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TAKING THE PULSE OF OUR PLANET FROM SPACE

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Citizen science for assuring safe drinking water in a flood-affected region

Anas Abdulaziz, Jaleel AKU, Menon N, George G, Pai PG, Dinesh KPK, Shubha Sathyendranath

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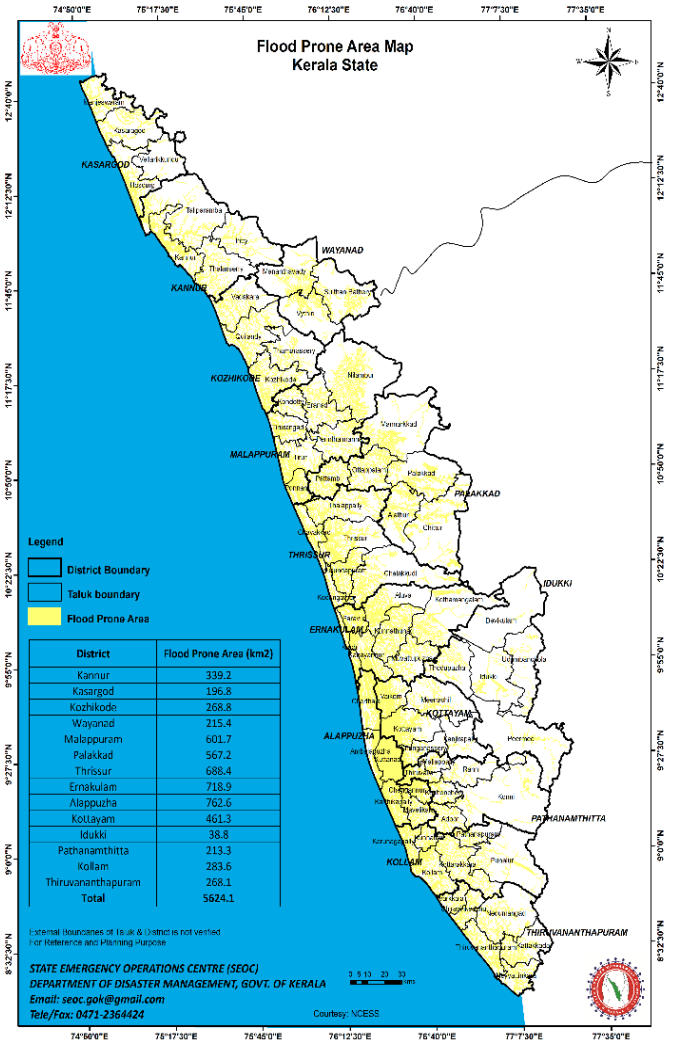
Kerala flood 2018 and impact

- Kerala is vulnerable to natural disasters
- Two flood events occurred between June and August 2018
- Kerala received 770 mm of rain during 1-20 August, which triggered 341 landslides, 37 dam sluiceways were opened
- 5.4 million people were affected, 1.4 million displaced and 433 fatalities
- 1259 out of 1664 villages spread across 14 districts were affected: Ernakulam severely affected
- 60,000 hectares of agricultural crops were destroyed
- 83000 km of roads were damaged
- Volunteers (fishermen, “self help group” units (women’s, citizens) were central in rescue operations, arranging shelters, food and cleaning flood affected houses



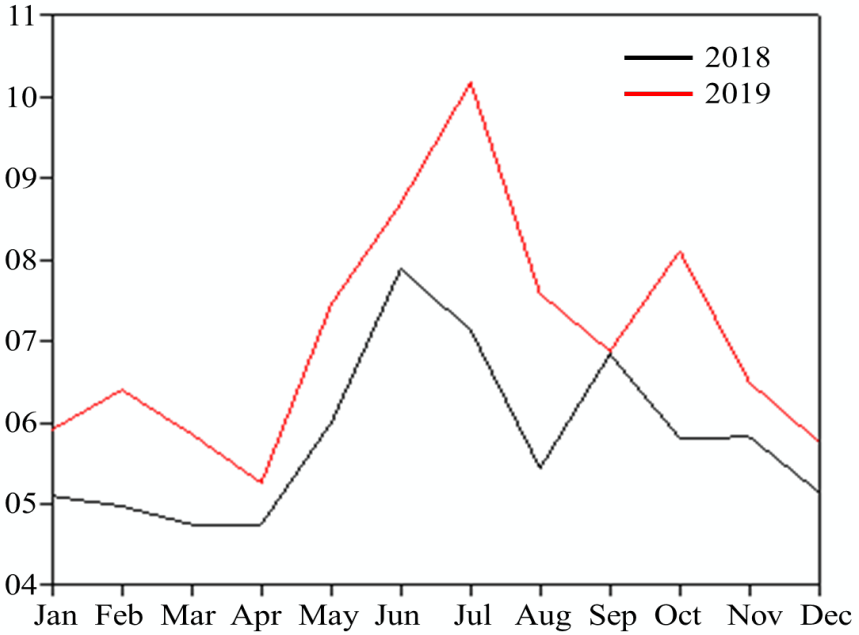


District	Flood Prone Area (km2)
Kannur	339.2
Kasargod	196.8
Kozhikode	268.8
Wayanad	215.4
Malappuram	601.7
Palakkad	567.2
Thrissur	688.4
Ernakulam	718.9
Alappuzha	762.6
Kottayam	461.3
Idukki	38.8
Pathanamthitta	213.3
Kollam	283.6
Thiruvananthapuram	268.1
Total	5524.1

Kerala flood 2018 and public health

- Disrupted access to public water supply to 6.7 million people
- Damaged 317000 shallow wells and 100000 toilets
- Toilets and septic tanks were flooded and overflowed in many areas, enhancing risk of disease outbreaks
- Chances of outbreak of water associated diseases (Acute diarrheal diseases, Leptospirosis, Chikungunya) were much higher after flood
- But disease outbreaks were averted through scientific intervention and management of the supply of safe drinking water



Incidence of Acute diarrheal diseases in flood affected districts around the Vembanad Lake (Ernakulam, Alappuzha, Kottayam)

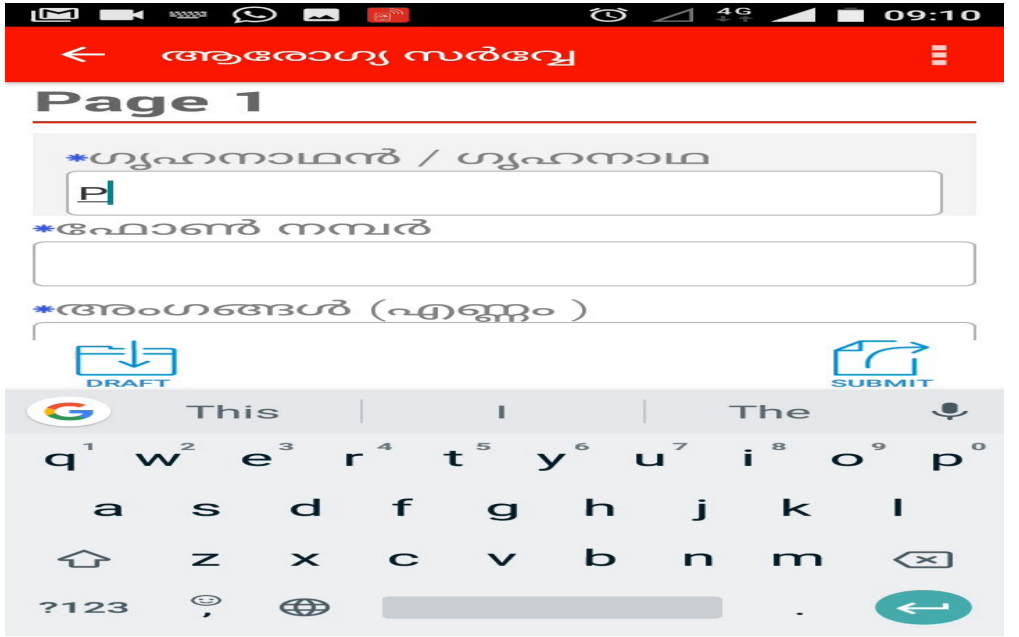
Kerala flood 2018 - Citizen Science

- Assuring access to safe drinking water and sanitation facilities for the public was a major concern
- Well mapping mission: Conducted in association with health department in Ernakulam district
- It was aimed at
  - identifying usable wells in areas of selected flood-affected villages
  - analyzing the microbial quality of drinking water sources
  - translating data to reduce the spread of water-associated diseases
- 30 citizen scientists (mostly post graduate and research students) assessed 300 wells in four days in five villages (Alangadu, Chennamangalam, Chittethukara, Varappuzha and Moothakunnam)

Kerala flood 2018- Capacity building

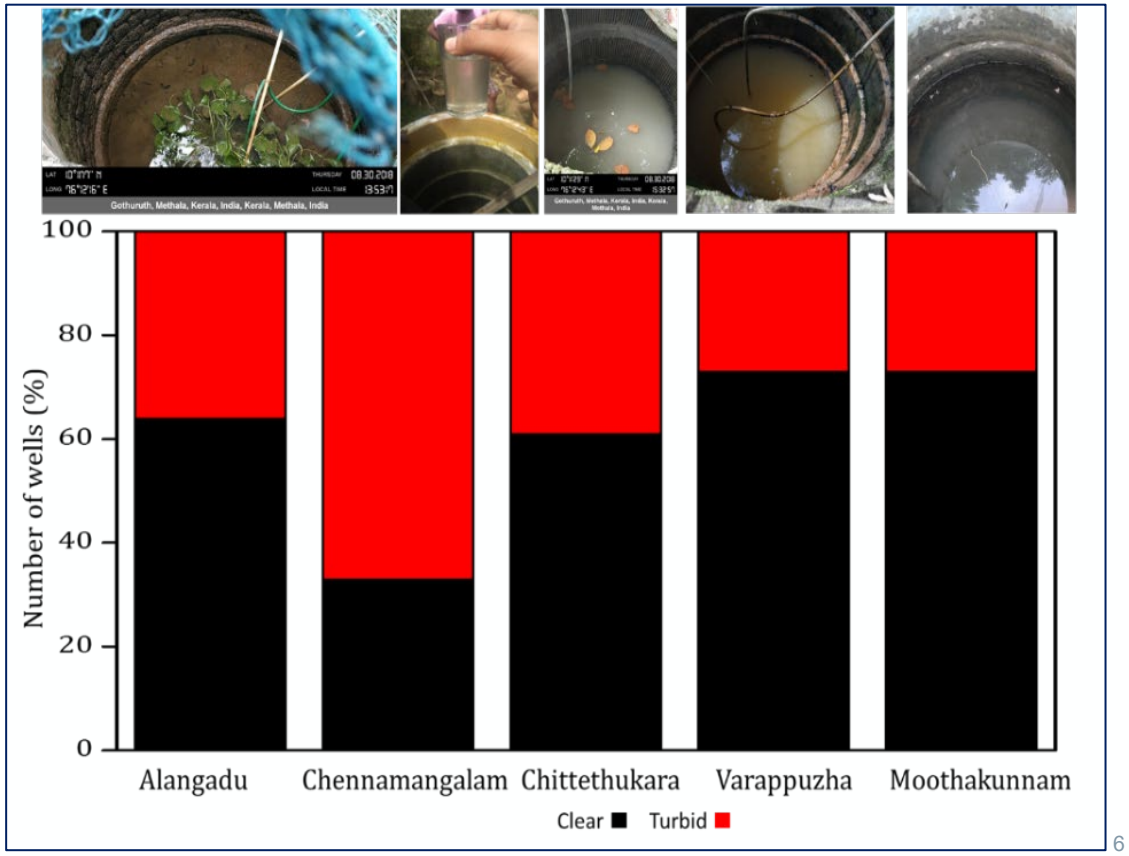
Citizen scientists used mobile applications to collect data on

- whether they are getting safe drinking water currently (yes/no),
- source of current drinking water (water authority (pipe), well, tanker, mixed),
- the height of inundation during the flood,
- cleanliness of surrounding (clean/ dirty),
- the appearance of well water (turbid/clear) and
- the proximity of septic tank to the well.



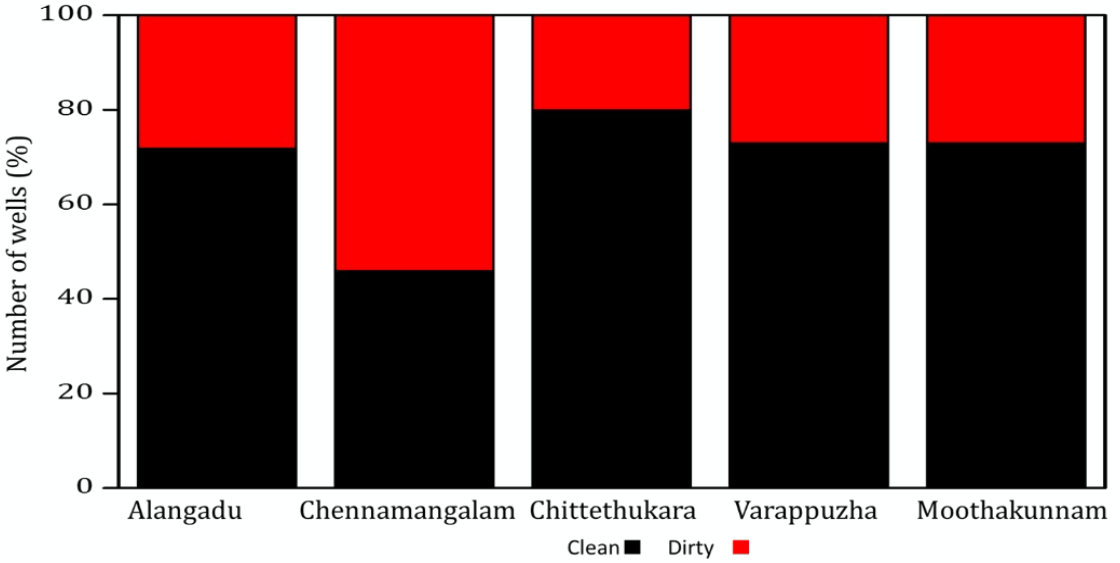
Kerala flood 2018- Well mapping

- ~ 37% of the wells in the study area were visually contaminated with floating plants, high turbidity
- This might have occurred when flood waters surged over the top of the open wells



Kerala flood 2018- Well mapping

- Areas surrounding the wells were clean in nearly 70% of the cases
- Solid waste was disposed near 30% of wells and stagnant water was observed in many areas
- Standing water in canals and low lying areas after a flood can function as breeding grounds for mosquitos, which may contribute to the outbreaks of water associated diseases such as leptospirosis and dengue



Kerala flood 2018- Well mapping

- More than 60% of the wells had a septic tank in the proximity (i.e., within 7.5 m) of the wells
- High chance of faecal contamination during flood due to mixing of sewage with well water during inundation or through seepage

Kerala flood 2018- Capacity building

The wells were categorized as

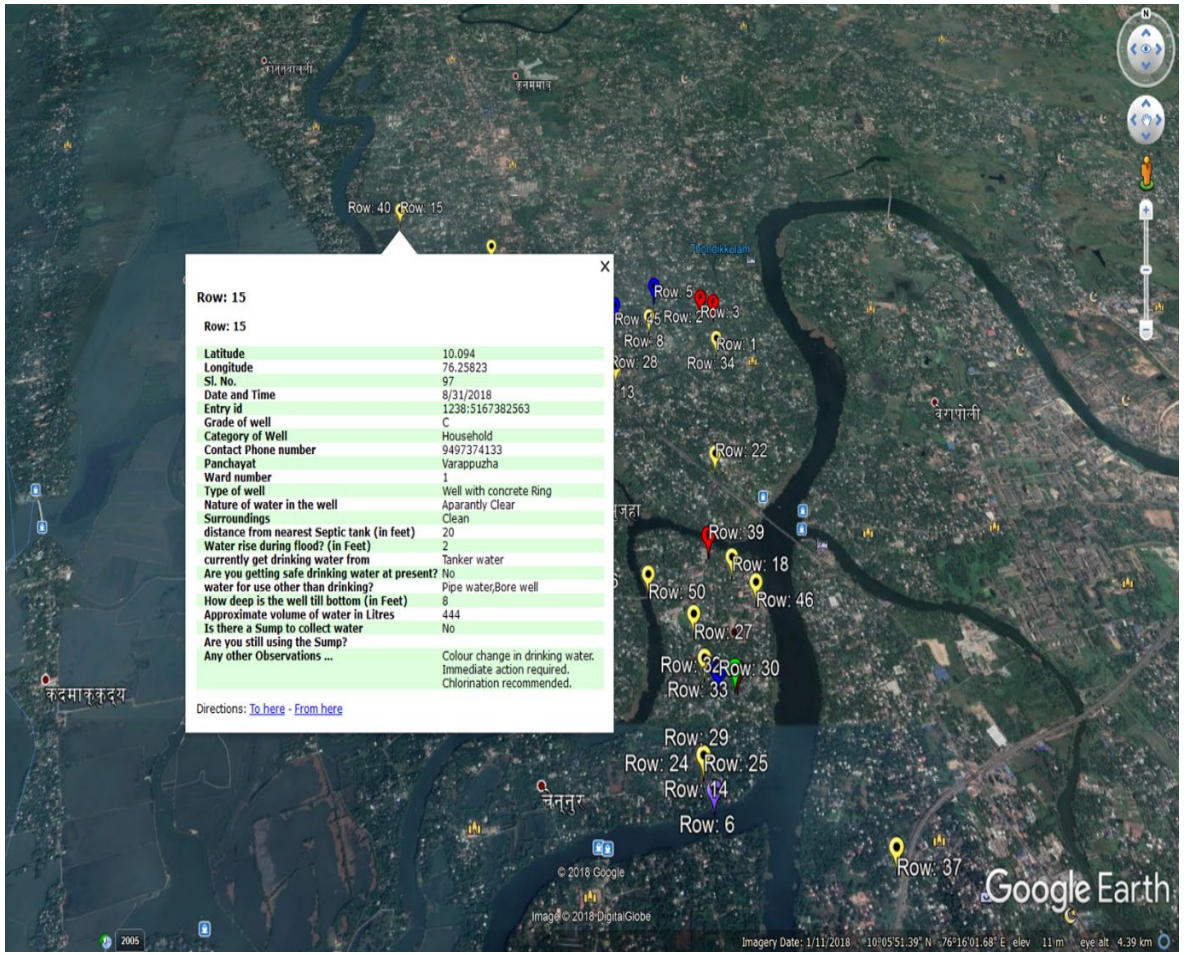
Green: Those wells with visually clear water and septic tanks at >15 m away

Yellow: Wells with clear water but septic tank within proximity

Red: Turbid water with septic tank in the proximity

Recommended that the water in Green and Yellow labeled wells could be used after chlorination and testing for faecal contamination

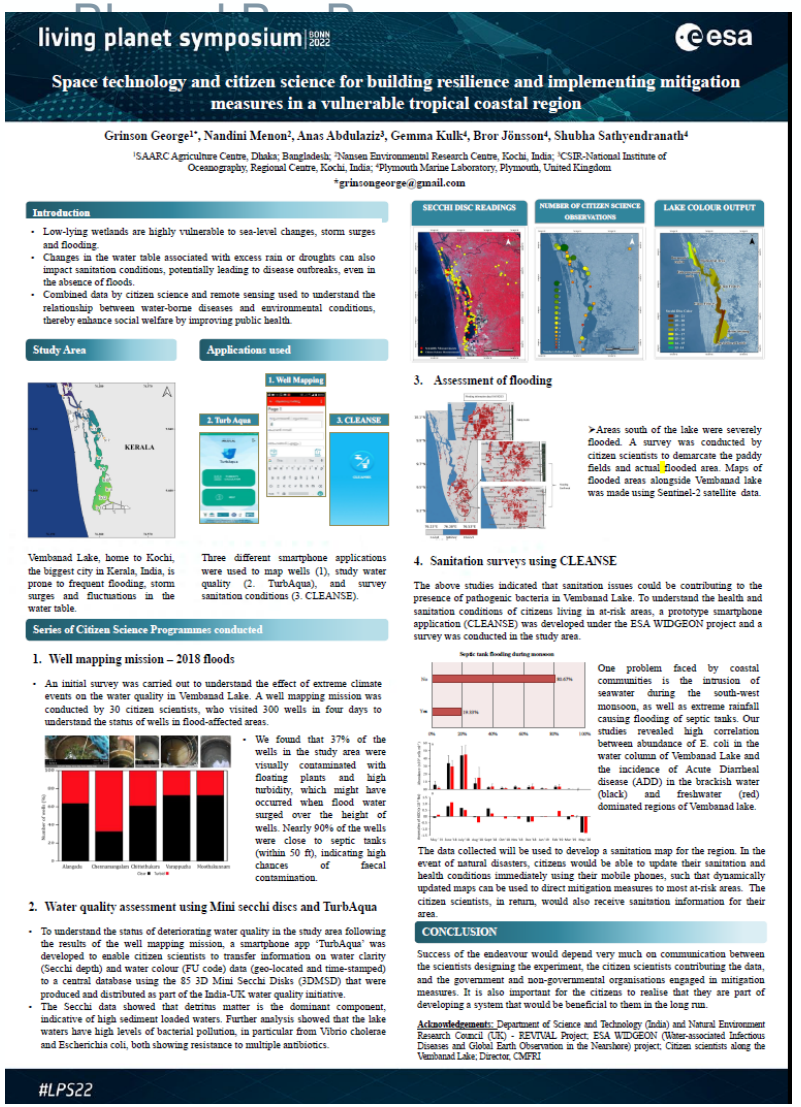
An interactive map of these wells was made available on google



Representative image of google map showing the location of wells (Row) and their grade. The parameters tested are shown in the popup

Conclusions

- Capacity building for water quality monitoring is important for attaining SDGs
- Citizen scientists aided with the mobile applications can identify sources of safe drinking water to avoid outbreaks of water-associated diseases in post-flood times
- Remote sensing based risk maps, water clinics and well-mapping missions are suggested



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Space technology and citizen science for building resilience and implementing mitigation measures in a vulnerable tropical coastal region

Grinson George[1*], Nandini Menon[2], Anas Abdulaziz[3], Gemma Kulk[4], Bror Jönsson[4], Shubha Sathyendranath[4]

[1]SAARC Agriculture Centre, Dhaka, Bangladesh; [2]Nansen Environmental Research Centre, Kochi, India; [3]CSIR-National Institute of Oceanography, Regional Centre, Kochi, India; [4]Plymouth Marine Laboratory, Plymouth, United Kingdom

*grinsongeorge@gmail.com

Introduction

- Low-lying wetlands are highly vulnerable to sea-level changes, storm surges and flooding.
- Changes in the water table associated with excess rain or droughts can also impact sanitation conditions, potentially leading to disease outbreaks, even in the absence of floods.
- Combined data by citizen science and remote sensing used to understand the relationship between water-borne diseases and environmental conditions, thereby enhance social welfare by improving public health.

Study Area

Vembanad Lake, home to Kochi, the biggest city in Kerala, India, is prone to frequent flooding, storm surges and fluctuations in the water table.

Applications used

Three different smartphone applications were used to map wells (1), study water quality (2. TurbAqua), and survey sanitation conditions (3. CLEANSE).

Series of Citizen Science Programmes conducted

1. Well mapping mission – 2018 floods

- An initial survey was carried out to understand the effect of extreme climate events on the water quality in Vembanad Lake. A well mapping mission was conducted by 30 citizen scientists, who visited 300 wells in four days to understand the status of wells in flood-affected areas.
- We found that 37% of the wells in the study area were visually contaminated with floating plants and high turbidity, which might have occurred when flood water surged over the height of wells. Nearly 90% of the wells were close to septic tanks (within 50 ft), indicating high chances of fecal contamination.

2. Water quality assessment using Mini secchi discs and TurbAqua

- To understand the status of deteriorating water quality in the study area following the results of the well mapping mission, a smartphone app 'TurbAqua' was developed to enable citizen scientists to transfer information on water clarity (Secchi depth) and water colour (FU code) data (geo-located and time-stamped) to a central database using the 85 3D Mini Secchi Disks (3DMSD) that were produced and distributed as part of the India-UK water quality initiative.
- The Secchi data showed that detritus matter is the dominant component, indicative of high sediment loaded waters. Further analysis showed that the lake waters have high levels of bacterial pollution, in particular from Vibrio cholerae and Escherichia coli, both showing resistance to multiple antibiotics.

SECCHI DISC READINGS | NUMBER OF CITIZEN SCIENCE OBSERVATIONS | LAKE COLOUR OUTPUT

3. Assessment of flooding

➢Areas south of the lake were severely flooded. A survey was conducted by citizen scientists to demarcate the paddy fields and actual flooded area. Maps of flooded areas alongside Vembanad lake was made using Sentinel-2 satellite data.

4. Sanitation surveys using CLEANSE

The above studies indicated that sanitation issues could be contributing to the presence of pathogenic bacteria in Vembanad Lake. To understand the health and sanitation conditions of citizens living in at-risk areas, a prototype smartphone application (CLEANSE) was developed under the ESA WIDGEON project and a survey was conducted in the study area.

One problem faced by coastal communities is the intrusion of seawater during the south-west monsoon, as well as extreme rainfall causing flooding of septic tanks. Our studies revealed high correlation between abundance of E. coli in the water column of Vembanad Lake and the incidence of Acute Diarrheal disease (ADD) in the brackish water (black) and freshwater (red) dominated regions of Vembanad lake.

The data collected will be used to develop a sanitation map for the region. In the event of natural disasters, citizens would be able to update their sanitation and health conditions immediately using their mobile phones, such that dynamically updated maps can be used to direct mitigation measures to most at-risk areas. The citizen scientists, in return, would also receive sanitation information for their area.

CONCLUSION

Success of the endeavour would depend very much on communication between the scientists designing the experiment, the citizen scientists contributing the data, and the government and non-governmental organisations engaged in mitigation measures. It is also important for the citizens to realise that they are part of developing a system that would be beneficial to them in the long run.

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#LPS22

Space technology and citizen science for building resilience and implementing mitigation measures in a vulnerable tropical coastal region

Today evening at poster board number 397

Who can join ONWARD?

We invite all interested parties to join ONWARD. These may include (but are not limited to)

- Remote-sensing scientists
- Microbiologists
- Ecologists
- Social scientists
- Epidemiologists
- Medical practitioners
- Mathematical modellers
- Aquatic scientists (oceanographers, limnologists, wetlands experts)

How to join ONWARD?

Those interested in joining the network please fill the google form
https://forms.gle/DNEC15QDWuH5mw5L7

Trevor Platt Science (TPS) Foundation

- Trevor Platt Science (TPS) Foundation is the fulfilment of a long cherished dream of Prof. Trevor Platt, FRS, FRSC, and his wife Dr. Shubha Platt to establish an international organization to carry on capacity building for future generations of scientists and to sustain environmental research, especially of the oceans.

- Please check out our website (https://www.trevorfoundation.org) for updates on the activities of the Foundation.

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A TRIBUTE TO TREVOR, OUR MENTOR, TEACHER, FRIEND AND PHILOSOPHER……

THANK YOU