EFFECT OF INFORMAL SETTLEMENTS ON WATER QUALITY

Brookhouse School

PURPOSE OF THE STUDY

- We selected Kabuthi river, as our case study in an area called Dagoretti.
- Currently, the river around the informal settlements is heavily polluted, so the purpose of our study is to investigate if and how informal settlements affect the quality of water in Kabuthi river.
- Once we identified, the causes of pollution in the river, we attempt to offer practicable solutions, to help reduce the level of pollution to levels that are suitable for domestic use.
- This would help reduce costs significantly for the low-income population in the area, who currently have to spend large proportions of their income on expensive water.

WHY IS WATER QUALITY IMPORTANT?

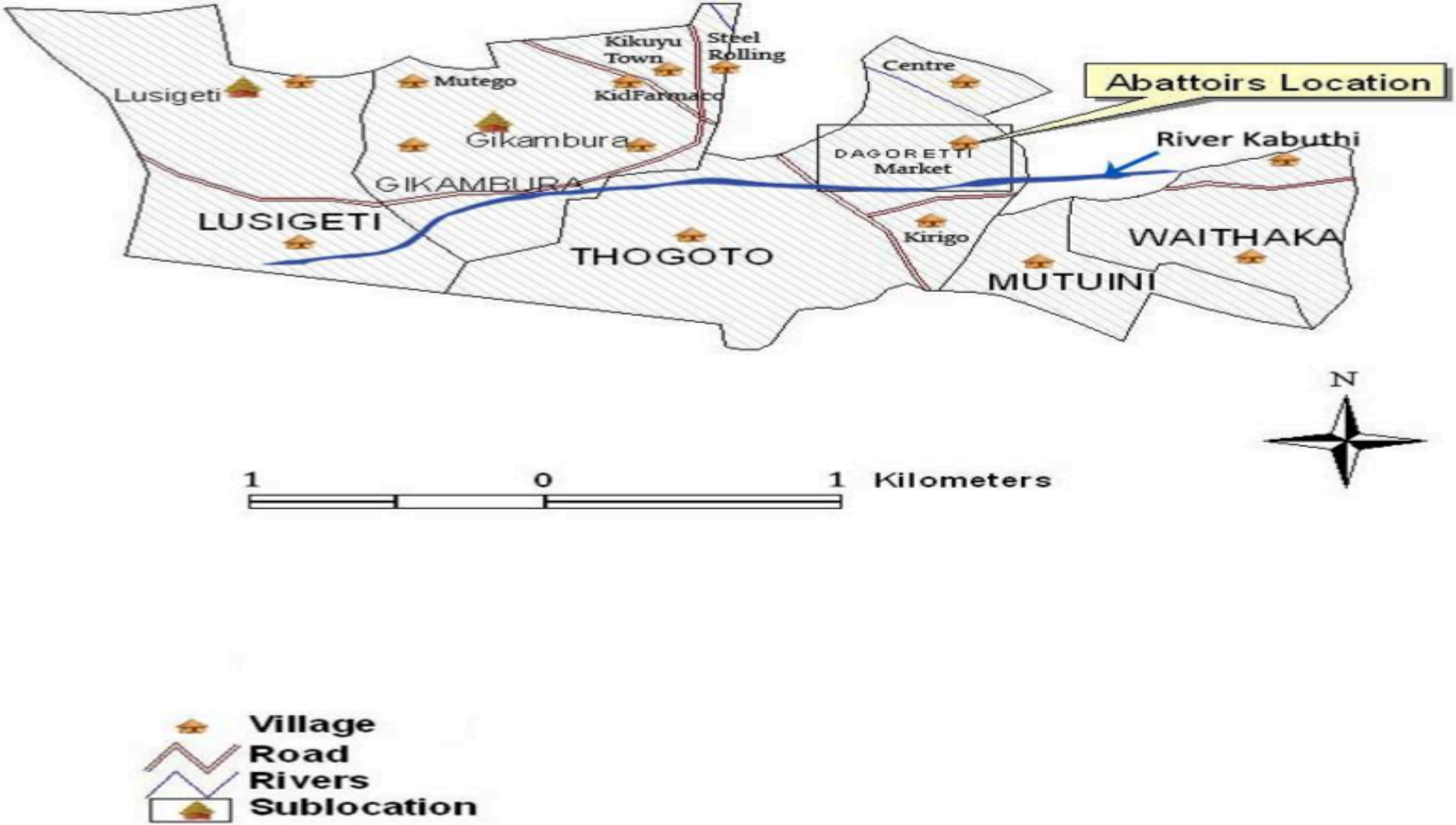
- Surveys done by the WHO show that around 423 million people worldwide take water from unprotected wells and springs. About 159 million people collect untreated surface water from lakes, ponds, rivers and streams.
- Contaminated water and poor sanitation have been linked to various diseases e.g. cholera, bilharzia, dysentery among others.

STUDY METHODOLOGY

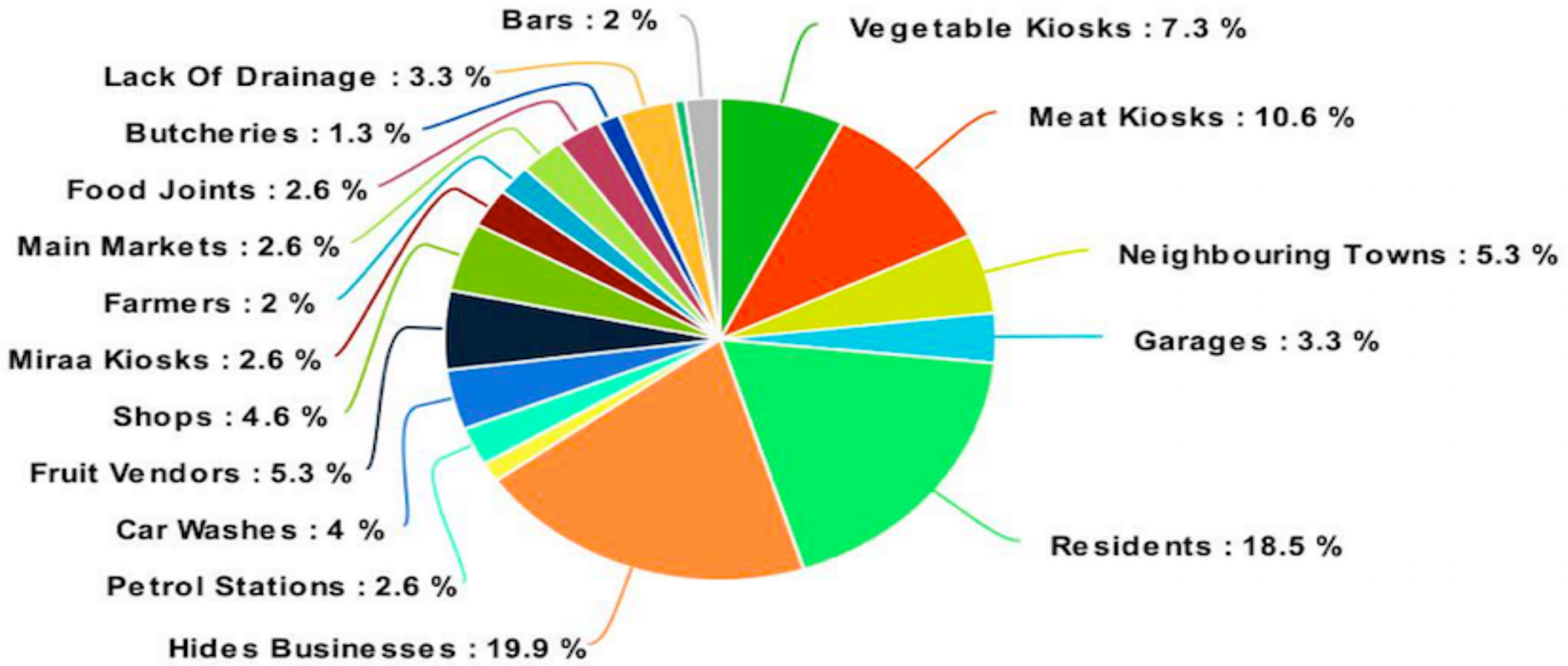
- Identifying the tributaries of Nairobi river that pass through informal settlements. i.e Kabuthi river
- Zoning out of the accessible informal settlements where Kabuthi river passes
- Collecting of water samples from Kabuthi river at different points, and taking them for analysis
- Sampling, both random and stratified
- Photographs and actual site visit
- Hypothesis testing

RESEARCH QUESTIONS

- In Nairobi, Kenya, who is the greatest polluter of urban rivers such as Kabuthi river?
- Are the informal settlements the sole polluters of Kabuthi river?
- What are the specific elements that constitute the pollution of urban rivers such as Kabuthi river?
- Can the identified polluting elements be reduced to levels that are suitable for domestic use?
- Are there possible solutions to treating urban water?


Abattoirs Location
Kikuyu Town
Steel Rolling
Mutego
KidFarmaco
Centre
Lusigeti
Gikambura
River Kabuthi
DAGORETTI Market
GIKAMBURA
LUSIGETI
THOGOTO
Kirigo
WAITHAKA
MUTUINI
N
1 0 1 Kilometers
Village
Road
Rivers
Sublocation

Respondents Data



POLLUTION OF THE RIVER

POLLUTION OF THE RIVER

COMPARISON BETWEEN UPSTREAM AND DOWNSTREAM

EFFECTS OF POLLUTION

- **Loss of oxygen**. When a pollutant such as untreated sewage enters the river, it is broken down by bacteria. This process, however uses up a lot of oxygen. Plants and animals in the river can die due to lack of oxygen.
- **Eutrophication**. When nitrate levels rise due to pollution (e.g. from run-off of fertilizers), it encourages growth of algae. If this happens on the surface of the river, it blocks out sun light which plants need. The plants die, and hence animals die too.

VARIABLES AND CONTROLS

- **Independent Variable:** The location samples were taken from (upstream and downstream)
- **Dependent Variable**: The quality of water as measured by our chosen parameters.
- **Control Variables:** The volume of the samples taken as well as the distance from the informal settlement where we took the samples (1km).

PARAMETERS

- Our chosen parameters were:
  - Chemical Oxygen Demand (COD)
  - Biochemical Oxygen Demand (BOD)
  - TURBIDITY
  - pH

WHAT IS COD?

- Chemical oxygen demand
- It is a measure of the amount of oxygen that can be consumed by reactions in a measured solution
- COD can be used to assess the amount of oxidizable pollutants found in water

HOW IS IT MEASURED?

- A strong oxidizing chemical, potassium dichromate is used to oxidize the organic matter in solution to carbon dioxide and water under acidic conditions
- Often the test also involves a silver compound to encourage oxidation of certain organic compounds and mercury to reduce the interference from oxidation of chloride ions .
- The amount of oxygen required is calculated from the quantity of chemical oxygen consumed

WHAT IS BOD?

- Biochemical oxygen demand
- The amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample.
- Often used as a measurement of the degree of organic pollution water
- Can be used as a gauge of the effectiveness of wastewater treatment plants
- The greater the BOD the more rapidly oxygen is depleted in the stream. This means less oxygen is available to aquatic wildlife. The consequences of high BOD are that aquatic organisms become stressed, suffocate and die.

HOW IS IT MEASURED?

- A sample is first analyzed and conditioned to ensure favorable growth conditions for bacteria.
- The sample is then diluted and the appropriate amount of seed bacteria is added
- The initial dissolved oxygen content is recorded and the sample is then incubated for five days at 20 degrees Celsius
- It is then removed from the incubator and the final dissolved oxygen reading is taken
- BOD is calculated from the dissolved oxygen depletion and the volume of sample used.

WHAT IS TURBIDITY?

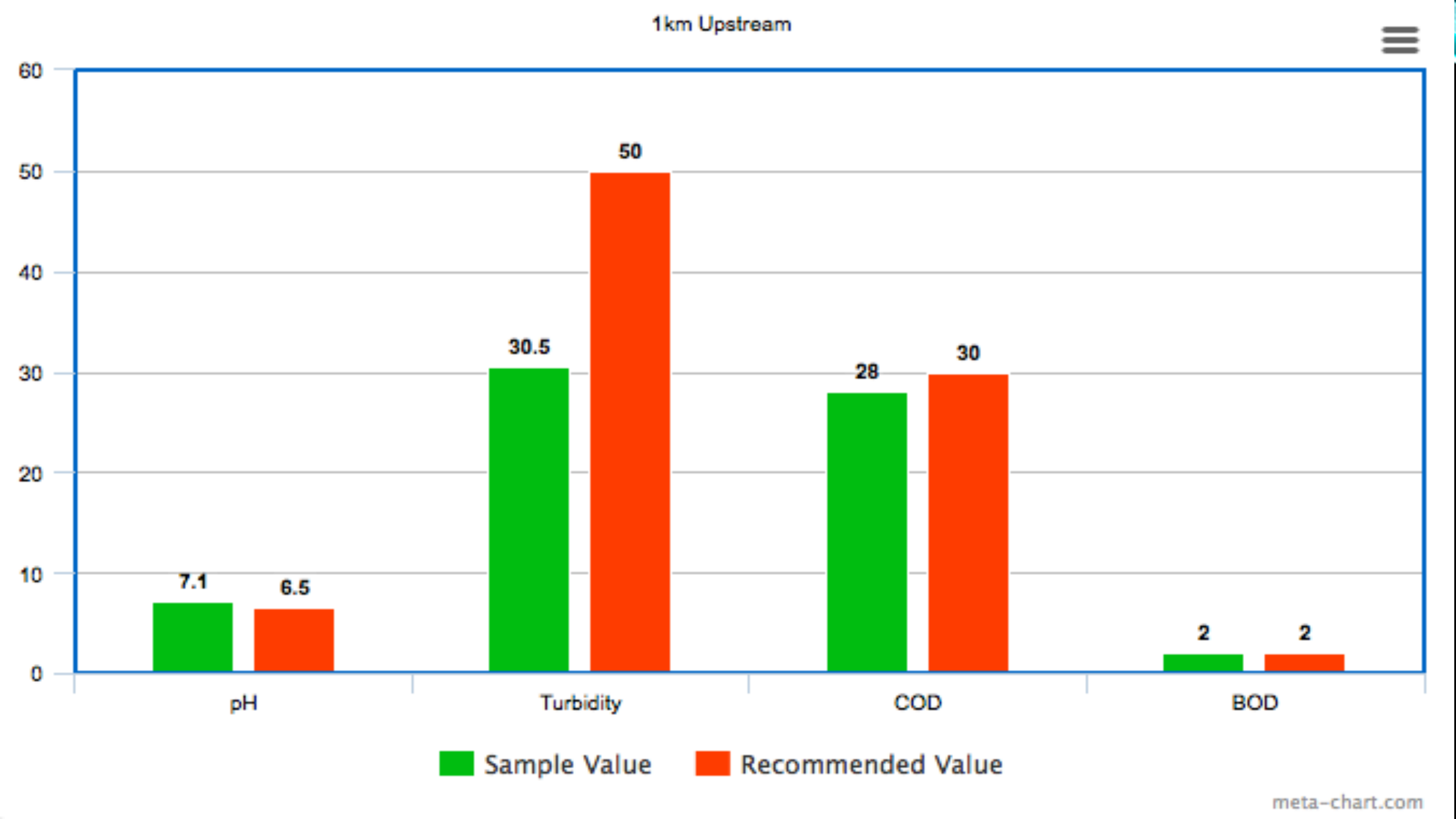
- The cloudiness or haziness of a fluid .
- The measurement of turbidity is a important test when trying to determine the quality of water
- It is caused by:

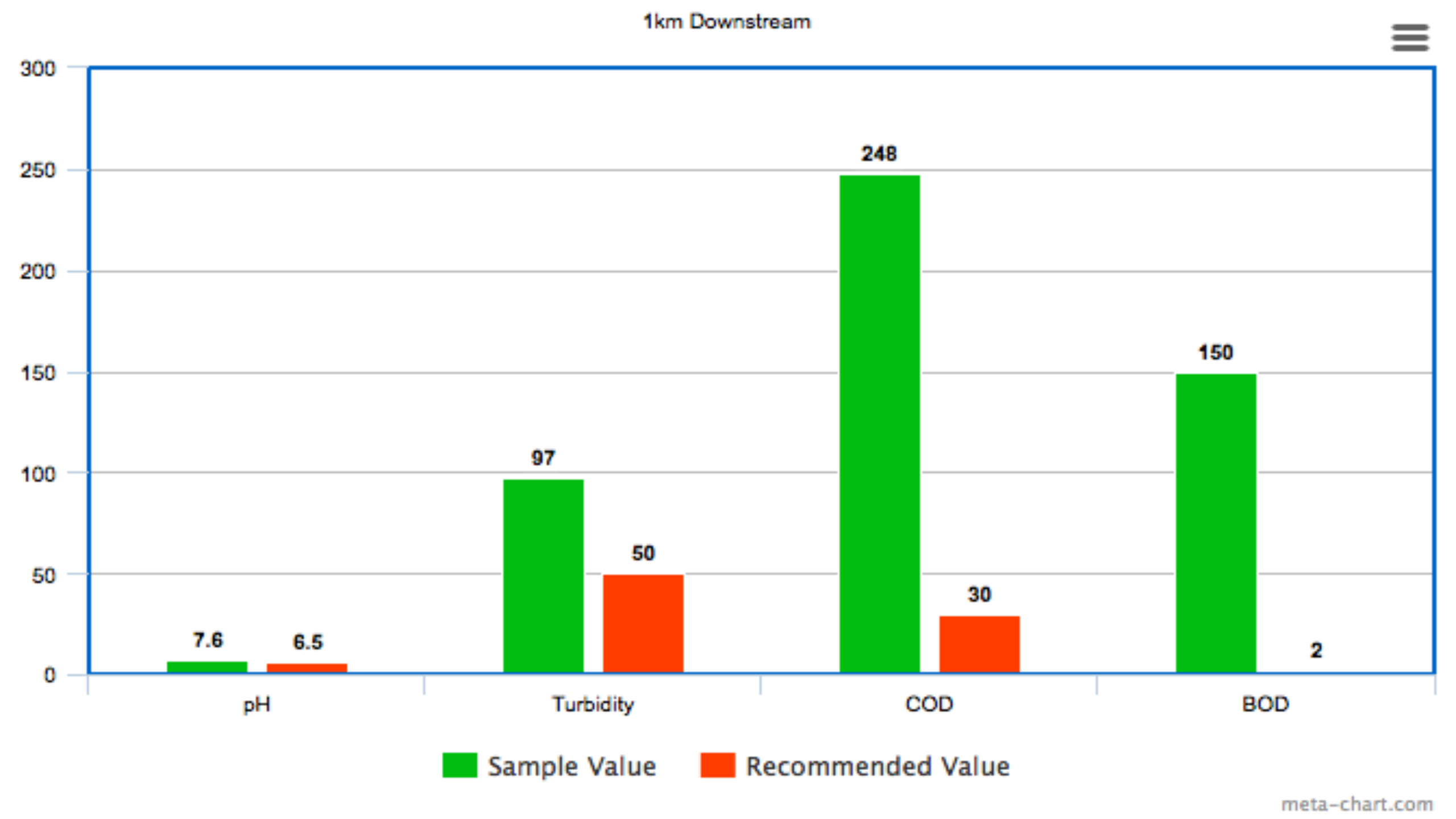
  -erosion and effluent from highly urbanized zones

  -construction, mining and agriculture disturb the soil and can lead to raised levels of sediment which run off into waterways
- In drinking water the higher the level of turbidity the higher the chance that those using it could develop water borne diseases

HOW IS IT MEASURED?

- Usually measured in nephelometric turbidity units (NTU)
- The particles suspended in the water will scatter a light beam focused on them .the scattered light is then measured at various angles from the incident light path. To measure turbidity this way uses a nephelometer
- Nephele is the Greek word for cloud; metric means measure, so nephelometric means measuring cloudiness.


1km Upstream
60
50
40
30
20
10
0
7.1
6.5
30.5
50
28
30
2
2
pH
Turbidity
COD
BOD
Sample Value
Recommended Value
meta-chart.com


1km Downstream
300
250
200
150
100
50
0
7.6
6.5
97
50
248
30
150
2
pH
Turbidity
COD
BOD
Sample Value
Recommended Value
meta-chart.com

ANALYSIS AND FINDINGS

- As you can tell from the comparison of Figures 1 & 2, informal settlements have a significant impact on the water quality of the river.
- Most noticeable is the difference in both COD and BOD values in the samples collected. The COD levels increased by 220 mg/l, while the BOD value rose by 148 mg/l.
- Turbidity also increased beyond the maximum allowed levels, further indicating pollution

POSSIBLE SOLUTIONS

- **Rapid Sand Filtration** – A possible solution could be the setting up of treatment plants along the river, where the water is passed over plastic bottles filled with sand. This acts as a sort of filtration mechanism, and can help solids suspended in the water.
- **The government could put up strict laws** – They could introduce hefty fines for polluters, and also launch campaigns against water pollution to educate the public. In addition, we could set up warning signs near the river in settled areas e.g. The recent plastic bag ban imposed in Kenya last year, which has caused greatly reduced plastic bag pollution.
- **Industries should behave more responsibly** – It should become a requirement for industries to dispose of their waste properly. Also, industries should be encouraged to use more environmentally friendly methods of production.

RESEARCH GAPS

- We only took samples from a very narrow area along the river, this means the results are not very representative.
- We only took samples from Kabuthi river.
- We only used four parameters to measure the quality of water, so there could be several other pollutants that we could have missed.
- We only took two samples, on the same day, and the conditions might change throughout the year.

IDEAS FOR FURTHER RESEARCH

- Take more samples from a wider area along the river, to help us better identify the particular polluters of Kabuthi river.
- Perform the study on other water bodies across the country to find out whether the same situation is replicated in other areas.
- Take samples at different times of the year, e.g. during the dry season vs. rainy season, to further analyze the significance of surface runoff on the pollution of Kabuthi river.
- Including more parameters when testing the quality of water, so that we can identify a wider range of pollutants in the Kabuthi river.
- In addition, we plan to share this research with governmental and environmental organizations, collaborating to solve the problem of pollution.

CONCLUSIONS

- Since we only have only two data points, we cannot come to any definite conclusions.
- However, from the results collected and the trends observed we can strongly suggest that due to the nature of the livelihood and economic activities in informal settlements, they contribute to the pollution of Kabuthi River.

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