40. Kibosho

The impact of nitrate on water due to the application of fertilizers

Aisha Nduka, Nengai Moses, Monica Shirima

Introduction: The ground water and river that passes through the Ng'omberi Coffee Plantation is largely covered by algae. We wanted to know why. The literature suggests that excessive application of nitrogen containing fertilizers near the water sources increases the amount of nitrate in soil which as result increases the acidity. When nitrate accumulates in water, it stimulates the growth of algae which increases the biomass of phytoplankton and ultimately decreases the dissolved oxygen level in water, the process known as eutrophication.

We investigated the relationship that exists between the increased application of fertilizers and the eutriphication. The hypothesis was excessive increase of nitrate due to fertilizers near the water bodies increases the growth of microscopic plants in water bodies. Our task was to investigate the acidity and nitrate level in water which eventually helped in determining Biochemical Oxygen Demand (BOD) test. BOD is a measure of the oxygen used by microorganisms to decompose organic waste. BOD is calculated by measuring the decrease of dissolved Oxygen (DO) due to decomposition of organic material by aquatic organism. Therefore BOD = Initial DO - Final DO

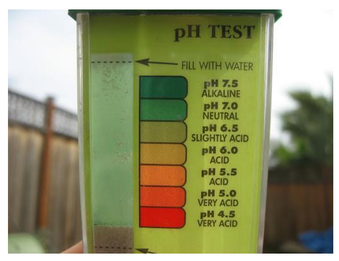
Method:

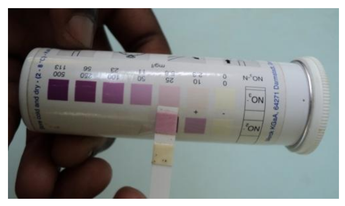
Three main experiments were conducted;
Experiment 1: pH test to find out which soil samples are acidic;
Experiment 2: Nitrate test to investigate the relationship between acid soil and increased nitrate and
Experiment 3: BOD test to find out the relationship between nitrate and decreased Dissolved Oxygen in water.

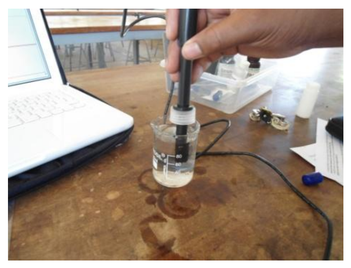
Fig. 1 Project design

Soil + Fertilizers
↓
Increased acidity
(pH Test) Exp 1
↓
Increased Nitrate in water
(Nitrate Test) Exp 2
↓
Growth of Algae
↓
Decreased Dissolved Oxygen
(BOD test) Exp 3

Experiment I: pH test
Variables: Coffee plantation soil, limed plantation soil and ground water in the plantation
Control: School garden soil
Materials: Test tubes, syringe, plunger, filters, test chemicals, standard pH scale.
Procedure: The syringe was filled with soil. Test solution was added. The plunger was inserted inside the barrel of the syringe and shook for 30 seconds. Soil particles are settled and the solution was filtered and filled into the test tube. The colour developed was compared against the standard readings to estimate the pH value.







Results:
The experiment gave excellent results. The area whose soil had lower pH (was acidic) appeared to have more amount of nitrate while the area with higher pH (basic or neutral) appeared to have less amount of nitrate. Moreover, soil and water samples with more nitrate level gave had higher BOD level while lower BOD level was observed in samples which showed less level of nitrate.

Sample	Control soil	Plantation soil	Limed plantation soil	Ground water	River water
pH	7.2	3.1	4.2	5.2	6.2

Sample	Control sample	Plantation soil	Limed soil	Ground water (plantation)	River water (plantation)
NO_3^- amount (mg/l)	10	250	100	50	25

Sample	Control water (River far from plantation)	Plantation soil (highly fertilized)	Ground water (plantation)	River water (plantation)
Dissolved Oxygen (DO1) in mg/l on Sept 19	6.8	5.1	11.2	10.3
Dissolved Oxygen (DO5) in mg/l on Sept 25	6.2	1.2	1.6	2.1
BOD (DO1-DO5)	0.6	3.9	9.6	8.2

Conclusions:
Higher BOD levels in water samples which had previously tested higher nitrate concentration supported the hypothesis that water samples with higher nitrate level had more microscopic plants.
Higher BOD value is due to the consumption of oxygen by microscopic organisms (through respiration). Since the nitrate level corresponded to the increased acidity in soil samples in the coffee plantation, then it's clear that the use of fertilizers had polluted the soil and the water. The fact that the controlled soil which wasn't affected by nitrogen containing fertilizers was found to have low level of nitrate and higher amount of dissolved oxygen proves that growth of algae water bodies surrounding the plantation is due to the application of artificial fertilizers.
The excessive growth of algae and other aquatic plants form a blanket on the water surface, preventing sunlight from entering the water and using up most of the dissolved oxygen. This suffocates and kills other forms of aquatic life.
Since increased amount of nitrate in water is known to cause cancer, this project suggests that people should test the nitrate level before they drink. Water with nitrate level higher than 40 mg/l is not safe for use for adults and 10mg for children.
Responsible authorities should ban the use of water with BOD level 6-9mg/l even if it appears to be 'spring' water from Mount Kilimanjaro.
Future project may be done to find out how to protect water bodies from fertilizers and remove the amount of nitrate present in already polluted water.

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Acknowledgements: Sister Hermania (Head of School) for financial support and Dr. Karl Fleishman (Some equipments donation and comments) & Susan Tyzack (laboratory assistance) both of Mwenge University College, Mos**hi**