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Highlights

- Various Gaseous Pollutants
- Assessment of Shoreline Changes
- Wastewater Treatment Plant
- Hydrogen Production by Electrolysis

Discovering Thoughts, Inventing Future

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Would it be Possible to Optimize a Municipal Wastewater Treatment Plant?

By Stig Morling & Niclas Åstrand

Abstract- Operation of modern wastewater treatment facilities (in the following: WWTP) are to a very large extent based on different forms of biological treatment. Historically a number of activated sludge models have dominated the market. The model that originally was developed during the second decade of the 20th century is often addressed as a suspended growth system as a contrast to attached growth models, such as trickling filters, rotating biological contactors (RBC:s) and more recently the moving bed biological reactors (MBBR:s). Regardless of the system chosen the biological stage in a modern WWTP represents the major energy consuming stage. The obvious exception for this statement is by convention the anaerobic treatment, especially used when the wastewater is a "high strength" stream, rich in hydrocarbonates. The sharpened demand on biological nutrient removal, especially nitrogen removal has even more highlighted the needs for an efficient process control.

Keywords: bod (biochemical oxygen demand), loading conditions, measurement, nitrogen, nitrification, phosphorus, solids retention time, temperature.

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WOULDITBEPOSSIBLETOOPTIMIZEAMUNICIPALWASTEWATERTREATMENTPLANT?

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Would it be Possible to Optimize a Municipal Wastewater Treatment Plant?

Stig Morling [α] & Niclas Åstrand [σ]

Abstract- Operation of modern wastewater treatment facilities (in the following: WWTP) are to a very large extent based on different forms of biological treatment. Historically a number of activated sludge models have dominated the market. The model that originally was developed during the second decade of the 20th century is often addressed as a suspended growth system as a contrast to attached growth models, such as trickling filters, rotating biological contactors (RBC:s) and more recently the moving bed biological reactors (MBBR:s). Regardless of the system chosen the biological stage in a modern WWTP represents the major energy consuming stage. The obvious exception for this statement is by convention the anaerobic treatment, especially used when the wastewater is a "high strength" stream, rich in hydrocarbonates. The sharpened demand on biological nutrient removal, especially nitrogen removal has even more highlighted the needs for an efficient process control. Four Some different plants with similar but nevertheless distinctive unique conditions have been used to exemplify both the difficulties as well as potential pathways to control a biological reactor:

- A demonstration plant for biological phosphorus removal operated at low temperatures in Northern Sweden;
- Low loaded plant for a combined industrial/municipal wastewater on Sri Lanka;
- A SBR-plant in Southern Poland operated with unexpectedly high chromium loading;
- A midsized plant for advanced nitrogen and phosphorus removal operated with typical weekly variations with respect to loading conditions. This plant was located outside Stockholm, and presents special conditions for plant operation.

The four examples demonstrate empirical findings from most different operation conditions. These findings illustrate some crucial points with respect to operation of biological plants. The insights may be summarized in three major perspectives:

- An understanding of the more or less inevitable load fluctuations that will govern the plant operation during its lifetime. This understanding must be reflected in the fundamental design of the plant. An incorporation of a sufficiently flexible operation mode would be of great value in this respect;
- Needs for a comprehensive process control, based on an extended use of on-line instruments both at the inlet side of the plant, inside the process train, as well as at the discharge point of treated water;
- And last, but not least, a committed and process-oriented operation management at the plant that results in improved operation efficiency.

Keywords: bod (biochemical oxygen demand), loading conditions, measurement, nitrogen, nitrification, phosphorus, solids retention time, temperature.

I. Background

Operation of modern wastewater treatment facilities (in the following: WWTP) are to a very large extent based on different forms of biological treatment. Historically a number of activated sludge models have dominated the market. The model that originally was developed during the second decade of the 20th century is often addressed as a suspended growth system, is a contrast to attached growth models, such as trickling filters, rotating biological contactors (RBC:s) and more recently the moving bed biological reactors (MBBR:s). Regardless of the system chosen the biological stage in a modern WWTP represents the major energy consuming stage. The obvious exception for this statement is by convention anaerobic treatment, especially used when the wastewater is a "high strength" stream, rich in hydrocarbonates. The sharpened demand on biological nutrient removal, especially nitrogen removal has even more highlighted the needs for an efficient process control. This demand has become especially apparent when it comes to different types of activated sludge plants. The by far dominant principal activated sludge configuration is labelled "a one sludge system". This means that the activated sludge process by convention has to host very different populations of micro-organisms in a single stage process. One "classic" problem connected to this mode is the occurrence of an uncontrolled growth of filamentous bacteria. Jenkins et al [1] have addressed this problem in several versions of a comprehensive handbook regarding sludge quality in activated sludge plant performance. A very interesting presentation was made by Leslie Grady (one of the most distinguished scientists in sanitary engineering) in his inauguration speech at the WEFTECH conference in New Orleans in 1999. He referred to side-by-side tests that were done at the Clemson University, South Carolina. Two parallel lab scale reactors were operated for a month at identical conditions. A microbiological analysis of the populations in the two reactors was performed. Professor Grady stated that the two populations had no resemblance at

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all! He concluded, philosophically: "Perhaps we must realize that we face another example of the Heisenberg thesis of unpredictability, even in our field!" The stipulated enhanced objectives for the treatment will put further questions whether it is possible to arrange strategies and models that will satisfy a really efficient operation. Now the question arises: Will it be justified to talk about a process optimization when you take on board a number of fundamental conditions characterizing a modern biological wastewater treatment plant, such as:

- A treatment plant will be designed for a certain period, often around 20 years. During the plant´s lifetime the load variations will be substantial, the first year´s operation will face an often far lower loading than the design load. In this context it may be relevant to actively question the use of BOD as both a design and consent parameter, see Morling [2];
- The short time variations with respect to loading may be characterized by the evident daily rhythm in flow and pollutants, from the morning and evening peak loads to the obvious minimal loadings during night time. This pattern is most apparent at small to medium sized plants;
- Other variations may be either seasonal, mostly found at resort or typical vacation sites, or a weekly variation found especially at towns with day migrants moving to a larger center to work during daytime. In addition to these problems it is essential to address the chosen sewer system. Especially older systems are based on the "combined concept" meaning that both wastewater and storm water are collected and transported in one pipe. This in turn causes unwanted flow peaks, and thus very diluted inlet water. In addition to the flow peaks also water with unnecessarily low temperatures are to be treated.
- A fourth condition typical for wastewater treatment plants operated in semi-arctic or moderate temperature climates is the water temperature variation during a year. A range from 4 – 5 °C during winter conditions to around 18 °C in late summer may be frequently found in these locations.

These variations will all cause more or less demanding conditions in relation to the question of how to run a treatment plant at efficient conditions. The concept "optimization" will be further scrutinized through the discussion of four examples. A first question to be raised in relation to the concept is however: How do we more specifically define "optimization"? From a more "philosophical" perspective it may be stated that the word optimization has to a very large extent a "quality" implication, while the applied science we practice in waste water engineering is based on "quantifications" based on empirical data. In the following the possibilities and limitations to quantify the concept optimization will be discussed.

II. Materials and Methods

The presented plants in this paper have been in operation for some time and the operation data are to a large extent comprehensive, thus making it possible to illustrate the addressed issue of plant operation efficiency (optimization). These plants have accordingly been chosen as they present different operation conditions that will enlighten the question. It is acknowledged as a basic condition that in all circumstances the ruling effluent standards are met in all circumstances. However, hardly anybody would accept this condition is a sufficient one to qualify a process performance to be "optimized".

The efficiency or optimization of the process must be thoroughly defined and also expressed by some criteria related to measurable values.Among these criteria may be found clear definitions of the load composition, and variations over time. Other conditions to consider are the water temperature influence on the process performance, and other typical water quality issues, such as the alkalinity, pH, conductivity as well as the content of more or less "unwanted" matters, for instance certain heavy metals and complex organic compounds.

A way to address the question of operation efficiency would be to relate the direct operating costs to the actually achieved purification result. Now you could object that this is not sufficient, also the (annual) capital costs should be included! On the other hand it is somewhat a questionable model, as this one would be related to both the plant age and the chosen depreciation model for the investments.

A practical and interesting model to address the operation efficiency has been developed inter alia in Denmark, where the actual discharge of pollutants has to be paid for. This in turn means that an improved treatment – beyond the consent levels may be found feasible for the operator.

Another more fundamental problem especially in municipal wastewater treatment management in relation to an "optimization" is related to the initial planning and design of the plant.

The occurrence of a major shift to biological nutrient removal systems have by necessity called for a far more deepened knowledge in the microbiological behavior. Today a large number of design manuals, often edited more or less "officially", represent a much needed tool for modern process design, see for instance Standard ATV-DVWK -A 131E [3]. These manuals often clearly point out the needs for safety factors when sizing volumes and process capacities. Sometimes even "built-in" safety-factors are used in the

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given design outline data, and thus not necessarily explicitly shown.

The introduction of advanced biological nutrient removal has also resulted in a large number of computerized design modelling. These models are by necessity based on a number of so called "default values" that sometimes need to be calibrated for the specific case. One of the most recent ones is BioWin 4.1, Envirosim [4]. However, these models will serve as a most important tool if true sensitivity analyses of different operation situations are to be investigated. This in turn may be at least a good possibility to come closer to an "optimized" operation.

However, the concept "optimization" will be further scrutinized and questioned by presenting the operating conditions and actual performance of four different wastewater treatment plants.

III. Discussion on Four Cases

a) A small plant in operation in northern Sweden operated for biological P-removal at low temperatures

The issue of enhanced and – if possible – a non-chemical phosphorus removal enabled a small northern Swedish community to engage itself into a long-time test operation of a small activated sludge plant as a test unit for enhanced biological phosphorus removal. The work was done in collaboration with the Luleå University of Technology. The full results are presented in [5]. The most important findings from the test operation with respect to operation changes are summarized in the following. The main objective – apart from the "bio-P-removal" as such - was to determine the operation conditions at very low wastewater temperatures between 3 and 10 °C.

The test operation was based on a conversion of a "classic" activated sludge tank into a SBR-basin. The total pilot operation period was around 22 months. The constraints and limitations found in the operation may be seen as typical evidences for a need of improved process control. Again, the question is could the plant have been operated in an "optimized" way? It should however be underlined that some of the limitations found during the test operation were not related to process conditions. Two circumstances in this respect were the relatively small basin size along with its geometrical configuration and the decant system that allowed sometimes an unacceptable level of SS-concentrations in the discharge. It is further worth wile to notice that the main automation system was based on classic relays, mainly controlling the different operation phases.

The presentation of the identified limitations may be defined in relation to strive for a safe and efficient operation; see also Marklund and Morling [5]. On the other hand the study also points out pathways for improved operation modes. The crucial findings may be summarized as follows:

- It was clearly demonstrated that a fast shift in water temperature had a clear influence of both the process reaction rates, and the sludge separation performance. The operation cycle had to be adjusted from 6 to 12 h to meet the temperature change from 10 to 4 °C. In Figure 1 is shown the variation pattern of the water temperature over almost two year´s operation of the pilot plant. It is interesting to observe the sharp change in the temperature both in spring – a rise from 4 to 10 °C, and in fall from 8 to 3 °C.
- To overcome an "unwanted" process performance of the reactor – mainly defined as non-acceptable sludge characteristics - the needed adjustment time was 3 – 4 times the actual SRT (Solids Retention Time).
- The limitations with respect to biological P removal were found to be linked to the low water temperature. Figure 2 illustrates this relation

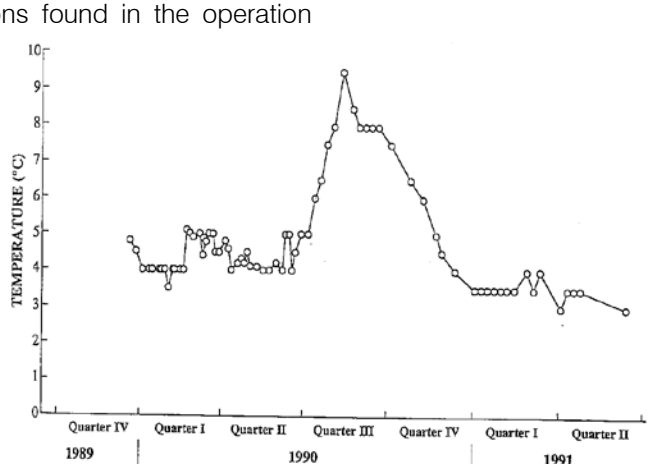

Figure 1 : Wastewater temperature variation at the Dokkas pilot plant operation during 7 quarters, after Marklund and Morling [5]

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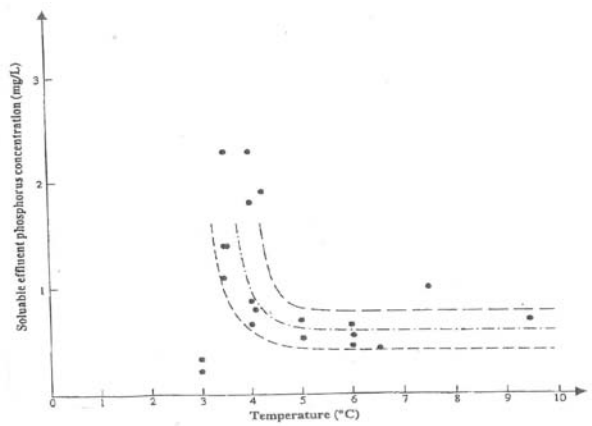

Figure 2 : Outlet soluble phosphorus levels versus reactor temperature during the period August 1990 to June 1991 (n =21), after Marklund and Morling [5]

As a summary: The pilot operation project enlightened some shortcomings with respect to the "optimization" possibilities, even though the objectives for the study were not focusing on these perspectives:

1. A biological treatment at low water temperatures are by nature retarded. The needs for a more active and efficient control and process adjustment call for rapid on-line information of the main process variables. The retarded information from an off-site laboratory will only provide "historic" data. The needs for swift change of the operation mode are then not satisfied.
2. In this case the intermittent operation anyhow was an efficient way to at least partly overcome the classic problems with the small plants to meet an improved performance (on the way versus an "optimization").
3. It is also more than likely that a more comprehensive on-line control instruments along with a more "intelligent" PC – operation control would be a further step towards a much better process control, and eventually coming closer to an "optimized" plant operation.

b) An industrial-municipal WWTP in Sri-Lanka

The second example with respect to operation efficiency is taken from in more or less opposite conditions as the first one: A nutrient removing plant located in a tropical climate. The industrial-municipal WWTP at Ja Ela/Ekala, north of Colombo, in Sri Lanka. The main issue in this case is the very low loads during the first year of operation. In this respect the plant performance enlighten a more or less classic situation for many plant operators: How to find an efficient and operating cost saving mode of operation. The case has been presented by Berg and Morling [6]. The paper presents a focus on mainly a way to improve the operation with respect to energy costs for aeration. Some of the obvious performance results are cited in the following.

The issue of operation of an under-loaded activated sludge treatment facility has been addressed and the basic problem has been identified as an excessive use of energy for the aeration. The way to mitigate this problem showed to be a very simple one—to operate the aeration basin at an intermittent mode. In this specific case it has been possible to implement this model; however, some important limitations have been identified at the same time. The most striking results are quoted in the following:

- *"It is found imperative that the on-line measurement of operation variables are viable and maintained on a regular basis;*
- *The automation mode must allow for a flexible intermittent operation. This is a consideration that should be reflected already in the design work;*
- *An additional removal strategy for the waste activated sludge may be needed: To withdraw the sludge from the intermittent reactor;*
- *The current mode of intermittent operation has been successful also thanks to an extended hydraulic retention time in the aerobic reactor. This matter must be addressed closely when applying the strategy; at shorter hydraulic retention times there is a risk that amounts of not nitrified ammonia will pass through the system;*
- *The outcome of the operation modification has been by large very satisfying, with a sustained biological performance with respect to organic removal (expressed as BOD and COD), an improved removal of total nitrogen thanks to an enhanced denitrification efficiency and finally but not least striking: An efficient biological phosphorus removal has been established in the vicinity of 80% to 90%.*

However, it may still be questioned whether the plant operation is really optimized. Over a certain period of time it is evident that the plant efficiency has been improved substantially. On the other hand it is not

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proven that the day-by-day performance is found to be really optimized.

c) An "over-loaded" WWTP in Poland

The third example is taken from a plant built in southern Poland. The city of Nowy Targ was one of the first to accept and perform a modern wastewater treatment plant after the fall of the communist era. Taken into operation in 1995 the plant that was built as a three reactor SBR-plant soon experienced an unforeseen heavy industrial load from a large number of tanneries (both legal and illegal). This in turn caused a from time to time substantial overloading of the plant. This has been described more in detail by Morling [7] and [8]. The experiences from the operation may in this context serve as illustrations of possibilities and limitations with respect to optimization of the operating conditions. The plant was operated with consistently very good removal efficiencies, even during the unexpected peak-load conditions. This fact may be attributed as an indication of an important factor to sustain the following statement: Improved plant operation efficiency, aiming for optimization calls for a committed and process-oriented operation management at the plant.

The plant operators adopted an "optimization" strategy for the SBR operation. These include the following main actions:

1. To operate the plant with SBR cycles of about 5.5 hours. This means that the start of "fill" for reactor number one (as an example) will not occur at the same time from day to day. A clear advantage was found with this operation mode: A regular peak load occurring at about 09.00 hours each day was directed to different reactors following a systematic main cycle mode.
2. The loading variations on the SBR units were met by altering the aerated time by three different modes as shown in Table 1:

Table 1 : Variation of the SBR-cycle related to the load conditions, total cycle length about 5.5 h

Cycle phase	Normal operation	High load operation	Peak load operation
Fill/mix	1 h 30 min	1 h	30 min
Fill/react	30 min	1 h	1 h 30 min
React	2 h	2 h	2 h
Settle	1 h	1 h	1 h

Compared with the initial operation mode, the aerated time of the cycle during "normal" operation has been shortened by one hour. This alteration does not illustrate a true optimization of the plant, but could be seen as a step towards a needed, better energy efficiency.

The plant operators were carefully recording a number of important process variables. By investigating these it has been possible to enlighten the obvious difficulties to really create an optimized operation mode. The figures 3 and 4 illustrate the nitrification capacity linked to on one side nitrogen loading and on the other hand the ratio COD/N.

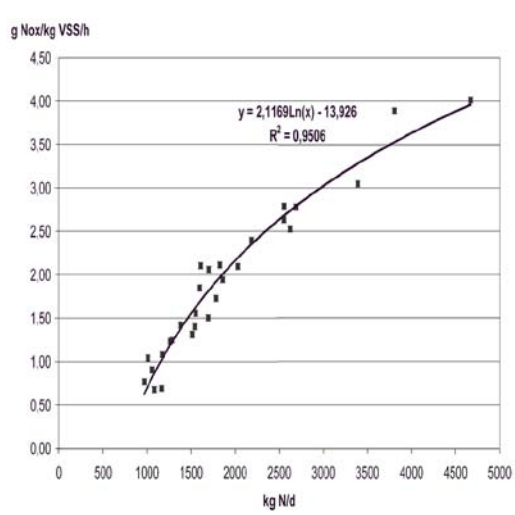

Figure 4 : Nitrification rate versus inlet nitrogen load at Nowy Targ, first quarter 2005, based on 29 observations, after Morling [8]

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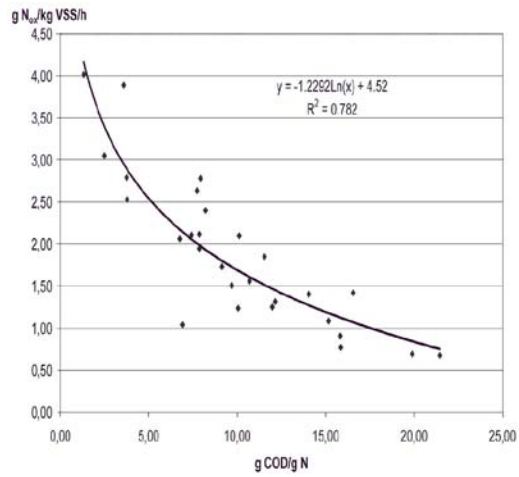

Figure 5 : Nitrification rate versus inlet ratio COD/N at Nowy Targ, first quarter 2005, based on 29 observations, after Morling [8]

The two figures illustrate that the nitrification rate is not only related to water temperature, but also to the actual nitrogen loading and the ratio COD/nitrogen in the incoming wastewater. The two figures illustrate a more or less normal, and very dynamic load situation at many WWTP:s. That in turn puts the question forth: is it really possible to find an operation pathway that may be called "optimized"? The more or less continuously changing conditions, would call for an automation control and operation system of really comprehensive capacities.

The classic and relevant way to assess any WWTP performance is to study an extended operation period, still with rather uniform conditions. The two figures 4 and 5 are based on a low water temperature situation at the plant. Of special interest at this plant was the nitrogen removal performance, both with respect to the seasonally low water temperatures, and the high Cr content in the crude wastewater. The "overloading" situation was terminated in 2008, when the tanneries in Nowy Targ to a very large extent were closed due to the change in market conditions. This in turn has made it possible to compare the plant performance during the "overloading" situation, with a later more normal load situation, the latter based mainly on municipal wastewater, see Table 2:

Table 2 : Comparison of discharge wastewater quality at the Nowy Targ plant, year 2004- 2005 (with high nitrogen and Cr load) and year 2009, mainly municipal wastewater

Period	Year 2004 - 2005	Year 2009
Nitrogen, consent level, mg N/l	20	20
Mean value mg N/l	15.5	9.5
Median value, mg N/l	15.0	6.6
Phosphorus, consent level, mg P/	0.5	0.5
Mean value mg P/l	0.49	0.38
Median value, mg P/l	0.40	0.17

When addressing these discharge figures you may assume that a substantial improvement has been achieved with respect to operation efficiency. This assumption may however be somewhat premature. There are a number of detailed information details missing that would be indispensable to correctly asses the performance. An improvement with respect to the effluent levels is evident, but is it really an improvement with respect to the efficiency? The basic answer is: More information is needed.

d) A plant operated with a typical weekly load variation outside Stockholm, Sweden

The last example represents a more or less classic problem found at many municipal WWTP outside Stockholm. The plant is built as a two-reactor SBR-facility, followed by a polishing chemical precipitation.

- A low load situation during the first years of operation;
- A load variation due to a daily work migration during weekdays.

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The second problem could be defined as an insufficient amount of organic matter in relation to the nutrient load. However, the limited load resulted in an extended solids retention time (SRT). An initial SRT during the first half year operation was estimated at close to 40 days. This in turn resulted in a complete nitrification, but a rather limited denitrification, but foremost an unexpected high discharge level of phosphorus. This discharge was suggested to be caused by a secondary release of polyphosphate. The mitigation method was to add septic sludge as an organic carbon source. This action proved to be efficient. Shown in Table 3 are the annual mean values of the relevant pollution variables in the wastewater into the biological reactors. The removal of all pollution variables was improved. The discharge values over three years are presented in Table 4.

Table 3 : Comparison of inlet concentrations and pollution ratios during year 1997 and 1998/1999, (after Morling [9])

Period	Year 1997	Year 1998/1999
Inlet concentrations		
COD, mg/l	353	650
BOD_7, mg/l	121	194
BOD_5, mg/l	105	169
Tot-N, mg/l	26.5	26.2
Tot-P, mg/l	7.9	9.7
Ratios		
COD: BOD_5	3.36:1	3.85:1
BOD_5: Tot-N	3.96:1	6.45:1
BOD_5, Tot-P	13.29:1	17.4:1

Table 4 : Summary of discharge figures at the Tjustvik WWTP from 1998 through 2000 (72 obs.), all values in mg/l, (after Morling [9])

Variable	COD	BOD_7	Total P	Total N	NH_4-N
Consent level	(< 70)	< 10	< 0.3	< 15	< 4
Max value	168	10	0.4	18	14
75 % level	32	< 3	0.24	9.3	3.2
50 % level	< 30	< 3	0.15	5.9	0.27
Min value	< 30	< 3	0.05	2.4	0.01

This process alteration may be characterized as a substantial improvement of operation efficiency. On the other hand was it really an optimization of the plant? Still it is difficult to answer this question accurately, as the main objective for the process modification was first of all to safeguard the consent values for the pant. On the other hand rather than representing a "true" optimization of the plant operation, it does exemplify a necessary step towards an optimization.

IV. Conclusions

The four examples demonstrate empirical findings from wastewater treatment plants with most different operation conditions. These findings illustrate some crucial points with respect to operation of biological plants. The insights may be summarized in four major perspectives:

- The needs for an understanding of the more or less inevitable load fluctuations that will govern the plant operation during its lifetime. This understanding must be reflected in the fundamental design of the plant. An incorporation of a sufficiently flexible operation mode would be of great value in this respect;
- Needs for a comprehensive process control, based on an extended use of on-line instruments both at the inlet side of the plant, inside the process train, as well as at the discharge point of treated water. Only an active process control by means of more or less instantaneous "feed-back" on changing conditions may justify the expression "optimized operation ";
- A separation of the storm water collection from the sewers that inevitably will result in improved

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operation conditions especially for a biological treatment installation;

- And last, but not least, a committed and process oriented operation management working at the plant. Or, in other words: The day-by-day operation of a wastewater treatment plant may be seen as an ongoing very large, full-scale scientific work. The need of interest and curiosity shown from the plant staff may be illustrated by a metaphor from one of the short stories by Sir Arthur Conan Doyle [10]. Sherlock Holmes says: *"We approached the case, you remember, with an absolutely blank mind, which is always an advantage."*

V. Acknowledgments

The paper has been commented by Ms Åsa Westlund, head of the Sweco Environment Process department from technical aspects. Mr Guy Taylor has corrected linguistic errors. Thank you both.

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The Effects and Linkages of Deforestation and Temperature on Climate Change in Nigeria

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Abstract- Deforestation has a negative impact on the immediate environment and on the global scale, climate change. This paper is aimed at assessing the effect of deforestation to temperature and invariably on climate change in Nigeria. It discussed the rates of deforestation in Nigeria and globally; climate change in Nigeria; impact of extreme weather events in Nigeria; the effect of deforestation with respect to temperature change; the greenhouse gas (GHG) emissions attributed to deforestation in Nigeria; the obvious relationship between deforestation, temperature and climate change; and the mitigate measures to deforestation nationally and globally. The research considered an extended Eighty years period for this work because it capture the period when climate change signals were not an issue (1901-1938) and when they are stronger (1971-2012).

Keywords: deforestation, greenhouse gases, temperature change, global warming, climate change, forest protection/conservation, nigeria.

GJSFR-H Classification : FOR Code: 961203

THE EFFECTSANDLINKAGESOFDEFORESTATIONANDTEMPERATUREONCLIMATECHANGEINNIGERIA

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The Effects and Linkages of Deforestation and Temperature on Climate Change in Nigeria

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Abstract- Deforestation has a negative impact on the immediate environment and on the global scale, climate change. This paper is aimed at assessing the effect of deforestation to temperature and invariably on climate change in Nigeria. It discussed the rates of deforestation in Nigeria and globally; climate change in Nigeria; impact of extreme weather events in Nigeria; the effect of deforestation with respect to temperature change; the greenhouse gas (GHG) emissions attributed to deforestation in Nigeria; the obvious relationship between deforestation, temperature and climate change; and the mitigate measures to deforestation nationally and globally. The research considered an extended Eighty years period for this work because it capture the period when climate change signals were not an issue (1901-1938) and when they are stronger (1971-2012). With 80 years, two climatic periods of 38 and 42 years can be studied and this will provide a better platform to investigate the changes within the climatic periods, these data from Nigeria Metrological Agency (NIMET) and World Resources Institute Climatic Analysis Indicator Tools (WRI-CAIT) form synergy of the data for result computations. The study shows that GHG emissions attributed to deforestation ranged from 168.64MTCO_2 (2006) to 171.93MTCO_2 (1999) contributing about 34.59% (2006) - 43.15% (1999) to the total greenhouse gas emissions. It was shown that there were sharp drops (year 2001 and 2006) in the amount of greenhouse gas emissions attributed to deforestation which must have been due to changes in firm government policy howbeit with attendant increase afterward which must have been due to unsustainable policy implementation. It was concluded that with the ever growing need for reduction in greenhouse gas emissions, unregulated and improper deforestation should be discouraged. It was recommended that various policies concerning deforestation should be properly implemented and all laws be enforced diligently by the agency charged with the responsibility of protecting and conserving forest resources.

Keywords: deforestation, greenhouse gases, temperature change, global warming, climate change, forest protection/conservation, nigeria.

I. Introduction

A forest is a land which is covered with more than 10 percent of trees and an area of more than half a hectare (FAO, 2005; Inyang and Esohe, 2014). Forests currently cover around 30% of the Earth's land surface, but are being lost at an "alarming rate" (FAO, 2010; Miller and Cotter, 2013). Forests serve many purposes. Through photosynthesis, forests serve as carbon sinks reducing the amount of CO_2 in the atmosphere thereby curtailing global warming. Forests serve as shade to the soil thereby preserving soil biodiversity. They control the rates of evapo-transpiration and transpiration due to the heat they absorb. They provide the raw material needed in the pharmaceutical industry, lumbering industry, for construction, for firewood, for the production of charcoal and so on. Spore, 2011 reported that forests also play a pivotal role in providing water resources, due to their influence on volumes and distribution of rainfall, the dynamics of water in soil and the quantities of water discharged into the atmosphere in the form of vapour. The importance of forests as a resource cannot be overstated. In line with the socioeconomic and climatic importance of forests there is need for protection and conservation. Most scientists agree that, in the past two decades, tropical deforestation has been responsible for the largest share of CO_2 released to the atmosphere from land use changes (IPCC, 2007; Gorte and Sheikh, 2010). At current rates of deforestation, clearing tropical forests could release an additional 87 to 130GtC of CO_2 to the atmosphere by 2100 (Houghton, 2005; Gorte and Sheikh, 2010). According to the Union of Concerned Scientists (2013), tropical deforestation accounts for about 10 percent of the world's heat-trapping emissions. They reported that tropical deforestation contributes about 3.0 billion tons of CO_2 a year to global warming pollution (Union of Concerned Scientists, 2013). This value of 3 billion tonnnes could be as a result of the loss in carbon sequestration and the added input of CO_2 to the atmosphere as a byproduct from the use of forest resources. Inyang and Esohe, 2014 also cited that deforestation accounts for 87 percent of total carbon emission in Nigeria. With more CO_2 in the atmosphere, more of the sun's radiation is reflected back to earth, instead of space, and this causes average temperature to rise. In this way, deforestation is a major issue when it comes to global warming (Jakubowski, 2013). As terrible the consequences of deforestation are, Nigeria has one of the highest rates of forest loss (3.3%) in the world (Butler, 2006). This study is therefore aimed at discussing the effect deforestation poses to temperature and invariably on climate change.

The forest resources of Nigeria as classified in Figure 1 are classified into rain forest, deciduous forest, savannah forest, thorn forest, fresh and salt water swamp

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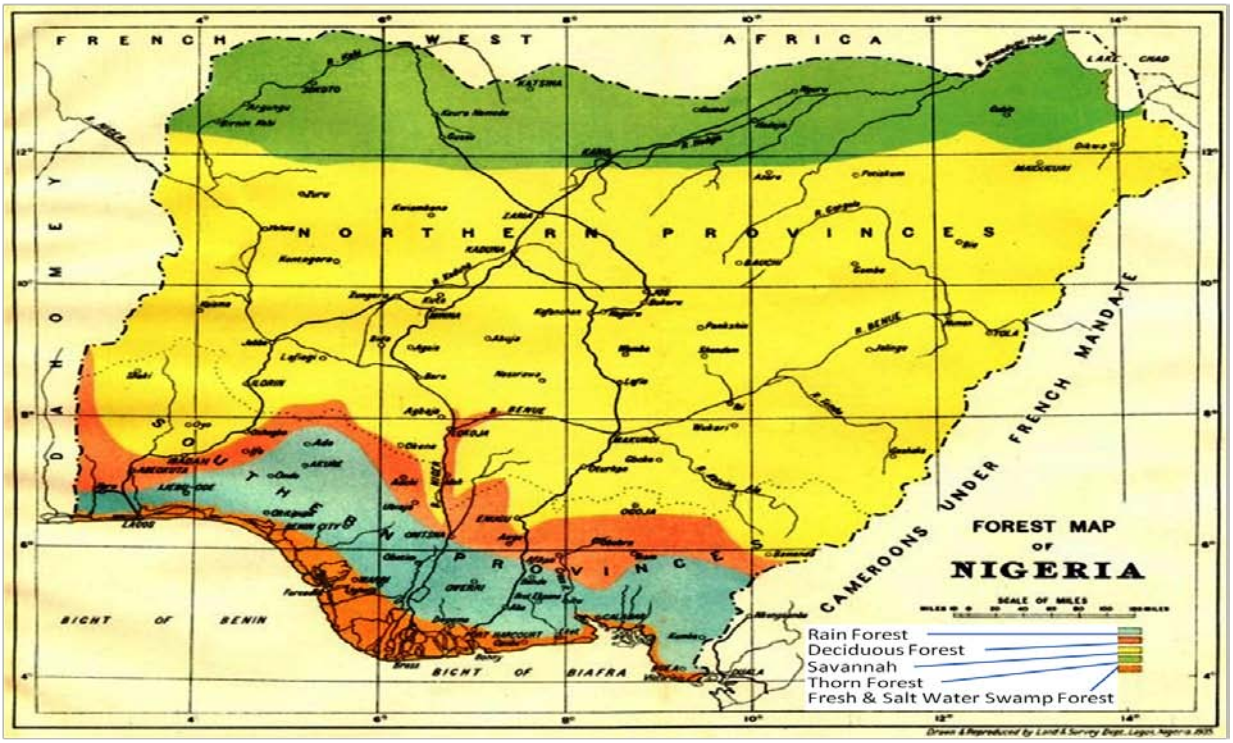

Figure 1 : Map showing the forest classification of Nigeria

Source: http://www.antiquaprintgallery.com/ekmps/shops/richben90/images/nigeria-forest-map-of-nigeria-1936-75130-p.jpg

Deforestation is the removal of a forest or stand of trees where the land is thereafter converted to a non-forest use (Dictionary of Forestry, 2008). It is the clearing or thinning of forests, the cause of which is normally implied to be human activity (Encyclopædia Britannica, 2012b). Deforestation also refers to indiscriminate cutting or over-harvesting of trees for lumber or pulp, or to clear the land for agriculture, ranching, construction, or other human activities (Microsoft Corporation, 2008).

It refers to measurable increases in the average temperature of Earth's atmosphere, oceans, and landmasses. Here, the terms global warming and climate change are used interchangeably (Mastrandea and Schneider, 2008). It also refers to the phenomenon of increasing average air temperatures near the surface of Earth over the past one to two centuries (Encyclopædia Britannica, 2012c)

It is the periodic modification of Earth's climate brought about as a result of changes in the atmosphere as well as interactions between the atmosphere and various other geologic, chemical, biological, and geographic factors within the Earth system (Encyclopædia Britannica, 2012a). Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 1994). Climate change can also be defined as a change in the statistical properties of the climate system when considered over long periods of time, regardless of cause (NSIDC, 2001).

II. Theoretical Review

a) *Climate Change in Nigeria*

According to Odjugo, 2010 who inferred from his research that for 105 years, temperature has increased by 1.1°C and rainfall has decreased by 81 mm. This was caused by high deforestation rate thus leading to increase in desertification (Inyang and Esohe, 2014). The Nigerian Meteorological Agency (NIMET) also reported weather anomalies, extreme weather events and their impact on the socioeconomic status of Nigeria (NIMET, 2010). The summary is as follows:

b) *Weather Anomalies in Nigeria*

i. *Temperature Anomaly*

NIMET, 2010 reported that warmer than normal maximum temperatures prevailed over most places in the country with high positive values between 1.9 – 2.9°C over Yelwa, Bauchi, Maiduguri, Potiskum and Ogoja. However, colder than normal weather conditions were experienced in a few places especially over Eket that recorded negative maximum temperature departures as low as 2.4°C. NIMET, 2010 also reported warmer than normal minimum temperatures of 0.5 – 1.5°C during the cold season (January) over most parts of the country with places such as Eket, Enugu, Gusau, Ibadan, Oshogbo, Owerri and Ikeja recording values

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which were 2.0 – 3.1°C warmer. On the other hand, Ibi, Yelwa, Jos and Kaduna were 0.8-1.8°C colder than normal. Extremely high daily temperatures in the range of 40.0°C and above were recorded in the northern part of the country for consecutive days beginning from the third week in February to the end of May. Also, Potiskum and Maiduguri in the northeast recorded the highest daily temperatures of 46.1°C and 45.5°C respectively (NIMET, 2010).

ii. *Rainfall Anomaly*

NIMET, 2010 further reported that wetter than normal conditions were experienced in the extreme northeast, northwest and cities such as Bauchi, Jos and part of Minna in the central states. Other areas that recorded wetter than normal rainfall conditions included southwest and Ogoja, Calabar and Eket in the southeast. Isolated case of drier than normal rainfall was recorded at Ilorin. The rest of the country had normal rainfall. In the last three years, the extreme northwest had experienced drier than normal rainfall condition but became wetter than normal in year 2010. Daily heavy rainfalls ranging from 103.00m and 199.50m were recorded. Highest daily rainfalls of 199.5mm, 184.6mm and 183.8mm were recorded at Uyo (June), Benin (September) and Umuahia (June) respectively (NIMET, 2010)

iii. *Inter-Tropical Discontinuity (ITD) Anomaly:*

It was also NIMET, 2010 who reported that the Inter-Tropical Discontinuity (ITD) was located at an average position of latitude 7.9°N in January. It then oscillated northwards to reach a northernmost position of latitude 20.9°N in August. Thereafter, the ITD began its seasonal southward movement to reach latitude 7.8°N in December. The decadal movements and average monthly positions of the ITD were, in most cases, above normal but lagged behind long term conditions in April and December but were near normal in May and November. The higher than normal ITD positions accounted for the high rainfall in many cities across the country, particularly in the north.

III. Effect of Weather Anomalies on the Socio-Economic Status of Nigeria

The extreme weather events had an impact on the agriculture, health, education, hydrology and aviation sectors of the country. The summary is as follows:

a) Effect on Agriculture

The Northern states of Borno and Yobe experienced a reduction in rainfall amount in August which led to a drop in millet, sorghum and cowpea production by about 10% as reported by NIMET 2010. Reports also indicated that Sokoto, Kebbi and Jigawa states had a reduction in rice production by 50% due to excessive flooding in September as compared to the same period in 2009 (FEWSNET 2010 report; NIMET, 2010). In the south, higher crop harvest was reported particularly in crops such as yam, maize and cassava. However, high relative humidity in September and October delayed maize and cassava drying which led to losses. Fishing activities were affected particularly in the coastal states of Bayelsa and Rivers due to rise in water levels and flooding caused by above normal rainfall (NIMET, 2010).

b) Effect on Health

Incidences of flood related diseases such as cholera were reported to have infected nearly 40,000 people and killed more than 1,500 in some parts of the country in October. This was the worst outbreak of cholera in the country for nearly two decades. The highest death tolls were in the north (Borno, Katsina and Bauchi) that experienced heavy rain falls. There were also cases of cholera outbreak in the south, including Rivers and Cross River states in the Niger Delta (NIMET, 2010).

c) Effect on Education

The educational sector also felt the effect of the floods in the country with the closure of the Usman Danfodio University, Sokoto as a result of the collapse of the bridge leading to the institution in September. The Lagos State University was also cut off as a result of the collapse of the bridge leading to the school in June. A number of schools at the primary and secondary levels were also forced to close down or relocate due to the

d) Effect on Hydrology

The wet season starts normally between March/April in the South and between late May/June in the North. Excessive flooding was reported in most parts of the country between August and September, particularly, occurring along major rivers in Jigawa, Sokoto and Ogun states. Coastal flooding was also reported in states such as Delta, Rivers and Bayelsa states. Communities along the Lagos/Ogun borders also suffered spillover effect of the Ogun flooding which resulted into loss of farmlands, sources of income, loss of lives and properties and displacement of people from their homes. The high impact of flooding in the country could be assessed, for example, from the recorded flow volume of about 17.27 billion m^3 of water between June 1- September 30, 2010 at Jiderebode (gauged station in Nigeria) which was the highest ever recorded during the period in recent years and about twice the total mean flow of the five-year return period (NIMET, 2010).

e) Effect on Aviation

NIMET, 2010 reported severe dust hazy spell and early morning fogs across the country which reduced horizontal visibility to between 200m-800m for several days causing disruptions in areas such as: Lagos, Abuja, Kano, Kaduna, Minna, Maiduguri, Sokoto, Enugu, Owerri, Port Harcourt and Calabar which led to

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flight cancellations. Also thousand of Europe-bound Nigerians were stranded at the Murtala Mohammed International Airport (MMIA) Lagos, as heavy snow pounded European airports in December. These harsh weather conditions affected the number of inbound and outbound flights at the Murtala Mohammed International Airport during the period (NIMET, 2010).

All these weather anomalies and climate change could be attributed in part to unregulated deforestation activities.

IV. Deforestation in Nigeria

According to FORMECU data, between 1976/1978 and 1993/1995, the area occupied by natural forest (excluding plantations) shrubs/grassland decreased from 23,439,000 ha, which is 26% of the country to 15,097,000 ha (16.6%) (NACGRAB/FDA, 2008). Since 1990, the country has lost some 6.1 million hectares or 35.7 percent of its forest cover. Worse, Nigeria's most biodiverse ecosystems—its old-growth forests—are disappearing at an even faster rate. Between 1990 and 2005, the country lost a staggering 79 percent of these forests and since 2000 Nigeria has been losing an average of 11 percent of its primary forests per year. This doubles the rate of the 1990s. These figures give Nigeria the dubious distinction of having the highest deforestation rate of natural forest on the planet (Butler, 2006). According to NACGRAB/FDA (2008), deforestation in Nigeria is put at about 3.5% per annum translating to a loss of 350,000 – 400,000 hectares of forest land per annum. Recent studies showed that forests occupy about 92,377 km or about 10 percent of Nigeria's land area. This is well below the Food and Agriculture Organization of the United Nations (FAO) recommended national minimum of 25 percent. In addition, forest estates are de-reserved by some State Governments. The State Forest Departments have been unable to curtail the spate of requests from the forest estate for the establishment of agricultural crops. The unfortunate impression has thus been created that the forest estate exists as a land bank for other sectors as the demands for de-reservation continue nationwide. Ola-Adams *et al*., 2006 reported 64 vulnerable, 14 endangered and 9 critically endangered tree species in Nigeria. NACGRAB/FDA also reported that while deforestation of off-reserve land is due to the reasons given above, the most important cause for deforestation in the forest reserves can be linked to the State Departments of Forestry who have abandoned any form of forest management for natural forests since the 1970s. As a result, reserve forests are being treated as an infinite resource, with no effective management practices in place to regulate the harvest. This finding is also backed up by Oduntan *et* al., 2013 who reported that all the protected areas surveyed in Yewa division of Ogun state are threatened by all the identified human activities; though at different level of severity. Sustainability of the forest resources is further threatened by the practice of short-term concession allocation tenures of 1-3 years that encourage annual re-entries. Other reasons for degradation in the reserves include inefficient wood utilization by industry and, therefore, a higher demand for industrial grade timber, and illegal logging (NACGRAB/FDA, 2008).

V. The Effect of Deforestation with Respect to Temperature Change

Trees serve as cover to the soil thereby protecting the variety of life existing in it from extreme temperatures. They serve as carbon sink by absorbing CO_2 which is a potent greenhouse gas that causes global warming. It is alarming that despite the importance and contribution of forests to global warming and climate change mitigation, many forests are being converted to agricultural lands, for industrialization and so on. This deforestation activities increase the amount of CO_2 released into the atmosphere directly and indirectly (Figure 2). Directly in the sense that, all the uses except lumbering for which the products of deforestation (such as wood) are used release CO_2 and sometimes CH_4 (in the case of decay) into the atmosphere. Deforestation increases the amount of CO_2 indirectly in the sense that there is greenhouse gas absorption deficit resulting from fewer carbon sinks thereby causing a surplus of CO_2 emissions. Canziani and Benitez, (2012) investigated the climate impacts of deforestation/land-use changes in Central South America in the PRECIS regional climate model. They concluded from their research that for temperature, significant changes are found within deforested areas and beyond, with major temperature enhancements during winter and spring. Mi Zhang *et al.,* (2014) reported in their research that along the North - South Transect of Eastern China (NSTEC) in Eastern China, deforestation caused cooling at the Changbaishan temperate mixed forest (CBS site) pair and warming at the subtropical and tropical site pairs. They inferred that deforestation increased the diurnal temperature range (DTR), especially in the temperate area. They also reported that precipitation was an important driver of the latitudinal and inter-annual variations in the deforestation effect. Green and Lindgren, 2012 reported that temperature change of -0.8°C, -0.04°C, +0.7°C respectively occur when either a boreal, temperate or tropical forest is deforested. This shows that tropical deforestation has a higher global warming potential compared to others. Gorte and Sheikh, 2010 cited that deforestation has been shown to reduce evapotranspiration (water loss to the atmosphere) by plants, which reduces cloud formation and downwind precipitation. Miller and Cotter, 2013 also

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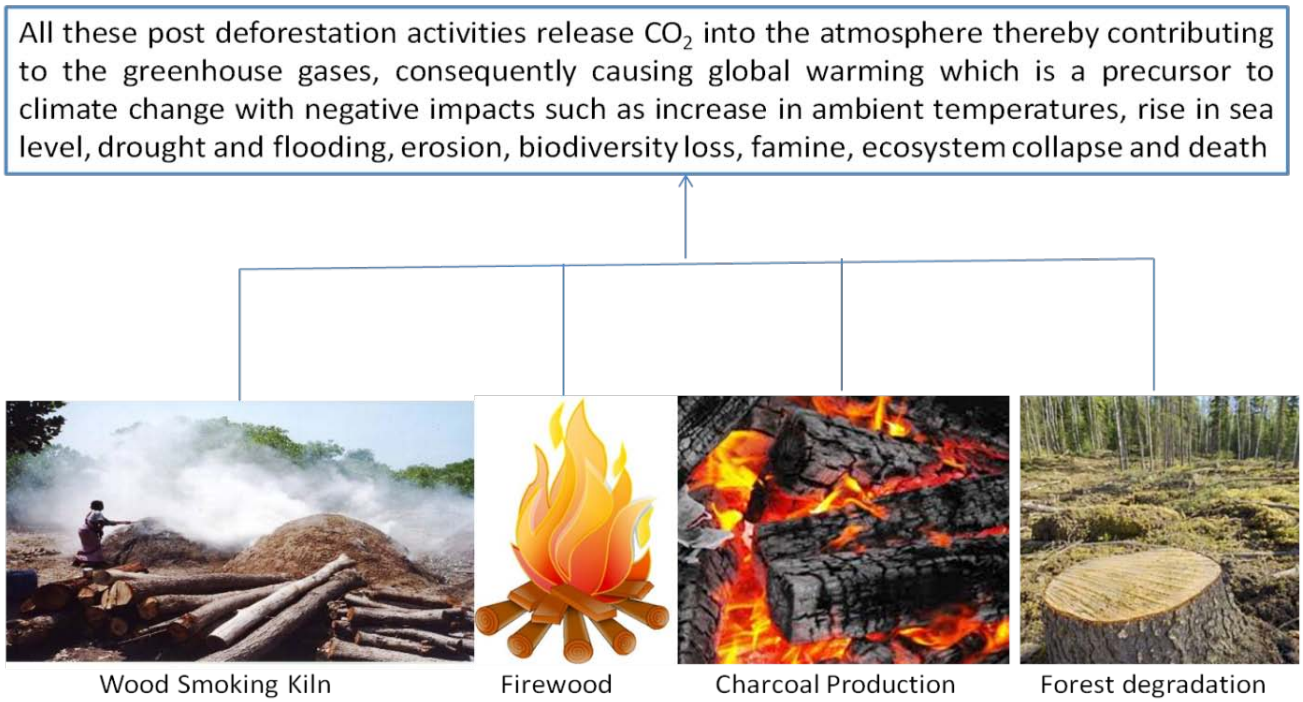

Figure 2 : The effect of deforestation with respect to temperature on Climate change

Source: www.biocoal/resources

cited that reduction in evapotranspiration and moisture circulation is indicated to weaken the hydrological cycle, with models suggesting up to 80% reduction in annual rainfall in deforested areas. Lal, 1995 inferred from their research that deforestation decreases the maximum relative humidity (Figure 3), especially during mid-day. There is also a corresponding increase in air temperature (Figure 4) and evaporation rate. Perhaps the most drastic effect of deforestation is on soil temperature (Figure 5). Lal, 1995 stated that maximum soil temperature at 1 to 5 cm depth can be 5°C to 20°C higher on cleared land on a sunny day compared with land under Forest cover. Lal, 1995 also stated that because of high soil evaporation, the soil moisture content of the surface layer is also lower in cleared than in forested soil.

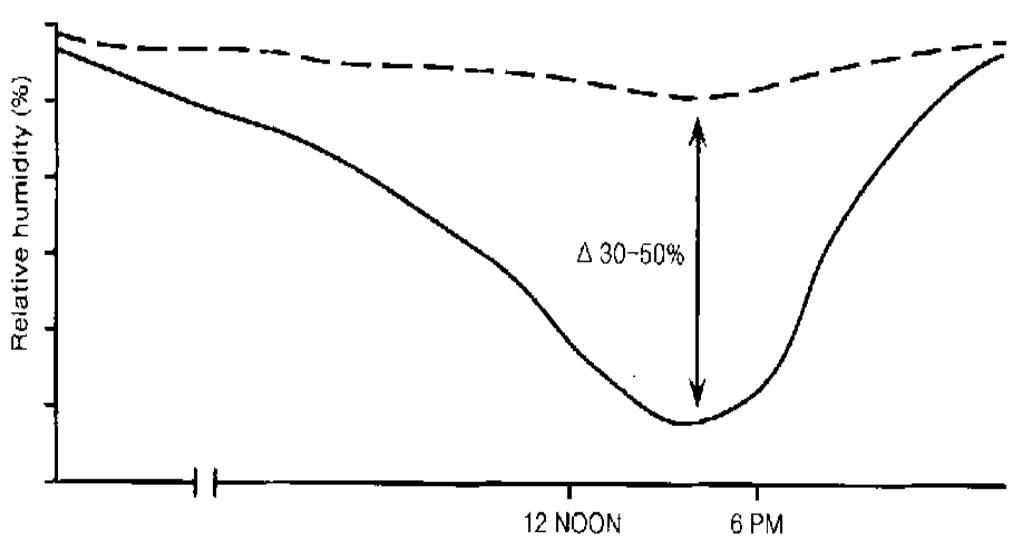

Figure 3 : Effects of deforestation on Relative humidity

Source: Lal, 1995

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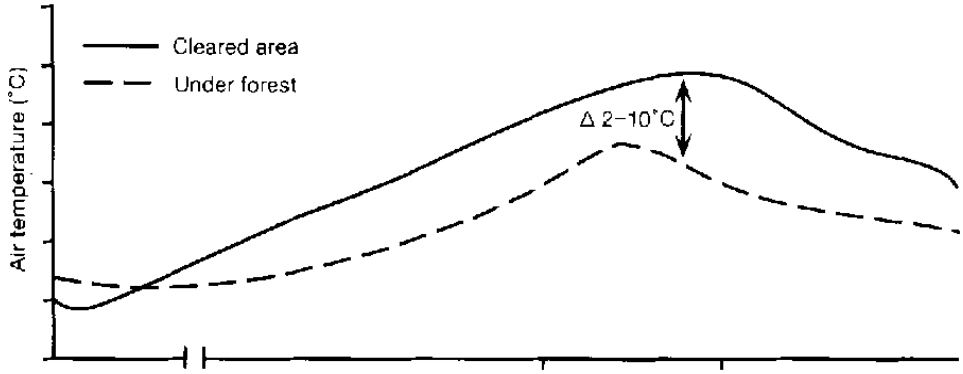

Figure 4 : Effects of deforestation on air temperature

Source: Lal, 1995

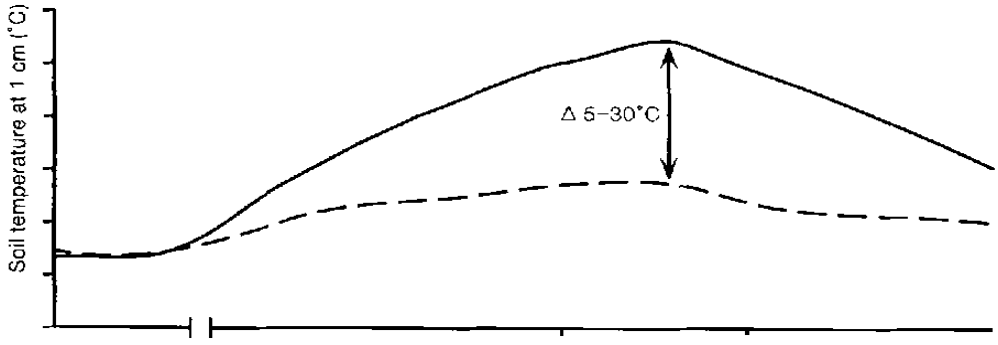

Figure 5 : Effects of deforestation on soil temperature

Source: Lal, 1995

VI. Materials and Method

Mean monthly and annual temperatures and rainfall from 30 synoptic stations between 1901-1938 and 1971-2012 in Nigeria were collected from the Nigerian Meteorological Agency, Lagos and Meteorological Department in some Airports. Although there are more than 30 meteorological stations in Nigeria, the study was limited to 30 stations because of consistency in available climatic data since the establishment of the stations.

Moreover the selected stations are true representative of the various climatic zones of Nigeria. The Two most important climatic elements (temperature and rainfall) were used in this study. These climatic elements were measured regularly in the stations used and these climatic elements best determine the prospects as well as the ecological and socio-economic problems of Nigeria. Data from different secondary sources were also used.

Eighty years period were covered in this research work. This is important because we were able to capture the period when climate change signals were not an issue (1901-1938) and when they are stronger (1971-2012). With 80 years, two climatic periods of 38 and 42 years can be studied and this will provide a better platform to investigate the changes within the climatic periods. The mean annual temperature data were used to construct the isothermal maps of Nigeria, while the rainfall data were used to construct the isohyets maps of Nigeria for the two climatic periods. With these maps, the analysis of the spatial pattern of rainfall and temperature with implication to climate change in Nigeria was carried out. The temporal climatic changes over the years were examined by employing the time series.

Also data from World Resources Institute via Climatic Analysis Indicator Tools (WRI-CAIT) were also employed to analysed recent and current Green House Gases with respect to Nigeria and the World at large.

VII. The Greenhouse gas Emissions Attributed to Deforestation in Nigeria

WRI/CAIT 2.0., 2014 reported the annual emission of greenhouse gases attributed to deforestation in Nigeria (Figure 6). It ranged from 168.64MTCO_2 (2006) to 171.93MTCO_2 (1999). The trend showed that the emission of greenhouse gases attributed to deforestation experienced a sharp drop in years 2001 and 2006. The sharp drop in greenhouse gas emissions in the years 2001 and 2006 must have been due to change in government policy. A new Nigerian Agricultural Policy with more focused direction and better articulation was launched in the year 2001

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(NIPC, 2001). So also, a new National Forest Policy which was to encourage and support an aggressive establishment of plantations of economic trees of both exotic species, such as teak and indigenous species; and foster the redirection of development resources was approved on June 14th, 2006 (Federal Ministry of Environment, 2006). The trend also showed that ever since the later sharp drop in the year 2006, the greenhouse gas emissions attributed to deforestation has been on the increase. This means that if deforestation is not curtailed any time soon, Nigeria will join the League of Nations with highest greenhouse gas emissions. Mfon *et al*., 2014 stated that based on visible results, so far only half-hearted efforts have been made to control deforestation. It can therefore be concluded that continued increase in greenhouse gas emissions after the sharp drops were as a result of the forestry policies not being sustainably implemented.

VIII. The Percentage Contribution of the Greenhouse Gas Emissions Attributed to Deforestation to the Overall Greenhouse Gas Emissions in Nigeria

From the WRI/CAIT, 2.0, 2014 data, deforestation contributed to between 34.59% in 2006 and 43.15% in1999 to the overall greenhouse gas emissions. There was a clear downward trend in the greenhouse gas emission contribution of deforestation to the overall (Figure 7). This is a pointer that apart from the contribution of deforestation to greenhouse gas emissions in Nigeria there have been some competitive increases in other greenhouse gas emitting sectors of the economy over the years.

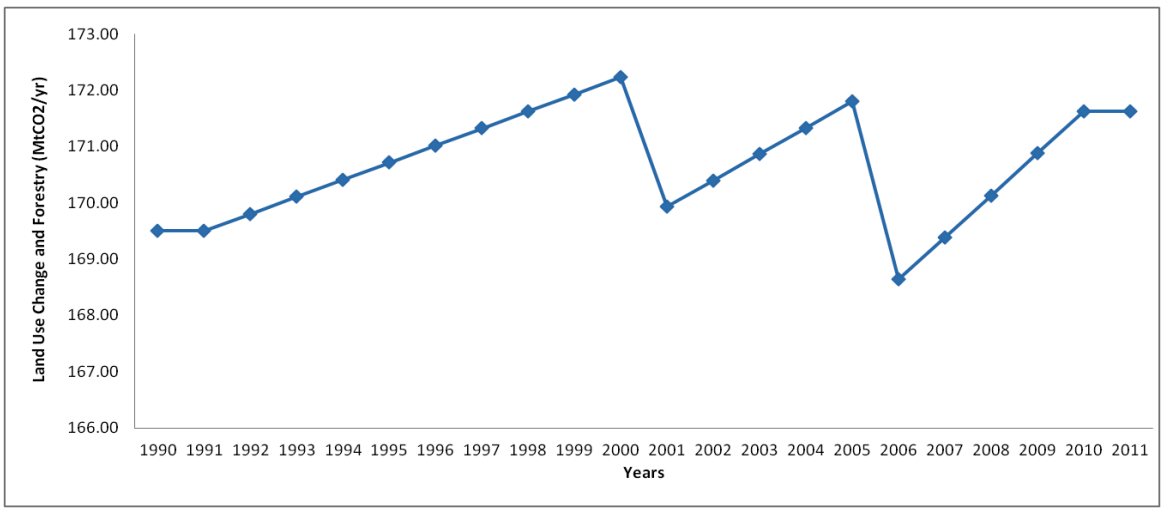

Figure 6 : The annual emission of greenhouse gases attributed to deforestation in Nigeria (1990 - 2011)

Source: Graph was built based on WRI/CAIT 2.0., 2014 and FAO, 2014 data

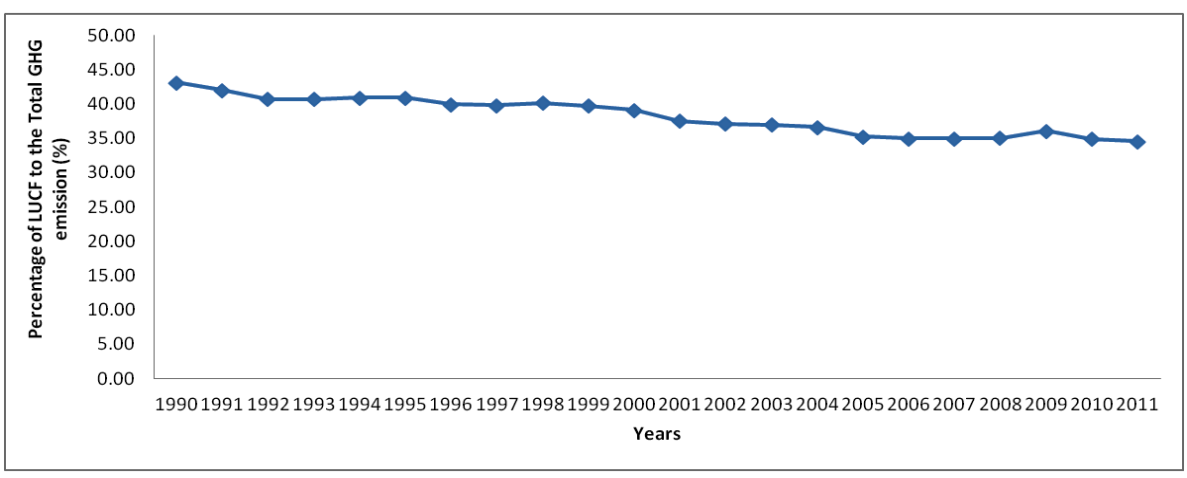

Figure 7 : The percentage contribution of GHG emissions attributed to Deforestation to the Overall GHG emissions in Nigeria (1990 - 2011)

Source: Graph was built based on WRI/CAIT 2.0., 2014 and FAO, 2014 data

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IX. Implication to Nigeria's Policies Formulation with Regards to Protection and Conservation its Forests

The forestry act which was promulgated in 1958 provides for the preservation of forests and the setting up of forest reserves. It is an offence, punishable with up to six months imprisonment, to cut down trees over 2ft in girth or to set fire to the forest except under special circumstances. The Federal Ministry of Environment, (2006) reported that one of the factors that militate against sustainable forest management is the absence of a National Forestry Act. Apart from using the provision of the Act to regulate forestry practices in Nigeria and to give also a legal backing for the National Forest Policy, it would further enable us to meet the obligations on the treaties and conventions relevant to forestry development to which Nigeria is a signatory. The Federal Ministry of Environment, (2006) also reported that the first ever National Forestry Act has been evolved to back the policy and have since been presented to the Council for ratification and to be passed into law.

X. Implication of Global Treaty to Protection and Conservation of Forests

To tackle deforestation, World Land Trust (WLT) is backing an initiative entitled Reducing Emissions from Deforestation and Forest Degradation (REDD). REDD is a way of putting a financial value on the carbon stored in forests, offering incentives to protect them. REDD+ goes beyond avoided deforestation and forest degradation to include the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks (World Land Trust, 2012).

XI. Conclusion

It has been established that forests serve as Carbon sinks. Therefore, improper deforestation practice will only add to the amount of CO_2 already in the atmosphere. If this goes on unchecked, the resultant effects will be global warming which will invariably bring about other climate change conditions such as increase in ambient temperature, wind and water erosion causing health hazard and siltation of water body; rise in sea level, coral reef destruction, loss of biodiversity, flooding (e.g. Haiti), , drought, famine, starvation and death. The negative implications of unregulated and improper deforestation are numerous as observed in many facet of the Nigeria sectors which by extension have global consequences. This calls for protection and conservation of forests vis-avis the following measures;

With the ever growing need for reduction in greenhouse gas emissions, unregulated and improper deforestation should be discouraged or with the fall one and plant ten seedling sustainable measures be put in place in Nigeria as is still be done in the United State of America.

There is a law that borders on conservation and protection of forests. This law should therefore be properly implemented and enforced to the law with proper policing and monitoring and stringent punishment.

Aforestation and Reforestation programmes with incentives should be organized to recuperate the dwindling forests.

Moderate Resolution Imaging Spectrometer (MODIS) should be launched onboard Nigeria's satellite so as to enable the monitoring of deforestation and necessitate quick action in case of unlawful deforestation.

More studies using advanced models should be carried out to investigate the actual impact deforestation has on global warming/temperature increase and climate change in Nigeria.

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Appendix 1

Year	LUCF ($MtCO_2$)	Total GHG Emissions Including Land-Use Change and Forestry ($MtCO_2e$)	Percentage Contribution of Deforestation to the Overall Greenhouse Gas emissions in Nigeria (%)
1990	169.50	392.83	43.15
1991	169.50	403.52	42.01
1992	169.81	416.76	40.74
1993	170.11	417.43	40.75
1994	170.41	416.20	40.94
1995	170.72	417.32	40.91
1996	171.02	428.08	39.95
1997	171.32	429.92	39.85
1998	171.62	427.51	40.15
1999	171.93	432.39	39.76
2000	172.23	440.01	39.14
2001	169.93	452.47	37.56
2002	170.40	459.29	37.10
2003	170.87	461.64	37.01
2004	171.33	467.70	36.63
2005	171.80	487.00	35.28
2006	168.64	481.64	35.01
2007	169.39	483.74	35.02
2008	170.13	485.03	35.08
2009	170.88	473.87	36.06
2010	171.63	491.67	34.91
2011	171.63	496.13	34.59

Source: Table was built based on WRI/CAIT 2.0., 2014 and FAO, 2014 data

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Assessment of Shoreline Changes in the Period 1969-2010 in Watamuarea, Kenya

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Abstract- Watamu coastlineis a major attraction site for tourist and also a source of income for the local people. However, the shoreline has been changing due to erosion. This study sought to find the trend of shoreline changes, and the factors attributed to the changes. Aerial photographs of 1969 and 1989 and a recent satellite image of 2010 wereused to digitize the shoreline.The Digital Shoreline Analysis System (DSAS) in ArcGIS environment was used to create transects and statistical analyses for the shoreline.Several GPS points were taken in October 2013 and 2014 during ground truthing following the High Water Mark (HWM). The 9.8 km long Watamu shoreline was divided in-to 245 transects with 40 meter spacing in order to calculate the change rates. The rates of shoreline change were calculated using the End Point Rate (EPR), Net Shoreline Movement (NSM), and Weighted Linear Regression (WLR) statistic in DSAS.

Keywords: aerial photographs, arcgis, coastline, digital shoreline analysis system, satellite image, shoreline erosion, watamu, kenya.

GJSFR-H Classification : FOR Code: 969999

ASSESSMENTOFSHORELINECHANGESINTHEPERIOD1969-2010INWATAMUAREAKENYA

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Assessment of Shoreline Changes in the Period 1969-2010 in Watamu area, Kenya

Fikir Alemayehu [α], Onwonga Richard [σ], Mwangi James Kinyanjui [ρ] & Wasonga Oliverv [ω]

Abstract- Watamu coastlineis a major attraction site for tourist and also a source of income for the local people. However, the shoreline has been changing due to erosion. This study sought to find the trend of shoreline changes, and the factors attributed to the changes. Aerial photographs of 1969 and 1989 and a recent satellite image of 2010 were used to digitize the shoreline.The Digital Shoreline Analysis System (DSAS) in ArcGIS environment was used to create transects and statistical analyses for the shoreline.Several GPS points were taken in October 2013 and 2014 during ground truthing following the High Water Mark (HWM). The 9.8 km long Watamu shoreline was divided in-to 245 transects with 40 meter spacing in order to calculate the change rates. The rates of shoreline change were calculated using the End Point Rate (EPR), Net Shoreline Movement (NSM), and Weighted Linear Regression (WLR) statistic in DSAS. In addition, Focused Group Discussion (FGD)and key informants interview were conducted with curio sellers, boat operators, fishermen, safari sellers, and longtime residents and hoteliers in order to get information about the drivers of shoreline change.The analysis from WLR indicated a mean of -0.89 m/year where 69.7% of transects fall under erosion and 30.2% accretion. The result from EPR and NSM revealed mean shoreline change of -0.7m/year and -30.3m/period respectively from1969 to 2010 with negative signs indicating erosion. Both EPR and NSM results showed out of 245 transects 158 or 64.4% experienced erosion and 87 transects or 35.5% accretion in the 41 year study period.Shoreline erosion was mainly attributed to anthropogenic factors. These include construction near the High Water Mark, defensive structures and sea walls, and destruction of vegetation along the beach. Therefore, it will be advantageous if all institutions and stakeholders with responsibilities for such coastal areas to work in collaboration so as to keep the coastline and its marine life and resources from further damage and erosion.

Keywords: aerial photographs, arcgis, coastline, digital shoreline analysis system, satellite image, shoreline erosion, watamu, kenya.

I. Introduction

A shoreline is defined as the interface between the land and the sea (WIOMSA, 2010) and the immediate position of the land–water line at one instant in time (Boak and Turner, 2005). Because of the active nature of water bodies and the coastal land, the shoreline is constantly changing (Paterson et al, 2010). Shoreline change depicts the way in which the position of the shoreline moves with time (WIOMSA, 2010). Several studies point out that two main factors can be responsible to change the shoreline, these are; human activities along the shore or natural processes (Richmond, 1997, Keqizhang et al., 2004, Boak and Turner, 2005, Hanslaow, D.J., 2007, Paterson et al, 2010,). An example of natural process can be sea level rise (SLR), change from storms and climate (Keqizhang et al., 2004) extreme weather events, including an increase in the intensity and frequency of waves on the shoreline face and beaches (Pearson et al., 2005). Williams and Gutierrez (2009) pointed out that sea-level rise is one of the most important impacts for shoreline change which causes variations in waves, currents and sediment availability in most US coastal areas. Shoreline can also move landwards through the process of erosion; or seawards by sediment accretion (WIOMSA, 2010). Shoreline change can also be used as a good indicator of possible coastal erosion and the best indicator for describing coastal erosion is the shoreline retreat rate (Boak and Turner, 2005).

Many beaches around the world are subject to problems associated with beach erosion and recession (Hanslaow, D.J., 2007). Paterson et al, (2010) defineshoreline erosion as the group of natural processes including; weathering, dissolution, abrasion, erosion, and transportation, by which material is worn away from the earth's surface.In Kenya Hoorweg and Muthiga (2009) reported that costal environment influenced by naturally occurring process such as erosion and sedimentation carried by Sabaki River.In addition to these natural processes, human action to control and mitigate erosion and maintain navigation channels can change the shoreline (Williams and Gutierrez, 2009). According to Richmond (1997), human actions such as the destruction of mangrove forests, seagrass beds, and coral reefs caused by tourism development can increase the exposure of the coast to wave actions which leads to erosion. In Kenya for example, a study by Kairu and Nyandwi, (2000) showed, that in the last three decades rapid development in the tourism industry has taken place on the beaches which have experienced increasing coastal erosion problems. Another study along the Kenyan coast by Government of Kenya, (2010a)indicated that in the built up areas, erosion in some cases has been exacerbated by human

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interference, with the construction of seawalls. Sea walls increase reflected wave energy, leading to erosion and flattening of the adjoining beach, an example of the effect of sea walls can be seen at Mtwapa in Kenya, where walls have been built to protect shoreline properties (Kairu and Nyandwi, 2000). According to the study by Government of Kenya, (2010a)the Kenya coastal areas are showing clear signs of damage and degradation due to over-exploitation, land use changes which has led to erosion, siltation and hydrologic modifications. The results were; loss of coastal and marine habitats, fish landing sites, beaches, turtle nesting areas, and damage to properties adjacent to the shoreline.Erosion is moderate to severe in parts of Watamu beach area (Government of Kenya, 2010b).

According to Moore et al., (2006), several coastal areas are heavily populated and have been continuously changing hence, shoreline change analysis research has become a common goal of most coastal management plans. Furthermore, shoreline change analysis has become a suitable tool to understand temporal and spatial trends of beach erosion and accretion triggered by natural and human impacts (Limber et al., 2007). Therefore, understanding the process causing shoreline change and quantifying the shoreline change rate is crucial for better coastal area management. This research focused on measurement of the rate of shoreline change and defines the drivers of shoreline erosion and accretion in the period 1969-2010 in Watamu.

II. Material and Methods

a) *Study site*

The study area is located in Kilifi County on the north coast of Kenya'scoastal region. It also borders the Watamu Marine National Park and Reserve. According to the report by Government of Kenya, (2010b) the morphology of this coastline is a fringing reef coast, comprising sandy beaches and reef limestone terraces. A study by Tychsen (2006) confirmed that the coastal region in Kenya is by and large low lying and categorized by an extensive fossil reef which lies a few meters above present sea level. The total area under study covered 9.8km starting from the mouth ofMida–Creek to the main Watamu beach front (Figure 1)up to the Jacaranda area.

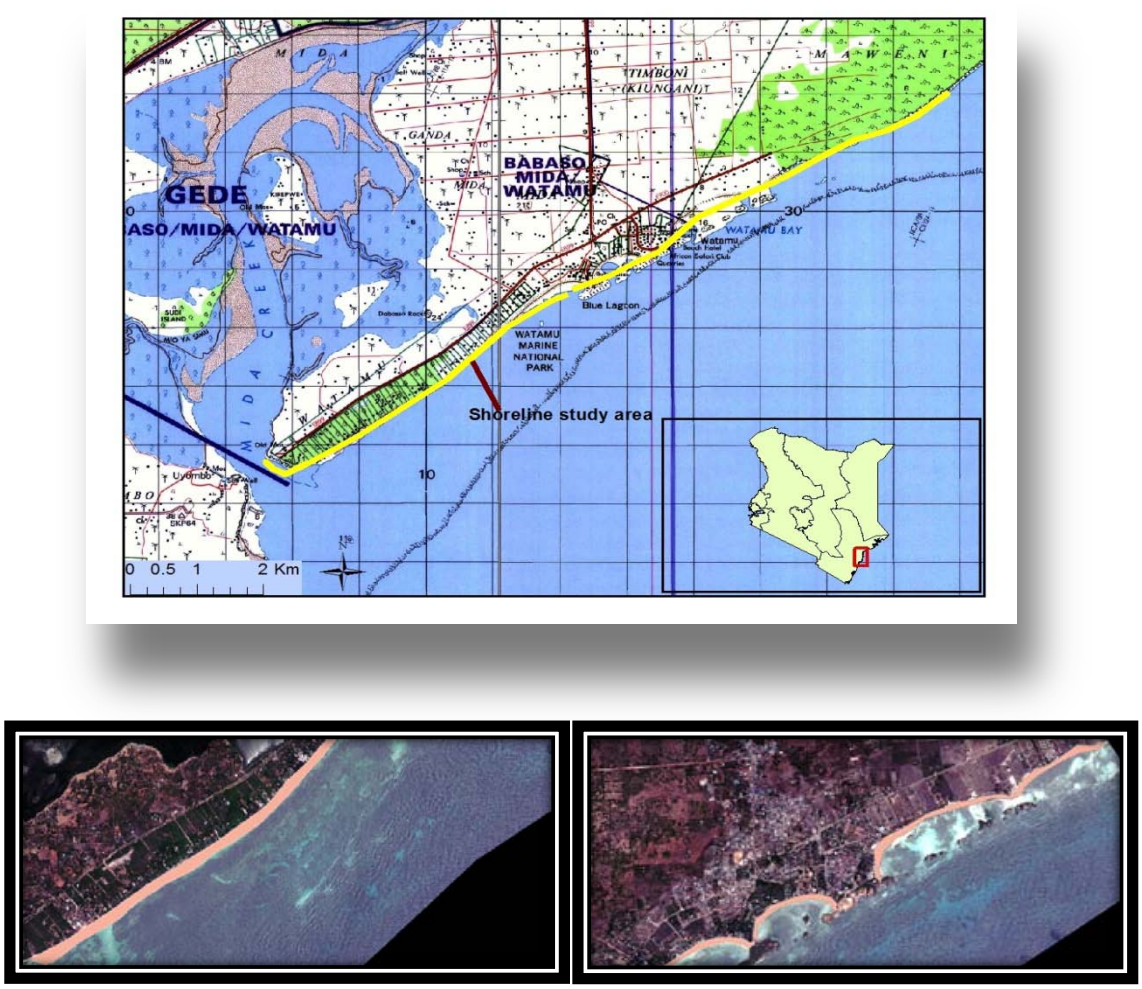

Figure 1 : Study site

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b) Data Sources and Study Approach

i. *Data sources*

The sources of shoreline data were; aerial photographs, satellite images, topographic maps and GPS points. The aerial photographs had a scale of 1:60,000 and 1: 50,000 for 1969 and 1989 respectively. The satellite image used for 2010 was WorldView with 0.5 m resolution. The aerial photographs were scanned at a minimum resolution of 800 dpi and geo-referenced using ERDAS IMAGINE 2014 software. A SPOT image of 2002 and WorldView 2010 geo-referenced satellite images were used as a source of Ground Control Points (GCP) in ERDAS AutoSync Workstation to geo-reference the aerial photographs with root mean square error of ±2m. The aerial photographs mosaiced using ERDAS IMAGINE 2014software mosaic toolbox.

ii. *Shoreline extraction*

The shoreline change datawas extracted from aerial photographs of 1969, and 1989 and satellite image of 2010 using ArcGIS.9.3.1 software. The shoreline change rate measurement followed the approach used by(Hanslow 2007, Thieler et al., 2009, Borrelli 2009,andFletcher et al., 2012)which includes: digitizing a shoreline on georeferenced images, and quantifying rates of shoreline change. Several literature suggest the use of High Water Line (HWL) shoreline indicators which include a debris line; wet/dry line and; change from low-marsh to high-marsh vegetation along marsh shorelines to delineate shoreline change (Crowell et al., 1991, Borrelli, M., 2009, Boak and Turner). According to Crowell et al., (1991) HWLis the best indicator of the land-water interface for historical shoreline studies. Based on this approach the shoreline was digitized onscreen using HWL indicator from the aerial photographs and the 2010 satellite image using ArcGIS.9.3.1 software. Additionally, GPS points collected in November 2013 and 2014 along the shoreline following HWLwere used to definecurrent shoreline.

iii. *Shoreline data analysis*

A geo-database was created in ArcGIS for the digitized shoreline positions with attribute tables for all shorelines which comprised;year, ID, shape and uncertainty. The historical change in shoreline was analyzed using a Digital Shoreline Analysis System (DSAS 4.3) computer software which is an extension for ArcGIS. The Digital Shoreline Analysis System (DSAS) computes rate-of-change statistics from multiple historic shoreline positions residing in a GIS (Thieler et al., 2009).

Three statistical methods were used to calculate the change in rates of shoreline from 1969-2010. The methods were End Point Rate (EPR), Net Shoreline Movement (NSM), and Linear Weighted Regression (WRL). In DSAS work flow the EPR is calculated by dividing the distance of shoreline movement by the time elapsed between the oldest and the most recent shoreline Thieler et al, 2009). The NSM reports the total distance between the oldest and youngest shoreline(Thieler et al, 2009).In the computation of rate-of-change statistics for shorelines, greater emphasis is placed on data points for which the position uncertainty is smaller. The weight (w) is defined as a function of the variance in the uncertainty of the measurement (e) (Thieler et al, 2009):

$$w = 1/(e^2) \quad (1)$$

Where

e = shoreline uncertainty value

The uncertainty field of the shoreline feature class is used to calculate a weight. In conjunction with weighted linear regression rate, standard error of the estimate (WSE), standard error of slope with user-selected confidence interval (WCI), and R-squared value (WR2) are obtained (Thieler et al, 2009).

The error or uncertainty that comes from different sources of data were calculated based on a number of studies(Crowell et al., 1991, Fletcher et al.,2012, Lauraand Javier, 2013). Using the approach by Laura and Javier, (2013) three main sources of errors identifiedwere; image resolution error (R), geo-referencing error (G), and a physical component of the error or shoreline proxy (D). Fletcher et al (2012), suggested the inclusion of digitization error, hence this variable was included in the following formula (Ed)

$$Ep=\sqrt{G^2 + R^2 + D^2 + \mathrm{Ed}^2} \quad (2)$$

Where

G= Geo-referencing error, R= Image resolution error, D= Shoreline proxy error, Ed= Digitization error

Using the above formula the uncertainty corresponding to each individual image was ±4.6 m and ±2.4 m for the aerial photographs and satellite image respectively.

iv. *Field verification*

Two ground truthing exercises were conducted in the study area during 2013 and 2014. In October 2013a number of GPS points were collected by walking along the beach during low tide following the HWM. At the same time digital photos were taken to improve knowledge of specific points along the Watamu shoreline (Figure 2). After the preliminary analysis of shoreline change results, an additional field verification was conducted in October 2014. During this time Focused Group Discussion and key informant interviews were conducted with;curio sellers, boat operators, fishermen, safari sellers, longtime residents, and hoteliers in order to get information about possible drivers of shoreline change in Watamu. A number of pictures were taken along the shoreline to compare with the 2013 pictures.

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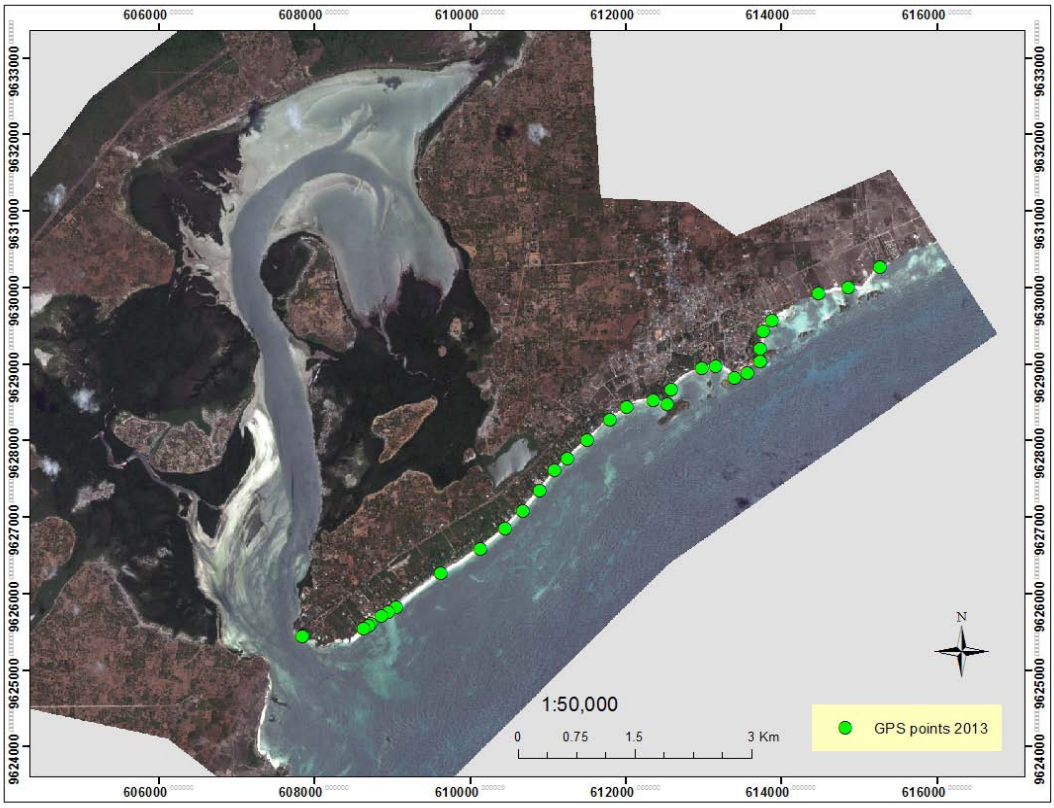

Figure 2 : GPS points taken in 2013 following the HWM overlaid on the satellite image of 2010

III. Result

a) *Shoreline changes*

The Watamu shoreline covers 9.8km was digitized from 1969 and 1989 aerial photographs and 2010 satellite image (Figure 3). A total of 245 transects were generated with 40 m spacing and an average change rate calculated from 1969 to 2010.

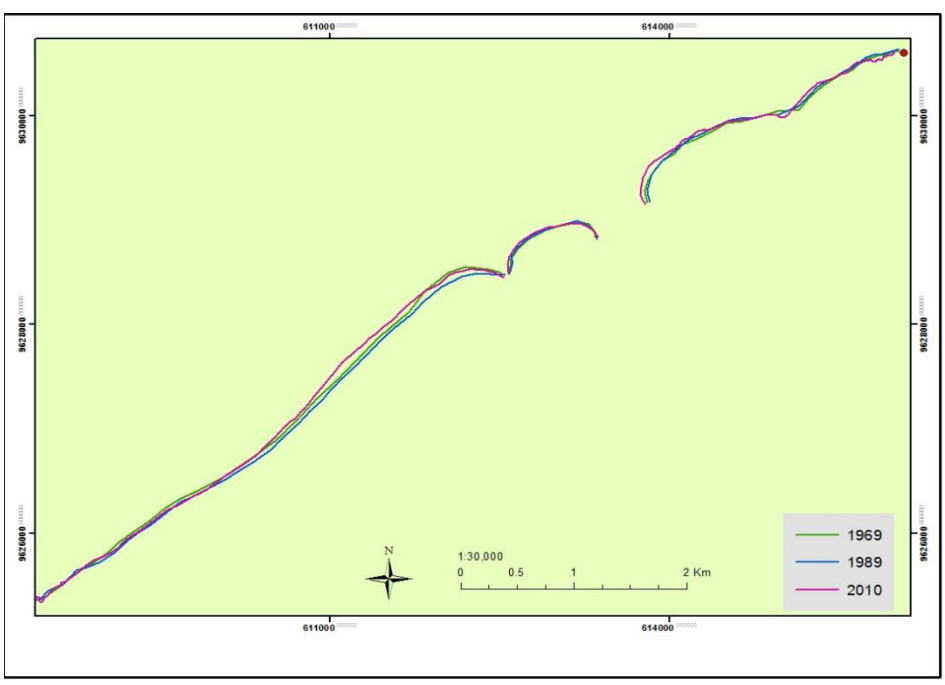

Figure 3 : Extracted shorelines

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The shoreline analysis for the period 1969-2010 revealed that most of the beach front underwent erosion with accretion observed in small patches. The WLR shoreline analysis for the beachfront showed a mean of -0.89 m/year where 69.7% of transects fall under erosion and 30.2% accretion (Table 1).This analysis gives emphasis on data points for which the position uncertainty was smaller. The EPR and NSM analysis revealed mean shoreline change of -0.7m/year and -30.3m/period respectively from1969 to 2010 (Table 1). The mean shoreline movement from 1969 to 2010 was -30.3m/year with a standard deviation of 19.4. The EPR calculates the rate of shoreline change whereas the NSM reports the distance between the oldest and youngest shorelines for each transect. Both EPR and NSM results showed 158 transects or 64.4% experienced erosion, and 87 transects or 35.5% with accretion (Figure 4 and 5).

Table 1: Overall shoreline change rates from 1969 to 2010

Shoreline Statistics	Shoreline change (m/year and m/period)	
	Erosion	Accretion
End point rate (EPR) (m/year)	-0.74	0.47
Weighted linear regression (WLR) (m/year)	-0.89	0.41
Net shoreline movement (NSM) (m/period)	-30.3	19.5

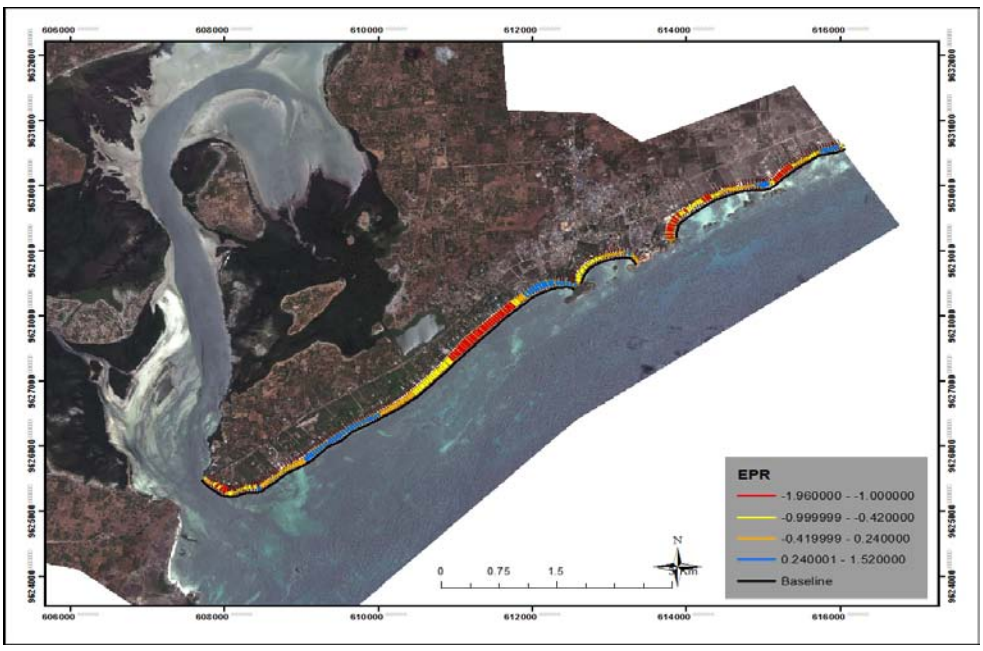

Figure 4: Rate of shoreline change (EPR m/year) along the shore from 1969-2010(all negative signs shows erosion, whereas the blue color shows accretion)

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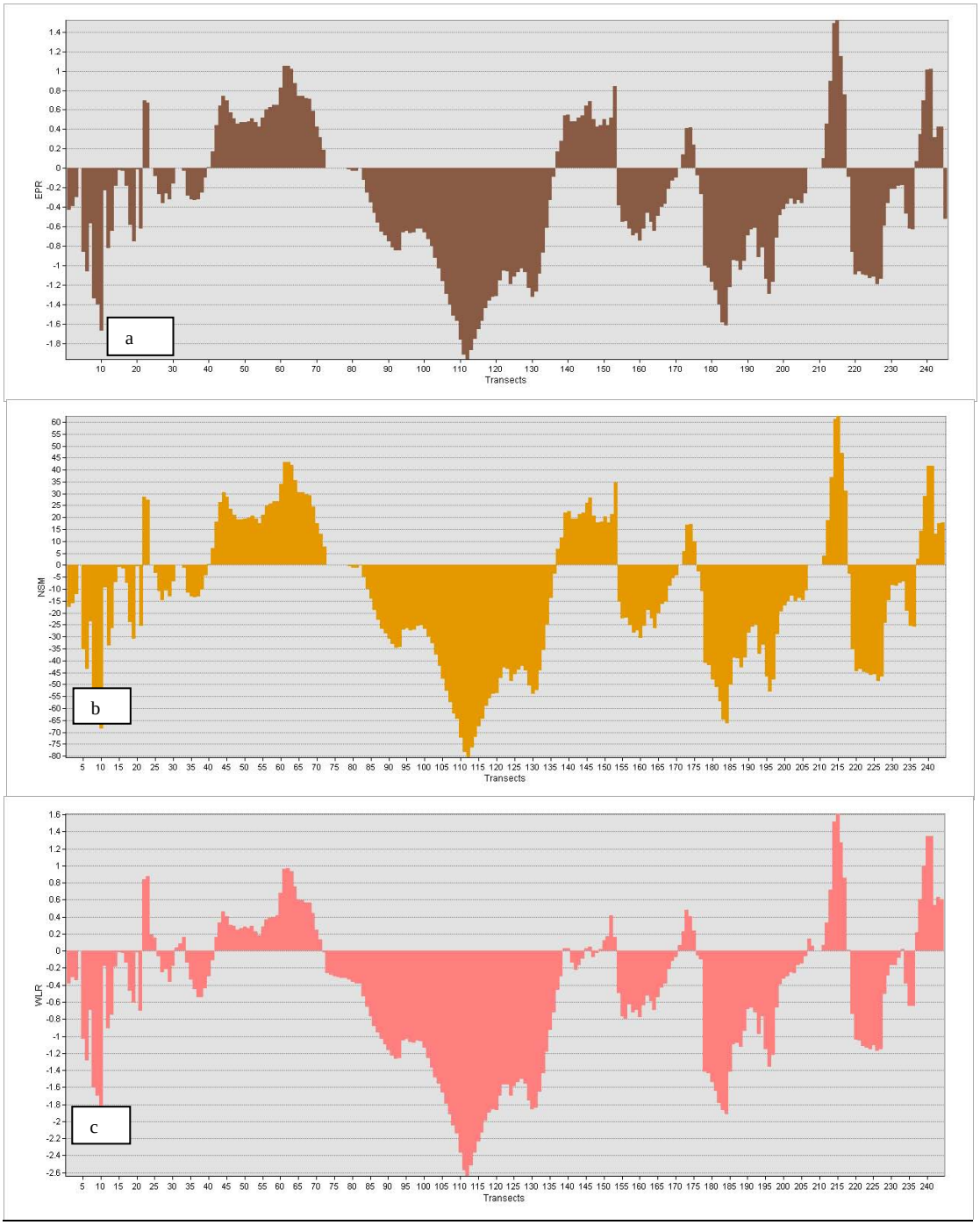

Figure 5 : Graphs of the shoreline changes 1969-2010, (a) End Point Rate (EPR), (b) Net Shoreline Movement (NSM) (c) Weighted Linear Regression (WLR). The EPR and WLR units are in m/year, while NSM is m/period. Most of the graph is in the negative area (i.e. below the line) which indicates shoreline erosion

b) Shoreline change trends

The result from the three shoreline analyses (EPR, WLR, and NSM) show that the shoreline has retreated (in general) along the Watamu beach over the last 41 years (Figure 6 and Table 2). The shoreline was divided in to sections comprising 50 transects each. Section S1 and S2 at the beginning of the Mida Creek entrance show a mean change of -0.25 and -2.1 m/year respectively (Figure 6 and Table 2). This result agreed with the EPR shoreline change analysis rates except that some of the area under EPR showed some accretions (Figure 6). Major erosion (retreat) was observed in S3 with the WLR mean of -1.32. The EPR analysis and the information gathered during ground truthing has shown similar shoreline erosion in this section (Figure 6). Section S4 and S5 also showed shoreline erosion though the rate of change is not as high as S4 (Figure 6

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and Table 2). According to Thieler et al, (2009), the R^2 statistic has a dimensional index that ranges from 1.0 to 0.0, the smaller the variability of the residual values around the regression line, the better the prediction.

Table 2 : Weighted Linear Regression (WLR) from 1969 to 2010

Section number	Transect number	Mean	WR2 (R^2)	St. Deviation
S1	1-49	-0.25	0.5	0.57
S2	50-100	-0.21	0.4	0.69
S3	101-149	-1.32	0.5	0.82
S4	150-200	-0.65	0.8	0.61
S5	201-245	-0.01	0.6	0.77

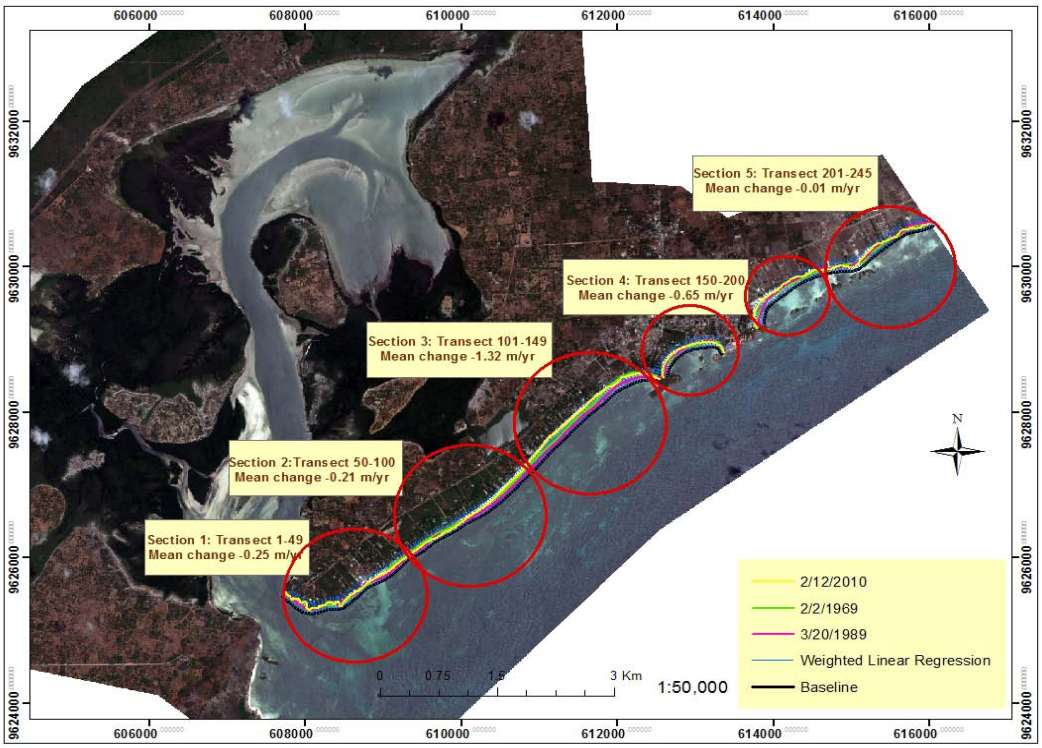

Figure 6 : WLR mean Shoreline change rates by sections (transects) from 1969-2010 (presentation adopted from Chaaban et al., 2012)

Numerous studies have used the ArcGIS extension DSAS to calculate long term shoreline erosion change rates (Borrelli 2009, Hapkeet al.,2010, Appeaning et al., 2011, Fletcher et al., 2012).In Kenya there was a research in Bamburi,Mombassa using an alternative methodology based on beach width measurements and a hydrodynamic parameters(Mwakumanya et al., 2009).

The outcome of the analysis from this study was similar with that of Fletcher et al., 2012. Based on Fletcher et al's., (2012) study on historical shoreline change in the Hawaiian Islands (1928-2006), long-term rates from all transects on the three islands are -0.11 ± 0.01 m/yr and 70% of transects indicate a trend of erosion.Another study in Keta, Ghana, using the same methodology came up with an erosion rate change ranging from 0.1 to 15.4 m/yr and accretion rates ranging from 0.1 to 21m/yrfrom a period of 25 years (Appeaning et al., 2011). However in each of these studies results from the analyses can differ depending on both the natural and human factors that cause variation in shoreline changes in each context.

IV. Discussion

Assessment of shoreline change rates showed a trend of shoreline erosion along Watamu coastline. Most of the beach underwent erosion while some part of the beach accreted during the study period. The observed patterns of erosion and accretion along the Watamu shoreline resulted from both natural and human impacts. Most of the shoreline was exposed to natural shoreline phenomena such as waves, tides and

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periodic storm surges. It was noted that during the southeast monsoon the shoreline showed signs of greater erosion, which was evidenced from uprooted trees and severely affected hotel and private property beachfronts (Figure 6 &7).The shoreline from Section 1 to Section 3 (S1-S3), as shown (Figure 6 above) was exposed during the southeast monsoon where the waves exert a strong alongshore influence on the beach causing movement of shoreline materials from one location to another. These findings confirm, a wider trend along the Kenyan coast, concerning the southeast monsoon as reported (Government of Kenya, 2010 (a)).

Figure 7 : Indicators of shoreline erosion in the study area. Pictures taken in; 2012, 2013 and 2014

Another natural factor which attributes to shoreline erosion in the study area isthe fine sandy nature of the beach material which makes it easily susceptible to erosion during periodic surges (Figure 8). Watamu beach has a fringing reef coast consisting of sandy beaches and reef limestone (Government of Kenya, 2010(b)).Coastal areas which are dominated by unconsolidated sediments are more susceptible to coastal erosion (IOC-UNEP- WMO-SAREC, 1994).

Figure 8 : Watamu beach front along the Long beach where the beach is covered by natural riparian vegetation and few tree species including Cocos nucifera, Casuarin equisetifolia and Pomoeapes-caprae,(photo taken during southeast monsoon period)

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Human impacts such as;areas where the riparian vegetation was cleared to expand the recreational beachfront and to get a better view of the sea, construction of sea walls to control shoreline erosion, and building developments near the HWM are all considered to be major contributors to shoreline erosion (Figure 9 &10). Along the beach several tourist hotels and expensive residential/holiday houses were observed, withsome of these being built just a few meters away from the High Water Mark (HWM)making them susceptible to flooding during spring tides(Figure 9).Studies conducted by IOC-UNEP-WMO-SAREC, (1994), indicated that; Diani, Shelly beach, Nyali, Bamburi, Kikambala,Watamu and Malindi coastal tourist centers are located on level (I) that is 0-5 meter above sea level and level (II) 5-10 meter above sea level.

Figure 9 : Some of expensive investments near the HWM

The Survey Act (Cap 299) of Kenya, provides a set-back of not less than 60 meters above HWM (Government of Kenya, 2010(a)).However the reality on the ground proved that this set-back was not appliedto some of the tourist hotels and houses (Figure 10). As reported in the shoreline change rate analysis Section 3 (S3) demonstrated marked erosion, this result agrees with other similar shoreline studies. For example a study in the Caribbean revealed that the shoreline has been significantly altered by human action such as coastal infrastructure (Restrepo et al., 2012). Another study in Ghana confirmed the impact of increased population along the coast followed by rapid urban development has been the main driving force for coastal erosion (Appeaning et al., 2011). A study of Bamburi beach, Kenya, also confirmed the anthropogenic activities such as recreational activities resulting in a trampling effect of the beach sediment aggravates shoreline erosion as the sediment gets loosened and carried away by the stronger waves (Mwakumanya et al., 2009).

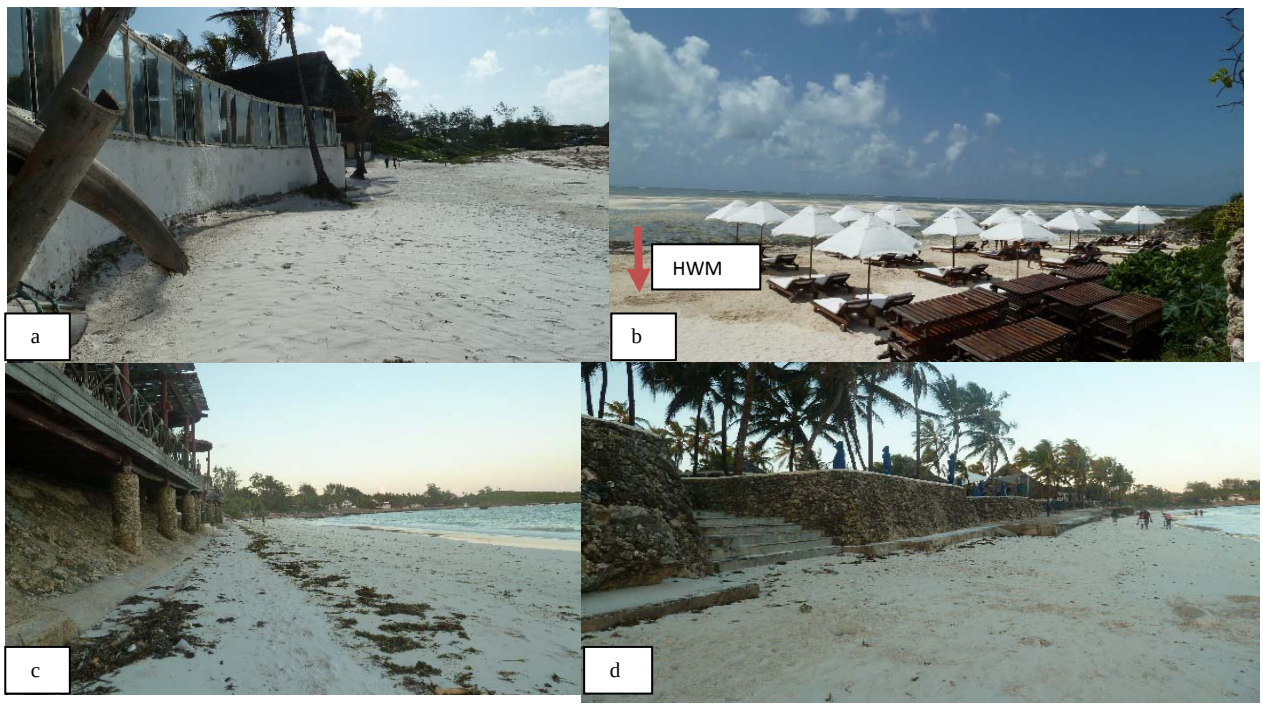

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Figure 10: (a) Construction near HWM, (b) Impact of recreational activities along the beach, (c,d) construction of sea walls ,(e) (2007),(f) (2014)clearing of riparian vegetation and natural dune

It was observed during field verification the construction of sea walls to combat shoreline erosion has caused major shoreline erosion and property damage in adjacent plotson the beachfront (Figure 11). Other studies have also confirmed the impacts of such sea walls, for example a study in Diani, Bamburiand Kikambala, revealed beach erosion and rapid degradation of the beach resources as the result of sea walls (IOC-UNEP- WMO-SAREC, 1994). Astudy by Kairu and Nyandwi (2000) reported the impact of sea walls as the cause for the increase in reflected wave energy leading to the erosion and flattening of adjoining beach areas. A study in America by Hapke et al., (2010) indicated that the emplacement of shoreline protection structures such as; seawalls, bulkheads, and barrages can result in erosion of the beach.

Figure 11 : Adjacent properties affected by erosion displaced by sea walls and other fortifications

Information gathered during Focused group discussions with community representatives and longtime residents (through key informant interviews) confirmed how different human induced activities and developments along the beachfront have caused shoreline erosion as well as destruction of turtle nesting grounds. Respondents also mentioned that the night lights from some tourist hotels have disorientated newly hatched sea turtles, leading to lower survival rates. Watamu beach is a high priority turtle nesting area (Figure 12), and according to a report by the UNIDO COAST project (2014), five species of sea turtles can be found in the study site.

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Figure 12 : (a)Turtle nesting areas marked by Kenyan Wildlife Services (b) turtle nesting site on a private beach plot (c, d) A good example of beach bank rehabilitation in Watamu

V. Conclusion

Watamu beach is one of the key tourist beach destinations in Kenya with a stunning white beach and a large variety of bird and marine life. The livelihood of the people also largely depends on income generated from different touristic activities. This study has demonstrated that almost 69% of the beachfront has undergone erosion in the period 1969-2010. The use of DSAS to calculate long term shoreline change was found to be very useful. A study of this kind is very valuable in helping to prepare a strategic coastal management plan and for future policy intervention.

Both natural and anthropogenic factors were observed to contribute for shoreline erosion and accretion. However the influence of human actions on accelerating shoreline erosion is a major concern. Construction of hotels or houses near the High Water Mark, sea defense structures or sea walls to combat beach erosion, high trampling effects due to orientated touristic activities, and destruction of vegetation along the beachfront were all observed to be aggravating shoreline erosion. These can all be easily observed when comparing areas covered by; indigenous coastal vegetation, under rehabilitation, and without coastal defensive structures.

In Kenya there are several parliamentary Acts and supporting legislation to protect and conserve riparian areas and marine environments. However, there is a problem of law enforcement and lack of regulation specifically on the 60 meter set-back regulation to prevent construction within such areas. Therefore, it will be advantageous if all institutions with responsibilities for such coastal areas to work in collaboration so as to keep the coastline and its marine life and resources from further damage and erosion. Rehabilitation of the shoreline with indigenous coastal vegetation is a good practice which needs to be replicated along the beach where major shoreline erosion is a problem. There should be a multi stakeholder discussion on the aesthetics of Watamu as a major tourist destination focusing on different shoreline protection practices, namely building of sea walls or, rehabilitation using natural vegetation protection techniques.

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Hydrogen Production by Electrolysis of Water: Factors with an Influence on the Corrosion

By Bouazizi Nabil, BenSlama Romdhane, Bargougui Radhouane, Lazhar Labiadh & Natija Barhoumi

ENIG/ University of Gabes, Tunisia

Abstract- For a better understanding toward corrosion in metallic electrode of copper and aluminum. Such factors with an influence on the corrosion were investigated via the hydrogen production process by electrolysis of water. The phenomenon of electrode corrosion was studied, and the corrosion is resulted in the appearance of large blisters and a gelatinous alumina gel Al $(OH)_3$. In addition, the measurements tests of reaction mid, used time, deposit, temperature of electrolyte and degree of pH on the metal corrosion regions were also conducted. According to the test results, the corrosion was strongly affected by these factors. Furthermore, the corrosion was necessarily depends on the medium pH value, an increase in temperature greatly increased the corrosion rate and the surface can be covered with a deposit of corrosion products (metal oxide hydrated, insoluble salts). The role of this film can influenced the corrosion was worsening the attack.

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HYDROGENPRODUCTIONBYELECTROLYSISOFWATERFACTORS WITHANINFLUENCEONTHECORROSION

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Hydrogen Production by Electrolysis of Water: Factors with an Influence on the Corrosion

Bouazizi Nabil [α], BenSlama Romdhane [σ], Bargougui Radhouane [ρ], Lazhar Labiadh [ω] & Natija Barhoumi [¥]

Abstract- For a better understanding toward corrosion in metallic electrode of copper and aluminum. Such factors with an influence on the corrosion were investigated via the hydrogen production process by electrolysis of water. The phenomenon of electrode corrosion was studied, and the corrosion is resulted in the appearance of large blisters and a gelatinous alumina gel Al $(OH)_3$. In addition, the measurements tests of reaction mid, used time, deposit, temperature of electrolyte and degree of pH on the metal corrosion regions were also conducted. According to the test results, the corrosion was strongly affected by these factors. Furthermore, the corrosion was necessarily depends on the medium pH value, an increase in temperature greatly increased the corrosion rate and the surface can be covered with a deposit of corrosion products (metal oxide hydrated, insoluble salts). The role of this film can influenced the corrosion was worsening the attack. Among the treating conditions investigated in this study, different effects on the corrosion in the aspects can be simplifying the corrosion phenomenon.

I. Introduction

The water electrolysis to produce hydrogen was the most common and most prized method. Indeed, the use of solar energy in electrolysis processes proved to be the method most cost-effective and protective of environment [1].

H_2 production by electrolysis water is also dependent on factors that directly affect the efficiency of H_2 production [2]. Thus products distribution depends on the environmental conditions. In fact, electrolysis water has received much attention which is easily controlled by different parameters [3]. Because of these unique features, water is employed as a medium for various reactions, and is used for a diverse range of applications.

Here, the corrosion is explained by the materials deterioration of chemical interaction with their environment. In addition, term corrosion is applied to the degradation of concrete and wood.

Although experimental data on the effect of many parameters on corrosion are limited, the studies available to date strongly indicated that the effects were one of the most critical parameters that affect corrosion.

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In fact, the corrosion consequences are varied and the effects of these on the safe, reliable and efficient operation of equipment or structures are often more serious than the simple loss of a mass of metal [4]. Failures of various kinds and the need for expensive replacements may occur even though the amount of metal destroyed is quite small. Some of the major harmful effects of corrosion can be investigated in the present work, when the metal is lost in localized zones. Starting from the study of water electrolysis, the effect of temperature, time, reaction medium, and the deposit are studied.

II. Corrosion Study

The chemical cause due to corrosion was the tendency of the material to return to its original state in the ore. Corrosion was a purely chemical reaction between the surface of the material and a gas or liquid.

The used electrodes in our work to produce hydrogen were based on aluminum (anode) and copper (cathode) Fig. 1. In fact, the metallic electron current contact with the ion current electrolytic contact was on the head corrosion generally.

In order to edit the corrosion mechanism, it is recommended to detail the electrochemical degradation. The type of degradation was an electrochemical corrosion where is an electric current flow to the material surface with aluminum as electrode. The different equations liable to corrosion of aluminum are:

$$Al + 3H_2O \longrightarrow Al(OH)_3 + 3/2H_2 \uparrow$$

$$Al \longrightarrow Al^{3+} + 3é$$

$$3H^+ + 3é \longrightarrow 3/2\ H_2 \uparrow$$

This phenomenon is encountered particularly aerated solution, in fact in such a medium the oxygen consumption at the metal-electrolyte interface, and then the reaction is limited by the transfer material [5]. This corrosion resulted in the appearance of large blisters and a gelatinous alumina gel Al $(OH)_3$ Fig. 2.

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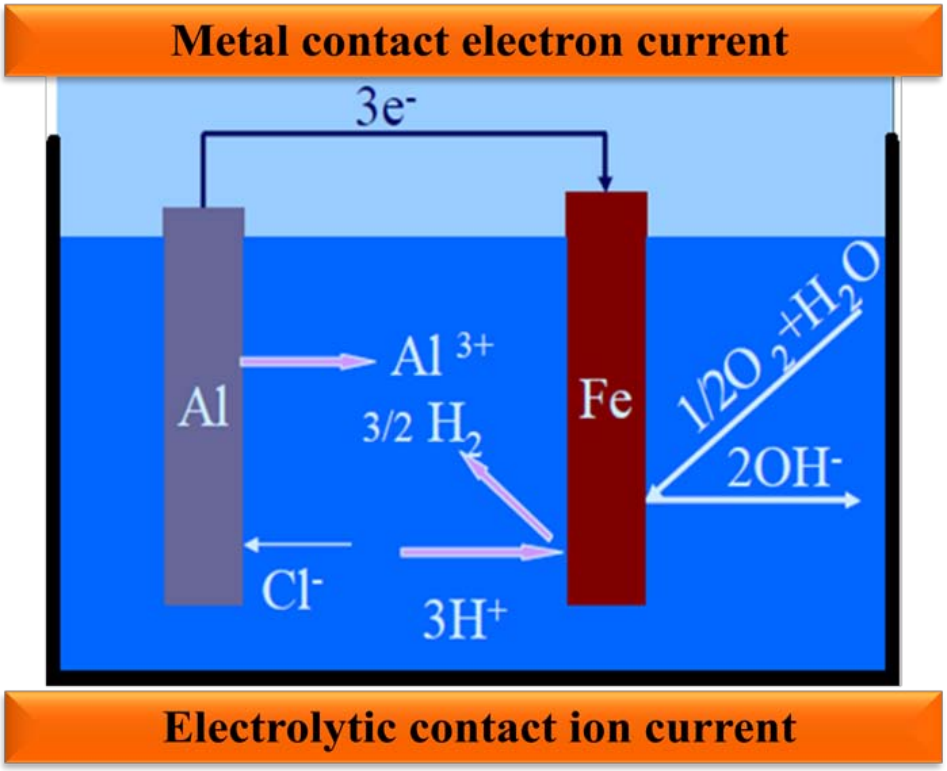

Figure 1 : Different equations occurred during the corrosion

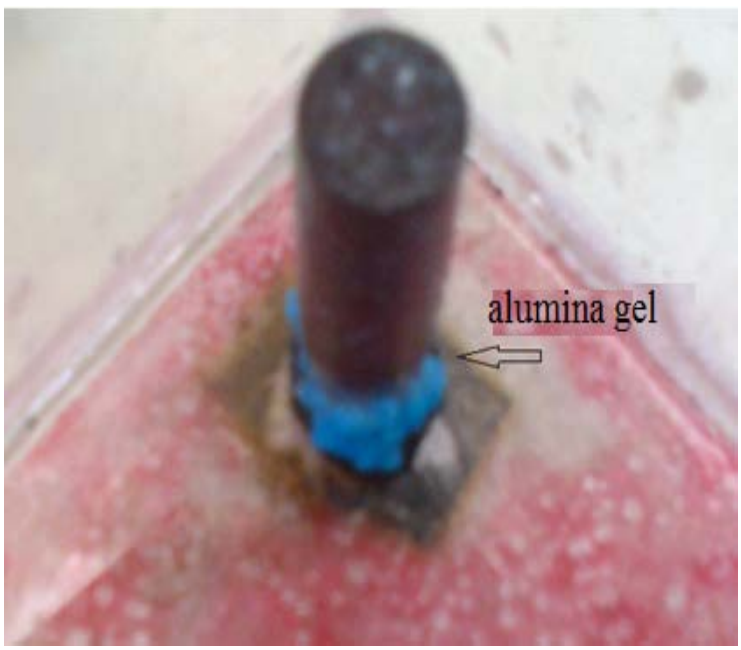

Figure 2 : Voluminous pustules and gelatinous of an alumina gel Al $(OH)_3$

III. Corrosion Phenomenon

Electrochemical corrosion resulted in dissolution of all points constituent of the material surface that is attacked by the corrosive environment. This was done by a micrographic scale globally steady decrease in thickness or weight loss of the material [5]. The metal material (aluminum) was in contact with a liquid electrolyte (presence of ions). Indeed, the attack was the anode regions and the intact was the cathode regions.

In fact, the corrosion phenomenon was the following sequence of steps:

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1) Dissociative adsorption of water on the support surface and formation of hydroxyl groups.
2) Migration of OH groups in the carrier surface and transfer to the metal.
3) Adsorption and dissociation of water to the metal surface [6].
4) Desorption of the products.

Also it was shown that in step (1) is kinetically limited and migration of surface hydroxyl groups of the support. Consequently, these reaction medium are strongly influenced the corrosion including how the chemical nature of electrolytes, composition, impurities pH (acidity), temperature, pressure, viscosity, solid deposits and agitation can cause corrosion.

IV. Corrosion Factors

a) Effect of the mid

When the pH deviates from neutrality (4 <pH <9), the corrosion results very quickly by a violent attack. The dissolution between the electrolyte and the electrode may vary depending on the acid or base. Indeed it can be define the dissolution rate by the mass loss of a few micrometers material per year to a few micrometers per day [7]. In neutral environments, general corrosion rate was very low but not zero. All of these results can be explained by the oxygen concentration which usually gives information of an increase or decrease in corrosion rate.

Additionally, in this case it noticed that corrosion necessarily depends on the medium pH value. In fact for most acidic environments found discoloration of the electrolyte, and the current was more intense which confirms the points separation existence of the materials with the electrolyte. The same is observed for pH values lower than 5, a decrease in the deposition solution is observed, it is translated by the absence of the alumina gel which minimizes corrosion [8]. In the range of 7-12 corrosion rate is fairly dependent of pH whereas for basic environment deposit formation is observed Fig.3.

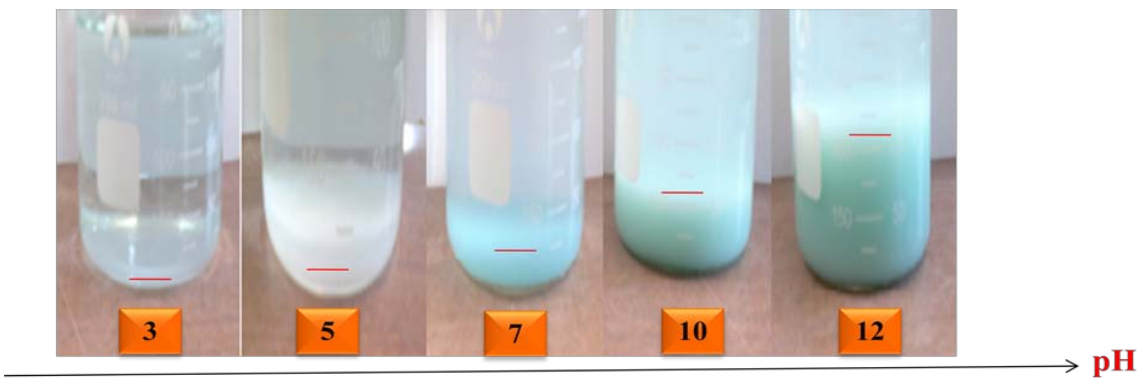

Figure 3 : Evolution of corrosion for different pH

b) Effect of temperature

Generally, an increase in temperature greatly increased the corrosion rate. This phenomenon can be explained by the fact that the anodic process (oxidation of the components of aluminum) and cathode (reduction in acid medium protons) are thermally activated. The exchange resulting current and representing the corrosion rate increased with the temperature.

c) Effect of deposit

When a material (aluminum) undergoes corrosion in an aqueous solution, its surface can be covered with a deposit of corrosion products (metal oxide hydrated, insoluble salts). The role of this film can influenced the corrosion is worsening the attack. A change product specification then allows defining the mechanisms governing the corrosion deposit.

Precipitation of corrosion products on the surface of a metal which corrodes is linked to a local solubility problem. The solubility limit is by experience, rarely achieved in all of the liquid; it is only at a liquid layer on the surface of the metal as corrosion product may precipitate. In other words, the precipitation of corrosion products involved initially because the cation diffusion in the liquid phase does not dissipate the flow of metal ion-induced corrosion. This effect can lead to corrosion with a possibility of pitting.

d) Effect of material nature

It was shown that the composition, processing, metallurgical, (thermal and mechanical treatments) impurities additions were most important to the corrosion state of such material. The aluminum was an amphoteric metal, it can be dissolved both in acid medium (Al^{3+}). The resistance of aluminum alloys is limited to neutral environments or very close to neutral (4 <pH <9) [5]. At low pH (acidic water) or in the presence of high concentrations of chloride copper tends to dissolve. However in our case, we note that the electrode corrodes aluminum of trying to time while watching a thickness reduction which controls the corrosion rate Fig.4.

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Figure 4 : Change in thickness of the aluminum electrode for different handling

e) Effect of Electrolyte concentration

For our experimental study allows us to control the corrosion rate of deposit formation at the level of the electrolyte. Therefore it is found that corrosion increased with the increase of the mass concentration of the liquid Fig. 5. The resistance of aluminum alloys is therefore limited to neutral media or very close to neutral (4 <pH <9).

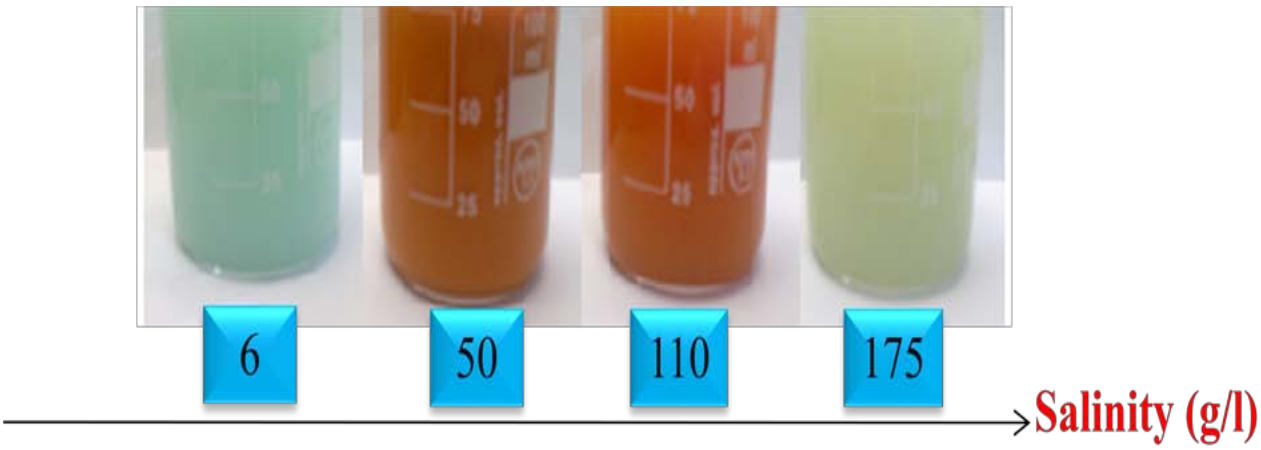

Figure 5 : Variation of the coloration of the electrolyte in function of the concentration

f) Effect of time

Aging structure, changing tension and temperature depend on the duration of use. Fig.6 shows that increasing the time cause the corrosion, in fact increasing the time minimizing the flow of hydrogen where the corrosion of the material was produce.

Here, the production duration are strong influenced on the corrosion and aging of the material structure using the deposit as corrosion controller.

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Figure 6 : Evolution of the corrosive condition of the electrodes

i. *Effect of the conception*

The surface condition, shape, assembly and contact with the medium, (partial or total immersion) are elements that affected the corrosion of materials Fig 7.

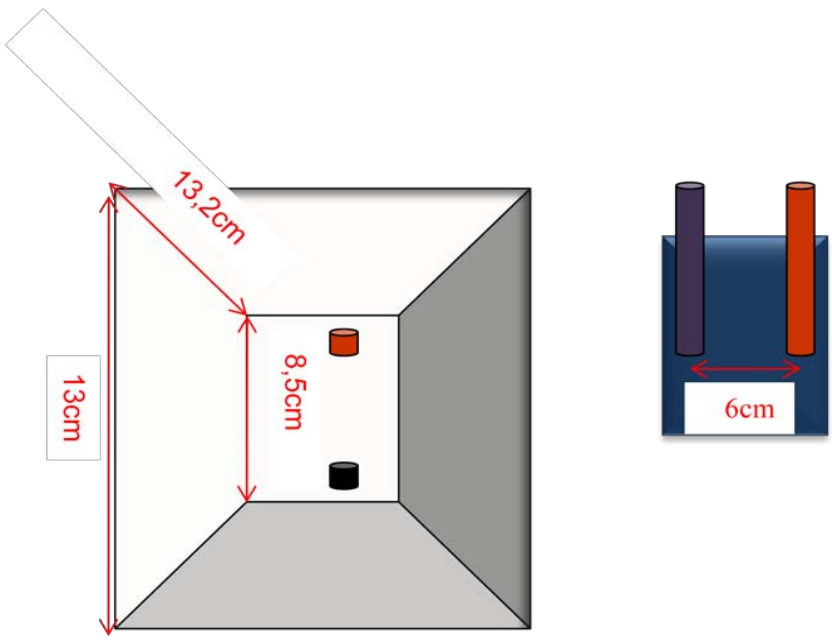

Figure 7 : Parameterization of the electrolyzer surface

g) Effect of the deposit

The most common form of corrosion is expressed by The uniform dissolution of the metal surface in contact with the corrosive agent. The metal to active controllable by weight loss measurements or decrease in thickness of the metal. The corrosion rate can be controlled by the amount of precipitate that persists for different electrolytes, indeed in our case note that the deposit increases in acid-base medium, while it decreases in a neutral medium and for close pH values neutrality Fig 8.

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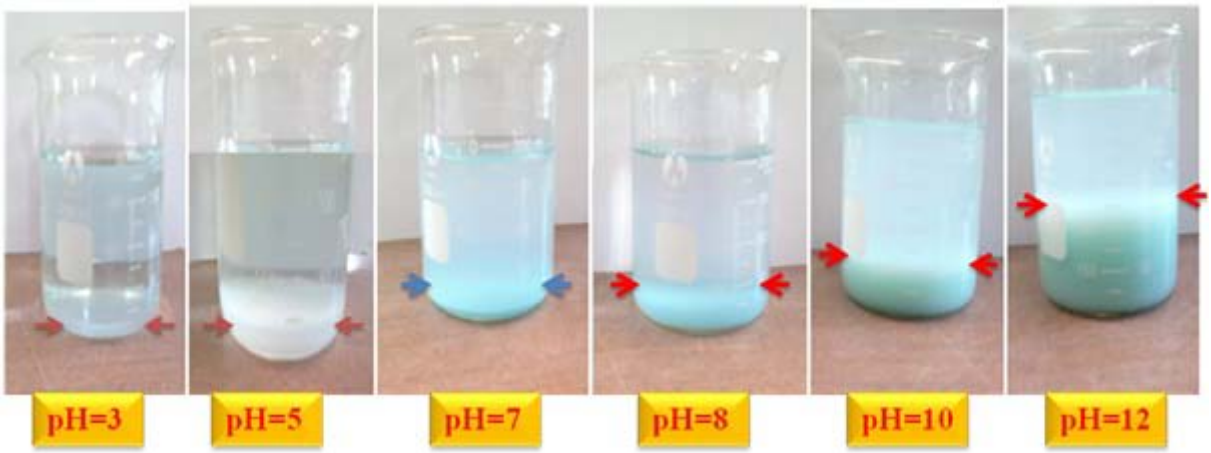

Figure 8 : pH influence on the corrosion rate

V. Conclusion

The corrosion behavior of aluminum/cooper electrodes and the electrolyte were studied using the production of hydrogen by the water electrolysis. Current experimental results are new and important to specify the corrosion by different factors which affected. Indeed, the nature and used time of electrode, electrolyte temperature, reaction mid, showed strongly corrosion in simulated water electrolysis environment.

From a comprehensive consideration, the study of the hydrogen production by water electrolysis, and forming the deposition were carried out in this study. The variation of their factors evidently, the media reaction nature, including any examination of the results, shows that current density is higher in acid-base environments.

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Climate and Crime

By Ashutosh Mishra

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Abstract- Few issues provoke as much public concern as violence. Persistent variations in the homicide rates of different countries have led sociologists, criminologists and geographers to question why violence, and lethal violence as an extreme example, is more common in some societies than in others. This paper focuses on one possible explanation: climate, and especially temperature. The analysis is based on monthly crime, temperature, relative humidity and precipitation data of 62-year period (1952 to 2013) of Allahabad city, India. Results show that temperature has a significant positive impact on criminal behavior, and murder incidences in Allahabad city were high in hot months. Relative humidity too seems having significant and positive influence on crime rate, while rainfall showed a negative correlation with crime pattern. Results reveal that climate-crime association follow a linear relationship and crime rate increases with rise in temperature.

Keywords: violent offenses, social interaction theory, ambient temperature, geographic resolution.

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Climate and Crime

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Keywords: violent offenses, social interaction theory, ambient temperature, geographic resolution.

I. Introduction

Scientists have long been wrestling on the effects of climate on human behaviour, including crime (Sorokin, 1928; Parker, 2000). There is considerable evidence that weather does affect criminal behavior (Brunsdon et al, 2009; Bushman, Wang, and Anderson, 2005; Cohn and Rotton, 2000; Cohn, 1990). Simister and Cooper (2005) observe a strong linear relationship between severe crime and temperature. In a study, Jacob, Lefgren, and Moretti (2007) find that rates of violent crime are elevated during weeks with hot weather.

Although studies suggest a plausible relationship between climate and criminal offences, there is disagreement between researchers on the effects of temperature on violence whether it is linear or curvilinear (Anderson et al., 2000; Rotton & Cohn, 2002; Rotton, 1986, 1993). Some writers, such as Van de Vliert et al. (1999), report evidence to support a 'curvilinear hypothesis': violence tends to increase with higher temperatures, up to a daytime temperature about 24°C, but then declines with further increases in temperature. Simister & Cooper (2005) reach an opposite conclusion: that there is more violence at very hot temperatures. Although these two claims are not as different as they appear – over a range of roughly 8 to 24°C, both groups of researchers claim violence tends to increase at higher temperatures.

Present paper focuses on the controversy of high temperatures: does violence fall above 24°C, or does violence continue to increase at higher temperatures? The study uses month-wise time series data of 62 years period (1952 to 2013). Murder is the most violent crime in all criminal offences hence the study deals with incidence of murders/attempted murders only for analyzing climate-crime association. The explanatory variables are temperature, humidity and rainfall. Annual crime data has been derived from National Crime Record Bureau (NCRB) while monthly crime data was collected by the various police stations of Allahabad city and from crime record bureau of Uttar Pradesh. Temperature and rainfall data was obtained from the local weather station, and from India Meteorological Department (IMD). The study uses simple correlation and regression techniques to understand climate-crime correlates.

II. Results

Results suggest that incidence of violent crime has significant association with climatic elements i.e. temperature, relative humidity and rainfall. Figure 1(a) shows very striking connection between temperature and crime (r = 0.75), and the rate of murder/attempted murder tends to increase with rise in temperature. It is evident from Figure 1 (b) that the relation between relative humidity and crime is strong (r = 0.68), while Figure 1(c) shows that rain has a negative impact on crime (r = 0.14), and violence decreases with increasing rainfall.

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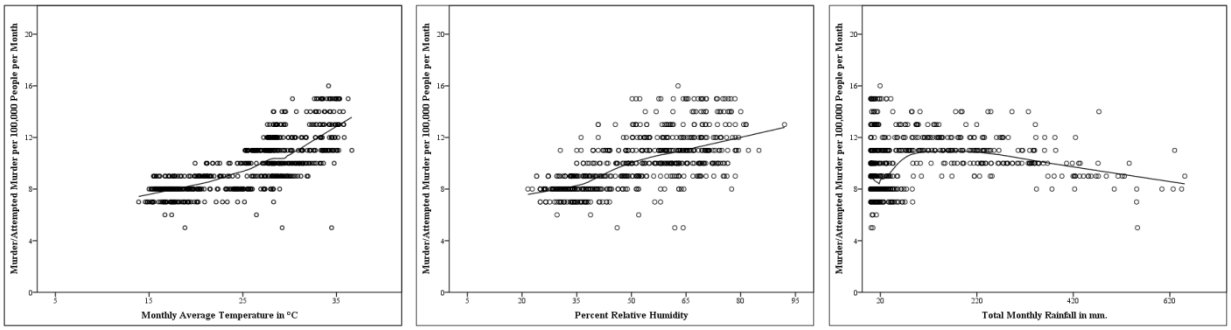

(a) (b) (c)

Figure 1 : Incidence of murder/attempted murder versus Temperature, Relative Humidity and Rainfall

Figure 2 presents the combined impact of all these factors on crime rate. It is evident that hot and humid months have recorded more criminal offences, while wet months, even having high temperatures, have registered less crime incidences comparatively.

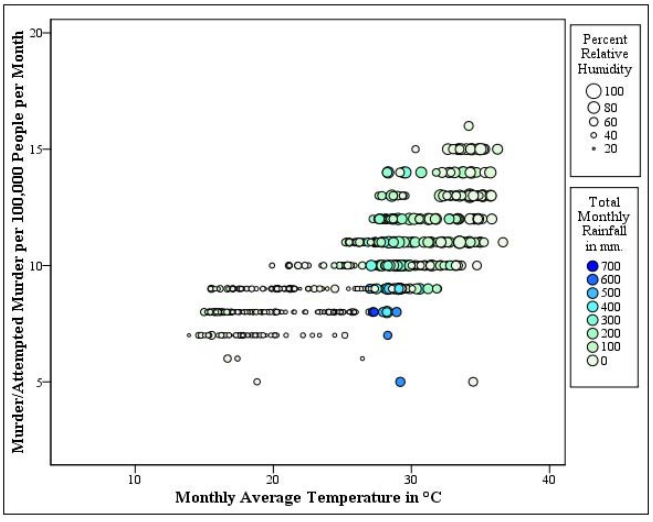

Figure 2 : Association of severe criminal offences with climatic elements

Month-wise correlates of climate and criminal offences support the linear hypothesis that rate of crime increases with rise in temperature, for such situations where average temperature varies between 16 to 35°C (Table 1). Relative humidity although has a significant and positive association with crime, yet, temperature is the most influencing variable among all climatic factors.

Table 1 : Crime statistics of Allahabad city (1995-2012)

Month	Average Temperature in °C	Average Rainfall in mm.	Average Relative Humidity in per cent	Correlations		
				Murder versus temperature	Murder versus Rain	Murder versus Humidity
January	16.3	26.3	38.8	0.19	-0.07	0.06
February	19.0	16.4	33.5	0.21	-0.05	0.19
March	24.8	13.1	32.8	0.24	-0.03	0.11
April	30.1	4.5	54.1	0.32**	-0.03	0.10
May	34.0	8.8	66	0.35**	-0.16	0.21
June	33.4	107.5	68.9	0.34**	-0.17	0.28*
July	29.4	288.2	70.6	0.29*	-0.28*	0.26*

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August	28.2	336.9	63.1	0.27*	-0.32*	0.19
September	28.0	178.1	53.6	0.26*	-0.26*	0.02
October	26.0	29.7	47	0.26*	-0.25*	0.12
November	21.1	10.8	37.4	0.20	-0.01	0.13
December	17	6	31.9	0.18	-0.18	0.12

*: $p < 0.05$; **: $p < 0.01$.

Source: NCRB, IMD

Regression analysis is a more convincing approach to test the hypothesis that the three variables- temperature, humidity and rainfall have determining influence on the crime rate of a region. Stepwise regression results are shown in table 2.

Table 2 : Step-wise regression result showing climate-crime co-variance

Model	R	R Square	F
1	0.75[a]	0.56	937.76***
2	0.76[b]	0.58	514.41***
3	0.78[c]	0.61	380.37***

***: $p < 0.001$

a. *Predictors:* Monthly Average Temperature in °C
b. *Predictors:* Monthly Average Temperature in °C, Percent Relative Humidity
c. *Predictors:* Monthly Average Temperature in °C, Percent Relative Humidity, Total Monthly Rainfall in mm.
d. *Dependent Variable:* Murder/Attempted Murder per 100,000 People per month

Regression result shows that coefficient of determination for the first model which considered only temperature as a predictor, was 0.56. This reveals the temperature alone explained 56 per cent of the variance of crime pattern. After including relative humidity and rainfall, the third model attained R^2 value 0.61. This affirms that among all the climate elements temperature has most significant impact on crime incidences. Figure 2 which shows approximately an upside V shape, portrays this claim more evidently: as temperatures rise above some threshold (which is about 25°C in case of Allahabad), violence tends to increase. Very high temperatures are associated with high rainfall, and rainfall tends to reduce thermal stress. But if rainfall (and humidity) were unchanged, very high temperatures would not cause a reduction in violence. Regression result seem inconsistent with the curvilinear hypothesis and does not support the claim that violence declines at very high temperatures.

Table-1 suggests that, if temperatures are high, rainfall has a significant tendency to reduce violence. The significantly positive coefficients for humidity may explain the discrepancy between the results. Rainfall and humidity tend to have opposite effects on violence: humidity appears to increase violence, but rainfall tends to reduce it.

III. Conclusion

It is evident that climate and especially temperature, has determining influence on human behavior. In case of Allahabad city, 25°C temperature seems tipping point for criminal offences and crime rate increases with increase in temperature. Thus, present study rejects the curvilinear hypothesis that after some point crime rate decreases with further increase in temperature. Result shows that rainfall tends to reduce violence, whereas temperature and humidity tends to increase it. But all climatic factors are inter-linked and, thus, carry some auto-correlation errors. Actually any climatic element viz. temperature, rainfall or humidity, is the production function of rest of the climatic variables. Hence regression analysis sometimes produces misleading results. Therefore, more variables like wind speed, human perception etc. should also be taken into account for such analysis to increase the accuracy.

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Community Participation to Support Sustainable Settlement and Economic Development

By Anggraeni Puspitaningtyas, Aprilia Eka Wulandari & Happy Ratna Santosa

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Abstract- Housing is complex sector and become a basic human need. Therefore, policies on housing directly impacts people's lives. Lately sustainable housing policy into trends and new requirements to prevent greater damage on Earth. Each policy requires public support to make it happen. The concept of sustainable housing related to environmental, social, economic, and cultural aspects. The purpose of this research is to understand activity of environmentally friendly by residents of kampung and its benefits in the economic field. This study will focus on the environmental and economic aspects. Selected case studies is a village that ever won an awards of green and clean from Surabaya city government, This kampung has succeeded in creating an environment beautiful and well cared for, also received economic benefit of the activity. The method used in this research is descriptive qualitative comparative analysis. The study examined the causes of the condition and explain it with words.

Keywords: economic development, participation, sustainable housing.

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Community Participation to Support Sustainable Settlement and Economic Development

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Abstract- Housing is complex sector and become a basic human need. Therefore, policies on housing directly impacts people's lives. Lately sustainable housing policy into trends and new requirements to prevent greater damage on Earth. Each policy requires public support to make it happen. The concept of sustainable housing related to environmental, social, economic, and cultural aspects. The purpose of this research is to understand activity of environmentally friendly by residents of kampung and its benefits in the economic field. This study will focus on the environmental and economic aspects. Selected case studies is a village that ever won an awards of green and clean from Surabaya city government, This kampung has succeeded in creating an environment beautiful and well cared for, also received economic benefit of the activity. The method used in this research is descriptive qualitative comparative analysis. The study examined the causes of the condition and explain it with words. Community participation in the study area to support economic development and sustainable housing include greening activities, nursery, waste recycling, waste water filtration, greening education, sales seedlings and waste bank program. The research indicates a good level of participation, so that the concept of improvements that can be made include any additional counseling, use of renewable energy resources, the revitalization of drinking water processing technology, rooftop greening, greening and plant diversity.

Keywords: economic development, participation, sustainable housing.

I. Introduction

Housing and residential area is one of strategic sector in territory development. This sector is the basic needs because people always grow and grow every year. Housing and settlement development sector will also contribute to the development of other sectors such as industry, trade and services, including infrastructure. The construction of housing and settlement activity is multi sector, whose outcome is directly touching one basic needs of society Housing problem has been a complex problem that is not merely the construction of the physical aspects. It is related very broad sector in procurement, such as land, industrial materials building, environment, socio-cultural, and economic aspect of community, in an effort to build a harmonious society. Hence, community role would influence the sustainable housing and economy development.

Limited land and resources not to be a barrier for people to build sustainable housing and economy. To understood how the community role in the study areas in building sustainable housing and economic, then it required further research. This research will be screened on how the community role in support the development of sustainable housing and economy. So the purpose of this research is formulated public active role in supporting the development of sustainable housing and economy. To reach the goal targets include:

1. Identify the elements in community role, sustainable housing, and sustainable economic development
2. Identify the characteristics of the case study
3. Formulate community participation in supporting the development of sustainable economic and housing.

II. Research Theory and Methods

a) Sustainable Settlement

According to UN Habitat (2012) concept of environmentally friendly settlement can be grouped according to four main aspects, namely economic, social, cultural, and environmental. Further described in 3 scale: macro (national), meso (regional, city) and micro (housing, household). In this study will be used three aspects (economic, social and environmental) in micro- scope for the study area is a residential area consisting of some households. For more details on the micro-scale framework for sustainable housing policies in the study area can be seen in Table 1.

Based Kohler in Cole & Lorch (2003) ecological aspects relating to the conservation of resources, while the economic criteria means considering the long-term conservation of natural and man-made capital; Social aspects related to fairness between generations and cultural aspects into account the conservation of cultural diversity.

There are several strategies in planning environmentally sound settlement as proposed by Grant et al in Aulia (2005), as follows:

1. The management and maintenance of the environment to be put to good use
2. Reduce the influence of buildings on the environment
3. Conserve natural resources
4. Reduce Waste

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5. Increase the participation and awareness of the importance of protecting the environment.

In this study, the above strategy can be used to analyze that as an indicator in determining the role of sustainable development in the study area.

Table 1 : Micro Scale Framework for Sustainable Housing Policy in Study Area

Aspects	Micro (housing, household)
Environmental dimensions	• Ensuring energy efficiency, water and resource efficiency. • Green design, using local sustainable construction. • Sanitation, preventing hazardous materials and pollution. • The use of renewable resources. • Increasing the resilience and adaptability of the house. • Empower and ensure community participation. • Ensure the health, safety, well-being at the level of the residence. • Creating a sense of community, a 'sense of place', and identity
Social dimensions	• Meeting the specific needs and desires in the housing (including those related to gender, age and health). • Provides access to infrastructure and public space.
Economic dimension	• Ensuring affordability of housing for different social groups. • Providing adequate shelter to increase labor productivity; ensure housing is integrated with the work. • Mendkung economic activity in the country. • Support small-scale landlords and self-help housing. • Management and maintenance of housing. • Strengthening the resilience and futureproofing home.

Source : UN Habitat, 2012

Based on the theoretical explanation above, the elements of sustainable housing that is used in this study are:

1. The management and maintenance of the environment put to good use
   - Ensuring energy efficiency, water and resource efficiency.
   - Provides access to infrastructure and public space.
   - Management and maintenance of housing.
2. Reduce the influence of buildings on the environment
   - Ensure the health, safety, well-being at the level of the residence.
   - Providing adequate shelter to increase labor productivity; ensure housing is integrated with the work.
3. Conserve natural resources
   - The use of renewable resources.
4. Reduce Waste
   - Sanitation, preventing hazardous materials and pollution.
5. Increase the participation and awareness of the importance of protecting the environment
   - Empower and ensure community participation.
   - Ensuring affordability of housing for different social groups.
   - Creating a sense of community, a 'sense of place', and identity.

i. *Community Participation*

Based Roseland (1997), social ecology focuses its critique on domination and hierarchy per se: the struggle for the liberation of women, workers, blacks, native peoples, gays and lesbians, and nature (the ecology movement) are Ultimately all part of the struggle againts domination and hierarchy. The main parts of the ecological community that is described in this paper include:

1. Eco-Community
2. Human-scale
3. Sustainable settlement based on the ecological balance
4. Community self-reliance and participatory democracy

Based Roseland, 1997, the social community must be involved in understanding the sustainability of local persefektif. Social ecology envisions a confederation of community assemblies, working together to foster meaningful communication, cooperation, and public service in the everyday practices of civic life, and a 'municipalist' concept of citizenship cutting across class and economic barriers to address global ecological dangers Reviews such as breakdown or the threat of nuclear war.

Based on the explanation of the above theory, the role of the community in creating a sustainable environment can be seen by:

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1. Eco-community, the environmental community that formed in the community in the region study.
2. Human-scale
3. Sustainable settlement based on ecological balance, ie residential areas arranged in balance with the environment.
4. Community self-reliance and participatory democracy, namely public awareness and cooperation based on democracy.

ii. *Economic Development Environmental*

Strange and Bayley (2008) stated that green development is the integration and development that benefit the sector as much as possible to reach. In other words, the decision is made not only consider the impact of social, environmental, and economic but also the impact on the future. Strange and Bayley (2008) also stated that humans depend on ecosystems and natural resources to run the business and meet human needs. In addition, long-term stability are dependent on the health and productivity of the population. Growth and economic activity is the main focus of human activity. Economic activity involving the production and consumption, so it is important to know the process of production of goods and consumption trends for someone to create environmentally sound economic development. So in addition to understand what we buy, use, and waste generated, we also need to understand the ecological footprint of the products we use.

Claiton & Bass (2002) identified several challenges to achieve environmentally sound development is as follows:

1. Disparities in economic and political instability
2. Extreme poverty
3. Poor nutrition
4. Diseases
5. marginalization
6. The growth of population
7. consumption
8. Use of global energy
9. Climate change
10. Nitrogen loading
11. Depletion of natural resources
12. The loss of diversity
13. Pollution
14. Lack of water

The problem of other urban (urbanization, industrialization)

Nixon (2009) suggested 8 initiatives for environmentally sustainable economic development, as follows:

1. Cleantech Business Cluster: cluster strengthening businesses that offer products and services that are environmentally friendly, such as the efficiency of natural resources, the use of renewable energy, alternative transportation, waste reduction / pollution and recycling.
2. Green Business: improvement of environmental quality and financial state of the company.
3. Sustainable Real Estate Development: support pedestrian facilities, mixed-use, mixed-income, transit-oriented real estate development.
4. Green Investment: investment initiatives on environmentally friendly vehicles.
5. Green Jobs: remove or improve the system development with green jobs green skills training.
6. Green and Cleantech Business Attraction and Retention: supports a city or region as the optimal place for green and clean technology businesses to start, is located, evolve, and grow in the long term.
7. Green Underserved Communities: linking business of green technology and clean and sustainable real estate development was initiated by the citizens of developing countries, women, and disadvantaged communities with appropriate business acceleration services, also through an agreement between the low- and middle-income workers in saving through ecological efficiency.
8. Sustainability Community Engagement: Agreement citizens in understanding the concept of sustainability, participate in the process of building a sustainable economy and decided to buy environmentally friendly goods.

Based on the above theory, environmentally sustainable economic development element used in this study include:

- Cleantech Business Cluster
- Green Business
- Sustainable Real Estate Development
- Green Investment
- Green Jobs
- Green and Cleantech Business Attraction and Retention
- Green Underserved Communities
- Sustainability Community Engagement

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Table 2 : Synthesis

No	Aspects	Theory	Research Variables
1	Sustainable housing	1. The management and maintenance of the environment put to good use • Ensuring energy efficiency, water and resource efficiency. • Provides access to infrastructure and public space. • Management and maintenance of housing. 2. Reduce the influence of buildings on the environment • Ensure the health, safety, well-being at the level of the residence. • Providing adequate shelter to increase labor productivity; ensure housing is integrated with the work. 3. Conserve natural resources • The use of renewable resources. 4. Reduce Waste • Sanitation, preventing hazardous materials and pollution. 5. Increase the participation and awareness of the importance of protecting the environment • Empower and ensure community participation. • Ensuring affordability of housing for different social groups. • Creating a sense of community, a 'sense of place', and identity	Energy Water Resources Natural Resources Human Resources infrastructure
2	Public Participation	Community participation in creating a sustainable environment can be seen by: 1. Eco-community, the environmental community that formed in the community in the region of study 2. Human-scale 3. Sustainable settlement based on ecological balance, ie residential areas arranged in balance with the environment. 4. Community self-reliance and participatory democracy, namely public awareness and cooperation based on democracy.	Communities Public Participation
3	Economic Development Environmental	Elements of environmentally sound economic development include: • Cleantech Business Cluster • Green Business • Sustainable Real Estate Development • Green Investment • Green Jobs • Green and Cleantech Business Attraction and Retention • Green Underserved Communities • Sustainability Community Engagement	• Cleantech Business Cluster • Green Business • Sustainable Real Estate Development • Green Investment • Green Jobs • Green and Cleantech Business Attraction and Retention • Green Underserved Communities • Sustainability Community Engagement

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Based on the translation of the above theories as well as the synthesis of a literature review can be seen that between sustainable housing and environmentally sound economic development is influenced by community participation.

iii. *Research Methods*

The method used in this research is comparative qualitative descriptive. According to Travers (1978) in Klee (1999), The descriptive meant to depict the nature of a circumstance that is on-going at the research done to examine the causes of a particular. Taylor and Bogdan (1984) Explained that qualitative data shaped descriptive, in the form of words spoken or writing about human behavior that can be observed. Sugiyono (2011) stated that analysis of descriptive qualitative step was as follows:

1. Data Collection
2. Data Reduction
3. Data Display
4. Conclusion

In this analysis variable resulting from study the sintesa the theory, assessed according to its existing data the study areas. Then it studied again based on sectoral planning documents relating to public active role in supporting sustainable housing and economic development. So that obtained the concept that recommended in this research. So is the descriptive analysis comparative qualitative.

III. Result and Discussion

Case studies chosen were in Rungkut Lor gang VII mosque. The location of case study can be seen from figure 1. This kampung got an award of Surabaya green and clean in 2008. This is consistent with placard award displayed in one side of the road. Other accomplishment is to become the top 10 posyandu competition and cleanliness winner of the neighborhood level in Surabaya. Hence, this kampung has often used as an example of successful kampung. Home improvement efforts initiated in 2005 that produces 9 programs. This kampung is densely populated, but about 60 percent of its citizens not settled. Most residents come from outside the city who work as laborers in Surabaya. This housing shaped elongated, and equipped several facilities to support the activities of environmentally friendly scattered in order to facilitate access to all citizens. This can be seen in figure 2.

a) Identify The Characteristics of The Study Area

The location is in the Highway Rungkut, belonging to the village Rungkut District of Kalirungkut. The bounderies of this region include:

- North: Lor Rungkut Gang III
- West: Road Rungkut Lor
- South: Lor Rungkut Gang X
- East: Highway Rungkut

Figure 1 : Study Area Location

Source: Google Map, 2014

Figure 2 : Kampung Rungkut Lor Gg VII Masjid Siteplan

Source : Personal documentation

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Table 3 : Identify The Characteristics Of The Study Area

No	Aspects	Existing Data	Informations	
			Condition	Others
1	Number of Real Households	80 householders	Real Population	Work in the informal sector
2	Number of Stranger Households	240 householders	Stranger Population	Worked as a factory worker
3	Number of Private Houses	80 units	The Size is 5 x 12 – 13 m	Simple house typical village , row house
4	Number of rental house	19 units	House -shaped barracks	Usually inhabited by a family and spouse
5	The availability Infrastructure	Drainage	Good, the wide is 30 cm	When heavy rains , sometimes overflowing but quickly subsided There are closed drainage , there is an open drainage
		The electricity	Good	
		Street lighting	Good Self-help	No help from the government so that the self-help
		Sanitation	Good	Use of septic tanks and wastewater treatment are / domestic effluent for watering plants
		Road	Good, Paving	Most government assistance, partly self-supporting
		Communication	No Base Transceiver Station	Already using cell phone
		Garbage	Good	There are innovations of the community (banks garbage, recycling of plastics and paper and composter), the system managed by the community
		Clean Water	Good	There is help water treatment apparatus of the Party of Japan but was broken and could not be repaired
		Gas	Good	Most use the gas network, partly using LPG gas cylinders
6	Public Facilities Availability	Posyandu	Good	Very active and never Runner II IHC best in Surabaya
		RT Hall	The size is 4 x 2 m	Used as an archive storage, office RT and the PKK as well as a chat
		Tourism Park Village	The location is in the middle of the village and is a center for residents	In the form of a garden with ornamental plants and nursery herb plants

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No	Aspects	Existing Data	Informations	
			Condition	Others
		Mosque	Tholabuddin	Being in front of the alley, the service includes one village
		Prayer house	2 x 3 m	Scale 1 RT services
		Urban Farming and Breeding	Locations in places that can be planted	Empty fields and other spots that can be used as an ornamental plant nurseries and toga (herb)
		Gazebo	2 x 2 m	Used to hang out
7	Community Social	PKK	Empowerment activities housewife whose activities focus on social, environmental protection and health	
		Youth group	Youth empowerment activities of the village which includes social, environmental preservation and religious	
		KRUCIL	Children's education with a focus on social and environmental conservation activities	
		RT	A micro-level organization of systematic and organized and facilitate all activities of citizens	

Source: existing data, 2014

b) *Formulating Community Participation hearts support Housing Development Environment and Sustainable Economy.*

Table 1 : Analysis

No	Aspects	Research Variables	Analysis Based on Existing Condition
1	Sustainable Housing	• Energy • Water Resources	Rungkut Lor village Gg VII has used innovation sewer water purification to water garden seeds. This is one of the innovative energy efficient and environmentally friendly (water resources and electricity). This innovation made by the people themselves based INSAG existing programs.

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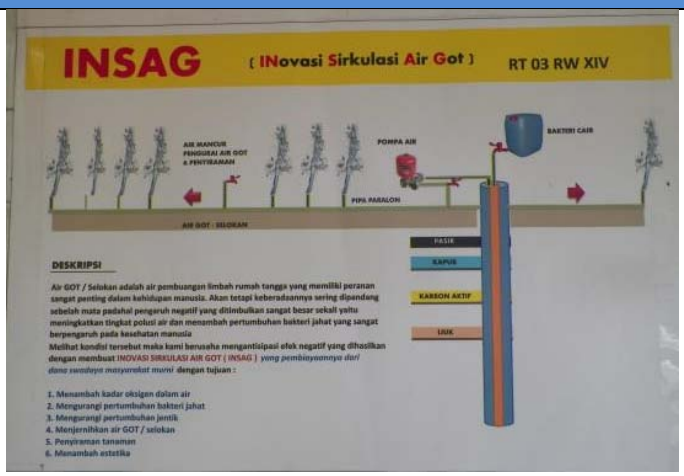
No	Aspects	Research Variables	Analysis Based on Existing Condition
			
		Natural Resources	One of the activities of the community in preserving the environment is urban farming and breeding. Urban farming and breeding conducted an ornamental plants and herbs (toga). The results are in addition to environmental sustainability can also be sold for cash to add RT. This activity is carried out once a week at the end of the week in mutual cooperation or togetherness. Not only adults are invited to grow crops but early age children were trained to grow crops.
		Human Resources	In the study area there are many activities that involve citizens and communities both in terms of social, health, environmental and religious. Here is a community located in the study area: • Organization of the RT-level residents • empowerment activities housewife or PKK • Youth • Krucil As for the activities carried out such as: • The logic Bu = PKK activities in combating mosquito Aides Aigepty • Krucil = activities of children of early age in the form of nurseries and urban farming is done once a month • Powerful cangkrukan = communication means residents in disseminating environmental cleanliness • nursery and urban farming activities undertaken work together • Event processing and recycling of waste, namely Bank Trash (dry

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No	Aspects	Research Variables	Analysis Based on Existing Condition
			waste into goods creations) and Composter (wet garbage and leaves into compost) • Posyandu activities that focus on child and maternal health • Physical improvement activities carried out by the Organization residential neighborhood RT
		Infrastructure	1. Road Road paving which is help city officials and local governmental organizations. Street decorated with various colors and well maintained. Road accessible via Highway Rungkut and through Rungkut Lor Gang V. 2. Electrical PLN electricity network served by reaching all homes in the study area. Electricity network also connects the lighting in the study area. 3. Gas Gas network served by national gas pipeline (PGN), which serves most of the homes in the study area. For unserved home network using LPG gas cylinders to meet the needs of gas. 4. Water Water networks served by the water network, but citizens also been using a water filter that is aid from Japan, which is still broken.

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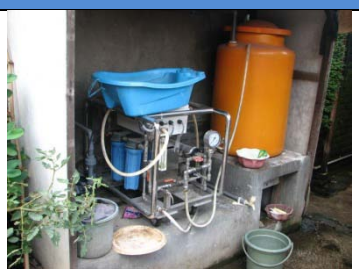
No	Aspects	Research Variables	Analysis Based on Existing Condition
			 5. Drainage Drainage network of empowered communities through close above the channel with the aim of reducing odors and put potted plants on it. 6. Sanitation Residents use INSAG system to process waste water from the drainage network for watering plants. Domestic sanitation systems also use septic tanks. 7. Garbage System of waste services performed by the citizens through the waste transport system which is done twice a week. Previous garbage bins can be divided into dry and wet. Dry waste such as bottles and plastic wrap in capacity in the waste bank and then processed into goods creations. While wet waste such as food scraps and leaves inserted into Takakura Composter that 6 months later into compost.

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No	Aspects	Research Variables	Analysis Based on Existing Condition
2	Community Participation	Community Community Participation	Communities in the study area include RT organization, PKK, Youth, Krucil and IHC. Activities include social, environmental, health and religious. Community very actively involved in sustainable development in the study area, seen with many facilities and activities that are innovative and non-residents.
3	Economic Development Environmental	Cleantech Business Cluster	Grouping in favor of environmentally friendly efforts can be seen from the success of the city of Surabaya to reduce waste from residential level with the Garbage Bank program. Trash has been reduced and separated prior to the landfill. This can reduce the burden on the city to manage waste on a large scale. Moreover, in the village Rungkut Lor Gg VII have found innovative sewer water purification to water the garden seeds are INSAG. Water treatment technology into potable water which is a relief from the Japanese as an appreciation for the success of this ward caring for the environment. This tool can add eco-friendly technology in this village if not broken. So where technology is not just about the amount and availability but the most important is the impact and sustainability of these technologies
		Green Business	Environmental well maintained village, villagers always maintain the cleanliness and beauty of the environment. The initiative to urban farming in the form of seed gardens provide income for the village to be used as capital of other eco-friendly programs or to maintain the environmental conditions (eg, increase reforestation). So the seed garden in this village can be called as a green business, in addition to the environmental benefits of plants is also economically beneficial to the villagers. In addition, there is also a waste bank programs that can increase incomes while reducing household waste.
		Sustainable Real Estate Development	Location village adjacent to the industrial area Rungkut, can reduce a person's mobility to the workplace. The village is probably not specifically designed as a formal housing, but thrive because of high demand for homes in the area. So maybe you need to watch out for

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No	Aspects	Research Variables	Analysis Based on Existing Condition
			is a high population density, so that the estate planning should be more focused on the development of the village in order to remain habitable.
		Green Investment	There has been no initiative to create an environmentally friendly means of transportation. However, this village can reach public transport easily. With its location adjacent to the industrial area, should the potential for residents to use public transportation is also higher.
		Green Jobs	Surabaya government has conducted training by inviting some representatives of this village to be able to manage waste and sewage processing for garden watering seedlings. Training and socialization program is environmentally friendly positive response by the villagers.
		Green and Cleantech Business Attraction and Retention	This can be attributed to the level of citizen participation Surabaya high. Participation showed good response making it suitable for developing business related to environmentally friendly programs.
		Green Underserved Communities	Each of the villagers can participate and express their opinions in a routine meeting. According to Mrs. RT, residents most industrious men to be invited to voluntary work and meetings, while the female residents prefer to make dry waste recycling while socializing. So every citizen both men and women can express the proposal but probably in a different forum.
		Sustainability Community Engagement	Discipline and willingness whole villagers to support environmentally friendly activities that have been agreed upon can not be separated from the existing sanctions. As villages are located close to the industrial area, most of the houses in this village used as a boarding house so many people who do not live long. Therefore, the need for more efforts to promote environmentally friendly activities this village. Sanctions are given when people do not obey the rules are complicated for residents will be paperwork. These sanctions proved able to "force" people to run programs environmentally friendly village well.

Source: Analysis, 2014

i. *The Result of Analysis*

Community participation in the study area to support economic development and sustainable settlement include:

1) greening in their homes and the environment by planting (at least 5 pot plants)
2) nursery by utilizing existing vacant land
3) Dispose of waste in place and differentiate dry and wet garbage
4) Recycling and garbage composting
5) Filtration of waste water for watering plants
6) Provide education to children greening early age.
7) Sell aunt nursery crops by the community.
8) Sell the results of the bank trash like trinkets recycling.

It can be said that the understanding of the sustainability of the public perspective in the study area is pretty good and can be developed to a higher level again as making innovations that are environmentally friendly.

ii. *Recommendation*

The concept that can be done in the study area through community participation are:

1) Build and redesign the mindset of society through education and practice
2) Using renewable energy resources such as solar energy as an energy source the study area
3) Recycle and purify water for drinking
4) Using the energy and material resources (to build) the efficient
5) Planting herbs, vegetables and organic fruits to reduce the use of plastic wrap and pesticides
6) Building a green house that can be placed on the roof and a hydroponic garden.

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To support the above concept, the things to do in the near future are:

1) There needs to be more support from the Provincial Government related to the development of villages in the study area both in terms of financial, moral, educational, and program development.
2) Conduct a comparative study program between villages in the entire region of East Java that aims to share knowledge, experience, knowledge and innovation created by each region.
3) Provide the spirit and space to innovate and creativity through the provision of competition between villages

IV. Conclusion

The participation of the study areas in support the development of housing complex and sustainable economic includes:

1. Conduct greening program in their homes and environments with grow crops (minimum of five plants pots)
2. Do nursery in vacant lots
3. Throw garbage in place and distinguish dry and wet waste
4. Recycling and garbage composting
5. Waste water purification for watering plants
6. Give greening education to children an early age.
7. Selling seeds from nursery plants conducted by the community.
8. Sell the result of trash bank

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Correlation of Various Gaseous Pollutants with Meteorological Parameter (Temperature, Relative Humidity and Rainfall)

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Abstract- In the atmosphere many gaseous pollutants like CO, O_3, NO_X and CH_4 are present fluctuates with the atmospheric temperature, relative humidity (RH) and rainfall. The annual average observation of the year 2013 is presented in this paper, which shows the entire monthly average from January to December. Correlation of carbon monoxide (CO), ozone (O_3) and oxides of nitrogen (NO_X) has shown negative correlation with temperature, relative humidity and rainfall. In addition to this, methane (CH_4) also shows negative correlation with temperature and positive correlation with relative humidity and rainfall. The major fluctuation of temperature and RH was observed in the month of May (increased) whereas, in the month of August rainfall was more fluctuated (decreased).

Keywords: atmospheric temperature, relative humidity, rainfall, positive and negative correlation.

GJSFR-H Classification : FOR Code: 969999p

CORRELATIONOFVARIOUSGASEOUSPOLLUTANTSWITHMETEOROLOGICALPARAMETERTEMPERATURERELATIVEHUMIDITYANDRAINFALL

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R. K. Srivastava [α], Shampa Sarkar [σ] & Gufran Beig [ρ]

Abstract- In the atmosphere many gaseous pollutants like CO, O_3, NO_X and CH_4 are present fluctuates with the atmospheric temperature, relative humidity (RH) and rainfall. The annual average observation of the year 2013 is presented in this paper, which shows the entire monthly average from January to December. Correlation of carbon monoxide (CO), ozone (O_3) and oxides of nitrogen (NO_X) has shown negative correlation with temperature, relative humidity and rainfall. In addition to this, methane (CH_4) also shows negative correlation with temperature and positive correlation with relative humidity and rainfall. The major fluctuation of temperature and RH was observed in the month of May (increased) whereas, in the month of August rainfall was more fluctuated (decreased).

Keywords: atmospheric temperature, relative humidity, rainfall, positive and negative correlation.

I. Introduction

The atmosphere is the body of gas that surrounds a planet. It acts as a bunch of all vital physical, chemical and biological properties which processes together at the same time. The major appropriate percentile of various gaseous components i.e. Nitrogen (78.09%), Oxygen (20.95%), Argon (0.93%), Carbon dioxide (0.039%) and traces amounts of neon, helium, methane, krypton, hydrogen, nitrous oxide, xenon, ozone, iodine, carbon monoxide, and ammonia are well known. The degree of balanced air decreases due to rapid and developing industrializations or urbanization. The major factors affects atmospheric quality is topography, climatic conditions and physical-chemical properties of pollutants.

Today, the discussion is going about gaseous pollutants whose fluctuation can directly or inversely affect the air quality. The primary pollutant (CO, CH_4 and NO_X) is quite less precarious than the secondary pollutants (O_3 and VOC_S). This pollutant needs to maintain their standards with the index which has made to observe its stable presence in air. Pollutants maintain their concentration with respect to the physical parameters. Temperature and rainfall are the two parameters which affect the concentration of gaseous pollutant mostly. Fluctuation of atmospheric temperature and rainfall can balance the seasonal cycle. Previously, it has noticed that the rise in temperature increased the concentration of gaseous pollutants.

Stathopoulou et. al. (2008) has observed the *impact of temperature on tropospheric ozone concentration levels in urban environments* of Athens. In the 3 monitoring stations ozone has recorded from 1996-1997 whereas continuous monitoring of temperature has recorded in 23 stations. They show linear correlation and temporal variation between ozone concentration and air temperature. Furthermore, neural arrangement it found that temperature is predominant parameters which affect the ozone concentration.

Bhardwaj (2012) analyzed wavelet and correlation of different parameters of air pollution using "*Haar Wavelet technique*" in Delhi, India. Parameters like Carbon Monoxide (CO), Nitrogen Oxide (NO), Nitrogen Dioxide (NO_2), Ozone (O_3) and Sulphur Dioxide (SO_2) were analyzed by taking hourly average. As per observation, it was found that Ozone has negative correlation with all the pollutant parameters.

Beig and Brasseur (2006) noticed the *influence of anthropogenic emissions on tropospheric ozone and its precursors over the Indian tropical region during monsoon.* During 1990s, in geographical region of India rapid human activities which include industrial and economic growth are responsible for the change in tropospheric ozone and its precursors. To study the impacts of emission in 1990-2000 a chemistry transport model (MOZART) showed maximum variation 5-10 ppbv in ozone concentration. The maximum increase in concentration of CO and NO_X i.e. 10-18% and 20-50% was observed in the boundary layer. Changes in NOx concentrations were larger than in the case of CO, and perturbations were less uniformly distributed near the surface.

Naja et. al. (2003) has observed the *diurnal and seasonal variabilities in surface ozone at a high altitude site Mt Abu (24.6°N, 72.7°E, 1680m asl) in India* by measuring surface ozone, CO and oxides of nitrogen in 1993-2000. The lower oxygen mixing ratio was observed throughout the year happened due to change during

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seasonal variation. Some meteorological parameters are responsible for the seasonal and diurnal variations. Different air samples have been analyzed for the presence of CH_4, CO and oxides of nitrogen. As a result, the average of 90 ppbv of ozone mixing ratio was found there.

The *ozone air quality and radiative forcing consequences of change in ozone precursor emissions* has studied by *West et.al. (2007).* Emissions of ozone precursors both air quality and climates has affected. To reduce NO_X, NMVOCS, CO and CH_4 concentration of surface ozone sensitivity (O_3^{srf}) and net radiative forcing of climate (RF_{net}) has estimated. The NO_x reduction increases CH_4, causes long term ozone increases. Decrease in CH_4 emissions caused the greatest RF_{net} decrease per unit reduction in O_3^{srf}, while NO_X reduction increased RF_{net}.

Multivariate methods for ground-level ozone modeling have studied by *Özbay (2011).* Multivariate statistical methods used to study tropospheric ground level ozone concentration and different meteorological parameters like PM10, SO_2, NO, NO_2, CO, O_3, CH_4, NMHC, temperature, rainfall, humidity, pressure, wind direction, wind speed and solar radiation. Bivariate correlation analysis investigated ozone data and other variable. The parameter CH_4, NMHC, NO_2 were shown negative correlation with ozone whereas highest positive correlation with temperature.

An emissions-based view of climate forcing by methane and tropospheric ozone has been studied by *Shindell et. al (2005).* Increased methane and tropospheric ozone precursor emission can simulate the atmospheric composition by a coupled chemistry-aerosol-climate model. The global annual average composition response to all emission changes is within 10% of the sum of the responses to individual emissions quantity. And methane emissions have enforced by double the precursors rather than ozone.

Correlation analysis on variation characteristics of surface ozone concentration and its precursor compounds in Chongqing has acknowledged by *Ping et. al. (2013).* The monitoring of surface ozone concentration and the correlation between ozone precursors compounds some meteorological factors shown positive correlation with solar radiation. VOCs (volatile organic compounds) were basically consistent with the variation of the ozone results. At the same time, there was a good negative correlation with NOx.

In between November 2009 to December 2011 an *observational study of surface O_3, NOx, CH_4 and Total NMHCs at Kannur, India* was done by *Nishanth et. al. (2014).* It was found that the surface O_3 concentration was higher in afternoon and declined at night. NOx concentration was exceeded during mid-night to early morning and low during noontime. The diurnal variations of mixing ratios for NOx and O_3 were anti-correlated. In December, the monthly average of CH_4 concentration was maximum (2.26 ± 0.44 ppmv) whereas in August it was minimum (0.43 ± 0.19 ppmv). The concentration of CH4 was similar to NOX which generally obtained in the early morning.

Jayamurugan et.al. (2013) has studied on the *influence of temperature, relative humidity and seasonal variability on ambient air quality in a coastal urban area* with respect to meteorological parameters. At North Chennai, during monsoon, post-monsoon, summer and pre-monsoon seasons (2010-11), SO2 and NOx were shown negative correlation in summer while positive correlation during post-monsoon season with temperature. In addition to this, RSPM and SPM had positive correlation with temperature in all the seasons except post-monsoon one. The influence of temperature on gaseous pollutants (SO2 & NOx) was effective in summer than other seasons, due to higher temperature range.

II. Significance of The Study

The selected site Pachpedi of Jabalpur is full of greenery. Observation of its air quality at a regular interval can generate useful data for prediction and further studies.

III. Material and Methodology

In the Environmental research laboratory various ambient air quality analyzers for detection of the ambient air quality are installed. The instrument *Ambient Air Quality Monitoring System (AAQMS)* was manufactured by Ecotech Australia. It consists of assembly of many transducers and analyzers employing various instrumentation techniques. These are:

a) Ec9830 Carbon Monoxide Analyzer (Co)

Carbon monoxide absorbs infrared radiations (IR) at wavelengths near 4.7 microns; therefore, the presence and the amount of CO can be determined by the amount of absorption of the IR. The absorption spectrum between the measured gas and other gases present in the sample is analyzed to determine the concentration of Carbon Monoxide.

b) Carbon Monoxide (CO) Analyzer - NDIR Gas Filter Correlation Technique

The EC9830 analyzer operates by measuring CO absorption of IR radiation at highly specific wavelengths near 4.7 microns. The broad infrared radiation (IR) that is absorbed by the CO is within the 5-meter folded path-length. The gas filter correlation wheel facilitates rejection of interference and the narrow band pass filter ensures measuring only the CO sensitive IR wavelengths. The CO content of the sample is continuously measured from a user-supplied air stream of which the instrument extracts 1 SLPM (standard liter per minute) of sample. The reference cell

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contains 100% CO and the measurement cell contains 100% Nitrogen (N_2).

i. *Principle of Operation*

- Non-dispersive IR gas filters correlation.
- Single channel differential measurement.
- Reference from sealed cell with CO.
- Measurement with sealed cell with N_2.
- Rotating wheel provides time sequential measurements.

c) *Ec9810 Ozone Analyzer (O_3)*

The ozone analyzer determines ozone concentrations by measuring the amount of ultraviolet light that the ozone absorbs. Ozone exhibits strong absorption in the ultraviolet spectrum around 250 nanometers (nm). The EC9810 ozone analyzer exploits this absorption feature to accurately measure ozone concentrations to less than 0.5 ppb. A stream switched, single beam photometer serves as the basis for the EC 9810. The ultraviolet light is detected by a photodiode that only responds to ultraviolet energy. The photodiode converts ultraviolet light to electrical signal that is proportional to ultraviolet light detected.

d) *EC9841 Nitrogen Oxides Analyzer (NO_X)*

The EC9841 analyzer uses gas-phase chemiluminescence detection to perform continuous analysis of nitric oxide (NO), total oxides of nitrogen (NO_X), and nitrogen dioxide (NO_2). The EC9841 design represents an advance in nitrogen oxides analysis technology achieved primarily by using adaptive microprocessor control of a single measurements channel. The instrument consists of a pneumatic system, an NO_2 to NO converter (Molygon), a reaction cell, detector (PMT), and processing electronics. The analysis for NO by chemiluminescence detector is the best direct technique. The operation is based on the chemiluminescence of activated molecular nitrogen dioxide species produced by the reaction between in an evacuated reaction cell. The NO reacts with O_3 to form the activated NO_2 species in accordance to the reaction mechanism shown below:

$$NO \longrightarrow O_3$$

$$NO + O \longrightarrow NO_2 + O_2 + h\nu \text{ (1200nm)}$$

The chemiluminescence reaction is between O_3 and NO only. In order to measure the NOx (NO + NO_2) component of the sample the NO_2 must be reduced to NO prior to its entry to the reaction cell. This process is accomplished by the Molycon catalytic converter.

i. *NO_2 Converter*

The NO_2 concentration is derived by subtracting the NO signal from the NOx. To obtain accurate and stable results, the converter must operate at above 96% (US EPA) and (95% Australian standard) efficiency. The Molybdenum converter will operate at nearly 100% efficiency for in excess of 8000 ppm-hours. Maximum conversion at 99% efficiency is 7 ppm NO_2. For higher NO_2 levels a stainless steel converter that operates at 650 °C is required.

e) *Gc Alpha 115 Methane/Tnmhc*

i. *Dimensions*

The instrument is built for a 19" rack. It is advised to reserve an extra-space of 1 standard HU (at a bottom and on a top) for the instrument ventilation and to mount the arrangement on a rail.

ii. *Gas fittings*

Pressure regulators must be of gas chromatographic quality i.e. must be dust free and should not absorb or emit hydrocarbons.

iii. *Gases needed for Alpha 115*

It is use of a combination of hydrogen and zero air generators. The zero air must be equipped with a catalytic methane scrubber.

FID detector needs hydrogen flame to generate a signal. For this purpose hydrogen and clean air are needed. Zero air is also used as carrier gas in a column.

- *The Study Area*

Jabalpur is one of the major centers of Madhya Pradesh in India and is famous for its green belt. Geographically, it is located at *23.17°N 79.95°E*. It has an average elevation of 411 meters (1348 ft).

Diagram: Location pointed "Jabalpur"

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Topographically, the city is surrounded by low, rocky, and barren hillocks. Jabalpur has got a humid sub-tropical climatic condition all over the year. The average temperature can rise till 45° C during summer which stretches from late March to June. The city experiences monsoon season in between June and early October with an average yearly precipitation of around 1386 mm, winter sets in during late November and stretches till early March. Average temperature in winter can fall down to as low as 7° C.

CLIMATE DATA FOR JABALPUR

MONTH	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temp. Avg. high °C (°F)	26.5 (79.7)	28.8 (83.8)	34.3 (93.7)	38.7 (101.7)	44.4 (111.9)	36.2 (97.2)	30.3 (86.5)	28.2 (82.8)	30.9 (87.6)	32.4 (90.3)	29.7 (85.5)	26.9 (80.4)	32.28 (90.10)
Temp. Avg. low °C (°F)	6.0 (42.8)	11.4 (52.5)	16.2 (61.2)	21.2 (70.2)	24.4 (75.9)	24.1 (75.4)	22.6 (72.7)	21.9 (71.4)	21.1 (70.0)	18.1 (64.6)	13.9 (57.0)	10.6 (51.1)	17.63 (63.73)
Precipitation mm (inches)	4 (0.16)	3 (0.12)	1 (0.04)	3 (0.12)	11 (0.43)	136 (5.35)	279 (10.98)	360 (14.17)	185 (7.28)	52 (2.05)	21 (0.83)	7 (0.28)	1,062 (41.81)
Avg. precipitation days	0.8	0.8	0.3	0.3	1.8	8.6	15.9	18.3	8.6	3.1	1.4	0.6	60.5
Mean monthly sunshine hours	288.3	274.4	288.3	306.0	325.5	210.0	105.4	80.6	180.0	269.7	273.0	282.1	2,883.3

Source: HKO

- *Observation Table*

Basically, Pachpedi of Jabalpur is a less polluted region. While on monitoring the ambient air by AAQMS (Ambient Air Quality Monitoring System) some gaseous pollutants like ozone (O_3), carbon monoxides (CO), methane (CH_4) and oxides of nitrogen (NO_X) have shown its fluctuated concentration. Here, the obtained monthly average data of the year 2013 is shown with the monthly average concentration of ozone, carbon monoxides, methane and oxides of nitrogen of the month January to December in Table 1:

Table 1 : Monthly average of gaseous pollutants of 2013

MONTHLY AVERAGE OF GASEOUS POLLUTANTS (2013)				
MONTH	CO ppm	O_3 ppb	NO_X ppb	CH_4 ppb
JANUARY	0.27	59	14	1327
FEBRUARY	0.18	52	12	2196
MARCH	0.21	62	11	1465
APRIL	0.24	63	11	1388
MAY	0.23	41	13	2005
JUNE	0.19	48	9	1765
JULY	0.17	33	10	2081
AUGUST	0.17	54	10	2407
SEPTEMBER	0.11	53	12	2686
OCTOBER	0.17	48	10	2564
NOVEMBER	0.16	66	14	2651
DECEMBER	0.22	53	10	2598
Annual Average	**0.19**	**53**	**11**	**2094**

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As we know already that the various physical parameters are responsible for the variation of the gaseous concentrations. The parameters like temperature, relative humidity and rainfall are observed with its monthly average and obtained its annual fluctuated level graphically of the selected region (Figure 1):

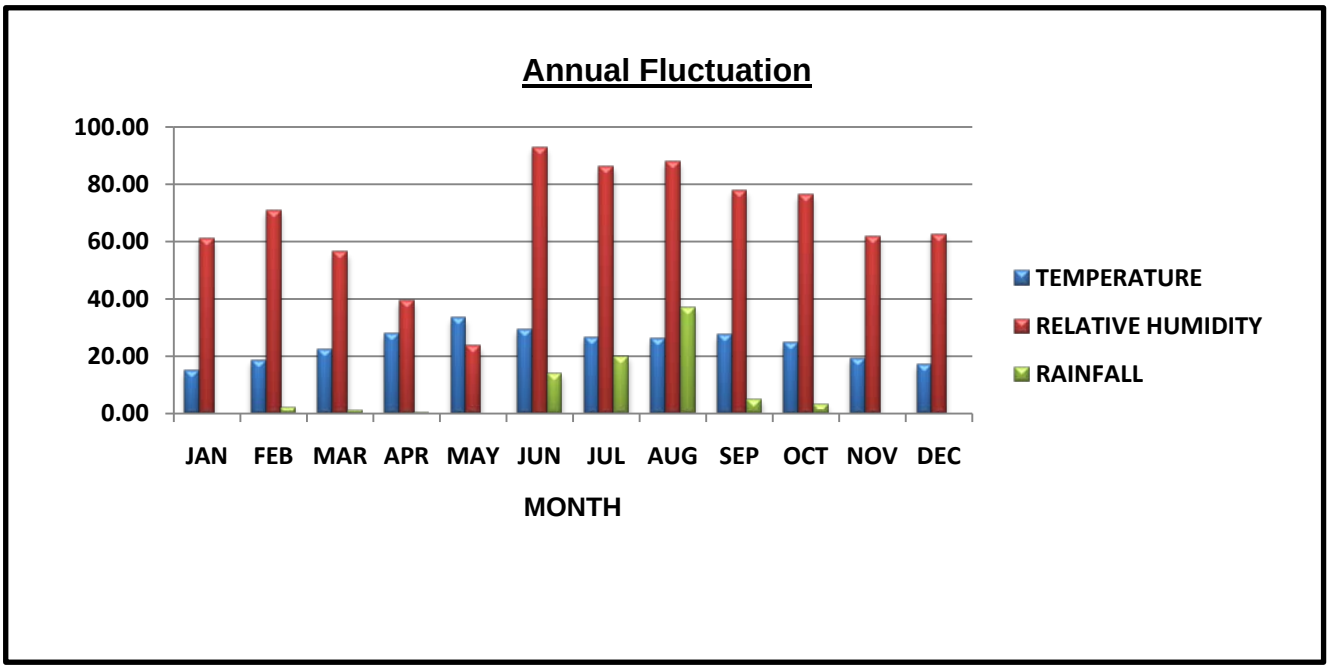

Figure 1 : Graphical presentation of relation between Temperatures, Relative Humidity and Rainfall

Table 2 : Monthly average of Temperature, Relative Humidity and Rainfall of 2013

MONTHLY AVERAGE OF TEMPERATURE, RELATIVE HUMIDITY AND RAINFALL (2013)							
MONTH	TEMPERATURE			RELATIVE HUMIDITY			RAINFALL
	MAX	MIN	Average	MAX	MIN	Average	
JANUARY	23.61	6.63	**15.12**	86.58	35.87	**61.23**	0.00
FEBRUARY	25.76	11.38	**18.57**	90.29	51.14	**70.71**	2.15
MARCH	31.78	13.42	**22.60**	81.10	31.65	**56.37**	1.07
APRIL	37.28	18.92	**28.10**	59.70	19.10	**39.40**	0.46
MAY	42.66	24.38	**33.52**	34.58	12.48	**23.53**	0.00
JUNE	34.35	24.16	**29.25**	80.43	58.70	**92.76**	14.08
JULY	29.80	23.72	**26.76**	92.90	79.74	**86.32**	19.80
AUGUST	28.82	23.43	**26.13**	94.61	81.55	**88.08**	36.93
SEPTEMBER	31.62	23.72	**27.67**	91.20	64.80	**78.00**	5.01
OCTOBER	29.65	20.24	**24.95**	90.77	61.87	**76.32**	3.35
NOVEMBER	28.10	10.85	**19.48**	90.23	33.30	**61.77**	0.00
DECEMBER	25.72	8.62	**17.17**	90.06	34.74	**62.40**	0.00
Annual Average	31.41	18.44	**24.11**	81.87	47.08	**66.41**	**6.90**

The correlation of ozone (O_3), carbon monoxides (CO), methane (CH_4) and oxides of nitrogen (NO_X) with temperature, relative humidity and rainfall has been presented and with graphically representation it has cleared with respect to annual averages (Table 3):

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Table 3 : Annual Correlation of CO, O_3, NO_X and CH_4 with Temperature, Relative Humidity and Rainfall

ANNUAL CORRELATION (2013)									
	TEMPERATURE			RELATIVE HUMIDITY			RAINFALL		
	R	R^2	CORRELATION	R	R^2	CORRELATION	R	R^2	CORRELATION
CO	-0.222	0.049	Negative	-0.590	0.348	Negative	-0.345	0.119	Negative
O_3	-0.479	0.229	Negative	-0.237	0.056	Negative	-0.344	0.118	Negative
NO_X	-0.323	0.104	Negative	-0.534	0.286	Negative	-0.520	0.271	Negative
CH_4	-0.034	0.001	Negative	0.338	0.114	Positive	0.163	0.027	Positive

Where, R= correlation, R2= coefficient of determination

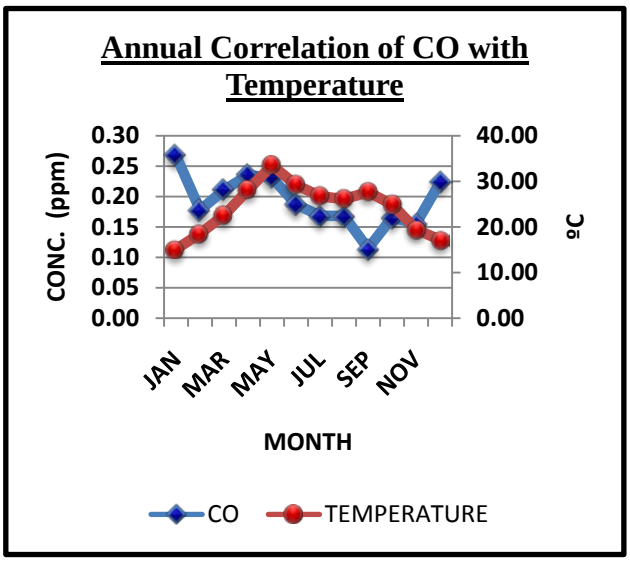

Figure 2(a) : Correlation of CO with Temp.
r^2= 0.049 (Negative Correlation)

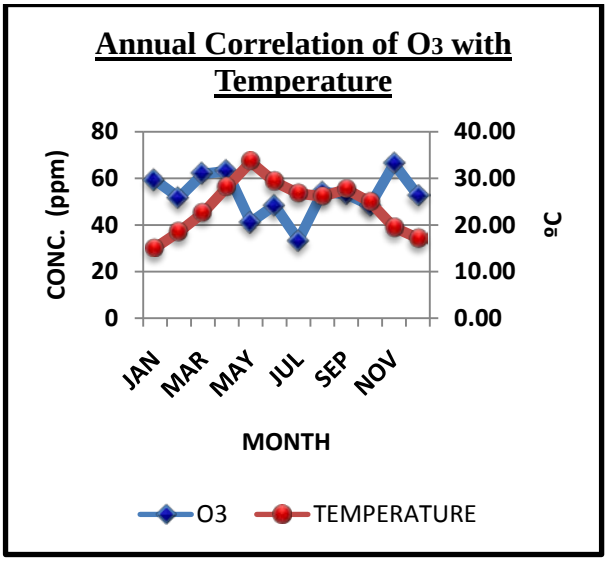

Figure 2(b) : Correlation of O3 with Temp.
r^2=.0 229 (Negative Correlation)

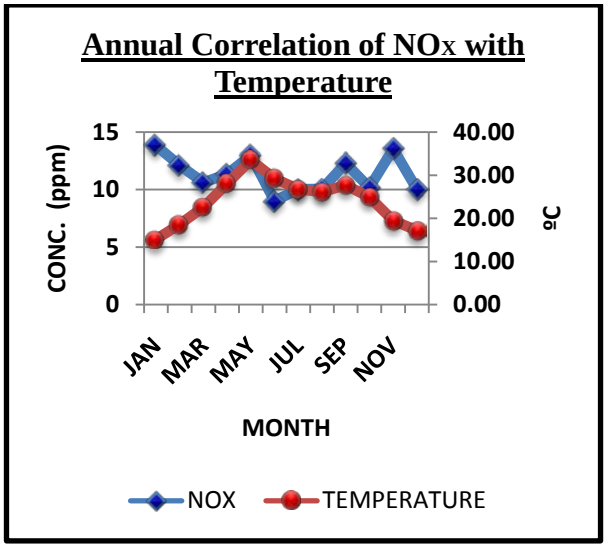

Figure 2(c): Correlation of NOX with Temp.
r^2= 0.104 (Negative Correlation)

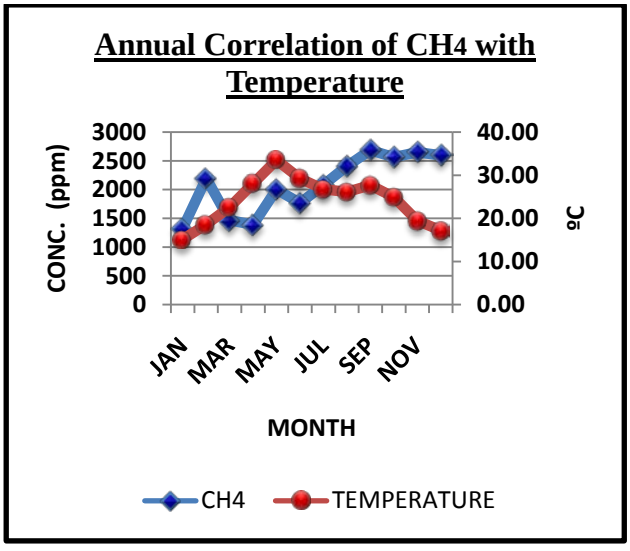

Figure 2(d) : Correlation of CH4 with Temp.
r^2= 0.001 (Negative Correlation)

Figure 2: Correlation of Temperature with carbon monoxides (CO), ozone (O_3), methane (CH_4) and oxides of nitrogen (NO_X) -

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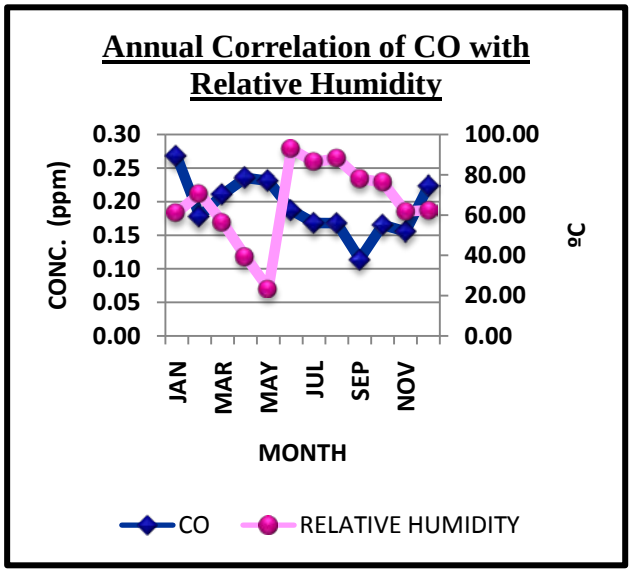

Figure 3 (a) : Correlation of CO with RH
r^2= 0.348 (Negative Correlation)

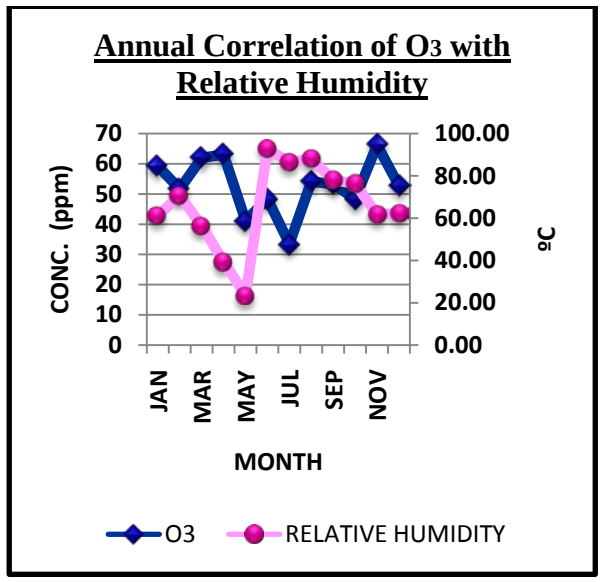

Figure 3 (b) : Correlation of O3 with RH
r^2= 0.056 (Negative Correlation)

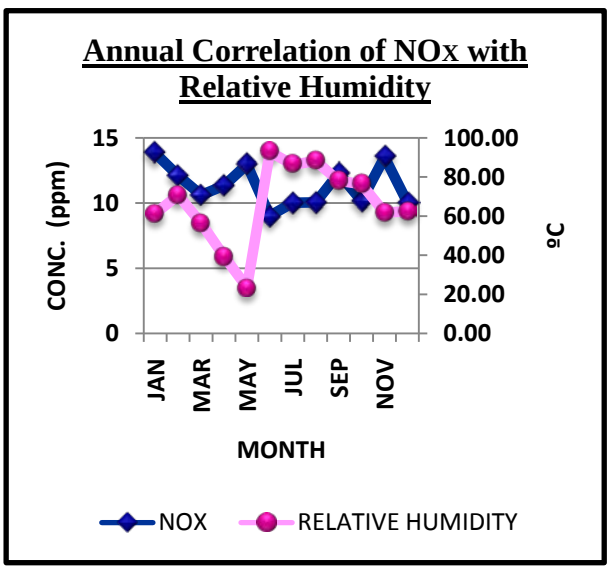

Figure 3 (c) : Correlation of NO_X with RH
r^2= 0 286 (Negative Correlation)

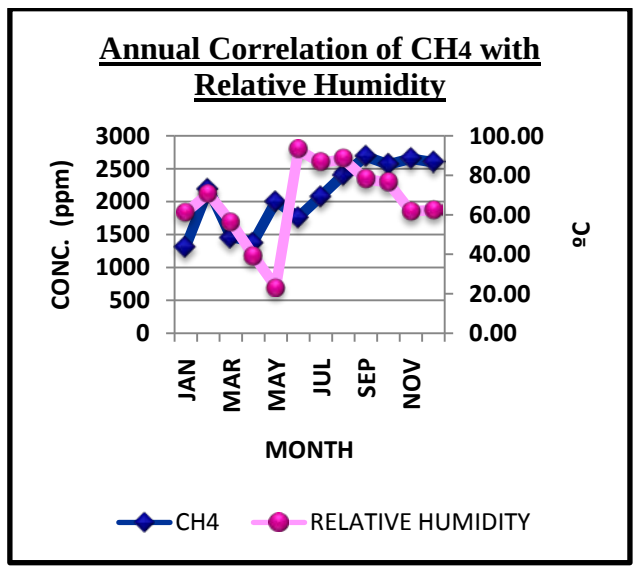

Figure 3 (d) : Correlation of CH_4 with RH
r^2= 0.114 (Positive Correlation)

Figure 3 : Correlation of Relative Humidity (RH) with carbon monoxides (CO), ozone (O_3), methane (CH_4) and oxides of nitrogen (NO_X) -

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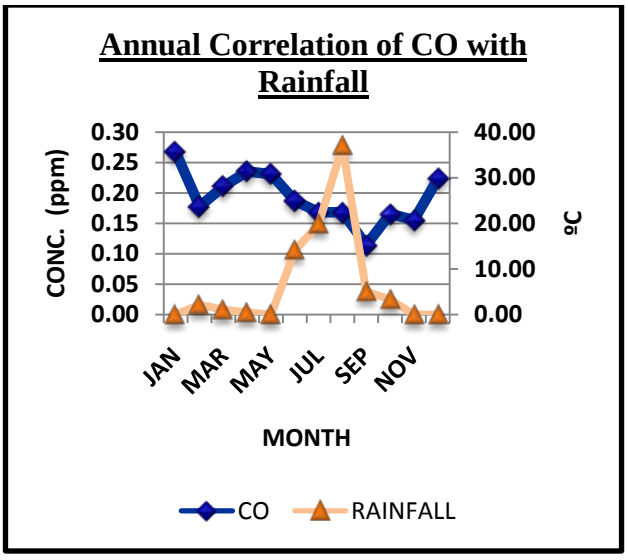

Figure 4(a) : Correlation of CO with Rainfall
r^2= 0.119 (Negative Correlation)

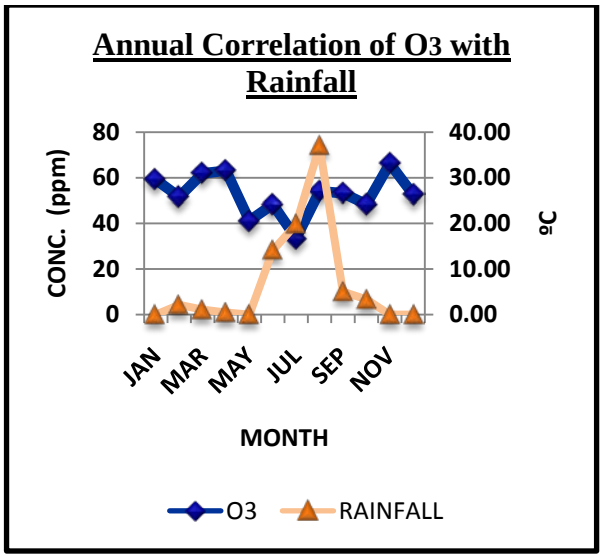

Figure 4(b) : Correlation of O_3 with Rainfall
r^2= 0.118 (Negative Correlation)

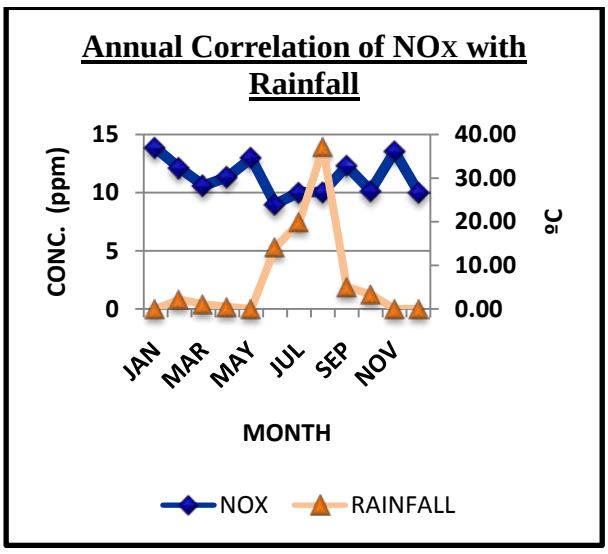

Figure 4(c) : Correlation of NO_X with Rainfall
r^2= 0.271 (Negative Correlation)

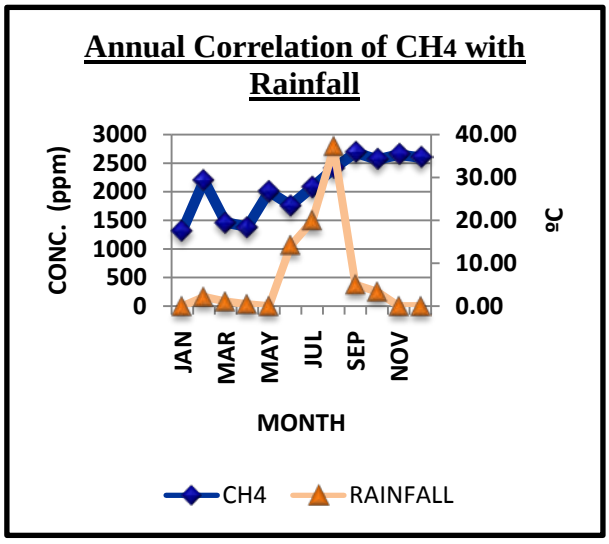

Figure 4(d) : Correlation of CH_4 with Rainfall
r^2= 0.027 (Positive Correlation)

Figure 4 : Correlation of Rainfall with carbon monoxides (CO), ozone (O_3), methane (CH_4) and oxides of nitrogen (NO_X) –

IV. Result and Discussion

As per the obtained result, it has been observed that the meteorological parameters like temperature, relative humidity (RH) and rainfall affect the level of gaseous contents in the atmosphere. Table 1, shows the average value of all the gaseous pollutant while, Table 2: shows all the annual average value of temperature, relative humidity and rainfall. Table 3, represents the correlation of gaseous pollutants with meteorological parameters. Thus, it has cleared that CO has shown negative correlation with Temperature, RH and Rainfall *(R^2=0.049, 0.348 and 0.348)* respectively, in the other hand, O_3 and NO_X also shows negative correlation *(R^2= 0.229, 0.056 and 0.118, R^2= 0.104, 0.286 and 0.271)* respectively. Whereas, CH_4 shows negative correlation with temperature *(R^2= 0.001)* and positive correlation with RH and Rainfall *(R^2= 0.114 and 0.027).* The major fluctuation of temperature and RH has been observed in the month of May whereas; in the month of August, rainfall was more fluctuated. The level of ozone concentration was higher in the urban environments which may be due to solar radiation and pollutants [Stathopoulou et. al. (2008)]. The monthly highest average temperature was observed in the month

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of May (33.52°C) from (fig. 1), with the moderate level of monthly average of ozone and methane concentration (41 ppb and 2005 ppb) and near to maximum monthly average of CO and NO_X (0.23ppm and 13ppb) respectively. The meteorological parameters, CH_4 and NO_2 were shown to have negative correlation with ozone whereas highest positive correlation was observed with temperature. [Özbay (2011)]. As such in the respective May month, the monthly average temperature was increased in the other hand, the value of monthly average relative humidity and rainfall was declined (23% and NIL) respectively. As per Table 3, the correlation of monthly average ozone concentration with temperature shows negative correlation may be due to the monthly average temperature of entire day and night, whereas generally, the observation has taken out with the average sunshine of the day.

V. Acknowledgement

We express our thanks to Indian Institute of Tropical Meteorology (IITM), Pune to install the Ambient Air Quality Monitoring System (AAQMS) in Environmental Research Laboratory of Government Model Science College (Autonomous) Jabalpur, which helped a lot in the present study.

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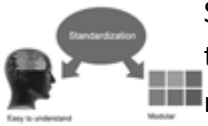

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After nomination of your institution as "Institutional Fellow" and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.
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Note :

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- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
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3. Submission of Manuscripts,

4. Manuscript's Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

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26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

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- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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