'41.27N 0°13'43.27W
Sub-Construction	Concrete bridge	Concrete	Bridge pier
Colour	Scale: black Base coat: white Paint: acrylic paint	Scale: black Base coat: white Paint: acrylic paint	Scale: black Base coat: white Paint: acrylic paint
Maximum of scale	4.10 m	2.40 m	
Date of installation (scale and poster / instructions)	Scale: Tuesday, September 20, 2022 Poster: Yet to be done	Scale: Friday, September 23, 2022 Poster: Yet to be done	
Photo			
Short description character of settlement / community	A residential settlement. There established business and companies around the vicinity. Such as GAS company, Agro Chemical Production Company, Bricks manufacturing, Health Care and a Bank	Informal settlement area with little shops around. Tailoring, mobile sales, repairs, etc.	Informal non settlement area with little shops around. Tailoring, mobile sales, repairs, etc.
Decision criteria	Well visible	A well-constructed foot bridge is located near to the location. Many passers-by. Well visible	Well Visible Many passers-by
Estimated frequency of flooding			
Actor (random passers-by not approached / informed residents)			

### 2.3. Setup of Poster

The poster should fulfil several requirements making the design sophisticated:

#### Motivation

- Easy comprehension (little text, rather use of pictures)
- Positive appeal of the data gathering
- Encourage the participation of many people over a long period of time in the neighbouring areas

#### Information

- Define clearly what the *Community Gauges* are about
- State why participation is important
- Outline how to participate and what equipment is needed
- What needs to be considered

#### Placement of posters and scales

- Ensure that there is no danger for the person installing the community gauge
- Make scale and poster as large as necessary, as small as possible (cost)
- Choose a material for the scale and poster that fits the surrounding
- Be clear about the location and time frame of the community gauge installation

The poster used in Accra is shown in Figure 1. The poster was printed on self-adhesive A3 paper.

### 2.4. Processing

There are a number of low-cost options for submitting, managing and saving the images, such as a dedicated e-mail address, or professional tools. The decisive factors here are certainly the number of gauges and the resources of the institution in charge. *KoboToolbox*<sup>6</sup> was used for the pilot project.

<sup>6</sup> <https://kf.kobotoolbox.org/>

## COMMUNITY GAUGES

**WHAT ARE WE DOING?**  
COLLECTING DATA ON WATERLEVELS

**WHY?**  
DATA HELPS TO UNDERSTAND, FORECAST AND PREVENT FLOODING

**HOW CAN YOU HELP?**

- 1

When you see the gauge under water like this: ➔

**TAKE A PHOTO**
- 2

SUBMIT THE PHOTO on our website:  
[tinyurl.com/CommunityGauge](https://tinyurl.com/CommunityGauge) or scan the QR Code
- 3

Leave us your contact details during the submission process and **GET A CERTIFICATE AS CITIZEN SCIENTIST**

WATER RESOURCES COMMISSION

Participatory assessment of flood-related disaster prevention and development of an adapted coping system in Ghana

For more information: <https://tinyurl.com/communitygauges-info> or contact WRC here: 0123456789

Figure 2: Poster Community Gauges Accra, Ghana.

### 3. Case Study Locations



Figure 3: Locations of the Community Gauges in Accra

The case study locations chosen were carefully picked by experts from the Water Resources Commission. Figure 3 shows in a map of Accra where those locations are in Accra.



### 3.1. Haatso

The first community gauge was located in the Haatso area, close to a footpath bridge. The location gave good sight for trespassers on the poster and the scale. The wall on which the scale was drawn is facing towards the North. After 10 months the scale was still intact and only the bottom meter of the scale showed some clippings. The posters that were placed in the beginning disappeared after 10 months.



Figure 4: Scale placement for community gauge: Haatso right after installation



Figure 5: Scale placement for community gauge: Haatso 10 months after installation

### 3.2. Dome

The second community gauge was located in the Dome area, close to a busy street. The location gave mediocre sight for trespassers on the poster as well as the scale. The wall on which the scale was drawn is facing towards the South-West. After 10 months the scale not visible anymore. The posters that were placed in the beginning disappeared after 10 months. Only poster hidden behind greenery were still in place after that time. This indicates that the sun was predominantly causing the poster and gauge colour to detach.



Figure 6: Scale placement for community gauge: Dome directly after installation



Figure 7: Scale placement for community gauge: Dome 10 month after installation

### 3.3. Alogbloshie

The third community gauge was located in the Alogbloshie area during a previous project. The scale was printed on a sheet metal. The location gave mediocre sight for trespassers due to constantly remerging greenery around the bridge pillar. The bridge pillar is part of a footpath bridge over an Odaw tributary.



Figure 8: Scale placement for community gauge: Alogbloshie installed during previous project.

## 4. Lessons Learned

### 4.1 Scale

Accuracy is important! Although a method was suggested to create a correct scale with few aids, this was not used on site, to the detriment of accuracy.

The scale should end at a prominent part of the substructure, such as the wall head or the end of a pier, so that the scale can be measured or reconstructed later if necessary.

The paint must be waterproof and adhere well to the substrate. It may be useful to test different colours.

### 4.2 Poster

The poster should be installed at the same time as the gauge. This way, any interest in the construction work can be used. Interested citizens could be instructed and the gauge would be ready for use immediately. If the scale is put up much earlier than the poster, it may weather before people have had a chance to act. The reverse would also be disadvantageous.



Additionally, it is advised to pick a different material for the poster. A printout on an adhesive foil showed effective for the set-up but does not supply a sustainable solution. Avoid that no greenery covers the exposition of the material.

## 5. Discussion and Outlook

The results of this project didn't show a strong engagement of the public since only few submissions to the system were made nevertheless the method has been documented and can be developed further.

The habit of people to take pictures of unusual events and disseminate them was tried to be used for the low-cost collection of water level data. However, the trial installation in Ghana revealed some challenges regarding the durability of the gauges and timing. However, as this approach is very cost-effective and at the same time sensitises, informs and involves citizens, the principle of community gauges could be tested and further developed in other countries. Suitable areas would be those that are relatively frequently affected, densely populated, and sufficiently supplied by communication networks. It would also be helpful to have a local institution with a strong interest in the data.



### Project Partners



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