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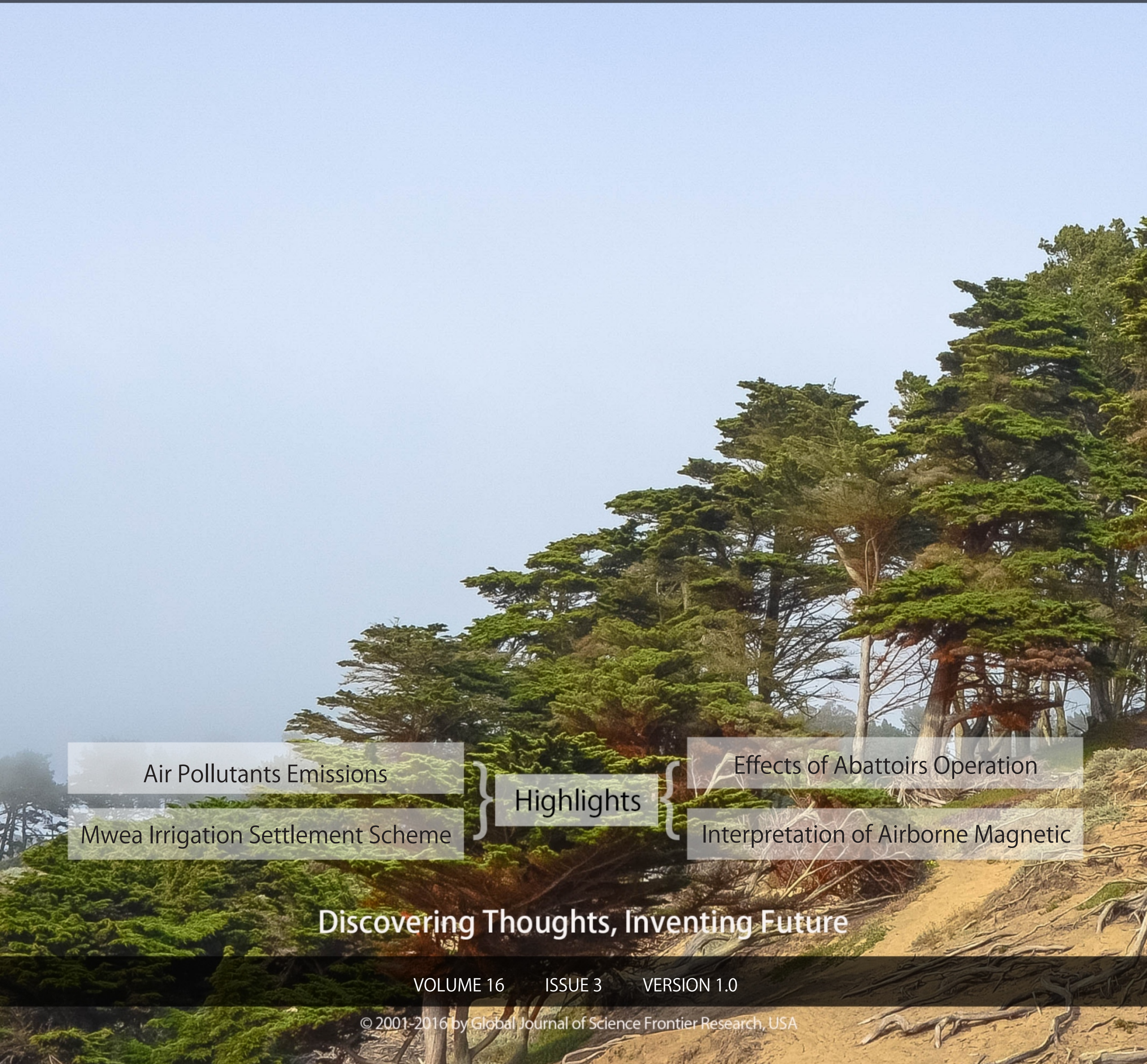

Air Pollutants Emissions

Mwea Irrigation Settlement Scheme

Highlights

Effects of Abattoirs Operation

Interpretation of Airborne Magnetic

Discovering Thoughts, Inventing Future

VOLUME 16 ISSUE 3 VERSION 1.0

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Implications of Wet-Rice Farming on Human Health and Physical Environment in Kenya: A Comparative Study in Mwea Irrigation Settlement Scheme, Kenya

By Samson Wokabi Mwangi
Egerton University

Abstract- This paper examines the implication of wet-rice farming or irrigated agriculture on the physical environment and human health. Environmental problems seem to have increased in the recent past posing a major threat to irrigation development. Several environmental problems created by irrigation development in Mwea Irrigation Settlement Scheme (MIS) could be attributed to improper understanding of the complex processes involved in the irrigation system. The main objective of this study was to examine cases and causes of some environmental and health problems and planning related issues in MIS. An environmental planning and management methodology is suggested which will attempt to minimize or at least mitigate against the environmental and health problems.

Keywords: environmental problems, irrigation development, human health problems, comparative method.

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IMPLICATIONSOFWETRICEFARMINGONHUMANHEALTHANDPHYSICALENVIRONMENTINKENYAACOMPARATIVESTUDYINMWEAIRRIGATIONSETTLEMENTSCHEMEKENYA

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Implications of Wet-Rice Farming on Human Health and Physical Environment in Kenya: A Comparative Study in Mwea Irrigation Settlement Scheme, Kenya

Samson Wokabi Mwangi

Abstract- This paper examines the implication of wet-rice farming or irrigated agriculture on the physical environment and human health. Environmental problems seem to have increased in the recent past posing a major threat to irrigation development. Several environmental problems created by irrigation development in Mwea Irrigation Settlement Scheme (MIS) could be attributed to improper understanding of the complex processes involved in the irrigation system. The main objective of this study was to examine cases and causes of some environmental and health problems and planning related issues in MIS. An environmental planning and management methodology is suggested which will attempt to minimize or at least mitigate against the environmental and health problems. 'Fool Proof' method of comparing the situation in an irrigation settlement with a neighboring off-scheme area where irrigation activities were absent, was utilized. The area selected for comparison has been earmarked for rice cultivation through irrigation and no environmental impact studies have been done. The results showed that there has been a dramatic increase in real and potential human health problems emanating from emergence of new diseases, the expansion of the vector base and the ease of spread of water borne-diseases. From the comparative method it was concluded that most of the problems observed were unique consequences of irrigation development since they were absent in the control region. It is recommended that an environmental plan should be instituted in the MIS management structure to ensure that the stress on the irrigation settlement ecosystem is within its carrying capacity. The management plan should incorporate and integrate baseline conditions, planned project activities, impacts anticipated and supportive and assimilative capacities of the system. Future irrigation development planning should therefore be holistic and multidimensional.

Keywords: environmental problems, irrigation development, human health problems, comparative method.

I. Introduction

Out of the Kenyas 44.6 million hectares of land, only 8.6 million hectares are regarded as medium to high potential for rainfed agricultural production (Odero, 1992). Kenyas population continues to increase and this means there is diminishing land per capita and hence the need to increase the arable land. The role of irrigation as a means of expanding agricultural land supply has long been recognized in Kenya and several irrigation schemes have been established. Irrigation and drainage activities which complement the rainfed agriculture continue to augment agricultural production by making arid and semi arid lands productive. Kenyas irrigation and drainage potential are estimated at 540,000 hectares and 80,000 hectares respectively. Presently some 54,000 hectares are estimated to be under irrigation representing only 10% of the potential irrigable land (GOK, 2014: 140). However it has been noted that most of the feasibility studies done before the establishment of the irrigation projects in Kenya tended to consider major engineering, economic and technical aspects but ignored adverse environmental and health related issues associated with irrigation development. Poor performance of irrigation projects has been a major concern for both the policy makers and researchers in the recent past. There are various reasons for this poor performance and factors of Environmental' nature have been prominent in many instances. Many irrigation systems have not provided environmentally sustainable output (Reddy, 1991). Few policy documents and studies have focused on environmental problems such as water logging, salinization, alkalinization, increase in aquatic weeds or water borne diseases which are typical consequences of bad irrigation water management. Irrigation without sufficient drainage disrupts the ground water equilibrium causing a rise of the water table to the plant root zone resulting in water logging. Salts are also brought to the root zone through capillary fringe leading to the buildup of salts in the root zone.

The establishment of an irrigation are not related to irrigation itself but to its misuse, and they may be avoided or alleviated by appropriate management (White 1978). According to FAO (1986), many irrigation schemes, especially those for the extension of agriculture in developing countries, are adversely affected by high prevalence of diseases. Often the prevalence could have been reduced, usually with some extra effort, it certain health and environmental

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safeguards had been taken into account in their planning and construction. For many of these projects restoration of a healthy environment may take considerable time, effort and resources. Failing that, continued degradation of health and environmental quality may largely defeat the very purpose of the project. This may eventually lead to the further decline of the socio-economic conditions of the population involved. Attention is therefore needed at the planning stage of a project to ensure incorporation of environmental and health safeguards. Engineers and managers in frequent contact with irrigation schemes are not specialists in medical or environmental sciences, and environmental and health impacts are frequently outside the scope of their stated responsibilities. As a result, information on environmental and health impacts are generally difficult to obtain and serious impact may go unrecorded and uncorrected. Increasingly, professional engaged in irrigation development and management are recognizing the importance of environmental factors. Agencies engaged in implementing or funding irrigation development are introducing procedures they believe will ensure that serious problems are avoided. The current government policy emphasizes that irrigation, land reclamation by drainage and flood protection are major and attractive alternatives for increased agricultural productivity. The other aims are to expand cultivatable land to meet the ever growing demand for food and restructure the countrys agricultural sector as well as settle people in new lands and create substantial employment opportunities.

II. The Problem

Irrigation development in the Mwea plains has created environmental conditions that are favourable for agricultural production. The same conditions have been ideal for habitants and breeding points of diseases vectors. Environmental and human health problems are some of the unintended consequences of irrigation development in MIS. As an interface between the natural environment and technology, irrigation activities in MIS have some environmental implications which have some adverse consequences on the socio-economic welfare of the supposed beneficiaries. The modification to the environment which usually accompanies rice growing in Mwea tend to create extensive habitants particularly suited for snail intermediate hosts of schistosomiasis and mosquito vectors of malaria. Thus people working in the rice fields and those living near them were often exposed to considerably greater risk from these diseases then those working and living away from the rice fields. There is the incidence of bilharzias and malaria and other water-borne diseases. The high incidence of diseases is not met with adequate health facilities and these diseases can also be attributed to lack of clean water and flood water from the irrigation scheme. Every aspect of an irrigation project has environmentally implications. The problem thus can be stated as: Irrigation development in MIS with inadequate drainage has led to environmental and health problems. Environmental damage associated with irrigation development in MIS is threatening the vitality of the irrigation settlement. Though it is now recognized that irrigation development in MIS have had adverse ecological and health problems, the level of recognition of such implications is still far from satisfactory because of lack of adequate data.

III. A Note on Methodology

In this section the methodological procedures of the study are discussed. These include, the data collection techniques, sampling techniques, and data schedule and the methods used in data analysis, interpretation of the findings. The conceptual-theoretical background of the study is examined and finally, the limitations and problems encountered in the study are outlined. The sampling frame for the study consisted of 3240 farmer households in several villages at the Mwea Irrigation Settlement (MIS). The farmer families are distributed within 36 villages which are located in the 5 sections of the settlement (see appendix V). The distribution of the villages in all the sections is shown on Table 4.1. In each section, for the purposes of a micro-study on environmental and health problems, at least 25% of the villages were sampled for the study. This yielded a number of 10 villages to be studied. All the villages were allocated arbitrary numbers and out of the 36, the 10 villages were selected using Tables of Random Numbers. To determine the number of households to be studied, a pilot survey was conducted. The results of the pilot survey showed that the population in MIS was highly homogeneous and the activities in the community homologous. A sample of 200 respondents was therefore assumed representative. In each of the 10 villages, 20 households were selected and subjected to intensive interviewing. The small sample size of 200 respondents representing 6.17% of the total population was selected on the basis of experience gained through the pilot survey and that from the previous studies on irrigation settlements. Studies conducted by Makanda (1984); Ireri (1986); Omosa (1987); JICA (1988, 1992); Odero (1992); and Hanneke (1993) have indicated the relative homogeneity in the farmer conditions in irrigation settlements which makes it possible to employ the use of small samples. Simple random sampling was used to select the representative sample of 20 household heads to be interviewed in each village selected. Simple random sampling is a method of drawing a sample from a population so that all possible samples of size *n* have the same probability of being selected from the population *N*. This method is regarded by many researchers and statisticians as the most practical and free of bias. A simple draw at random is unbiased in the sense that no member of the population has any more than one chance of being selected than any other. I the present study, *N* was represented by 3,240 households and *n* by 200 households. The size of the sample selected for the study was limited by time factor, financial constraints and the need to come up with accurate results.

Since the present study utilizes the fool-proof method of comparing the situation in MIS and another neighbouring area where irrigation activities are absent, a control sample selected for this purpose was the neighbouring Mutithi Location. The Mwea plains extend throughout the lower sections of Mwea Division covering Tebere, Thiba and Mutithi locations. These locations have alsomost the same biogeophysical characteristics. It was necessary to select a control region with the same bio-geophysical characteristics with the study area, where irrigation activities are absent. Mutithi area affected such opportunities compared with other alternative like Nyangiti and Murinduko in Mwea Division. Above all other reasons, parts of Mutithi location, about 2,900 hectares, have been earmarked for irrigation development. With the absence of an environmental impact assessment study done during the preparation of the feasibility study, it was imperative to assess the status of this area during this study. It is assumed that the results of this study will form a starting point for the future EIA in the Mutithi area. According to the available information on the area selected, there are 960 households as of 1987. The land is privately owned and therefore the absence of an organized settlement structure like in the MIS. Background information on the area indicates that the area is inhabited by a homogeneous community and the activities taken are also similar from a general point of view. Systematic random sampling was the main technique used in selecting the households to be studied. A sample of 20 households were selected to facilitate comparison with the situation in any one of the villages studied in MIS.

IV. Results and Discussion

In this section, the empirical results of the Mwea Irrigation Settlement (MIS) Field Survey are presented. The findings are based on the interview administered to 200 respondents of the settlement and 20 respondents from outside the settlement, interviews to key informants also generated important data. Data synthesized from field observations and secondary sources are also included. The information presented in this section stems from various sources. Specifically, data inventories in the present study comprised three categories:-

(a) Data collected through the interview scheduled, administered to sampled 200 household heads in 10 villages in MIS and also those administered to 20 off scheme respondents;
(b) Data collected through dialogue with schemes management staff and other selected key informants and
(c) Data collected through the researcher's field observations and secondary information from existing data.

Data collected centred mainly on the various aspects of the physical and human environments. The emphasis was to explain data within the context of environmental and human problems in MIS. Preference in the selection of data has been given to purely quantitative variables and data based on qualitative scales is also considered. Environmental and health problems revealed by these data are exposed and explained in details.

Table 1 : Age of the Respondents in MIS
n=200

Age Group	Frequency	Percentage
0 – 20	0	0%
21 – 40	42	21%
41 – 60	101	50.5%
61 – 80	45	22.5%
81 – 100	11	5.5%
100+	1	0.5%
Total	200	100%

Source: MIS field survey 2014

Most of the respondents were found to be married, a few being widowed, divorced or separated and a small number single as shown in Table 2. The size of the families were found to be fairly large, the majority being more than 6 persons per family (see table 3). It was found out that 57.5% had more than 8 persons per family. The age of the first born was also found to be high, over 35 years, and in most cases, they had their families living together with their parents (see Table 4). the problem associated with this analysis is that the original number of people settled in the scheme has increased by more than 4 fold and need to expand the settlements. From discussions with local elders and leaders this survey revealed that most of the respondents and their families and the families of their children continue to live in confined villages which are now over 35 years old. Majority of the respondents had their first siblings married and staying with them in the same plots. It can be seen from the above that there is population pressure in the villages, basing the argument on this surveys household characteristics. Congestion in the villages can also be seen as an adequate medium for the transmission of communicable diseases like cholera.

Cases and Causes of Environmental and Health Problems at the Household Level

To collect accurate data on these problems, a household survey was conducted by use of an interview schedule. A macro survey was also conducted using filed observations and secondary sources of data. Environmental and health problems identified are presented at these two levels. For purposes of household comparison on environmental and health conditions between MIS villages studied and Mutithi area (where irrigation activities are absent but has the same bio-geophysical characteristics) were compared. The viable compared were: housing conditions, water supply and sanitation systems, energy sources, farmers perceived environmental and health problems unique to irrigation settlement at the household level.

Environmental problems related to demographic and family characteristics of the respondents interviewed

For the purposes of this study, a household refers to a group of persons living together in the same home and or sharing the same housekeeping arrangements. A household therefore includes a husband, wife or wives and children living together. From the data collected, it was found out that the respondent ages varied between 20 and 100 years, the majority being between 40-60 years (50.5) as shown in Table

Table 2 : Marital status of Respondents in MIS

n=200

Marital Status	Frequency	Percentage
Married	164	82%
Widowed	24	12%
Single	2	1%
Divorced	7	3.5%
Separated	3	1.5%
Total	200	100%

Source: MIS field survey 2014

Table 3 : No. of children of the respondents

n=200

No. of children	Frequency	Percentage
0 – 2	5	2.5%
3 – 5	12	6%
6 – 8	68	34%
9 – 11	83	41.5%
12 – 14	14	7%
15 – 17	6	3%
18 – 20	8	4%
21+	4	2%
Total	200	100%

Source: MIS field survey 2014

Table 4 : Age of the First Born living with their parents (the respondents)

n=200

Age of first born	Frequency	Percentage
0 – 5	5	2.5%
6 – 10	8	4.0%
11 – 15	19	9.5%
16 – 20	15	7.5%
21 – 25	24	12%
26 – 30	30	15%
31 – 35	85	44.4%
36+	23	11.5%
Total	200	100%

Source: MIS field survey 2014

Environmental problems related to housing conditions

(a) MIS villages

All the respondents interviewed were allocated a 50ft by 80ft plot of land on the higher grounds for purposes of building residential houses. The results of the household survey shows that majority of the respondent, 73%%, live in brick iron-roofed houses and 90.5% of the respondents noted that the housing had 1 to 4 rooms (Table 5.5 and 5.6). Most of the respondents noted that the housing units owned were not enough for the entire family but could not build others because of lack of space. Almost all types of houses used by the tenants are characterized by factors which contribute to poor health. The interview survey showed there was the presence in the human environment of pathogens because of lack of basic infrastructure and services such as sewers, drains or services to collect solid and liquid wastes and safely dispose of them. There is lack of safe and sufficient water supply. Overcrowding and cramped living conditions as observed in all the villages can be said to increase the risk of transmission of airborne infections and increase the risks of accidents. Many diseases such as tuberculosis, influenza and meningitis are easily be transmitted from one person to another.

Table 5 : Type of houses in studied villages

	M I S Villages		Mutithi	
Type of House	Freq. n=200	%	Freq n=20	%
Mud grass-thatched only	25	12.5	0	0%
Mud iron-roofed only	8	4	0	-
Brick (earth) grass-thatched only	20	10	1	5%
Timber iron-roofed only	9	4.5	11	55%
More than one type	18	9	4	20%
Total	200	100%	20	100%

Source: MIS field survey 2014

Table 6 : Number of rooms per house of the respondents

	M I S Villages		Mutithi	
Number of rooms	Freq. n=200	%	Freq n=20	%
1 -2	75	37.5	0	-
3 – 4	106	53	4	20
5 – 6	14	7	11	55%
7+	5	2.5	5	25%
Total	200	100	20	100%

Source: MIS field survey 2014

Implications of demographic characteristics and housing conditions in nucleated settlements

Housing conditions are seen to be determined by the number of rooms and the household size. The results of the field survey revealed that most of the tenants still live in houses which were built during the inception of the settlement. There has been a dramatic increase in the population of the scheme since its inception in 1958. By 2014, when this survey was undertaken there were 3240 farmers families with an average family size of 9.6 which is very high. This implies that the housing structures which were originally meant for two persons have an additional 7 members. Because the size of the plots remain fixed (50ft x 80ft) the implication is that tenants have to squeeze in the little room available with their children and grandchildren. There were reasons given as to why there was a high birth rate in the scheme though it was also noted that the average was not very far from the national average which was by 1993, 6.7 children (GOK, 1993). There were two reasons given by the tenants:

(i) The high labour demands required by rice growing activities and the high costs of hired labour demanded reliance on the family labour and hence need for large families and

(ii) That since most of the tenants were formally detainees and landless, when they were freed and resettled, they found consolation in having children.

The validity of these arguments is debatable but these were from the tenants' point of view (today the medical and nutrition department of NIB includes family planning activities as part of the community health education to the tenants). The exclusive concern by the management of the scheme for a high level of technical achievement has led to neglect of the problems of human welfare. As a result, housing is unsatisfactory, overcrowded, smoke filled, and lacks privacy. Nutritional standards are low and this has severe health implications. The physical expansion of the scheme appears to have reached a limited and the management should seriously look into the welfare standards of the tenants. Apart from its social and health implications these conditions can be economically harmful, discouraging full participation in the scheme and commitments to long term investments and this may lead to poor performance of one of the successful irrigation settlement in Kenya.

(b) Housing conditions in the control area

The housing conditions of the farmers reflect their living standards. All the farmers live in their own houses. Data was collected on the number of rooms and whether there is provision of a separate kitchen and bathroom.

Most of the respondents had over 5 rooms in the Mutithi area (80%). This could be attributed to the fact that the land in the area is privately owned and there is no limited building space like in MIS villages. Housing units in this area are highly varied in type and nature. It was the feeling of those interviewed that the housing units were sufficient for the whole family. Majority of respondents owned at least o separate kitchen and bathroom. The average number of occupants in a room in MIS villages was 6 persons while in Mutithi area was 2 persons per room. This shows that people are more congested in MIS villages than in the control areas.

Environmental problems related to water supply and sanitation systems

(a) MIS villages

The results of the interview survey revealed that a greater majority of the respondents, 53% got their water supply from the nearby canals. Some chemical analysis of water quality showed that canal water was of poor quality and was contaminated with pathogens. The poor quality of water can be attributed to subsurface flows from the irrigated fields. It was also found out that 50% of the communities aged between 5 to 19 years defecate at the water points within the scheme. Considering that his water is used by residents for bathing and domestic use, these residents become extremely vulnerable to water-borne diseases. The results showed that 12% of the respondents many of whom were from Haraka and Kwihota villages from Thiba and Karaba sections get their water supply from boreholes. It was observed that in these villages some NGOs had assisted in construction boreholes. It was not possible to establish how many of these boreholes were actually functional but the respondents said that the supply from boreholes was sufficient throughout the year and was of good quality. Nearly 18% of the respondents got water for domestic uses from rivers and stream. Though the water was enough for their uses throughout the year, most respondents noted it was of poor quality because of subsurface return flows from the irrigated paddy fields. Only 7.5% of the respondents had the piped water supply. Respondents from Gathigiriri village of Tebere section had access to piped water supply which was in GOK's Gathigiriri Prison. However the supply was not guaranteed. It was noted that 9% of the respondents had more than one source of water. Within the scheme, improper human waste disposal can also be said to be responsible for water-borne diseases. All the respondents interviewed had pit latrines as the only method for excreta disposal and a large percentage, 83.5%, had shallow pit latrines were only 5-10 meters away from the houses because of the sizes of the plots as shown in Table 9. there is the absence of drains and sewers to take away waste water and rain water from the settlements and this leads to stagnated pools which harhour mosquitoes. There is therefore lack of sewerage connections and garbage collection and this may lead to critical environmental problems.

Table 7 : Sources of water for domestic use

	M I S Villages		Mutithi	
Sources of water	Freq. n=200	%	Freq n=20	%
Canal only	107	53.5	0	-
Boreholes only	24	12	2	10
River/stream only	36	18	3	15%
Pipe borne only	15	7.5	12	60%
More than one source	18	9	3	15
Total	200	100	20	100%

Source: MIS field survey 2014

Table 8 : Depth of pit latrines in the villages studied

	M I S Villages		Mutithi	
Depth of pit latrines	Freq. n=200	%	Freq n=20	%
0 -2	80	40	0	-
3 – 4	75	37.5	0	-
5 – 6	12	6	1	5
7 – 8	24	12	17	85
9+	9	4.5	2	10
Total	200	100	20	100%

Source: MIS field survey 2014

Table 9 : Distance of the pit latrine from the houses

	M I S Villages		Mutithi	
Distance in metres	Freq. n=200	%	Freq n=20	%
0 -5	108	54	0	-
6 – 10	76	38	0	-
11 – 15	16	8	0	-
16 – 20	0	-	1	5
21 – 25	0	-	15	75
25+	0	-	4	20
Total	200	100	20	100%

Source: MIS field survey 2014

i. *Implications*

A lack of readily available treated drinking water, of sewage connections or other systems of disposing of human wastes hygienically, of garbage collections and basic measures to prevent diseases and provide primary health care can result in many debilitating and easily prevented diseases becoming endemic. These include diarrhea, dysenteries, typhoid, intestinal worms and food poisoning. Many health problems are linked to water, its quality, the quantity available, the ease to which it can be obtained and the provisions made for its removal after use. The results revealed that the majority of respondents fetch their water from canals which were found to be contaminated by the irrigation subsurface return flows which is responsible for several waterborne diseases.

(b) Water supply and sanitation systems in the control area

Water Supply

Table 7 presents a summary of the major sources of water for domestic supply in the control area studied. Majority of the household heads interviewed said they got their water supply from piped water (60%) and a minority from boreholes (10%) as security since the tap water was not readily available during dry seasons. In all, 15% of the respondents get their water from rivers or streams. While respondents in MIS noted the water quality from canals and nearby river was of poor quality, those in Mutithi area said water used was of satisfactory quality. This was ascertained through water quality assessment at the government chemist and the results are summarized in Tables 16 and 17. It was noted that majority of the respondents in MIS villages have no pipe borne water supply and they rely on water from canals as shown in Table 7.

Sanitation

In Mutithi area, most of the respondents had their pit latrines with a depth of 8 meters (90%) and a distance from the house of over 9 meters (100%) away. The reason for the difference in depth was that most respondents in MIS villages found ground waste at a depth of 4 meters and therefore could not dig deeper than that depth, this was an absent hindrance in the Mutithi area. As regards the location of the pit latrine away from the house, it was observed that the size of the land was the determining factor. Respondents in Mutithi area owned large expanses of land as compared to 50 ft by 80 ft plots allocated to respondents in MIS villages studied. In both areas the method used for excreta disposal is pit latrines. It was observed that the major difference were in the depth and the distance of the pit latrines from the houses. In the villages studied in MIS, the majority of respondents had their latrines with a depth of up to between 2 – 6 meters (83.5%) and the distance from the house was 6 meters (90%).

Environmental problems related to energy sources and uses

(a) MIS villages

The major sources of energy mentioned by the respondents were firewood, paraffin, charcoal, animal dung, ad crop residues. Majority of the respondents interviewed, 49%, mentioned firewood as the only main source of energy and 22% combined it with other sources. It was observed that firewood used in the villages studied was either brought from a local market or from the surrounding off-scheme reserves. Informal interviews with the firewood and charcoal sellers revealed that these energy sources were supplied by dealers outside the scheme. Plates 5.1 (a) and (b) show heaps of firewood in the market awaiting consumers. Plate 5.2 shows cyclists coming from the off scheme reserves to buy firewood. Attempts were made to enquire the approximate daily firewood requirements. The average daily household requirement for fire wood was found to be 3 bundles of 15 kilograms of wood each. It is noted here that such high demand of wood fuel may lead to deforestation outside the scheme. Kerosene was used by all the respondents for lighting and only a minority, 2.5%, used it for cooking. Charcoal was used for cooking by a minority of the respondents, 4.5%. animal dung, it was revealed by the results o the interview survey was used by 16.5% of the respondents in almost all the villages studied. This was because animal dung served both as a source of energy and a repellent to mosquitoes in the houses. 5.5% of the respondents used crop residues (see Table 10 below).

However it was observed that there was a general shortage of wood fuel in the scheme and most of the respondents saw this as a major problem in the scheme. Other major problem area revealed by the survey was indoor pollution. This was caused by smoke from open fires from firewood, animal dung and crop residues and other biomass fuels. Relatively inefficient lamps used for indoor lighting were also a source of smoke and fumes which may be dangerous. As seen earlier, the small housing units necessitated the use of one room as both a kitchen, store and also as a bedroom. Many respondents knew that smoke and fumes from wood, animal dung, crop residues, effective and inefficient lamps and other biomass fuels can lead to serious respiratory problems.

Implications of environmental problems related to energy sources and use

Major sources of energy used in the study area were firewood, animal dung and crop residues. These sources of energy make open fires used indoors for cook and they produce fumes and smoke which can cause or contribute to serious respiratory problems. The other problem identified in the study area as far as the energy sources were concerned was the fact that these energy resources were not readily available. Omissions at the planning stage of the energy requirements of the tenants have lead to depletion of the few bushes in the settlement. These has been further depletion of forested areas in the hinterland of the scheme. The results showed that much of the fuel wood requirements is met by supplies from outside the scheme. The results of our field studies revealed that this is a looming problem it the trend is not reversed.

Table 5.10 : Major energy sources of households studied

	M I S Villages		Mutithi	
Sources of energy	Freq. n=200	%	Freq n=20	%
Firewood	98	49	5	25
Charcoal	9	4.5	6	30
Kerosene	5	2.5	5	25
Crop residues	11	5.5	0	-
Animal dung	33	16.5	0	-
More than one source*	44	22	4	20
Total	200	100	20	100%

Source: MIS field survey 2014

*firewood was mentioned by all the respondents who had more than one source of energy in both the MIS villages and the Mutithi area.

(b) Mutithi area

Table 5.10 summarizes the sources of energy, the proportion of the respondents using each type and the corresponding percentages have also been given. There was abudance of fuel wood in the Mutithi area. This was attributed to the large expanses of land in the Mutithi area and the land tenure system. The average size of land owned in the Mutithi area was high – 8 acres per household and most respondents had woodlots within their farms. The indoor pollution caused by fumes from biomass sources was seen to be low in the Mutithi area than in MIS villages where crop residues and animal dung were major sources of energy.

Environmental problems related to human health

(a) MIS villages

A total of 200 interviews were conducted. The study population consisted of household heads who were tenants in the scheme and owned paddy fields. Most of them were aged between 20 – 80 years.

(b) Malaria

The proportion of people bitten by mosquitoes was higher in the morning and evening in houses. The frequency of bites increases during the wet rice growing season (April to December). People use repellents but a low percentage use mosquito nets which showed that the consciousness of mosquito control was not high. In all, 75% of the respondents mentioned malaria as one of the common diseases they suffer in the course of the year. this shows that malaria is endemic at MIS. Secondary information from Mwea Mission Hospital's medical records supported our field surveys by showing that malaria is endemic and the cases increase after the flooding of the paddy fields.

(c) Schistosomiasis

It was observed that 95% of people live near water such as canal, river or ponds and use water for domestic affairs and for body hygiene. All the tenants work in the paddy fields without any protectors. They knew that the snails are the intermediate host of bilharzias but no control was progressing. A survey carried out by the African Biodiversity Institute (ABI) revealed that up to 70% of the inhabitants of the scheme are infected with schistosome, a bilharzias-causing worm. This is among the highest figures in the country. Our field surveys in 10 villages revealed that 58.5% of the respondents mentioned schistosomiasis as one of the common disease affecting human beings in the scheme.

(d) Amoebic dysenteries

In all 62% of the respondents listed amoebic dysenteries as one of the common diseases that they had suffered at least in the last 6 months. Most of these respondents were of the opinion that these dysenteries were as a result of poor water quality used for domestic supply.

(e) Typhoid

In the course of the study period there was an outbreak of typhoid in at least 5 villages I the settlement. In fact in one of the study village, Bahati, there was an outbreak as confirmed from a local health centre and had claimed at least four lives. Typhoid is transmitted direct by water ingestion. Most respondents noted that the disease was more severe because there were no drugs in the government aided health centres and they had to rely o private clinics which were expensive. It was observed that 54% of the respondents interviewed said typhoid was one of the common diseases they had suffered from.

(f) Cholera

Also related to the above, cholera was also mentioned as a common water borne disease at MIS. Official records showed that there had been at least an outbreak of cholera in some villages. Because of poor sanitary systems and congestion in the villages plus the poor quality drinking water, the spread of cholera was noted to be high in the villages where there was an outbreak. In all, 55% of the respondents said they had suffered from the disease in the last 6 months.

(g) Others

Other diseases mentioned as common in the scheme were: Hepatitis (infectious) which is transmitted through ingestion of contaminated water; bronchia pneumonia, cardiac failure, meningitis was also mentioned by quite a large number of respondents and finally, intestinal worms. About 3.5% of the respondents at least mentioned one of the above diseases.

In general, all the respondents noted that these diseases affected their working schedules seriously and finally affected the final yields.

Results from doctors and medical staff

A total of six doctors and two MIS medical staff were interviewed in order to cross check the information given about the common diseases by the tenant. They were asked to briefly comment on the three major diseases treated throughout the year. The information obtained was supplemented by secondary information about the diseases in MIS obtained from Mwea Mission Hospital's medial records for the years 1990-94 as shown in Figure5.1.

(a) Malaria

Almost all doctors had treated more that 200 patients in the last 6 months of the year. Principal medicines for treatment were chloroquine, fancidar, metakelfin and quinine. In all, 66% of doctors answered that there had patients who did not respond to medicine, which means drug resistant malaria was prevalent there. During the long and short rains and throughout the times when rice fields were flooded, the number of patients increased. This was also shown by the medical records from Mwea Mission Hospital and presented in figures5.1 and 5.2. In 2014 there was a sharp increase in malaria cases and this was due to continued rise in drug resistant malaria.

(b) Schistosomiasis

Almost all doctors had treated patients for bilharzias. The number of patients treated were less than malaria, with the number being the highest during the growing season when tenants frequently are in the flooded fields as presented in figures 5.3 and 5.4. The parasite species were both *Schistosome mansoni and S. haematobium.* Praziquantel was used for treatment.

(c) Amoebic dysenteries

More than 50% of the doctors interviewed noted that there was an increase in incidence of amoebic dysentery cases at the MIS. Over 66% of the doctors interviewed had treated more than 100 cases if amoebiasis and related problems of intestinal worms. The patients treated were responding well to medicines but because of the poor quality of water used, the cases continued to increase. The two medical staff from MIS interviewed agreed that the above mentioned disease were endemic at MIS and they were caused by the presence of disease vectors like mosquitoes and snails propagated by the flooded rice fields and the poor quality of canal water used by tenants as sources of domestic water supply. They acknowledged that community health education could help reduce incidence of these human diseases. They noted that since the NIB stopped spraying canals or treating the water, the farmers have been exposed to malaria, bilharzias, amoebic dysenteries, typhoid and other water borne diseases.

(d) Mutithi area

Table 5.11 shows the common human diseases in the control area. The interview schedules revealed that malaria was endemic in both the Mutithi and MIS villages with the latter recording that 100% of respondents had at least been attacked by malaria. However, 65% of respondents from Mutithi area also said they had suffered from malaria. This is because malaria transmitters, mosquitoes have been known to affect populations who are not necessarily within the boundaries of the breeding points. Malaria was the only disease which was mentioned by both the respondents from the study and the control area, Schistosomiasis was another vector borne disease found in rice growing areas was found to be endemic in the MIS villages. In the control region only 5% of the respondents had contracted bilharzias. It was found that this particular respondent had to be absent in non irrigated lands. Water-borne diseases like, Amoebic dysenteries, typhoid, cholera, diarrhea, intestinal worms and hepatitis were found to be endemic in MIS villages and absent in the control region. This could be attributed to the presence of treated pipe-borne water supply and uncontaminated water from borehole in the control area.

Table 11 : Major Diseases Mentioned by the Respondents in both areas

	M I S Villages		Mutithi	
Disease	Freq. n=200	%	Freq n=20	%
Malaria only	46	23	13	65
Schistosomiasis only	13	6.5	1	5
Amoebic dysentery only	20	10	0	-

Typhoid only	4	2	3	15
Cholera only	6	3	0	-
Malaria, Schistosomiasis, Amoebic dysentery, Typhoid and Cholera	104	52	0	-
Other diseases	7	3.5	3	15
Total	200	100	20	100%

Source: MIS field survey 2014

Table 12 : Causes of major diseases as given by the respondents

	M I S Villages		Mutithi	
Reason given	Freq. n=200	%	Freq n=20	%
The presence of many disease vectors and poor water quality	112	56	19	95
Poor sanitary conditions and congestion in the village	50	25	1	5
Poor housing and people's interaction with waters	38	14	0	-
Total	200	100	20	100%

Source: MIS field survey 2014

Implication of environmental problems related to human health in MIS

The disease associated with rice growing, and those identified in MIS, can for convenience be divided into three as seen from the results.

(i) Diseases transmitted by vectors or intermediate hosts living in the rice fields or associated irrigation canals i.e. malaria and schistomiasis,
(ii) Water related diseases such as dysenteries contracted through drinking contaminated waters, i.e. amoebic dysenteries, typhoid, cholera, intestinal worms, diarrhea and food poisoning, and finally,
(iii) Those related to insanitary housing conditions and overcrowding, i.e cholera, tuberculosis, influenza, meningitis and pneumonia since they can be transmitted from one person to the other.

In MIS, vector borne diseases were seen to have the greatest socio-economic impacts on the community. They affect large populations and in fact cause high mortality, especially among the infants and adolescents or to be more chronic and debilitating. These diseases can reduce working ability of those infected as well as reduce the quality of life. The most important of these diseases is malaria transmitted by mosquitoes and schistosomiasis, which has various aquatic or amphibious, snails as its intermediate hosts. Schistosomiasis is in fact the most important and widespread disease after malaria in the study area. Despite the vigorous anti-malarial efforts in MIS, malaria continues to be a major disease. Malarial infections in MIS are brought about by different malaria parasites of the genus plasmodium of which the most common are *P. falciparum and P. vivax*. Schistosomiasis ranks among the most important occupational and public health problem in MIS. Rice cultivation does not invariably lead to schistosomiasis problem. For example, collaboration between NIB and the MOH prevented snails becoming established at the Ahero Pilot Scheme; this action was prompted by the disastrous rise in the schistosomiasis prevalence in MIS. It was noted that environmental changes due to irrigation development transformed seasonal and moderate malaria into a permanent hyper-endemic situation currently in MIS.

Data generated from MMH's 2012 and 2013 annual reports reveal overwhelming effect of malaria on MIS population mortality. The seriousness of this disease is only partly reflected in the morbidity and mortality (it was top of 10 disease for both adults and children). Malaria peaks are found in March/April and August/September especially when fields are flooded with water. In 2012, 2752 in-patients and 1855 out-patients were treated for malaria while in 2013 the number rose to 3075 in-patients and 2279 out-patients respectively.

The economic consequences of ill health are difficult to assess. Economic loss through absenteeism caused by Schistosomiasis, was estimated at US$8,640,000 annually. Extrapolating from studies elsewhere, the production loss due to ill health was estimated at 10%, which in the case of schemes under NIB means an annual loss of US$818,700 (WHO/FAO/ UNEP, 1988, quoted in WHO/FAO/UNEP, 1990). Though the present study did not calculate the economic costs of ill health, it can be seen from the results that farmers in Mwea suffer a number of debilitating illnesses which if the economic loss is estimated it could be enormous. It is therefore observed that to ensure the timely considerations of health in the planning of irrigation development especially in Mutithi area, the opportunities for inter-sectoral cooperation have to be utilized at the crucial movements during the project cycle. It can be said that malaria, schistosomiasis and other water borne diseases identified in MIS have caused great damages since considerations for public health effects have been neglected by the NIB and MIS management in particular.

Farmer's perceived environmental problems

(a) MIS Villages

The interview survey revealed that the major environmental problems perceived by respondents were of two kinds: those that are social in nature and those that are physical. Human environmental problems as perceived by the respondents are: Human health problems and poverty among others while physical environmental problems are: diseases in aquatic weeds, salinity and alkalinity in the fields and waterlogging. Table 5.15 (a) gives a summary the perceived social environmental problems and percentages. It was the feeling of many respondents, 48%, that human health problems were the main problems in the social sphere in the settlement. 41% of the respondents however noted that poverty among other problems was the most important social environmental problem facing the settlement. The problem is discussed below. The remaining respondents, 9%, noted other social problems other than the above two as important. Among the ones mentioned which are of interest to this survey were seen as causes of the above two rather than problems on their own.

Poverty and its implications

In this context poverty is defined as lack of assets to pay large expenses or to meet contingencies and to powerlessness. It was indicated by malnutrition and high birth rates, high infant mortality, vulnerability to diseases, physical weaknesses and indebtedness. According to Chambers, R. (1991:112 in his book *Rural Development: Putting the Last First,* diseases like cholera is an indicator of poverty. Crowded conditions plus inadequate water and sanitation are ideal conditions for it. This disease seldom strikes those in upper socio-economic groups, even in region point of view, poor living standards and conditions, is the major cause of their ill health in the scheme. During the planning stage of the settlement the planners were preoccupied with the main objective of increasing agricultural productivity and farmers welfare was peripheral to this goal. A high degree of control of tenants activities is exercised by the management. The overall system of control is very strict based on irrigation rules (cap 347) and the success of Mwea has largely been attributed to the close supervision which has protected tenants from failure. However this type of control have made tenants apathetic and they now tend to mistrust the board and see themselves as slaves. The complete control over tenants activities, the far reaching sanctions, the absence of legal rights to holding, or the assurance of the inheritance of the holdings – all these led to tenants insecurity. The regime under which the scheme is managed, and to which most of its success is attributed, is probably its most disquieting feature. Much depends upon whether the present situation is considered a traditional phase, and it has taken too long, during which the tenants are educated towards becoming independent farmers, or whether this discipline is a built-in feature of the scheme, without which it would eventually breakdown, as has happened in other irrigation settlements in Africa. Its continuance would inevitably perpetuate the apathy and dependence of tenants lacking initiative, and drive others to search outlets for their initiatives and enterprise outside the settlment.

(b) Mutithi area

Table 5.15 gives a summary of perceived environmental problems in the control area. The major environmental problem which was found in the control area and not mentioned in the study area was soil erosion especially in the red soil area. This was completely absent in the MIS area since the agronomic practices presently in use do not aggravate soil erosion.

Table 15 (a) : Farmers perceived Environmental Problems in MIS and the control area – Social Environmental Problems

	M I S Villages		Mutithi	
Environmental problems	Freq. n=200	%	Freq n=20	%
Human health problems	96	48	5	25
Poverty	82	41	4	20
Others	11	22	11	55
Total	200	100	20	100%

NB: Respondents were asked to mention the most important social environments problem faced.

Source: MIS field survey 2014

Table 15 (b) : Farmer's perceived Environmental Problems in MIS and the control area: Pysical Environmental Problems

	M I S Villages		Mutithi	
Environmental problems	Freq. n=200	%	Freq n=20	%
Increase in aquatic weed	92	46	0	-
Water contamination	69	39.5	0	-
Salinity and alkalinity	27	13.5	0	-
Waterlogging	12	6	0	-
Soil erosion	0	-	20	100
Total	200	100	20	100%

Source: MIS field survey 2014

NB: Respondents were asked to mention the most important physical environments problem faced.

Environmental problems observed at the Macro-level MIS irrigation fields

Water Contamination

When water is not in conformity with the water quality standards, either existing or intended, the water is said to be polluted. Water is contaminated when there exists a real health hazard or damage risk from using that water for some specific purposes, and in this case drinking water. From this field survey and the results of the interview schedule, most respondents used canal water for domestic purposes. Samples were collected at Thiba Headworks (the incoming irrigation water) and other samples were collected from subsurface drains near exit. Thought only 10 sampling sites were selected in each category, the following results show that there was an increase in coliform count per 100ml of water. This is an indicator of the presence of disease causing pathogens in the water which eventually drains into the canals used as sources of domestic water supply. Table 5.16 presents a summary of the parameters measured in order to ascertain the changes in water quality of water after irrigation. There was an increase in hardness of water indicated by increase in calcium carbonate ($CaCo_3$) from 44 to 138 mg/l, dissolved salts as indicated by increase in conductivity, from 80 to 263 mmhols/cm, showing the surface drain was near exist is highly polluted. This was also indicated by increase in Chlorides, Nitrates, Calcium, Magnesium, Sodium, Potassium and Sulphates as shown in Table 5.16. when this irrigation drain water finally enter receiving water bodies this eventually affects the water quality and pose danger to aquatic life, animal and man. Water quality from the control region was of satisfactory quality as shown in Table 17.

Implications of Water Contamination

Adverse effects of irrigation on water quality have been seen and identified as increased salinity, turbidity, colour, taste, temperatures, nutrients, bacteria and viruses (indicated by increase in coliform count). These effects can cause economic losses and deterioration of the environment. The rise in total salts due to irrigation normally has effect of increasing hardness. Part of the irrigation return water flows gets back into the canals and rivers which are used as sources of drinking water. Ingestion of this contaminated water leads to the widespread of waterborne diseases in MIS. Pollution of eventual receiving water bodied is equally important as it poses real danger to aquatic inhabitants, animals and man downstream.

Table 16 : Water Quality of Constituent Applied Irrigation and Surface Drain Water near exit of Irrigation Water: Irrigation Season

Average for 10 Sampling Sites

Constituent for characteristic	Applied Water	Surface Drain Next Exit
Temperature °C	18.0	21.4
Dissolved Oxygen	10.2	8.0
pH units	7.62	8.5
Hardness as $CaCo_3$	44	168
Turbidity units	32	146
Conductivity mmhols/cm	80	263
Chlorides as mg/1	0.98	9
Nitrates as mg/1	0.25	6.5
Calcium as mg/1	9.8	33.2
Magnesium as mg/1	4.6	18.7
Sodium as mg/1	4.6	18.7
Potassium as mg/1	1.4	4.6
Sulphates mg/1	3.6	24.6
Total Dissolved Solids (TDS)	121	470
Coliform per 100 ml	150	1,079

Source: MIS field survey 2014

Table 17 : Water quality assessment for tap water in Mutithi area: Averages for 5 sampling sites

Constituent for characteristic	Amount
Temperature °C	17.4
Dissolved Oxygen	12.6
pH units	7.44
Hardness as $CaCo_{3(mg/l}$	32
Turbidity units	23
Conductivity mmhols/cm	73
Chlorides as mg/1	0.68
Nitrates as mg/1	0.05
Calcium as mg/1	6.2
Magnesium as mg/1	2.9
Sodium as mg/1	2.9
Potassium as mg/1	0.39
Sulphates mg/1	1.81
Total Dissolved Solids (TDS)	91.5
Coliform per 100 ml	46

Source: MIS field survey 2014

Increased aquatic weeds

Irrigated rice farming in MIS is a part of a complex practices comprising management of available water resources, controlled distribution of this water over the cultivated land, and withdrawal of excessive water through drainage. The ecological consequences of this complex systems include the radial modifications of ecological systems of the terrestrial habitat to aquatic habitats. Aquatic weeds immediately find a conducive environment where they thrive and compete with the rice crop. Of big concern in MIS in the *Typha latifolia species*, found in areas of high water table and other species of aquatic weeds. Early and continuous weeding is he only way of controlling these aquatic weeds. From the field survey, tenants complained of reduced production in areas with intense aquatic weeds.

Water logging

According to field surveys water logging was only mentioned as an environmental problem by 6% of our respondents. Field observations and the results of the key information interviews confirmed that there were only isolated cases of water logging and occurred in lower unit of Tebere section. Over six and a half (6½) acres had been abandoned because of water loggig according to official records from MIS. However field observations showed that there was an additional eight acres which were under cultivation and affected by the water logging problem. Waterlogged plots were identified by the presence of *Typha laifolia* species and where the rice seedling was observed to turn yellow while still in water. Waterlogged soils in the present study means a soil saturated with water or having excess water in the root zone. It may be temporary, seasonal or permanent. In this study permanent waterlogged conditions which could lead to abandoning the rice fields are the only ones observed because of the conditions under which wet rice is grown. Soils having permanent groundwater near the surface are considered waterlogged. In the areas the condition was observed in Tebere's T.19 and T.20 units, water logging was as a result of:-

- The low relief which make the area receive water from surrounding lands and thus become waterlogged,
- Introduction of an intensive network of irrigation canal system causing canal seepage that affect the water balance within the region with more incoming than outgoing. It was the observation of the irrigation officers interviewed that the problem of water logging was caused by poor drainage. The objective of drainage is to evacuate excess water from the soils. Plate 5.3 presents an abandoned paddy field because of water logging problems. The presence of *Typha latifolia* species indicated the high water table. Plate 5.4 presents a waterlogged plot which a farmer is tring to reclaim and *Typha latifolia* species can be clearly identified. Plate 5.5 shows a farmer leveling a partly reclaimed plot and in the background, plots which are not problematic have rice seedlings already transplanted and growing. Plate 5.6 presents a plot in the same unit where there is no waterlogged soils with the rice crop doing very well.

Salinity and Alkalinization of soils

The migration of salts in water, accumulation through evaporation and deposition are responsible for salinization of soil. Dissolved salts migrate with artesian waters through tectonic cracks and re-migrate to the surface and then salinity may develop as a result of evaporation during very dry or hot conditions. Secondary salinization often results following irrigation as a result of rising water table above the minimum level. The concentration of soluble salts in the soil solution increases as water is removed from the soil by evaporation and transpiration. Alkalinization may result from the evaporation of water containing low concentrations of sodium salts. As observed in some areas, the white accumulation of bases were obvious in some units. The concentrations sometimes were above critical levels as in Thiba units 6 (see Table 5.18). The damages caused by accumulation of bases are divided to 2 types:

- High total concentration of bases, Calcium (Ca) is a major base i.e. salinity. This causes the inhibition of water uptake by plant because of high osmotic pressure. The measure of conductivity is a way of estimating soil salinity in general. The higher the conductivity, the higher the level of salinity.
- High pH because of sodium (Na) is an indication of alkalinity. Where (Na) is high, pH becomes high in fact >8.5. The alkalinity causes the deficiency in some elements of which availability of low in high pH., (Na) inhibits Potassium uptake. Alkalinity can be proved by pH and sodium concentration. The accumulation of bases on surface is caused by poor drainage.

Table 18 : Soil Characteristics in selected areas in MIS

Parameter/Station	K2	W7	H6	M13	T19
pH- H_2O (1:2.5%)	7.94	5.79	8.29	6.68	7.72
Hcl Reaction (10%)	X	X	oo	X	oo
CEC (ml/100g) pH 7.0	61.0	68.0	76.0	70.0	68.0
Exch. Ca. (me/100g)	45.5	36.0	136.9	34.2	52.6
Exch. Mg. (me/100g)	19.9	15.3	29.9	20.2	31.2
Exch K (me/100g)	0.5	0.3	0.1	0.1>	1.0
Exch Na. (me/100g)	1.0	0.5	6.8	3.5	3.4
Avail. P ppm	15.3	25.3	24.9	22.7	94.8

Horizon 0-15 cm
Source: MIAD Soil Labs Feb. 1992
K2= Karaba Unit K2
W7= Wamumu Unit W7
H6= Thiba Unit H6
M13= Mwea Unit M13
T19= Tebere Unit T19
X= no reaction at all
oo= slight reaction

NB. The units where soil analysis was done were selected as problematic soils with the assistance of Irrigation officers in charge.

Table 19 : Soil Characteristics in selected areas of Mutithi area

Parameter/Station	Mut. 1	Mut. 2	Mut. 3	Mut. 4	Mut. 5
pH- H_2O (1:2.5%)	7.65	7.25	6.30	6.45	6.46
Hcl Reaction (10%)	6.05	5.50	4.25	4.90	5.20
CEC (ml/100g) pH 7.0	78.5	65.4	25.2	29.2	38.7
Exch. Ca. (me/100g)	32.2	27.5	10.6	11.5	11.2
Exch. Mg. (me/100g)	22.6	13.9	1.6	4.8	4.8
Exch K (me/100g)	0.1	0.1	0.1	0.6	2.1
Exch Na. (me/100g)	2.0	0.8	0.8	1.0	4
Avail. P ppm	77	75	80	120	112

Horizon 0-15 cm
Source JICA 1988.
Mut.1= Mutithi station 1
Mut.2= Mutithi station 2
Mut.3= Mutithi station 3
Mut.4= Mutithi station 4
Mut.5= Mutithi station 5

Implications of Waterlogging, Salinity and Alkalinization

The most important factors causing waterlogging, salinization and alkalinization is MIS are aridity of the climate together with geomorphology, topography, physiochemical characteristics of the soils and soil and water management practices. The presence of high water table and high evapo-transpiration sometimes alkalinization of soils. The development of waterlogged soils is mainly associated with low-lying lands of poor soil physical conditions and internal drainage. As a result of intensive and continuous application of water in the paddy fields in MIS, with the absence of efficient drainage systems or good internal drainage in some units, waterlogging may become a serious problem in the scheme. Quantitative data on the extent of the present and potential salinity, alkalinization and water logging was not available and this should be a research priority in MIS. However from the examples given in the results, it should be noted that these problems, though at low magnitudes, should be mitigated against to avoid future deterioration of the schemes soils. The reclamation of the already affected soils will depend among other things on the proper selection of them method that best suits the specific conditions in the field. In order to reach such a decision, field and laboratory works are required to indicate the extent of the problem.

Comparison at the Macro level (MIS irrigation fields and the Mutithi area)

At the macro level, the variables compared are water quality, waterlogging, soil characteristics (salinity and alkalinization) and vegetation characteristics in MIS and the Mutithi area. Tables 5.16 and 5.17 show the water characteristics in MIS and the Mutithi area could be said to be as a result of irrigation activities. It was observed that there was a high number of coliform in water from MIS than the samples analyzed from the control area. This may be the prime cause of many water borne diseases in MIS than in the control area. The interpretation of soil analysis from MIS (Table 18) and the control area (Table 19) indicates some degree of salinization and alkalinization in MIS. These are absent in the Mutithi soils which are not irrigated (see Tables 18 and 19). Water logging was found to be isolated in some units of MIS as revealed by field observations. This phenomenon was found to be absent in the control area. Soil erosion was found to be serious problem in the control region especially in the heavily cultivated red soils of the Mutithi area. It was established through interview schedules, informal interviews, interviews with key informants, literature survey and interpretation of aerial photographs that the Mwea Plains, which now supports rice paddy fields and villages were once open grasslands with isolated shrubs. However this type of vegetation has been modified to suit wet rice cultivation. In the Mutithi area, areas with black cotton soils were also found to be devoid of intense vegetation though it supports isolated vegetative cover. In the red soil areas in MIS we find nucleated settlements while in the Mutithi area these areas were cultivated and support thick vegetation. In both areas, attempts have been made to regenerate vegetation and now the MIS villages support thick *Grevillea robusta* species. These species were also observed in the control area. Interestingly the reasons for planting trees in both areas were different with the respondents in MIS acknowledging that they have planted trees to provide fuel wood. Respondents in the control area said they had participated in three planting to improve the soil quality and present soil erosion.

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Analysis and Interpretation of Airborne Magneticdata of G.Abu Had-G.Umm Qaraf Area, South Eastern Desert, Egypt

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ANALYSISANDINTERPRETATIONOFAIRBORNEMAGNETICDATAOFGABUHADGUMMQARAFAREASOUTHEASTERNDESERTEGYPT

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Abstract- The aeromagnetic survey is important to delineate the relationship that is usually present in survey areas, between magnetic anomalies and tectonic pattern. This is primarily based on the fact that the tectonic history of the rocks is recorded in the magnitude and pattern of magnetic anomalies. Thus, any extensive magnetic survey will contain anomalies whose pattern is not random. G.Abu Had-G.Umm Qaraf area is located in the southern part of the Eastern Desert of Egypt. It is about 100 km southwest Marsa Alam City. This approach utilized interpretation techniques that independent of magnetization direction such as source parameter imaging, Euler deconvolution and analytic signal to estimate body location and depth. The estimated parameters were further used to image the basement rocks using modeling techniques.

Keywords: aero magnetic-depth calculation- modelling - egypt.

I. Introduction

This paper discusses some of the guidelines used in analyzing high-resolution aeromagnetic surveys and illustrates some of the techniques and software tools used for reducing, processing and interpreting such aeromagnetic data for structural and tectonic features. Geologic structures (like ore bodies or faults) often produce small magnetic fields that distort the main magnetic field of the earth. These "anomalies" can be detected by measuring the magnetic field near the surface of the ground. By analyzing these measurements, geophysicists can learn about geologic structures, even though the structures may be concealed entirely below the earth's surface (Blakly. 1995).

The present study deals essentially with the analysis and interpretation of aeromagnetic survey data acquired. The data interpretation would be supplemented by the consideration of all available previous geological and all information works in this area. In brief the proposed study has the following main objectives:

1- Analyzing the airborne magnetic data to define the basement rock units.
2- Mapping the surface and subsurface structures that can be shade more light on the structural setting by using 2D modeling technique.

Area is located in the southern part of the Eastern Desert of Egypt. It is about 100 km southwest Marsa Alam City. The surveyed area is bounded by latitudes 24° - 25°N and longitudes 34^0- 35^0 E with 1221 km^2 area (Fig.1). More than 95% of the area is covered by crystalline basement (igneous and metamorphic rocks). Sedimentary rocks and wadi sediments cover small region. Quaternary sand and gravel extensively cover plains and wadis. The compiled geological map shows the available information about the surface geology. Faults, joints and foliation, in addition to lithologic boundaries, are the main features controlling the dendritic drainage pattern of the area.

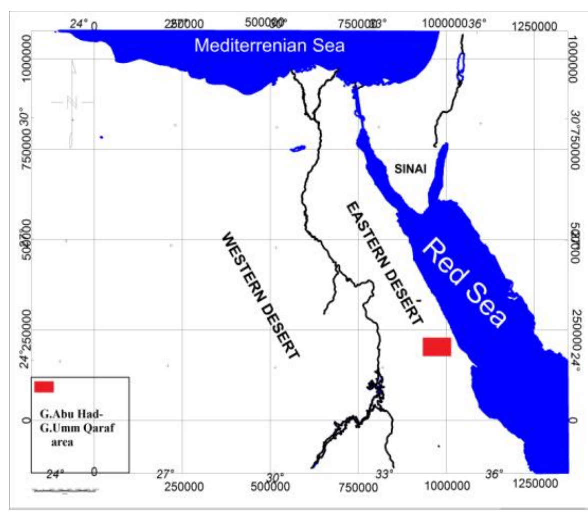

Figure 1: location map of G.Abu Had-G.Umm Qaraf area, South Eastern Desert, Egypt

II. Geological Outline

The study area is a part of the Precambrian belt in the south Eastern Desert of Egypt. Proterozoic (igneous and metamorphic) and Phanerozoic rocks are exposed in the studied area as illustrated in the geologic map (Fig. 2) that modified after EGSMA (1997 and 2001).

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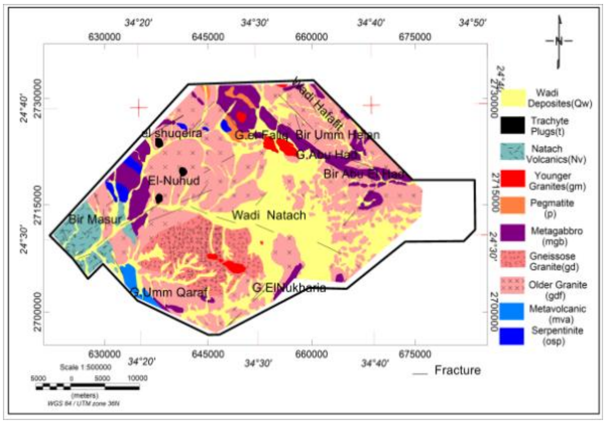

Figure 2: geologic map of G.Abu Had-G.Umm Qaraf area, South Eastern Desert, Egypt, after EGSMA (1997 and 2001)

a) *Quaternary Sediments (Qw)*

Detritus, sands, gravels, pebbles, cobbles and boulders are distributed all over the area and constitute the surficial cover in the main Wadis. They are generally formed by the weathering of the different types of rocks. Quaternary deposits are represented by wadi deposits (alluvial sediments) along the courses of wadis such as Wadi Natach at the centre of the studied area and Wadi Hafafit at NE part of the area. Also there are wadies at south, north and central parts.

b) *Trachyte plugs (T)*

They are represented by trachyte plugs and sheets. They have exposure like spots at the west of the area. These trachyte plugs are located at El-Nuhud; they are fine-grained, massive and vary in coulor from dark grey to grayish brown.

c) *Natash volcanics (Nv)*

These volcanics are well exposed west of the area. They are basic to acidic alkaline, undeformed volcanic rocks. Wadi Natash volcanics acquired their name from the type locality, Wadi Natash, located at the western border of the basement complex at the South Eastern Desert of Egypt. They were extensively erupted during the upper Cretaceous associated with the regional uplift preceding the northern Red Sea rifting. Surface manifestation of these volcanics is cropped out in separate locations in the study area as alkaline basalts and numerous of small trachytic intrusions (Hashad, et al., 1982).

d) *Younger Granites (gm)*

The younger granitic rocks (alkali feldspar granites) are outcropping in northern and southern parts of the studied area with small exposure. The majorities of these intrusions are rounded or elongate parallel to the direction of the Red Sea and possess relatively sharp contacts with the surrounding rocks. The younger granites are exposed in the eastern side of G. El Faliq, Naslet Abu Gabir as well as northeast W. Abu Gherban. They are characterized by low to moderate topography (375 m), cover about 95 km2, constituting some 45 in vol. % of the total exposed basement rocks and form elongated mass in NW-SE direction(Mostafa, 2013).

e) *Pegmatite (P)*

Pegmatite occurs as steeply dipping bodies of variables size. These rocks are very coarse grained mainly observed in the older granites near the contact with ophiolitic mélange. They are mainly composed of milky quartz, plagioclase with small pockets of mica. Also all the granitoid rocks of G. El Faliq are cut and crossed by several pegmatite bodies. These bodies are trending (NNE-SSW) and ranging in length from 50 m to several meters. Also, they occur as pockets or lenses (10-20 m in length) at the margin and the core of the gneisses rocks as well as ophiolitic mélange (Mostafa, 2013).

f) *Metagabbro (mgb)*

It is undifferentiated Intrusive metagabbro. It is exposed as limited outcrops at the western and northeastern parts of the studied area. It is composed of heterogeneous assemblage of rock types. They are mainly metamorphosed basic rocks including gabbro, norites, delorites, and basalts, in which the igneous textures are partly preserved.

g) *Gneissose Granites (gd)*

Gneissose granites are highly mylonitized and dissected by several faults mostly oriented to NW-SE directions. They show a well developed planer banding, gneissosly and folding. Small size quartz and pegmatitic veins are common and seem to be developed from the gneiss through mobilization and crystallization.

h) *Older Granites (gdf)*

They are exposed as wide outcrops located around Wadi Hafafit at the northwestern and eastern parts and represented a wide exposure of G. Umm Qaraf at the southern part of the area.

It occupies the extreme eastern side of the G. El Faliq. Also they have a wide exposure around G. Umm Qaraf. It occurs along the contact between the ophiolitic mélange and the younger granites. The older granites are characterized by relatively low to-medium topography. In hand specimens they are whitish in colour and characterized by medium to coarse grained and obvious biotite flakes (Mostafa, 2013).

i) *Acidic metavolcanics (mva)*

It is Intermediate to acidic metavolcanics and metepyroclastics. It is exposed in a small part in the area at the southwestern part. The metavolcanics constitute a pile of regionally-metamorphosed submarine lava flows of alternating basic, intermediate and acidic compositions.

j) Serpentinite (osp)

The ophiolitic rock in the area under study represented by Serpentines (osp), talc carbonates and related rocks. Serpentinite, essentially formed after harzburgite and to a lesser extend after dunite and lherzolite, are frequently transformed into talc-carbonates particularly along thrust fault and shear zone. Outcrops are located as few masses at the west. Serpentinite at G. Faliq area occurs either as huge masses or small masses at the western part of the studied area (Fig.2).

III. Airborne Survey Specification

Airborne Geophysics Department of the Egyptian Nuclear Materials Authority (NMA, 2012), Exploration Division conducted a comprehensive airborne high resolution magnetic survey, over G.Abu Had-G.Umm Qaraf, South Eastern Desert, Egypt,. Along flight-lines oriented in NE-SW direction using 250m line spacing for central and east area but 1000 m for the north and west area meanwhile the tie-lines oriented in NW-SE direction using 1000 m line spacing for all the area. Nominal flying elevation was 100m above ground surface. The airborne geophysical department (AGD) of the nuclear materials authority began operations by the beginning of 19 Jan, 2012 until March 2012.

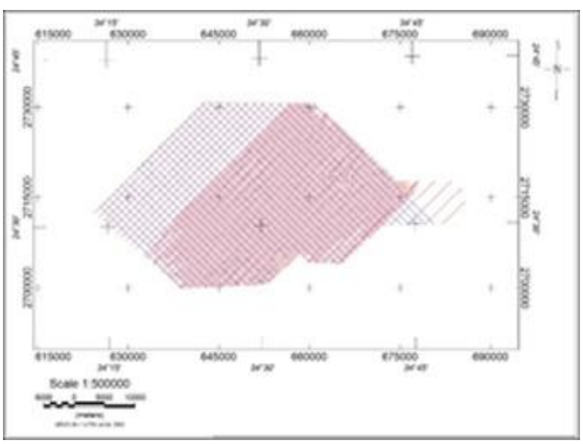

Figure (3): survey lines over South Eastern Desert, Egypt

IV. Total Magnetic Intensity Map(TMI)

The careful examinations of the TMI map (Fig. 4) showed that, the investigated area is characterized by the presence of numerous groups of shallow positive and negative magnetic anomalies of varying wavelengths, amplitudes, sizes, as well as magnitudes. The variation in magnitude of amplitudes and wavelength of these magnetic anomalies may reflect changes in the composition of geologic rocks and their depths, respectively. Meanwhile, the differences in sizes of the anomalies reflect the sizes of the various intrusions. The apparent correlation between the magnetic features of the TMI map and the compiled geological map of the area was found to be generally good. The main effected trends at TMI map are northwest-southeast trend located all over the area.

According to the magnetic characters, frequencies and amplitudes of the magnetic anomalies, the TMI map could be subdivided into three zones (Fig.46). The first zone (Zone-1) is characterized by low to very low magnetic values of high frequencies. It ranges from -4327to -202 nT at the northern and western parts of the map. (Zone-1) is recorded over younger granite, Natach volcanic and parts of older granites rocks. The main trend of this level is Northwest-Southeast and North-South trend (Fig. 5).

The second zone (Zone-2) occupies the central and eastern portion of the study area. It has irregular low to intermediate magnetic anomalies in different directions, reflecting different magnetic sources. The intermediate amplitudes range between -202 and -10.9 nT. Geologically, this zone is covered by wide portion of older granites and trending East-West trend (Fig. 5).

The third zone (Zone-3) represents the high amplitude and dense frequency of magnetic field. It characterized by strong positive anomalies with amplitudes ranging between -10.9 nT to 3968 nT, with large variation between them. It occupies parts of the west and south of the area. Geologically, this zone is covered by the, parts of metagabbros, pegmatite and serpentinites. The southern anomalies may be related to the basic and ultrabasic roots of basement rock extended at high depth and appear at the southern part of the Eastern Desert. This configuration of positive anomalies may be attributed to relatively deep-seated low relief basement structures. This suggests that the TMI anomalies are strongly influenced by the regional tectonic.

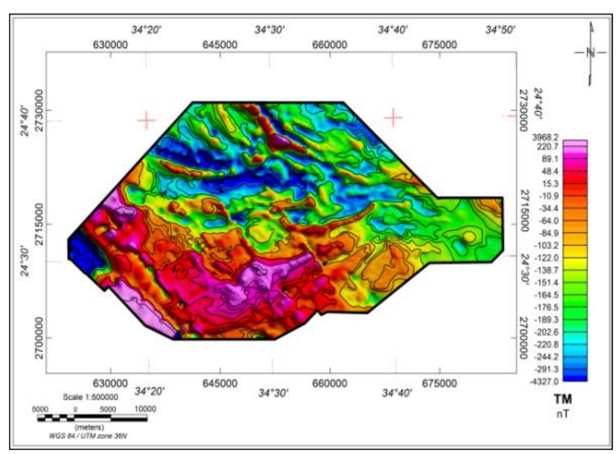

Figure (4): Total Magnetic Intensity Field, G.Abu Had-G.Umm Qaraf area, South Eastern Desert, Egypt.

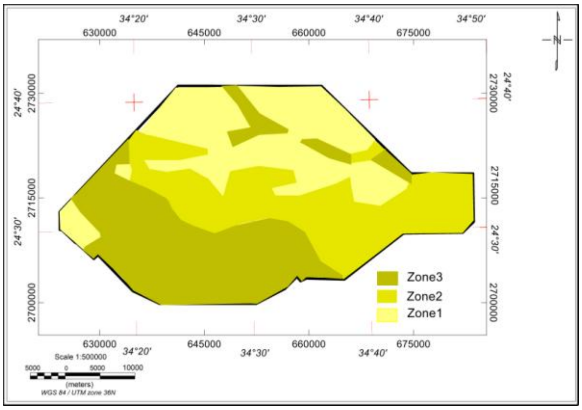

Figure (5): Magnetic Zones Map G.Abu Had-G.Umm Qaraf area, South Eastern Desert, Egypt.

V. Spectral Analysis and Regional-Residual Separation

There are many techniques to separate regional and residual magnetic component from magnetic map. Spectral analysis is the best of these techniques which is based theoretically on a Fast Fourier Transform (FFT). The method of frequency analysis is most appropriate, since it provides better resolution of shallow sources. Fourier spectral analysis has become a widely used tool for interpretation of potential field data, especially for depth estimation. This approach has been developed by many workers (Spector and Grant 1970). The energy decay curve (Fig.6) includes linear segments, with distinguishable slopes, that are attributed to the contributions in the magnetic data from the residual (shallower sources), as well as the regional (deep sources). The presentation of the method depends on plotting the energy spectrum against frequency on a logarithmic scale. Figure.6 shows two different components as straight-line segments, which decrease in slope with increasing frequency. The slopes of the segments yield estimates of the average depths to magnetic sources. Regional-residual separation was done at 0.15 frequencies. The depth of deep-seated (regional) magnetic component maps ranges from 500m to more than 1000 m and that of near-surface (residual) magnetic component ranges from 150m to 500m.

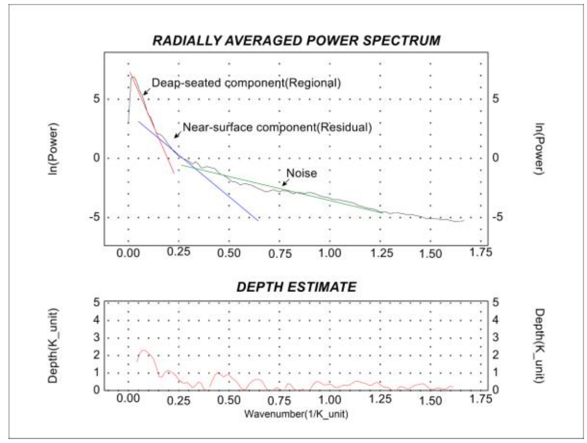

Figure (6): Power spectrum of magnetic data showing the corresponding averaging depths, of G.Abu Had-G.Umm Qaraf area, south Eastern Desert, Egypt.

a) *Residual Magnetic Component Map*

Qualitative and quantitative interpretation can be made more objective by constructing the residual maps of the observed field. Residual maps have been used by geophysicists to bring into focus local features, which tend to be obscured by the broader features of the field (Ammar et al., 1983). The construction of the residual map is one of the best known ways of studying a potential map quantitatively, where the measured field includes effects from all bodies in the vicinity (Fig.7). The residuals focus attention to weaker features that are obscured by strong regional effects in the original map (Reford and Sumner, 1964).

The investigation of the residual magnetic component map (Fig. 7) shows that, it is characterized by the following features:

1. A good similarity to the geologic map at north with anomalies have northwest-southeast and east-west trend which may suggest that, most of the basement rocks in the area, responsible for the magnetization, are either cropping out on the surface or buried at shallow depths like metagabbro and pegmatite intrusions.
2. Presence of broad negative magnetic zones located at southwestern and west parts of the map differing in their shapes and trends. They may reflect different compositions of the basement rocks at the subsurface or shallow basins due to subsiding. These zones are dissected by high frequency irregular and linear anomalies of shallower magnetic sources.
3. Some of the magnetic anomalies are of large areal extent. These anomalies are of moderate to high amplitudes with high magnitudes and high to low frequencies, suggesting that, the magnetic bodies, responsible for the magnetization, are extended at depth.

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b) Regional Magnetic Component Map

The regional magnetic component map (Fig.8) at the assigned interface is the result of removing the residual effects from the TMI map, where the separation procedures are designed to separate broad regional variations from sharper local anomalies. This map could be described as follows:

1. Negative magnetic anomalies (low zones) located in southwestern part of the map extended from northern to southern and far northern parts of the studied area. They covered with, Natach volcanic and granites trending NW-SE and E-W. Their amplitudes range from -990 to -7 nT.
2. Positive magnetic anomalies (high zones). They covered the northern part trending NW-SE trend and found as mass extend in southern part and their amplitudes range from 17.2 nT to 2179 nT and they are covered by pegmatite and parts serpentinite. Also positive values are located at the western part trending NW-SE trend which is covered by serpentinites, metagabbros, parts of older granites and metavolcanics. The anomalies at the southern parts are related to the deep root of basic and ultrabasic rocks.

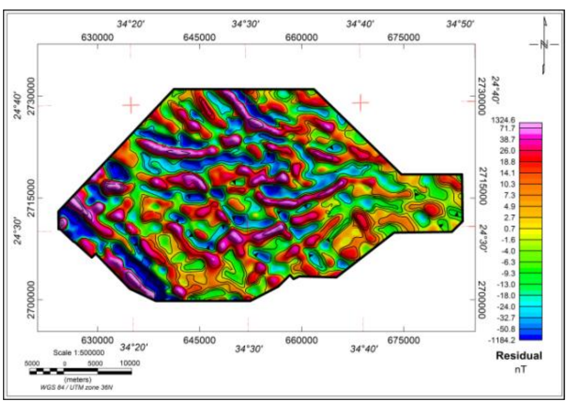

Figure (7): Shaded color contour map of the residual magnetic component, G.Abu Had-G.Umm Qaraf area, South Eastern Desert, Egypt

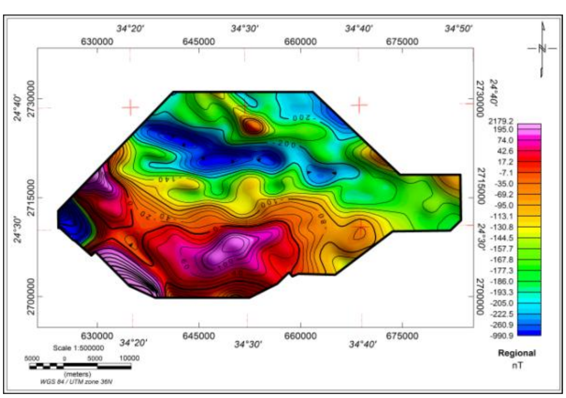

Figure (8): Shaded color contour map of the regional magnetic -component, of G.Abu Had-G.Umm Qaraf area, South Eastern Desert, Egypt

VI. Discussion of the Magnetic Depth Calculations

Depth estimation tools are mainly based on a specific algorithm that highly governs the estimated results. Derivation of the algorithm of each method depends on different constraint parameters. For example, Euler deconvolution is mainly constrained by the structural index of the source body, while the power spectrum is constraint by the spectral window of the FFT and the fitting method, and the 2-D modeling is constraint by the magnetic susceptibility of the subsurface layers. The constraint parameters of the applied tools in this study were also reasonably detected because the nature and geometry of the source body is well known. Knowing the source geometry made it possible to constrain the suitable structural index and accordingly estimate well its depth parameter. Although imaging the subsurface geological sources using maps form is advantageous, it was preferred in this paper to interpret the magnetic data in profiling form to avoid the negatives of interpolation used in maps which is believed to reduce the accuracy.

In this work, three advanced techniques were used to analyze the magnetic data as a guide for structural interpretation and basement configuration. These methods are analytical signal (AS), Euler technique and source parameter imaging "SPI" (Thurston and Smith, 1997). These methods are proved as efficient tools to map the location of magnetic structures such as faults and dykes. Magnetic depth estimation is one of the important steps in the quantitative interpretation of magnetic data to help providing useful information about the source body.

The three techniques SPI, AS and Euler results are closed to each other (Figs. 9, 10and 11 respectively). The maps of the depths help us very much to lineate the general structures of basement surface. In this study we applied the Euler method using the structural index (SI≈0) for contact or step and (SI≈1) for sill or dykes (Thompson, 1982 and Reid et al., 1990), since the main objective is to map the faults and contacts. Despite of generating scattered solutions, using structural index very near to zero is the way for better estimation of depth and location of the contact/fault. The estimated depths and locations using Euler methods were compared with that estimated using the SPI methods and the consistent solutions get the highest consideration in the interpretation.

From combination of the three maps, the NE-SW trend show shallower depth presented at the central to eastern parts. The depths at the two zones are related to the results which are calculated at the three methods. The first zone is characterized by deep depths which ranged from -278 to more than-580 for SPI method, from-225 to more than -695 for AS method and ranged from-360 to more than -800 for Euler method.

The second zone has shallow depths. These low values of depths range from -278 to -110 for SPI method, from -225 to -101 for AS method and from -360 to -129 for Euler method. This zone found from east to central parts. The shallow depths have main trends N-S, NE-SW and NW-SE trends.

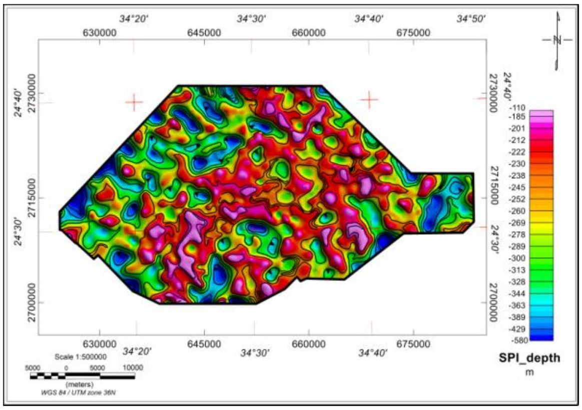

Figure (9): Depth to magnetic basement as calculated using source parameter imaging (SPI), G.Abu Had-G.Umm Qaraf area, south Eastern Desert, Egypt

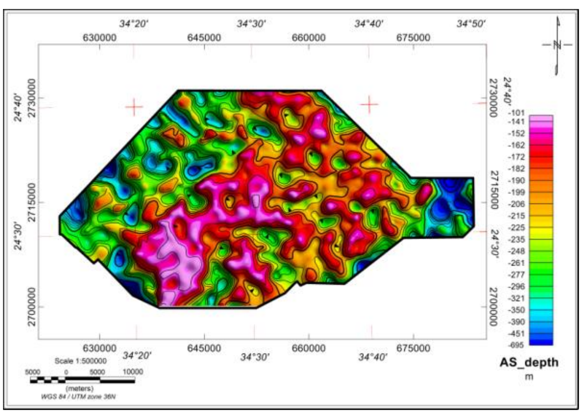

Figure (10): Depth to magnetic basement as calculated using analytical signal (AS), G.Abu Had-G.Umm Qaraf area, south Eastern Desert, Egypt

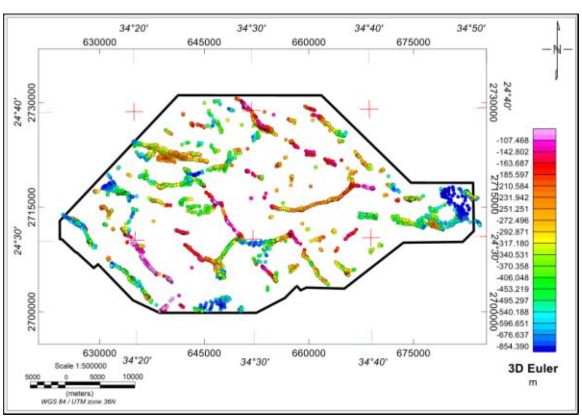

Figure (11): Depth to magnetic basement as calculated using Euler, G.Abu Had-G.Umm Qaraf area, south Eastern Desert, Egypt

VII. Modelling Technique

The two dimentional modelling is simple way to imagine the subsurface structure. The following 2-D model explains profile AA˴,BB˴ and CC˴ (figure 12).

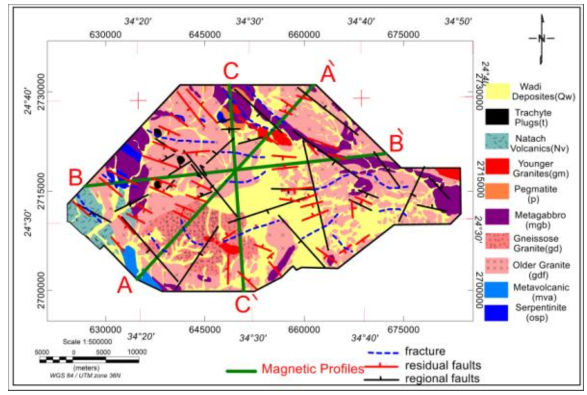

Figure (12): location of 2-D model drawn at Abu Had-G.Umm Qaraf area, south Eastern Desert, Egypt

a) *Two-Dimensional Magnetic Modelling of Profile AA˴*

Model AA˴ was taken at southwest-northeast direction. Close examination of the modelled profile AA˴ show an excellent fit between the observed and calculated anomalies with error reach 2.78. The magnetic susceptibility values were assumed to be 0.00045 metavolcanic rocks, 0.0043 for metagabbro, 0.00042 for gneissose granites, 0.0004 for older granites and 0.00042 for younger granite for this model. There is may be basement effect of 0.002 magnetic suscibtability. The profile was affected by the faults which appeared at the structural tectonic map.(Fig. 13).

b) *Two-Dimensional Magnetic Modelling of Profile BB˴*

The profile BB˴ located at west-east direction. The modelled profile BB˴ shows an excellent fit between the observed and calculated anomalies with error reach 0.5. The magnetic susceptibility contrast values were assumed to be 0.0.0004 for older granites, 0.0043 for metagabbro and 0.00045 for metavolcanics rock. We assumed that the magnetic susceptibility for Natach volcanic is 0.029 (Fig. 14). The basement effected bed has magnetic susceptibility of 0.002.This model show faults locations as found at the tectonic map. At this model the Natach volcanic intrusion are located at the west side.

c) *Two-Dimensional Magnetic Modelling of Profile CC˴*

Modelled profile CC˴ was taken at north- south direction (Fig.15). The model passed the same interception point with model AA˴ and model BB˴. The magnetic susceptibility values were assumed to be 0.0043 for metagabbro, 0.00042 for younger granite rocks, 0.0004 for older granites and gneissose granite rocks. Magnetic susceptibility values were assumed to be 0.003 for pegmatites and it was assumed to be 0.002 for basement rocks.

The resulted models show that an image that two faults affected this profile and show the lateral change in lithology. At this model we suppose that the effect of magnetic susceptibility was because of the surface basement rock or their changes in composition and structure.

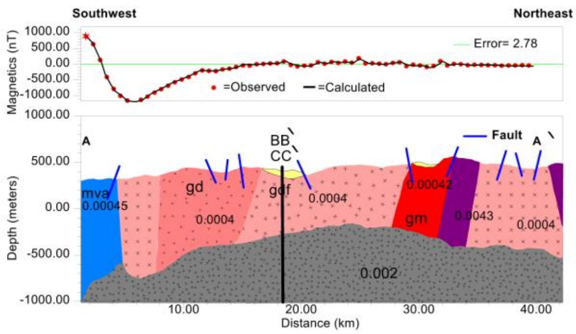

Figure (13): 2-D modelling of profile (AA\`), .Abu Had-G.Umm Qaraf area, south Eastern Desert, Egypt

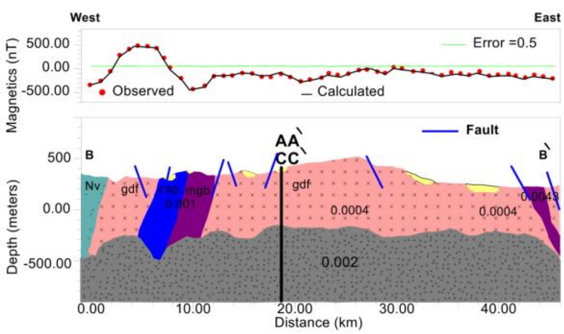

Figure (14): 2-D modelling of profile (BB\`), Abu Had-G.Umm Qaraf area, south Eastern Desert, Egypt

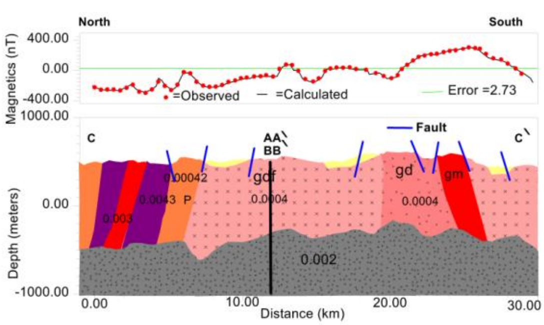

Figure (15): 2-D modelling of profile (CC\`).Abu Had-G.Umm Qaraf area, south Eastern Desert, Egypt

The resulted models show that an image that two faults affected this profile and show the lateral change in lithology. At this model we suppose that the effect of magnetic susceptibility was because of the surface basement rock or their changes in composition and structure.

VIII. Conclusion

The reduced to pole (RTP) magnetic map was separated using Gaussian technique into two magnetic components named: regional and residual magnetic components. The SPI and AS result are closed to each other. Meanwhile, Euler method shows little difference. The maps of the depths help us very much to lineate the general structures of basement surface. 2D magnetic modelling was carried out along three profiles AA\`, BB\` and CC\` oriented in SW-NE, W-E and N-S trends respectively.

IX. Acknowledgments

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Physico-Chemical and Microbial Analysis of the Effects of Abattoirs Operation in Estako-West and Central, Edo-State, Nigeria

By Olaiya. S, Mahmud Hauwau, Eboreime Lucky & Afolabi O. C
Auchi Polytechnic

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Keywords: slaughterhouse, wastewater, environment, bacteria, abattoirs, water quality, physico-chemical and microbial properties, hazard and safety.

GJSFR-H Classification : *FOR Code: 090409*

PHYSICOCHEMICALANDMICROBIALANALYSISOFTHEEFFECTSOFABATTOIRSOPERATIONINESTAKOWESTANDCENTRALEDOSTATENIGERIA

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Physico-Chemical and Microbial Analysis of the Effects of Abattoirs Operation in Estako-West and Central, Edo-State, Nigeria

Olaiya. S α, Mahmud Hauwau σ, Eboreime Lucky ρ & Afolabi O. C ω

Abstract- Abattoir wastewater has a complex composition and very harmful to the environment. There is always need for reduction in the impact of natural and most especially anthropogenic pollution to enhance water quality, food safety and sustainable development. Physico-chemical and microbial properties analysed using standard laboratory procedures were temperature, pH, conductivity, turbidity, total solid (TS), total dissolved solid (TDS), total suspended solid (TSS), dissolved oxygen (DO), acidity, alkalinity, total hardness, calcium and magnesium hardness, chloride, iron and nitrate. Temperature ranged from 28.04-29.12C, pH between was 7.67-8.01, Alkalinity is 0.45 mg/l, TS, BOD and TSS were 700 mm/l, 48 mm/l, 500 mm/l, DO is 2,100 ppm. Holistic outputs of the investigation revealed various water samples were contaminated with *E. Coli* and other enteric bacteria. The presence of coliform *staphylococcus aures* indicated the presence of microorganisms which are associated with water borne disease.

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I. Introduction

Meat quality control is a system that regulates the measure of extrinsic materials such as chemical residues, toxins, pathogenic microorganisms and putrefied tissues, which could be present in meat and are deleterious to human health [1]. Abattoirs generate large amounts of solid waste and effluents such as rumen contents, blood and waste water [2]. Abattoirs often have difficulties in disposing of the solid wastes and wastewater in an environmentally acceptable fashion and in many instances untreated rumen contents, blood and/or other Abattoir effluents and wastewater are released into the environment [3].

The resulting pollution not only cause problems related to odour, flies and hygiene, but surface and ground water can be polluted with pathogens and undesirable chemical compounds [4]. While the slaughtering of animals results in significant meat supplies, a good source of protein and production of useful by-products such as leather, skin and bones, the processing activities involved sometimes result in environmental pollution and other health hazards that may threaten animal and human health [4].

Abattoir and slaughter houses have been defined as premises approved and registered by the controlling authority for hygienic slaughtering and inspection of animals, processing and effective preservation and storage of meat products for human consumption [5]. Previous studies have shown that the characteristics of abattoir wastes and effluents vary from day to day depending on the numbers and type of stocks being processed [6].

Animals (cow, goat e.tc) prepared in Auchi abattoir alone accounts for about 65% of the total animal in Etasko-West, Edo State, Nigeria. The waste from the slaughtering and dressing grounds in the abattoir are washed into open drainages untreated and the leachates from the series of decomposition processes of these wastes can introduce enteric pathogens and excess nutrients into the surrounding surface waters and also percolate into the underlying aquifers to contaminate the hand-dug wells which serve the dual purpose of drinking water for the butchers and others working in the abattoir, and the people in the neighbourhood [7]. Uncontrolled discharge of abattoir effluent on the soil surface and water could lead to serious land and water degradation causing serious economic and health problems. This paper investigates microbiological and physicochemical of effluent being discharge to the river and resulting effects on the environment.

II. Materials and Methods

a) Sample Collection

Water samples were collected from five abattoirs with sterile polyethylene bags. The abattoirs were located at different locations in Estako west and central in Edo State, Nigeria. Samplings were done as early as 6.00 am when slaughtering processing to the sales of the meat were carried out. The procedure used is similar to the reported [5]. All glasswares such as Petri dishes, conical flask, measuring cylinder and test tube were washed with detergent, rinsed in clean water and

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dried in the drying cabinet. The glasswares were then sterilized in the hot air oven (autoclaves) at 121^{0}C for 20 minutes. All samples were well labeled and transported to the laboratory for analyses immediately after collection. There were a total of 3 replicates for each sample. The effluent was investigated for physicochemical and microbiological characteristics. The observed laboratory results were compared with World Health Organization (WHO) standard.

i. *Determination procedures for microbiological and physico-chemical characteristics*

The chemical and biochemical oxygen demands were measured according to standard methods described by [8]. The conductivity of the effluent was determined using a conductivity meter (YSI Model 34) according to [9] while the pH of the sample was determined with a pH metre (7020 HACH) following standardization with a buffer solution [9]. Temperature of the effluent and soil stock solution was determined using a mecury-in-glass thermometer (0 – 100^{o}c) in accordance with the method described by [10]. The sample was poured into different clean odour free glass bottle and warmed to room temperature using water bath. The samples were shaken and the stopper of the bottle was removed. The odour was tested using the nose and the characteristic odour was recorded by five judges.[10].

ii. *Results-analysis and discussion*

The results of the research study reveal the physicochemical and microbiological characteristics of the effluent from the abattoirs. Results of physiochemical and microbiological tests are shown in table 1 and 2.

Table 1 : Physicochemical characteristics of effluent from the abattoir

Parameter Tested	Mean
Temperature	28.40C (±10.25^{0}C)*
pH	7.67(±0.36)
Colour	Dark brown
Odor	Offensive
Conductivity	18.0 x 10^2 (±9.25)
Acidity	(ppm) 0.9 (±0.13)
Alkalinity	(mg/l 0.45(±0.04)
Dissolved Oxygen	(ppm) 2,100 (±233)
Total suspended solid	(mm/l)500
Total Solid	(mm/l) 700
Biochemical Oxygen Demand	(mm/l) 48
Total Hardness	176.4
Magnesium ND	
Calcium	85
Chloride	(mm/l) 4.8
Aluminium	ND
Lead	ND
Iron	7.6

Standard deviation in parenthesis

Table 2 : Result from the bacteriological analysis

Samples	Coliforms	Other Enteric Bacterial (Cfu/mu)
A	174	7.10 x 10^6
B	185	7.45 x 10^6
C	180	7.15 x 10^6
D	178	7.19 x 10^6
E	186	7.47 x 10^6

Source: Lab. Result, 2010

The composition of the slaughterhouse is affected by the number of animals slaughtered and the disposal method employed. A significant part of the variation can be seen in the Total Suspended Solids (TSS) and the exhibited high dissolved oxygen and Biochemical Oxygen Demand (BOD) (Akinro et al., 2009). The effluent from the abattoir has high offensive odour. The pH is slightly neutral ranging from 7.92-7.96 which is within WHO standard of 6.5-9.5.WHO defines 6.5-8.5 as the suitable range for hydrogen concentration (pH) levels. The range in the effluent is considered suitable. Conductivity ranges which is within 18 *10^2 mS/cm which are within WHO standard permissible limit of 200-1200 mS/cm. Total Suspended Solid (TSS) ranged from 500-550mm/L. This far above the of WHO permissible limit. The concentration of dissolved oxygen (DO) is 2100 ppm. The Total hardness of the water sample ranged from 176.4 mm/l which was also below

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the WHO (2006) allowable limit of 500 mg/L and Calcium hardness value which 85 is not specified by WHO standard so pollution cannot be predicted and the value of Magnesium hardness was not determined. Chloride, Iron and Nitrate values are all within the permissible limit of WHO (2006) standard permissible limit. DO result indicated that the various samples were contaminated in one way or the other with E.*Coli* and other enteric bacteria. It can be deduced from Table 2 that all the water samples used for the test were polluted biologically beyond permissible limits. The presence of coliform *staphylococcus aurens* was confirmed in all the abattoirs. The presence of this bacteria in intolerable number obviously constitute a serious public health hazards as the presence of these microorganisms is associated with water borne diseases since the waste is discharged into the streams. Such systems of production are not sustainable in the long-term and it is possible to develop integrated systems where local inputs are optimized and recycled, with a reduction in external inputs. Sustainable animal production means, that we are able to produce food animal and animal products without lasting damage to the environment, which means that essential elements like water, air and soil are left without dead loads and that by-products of animal production creates no animal and human health risks through environmental protection and animal waste management (TIELEN, 2000).

III. Conclusion

The result revealed that effluents from the abattoir pose health and environmental problems. Other possible sources of pollution could be point source discharge from industrial effluents (solid, liquid etc). High level of Total Suspended Solid (TSS) and conductivity show that the samples were heavily loaded with colloidal, organic, inorganic and suspended matters. The maintenance of good environmental conditions by disposing sewage and refuse in a sanitary manner in the abattoir starts with the definition of the minimum requirement for all the links in the production chain. Also the effluent should be well treated and ensure is not harmful before it is discharged.

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Removal Anionic Dye from Aqueous Solutions using Biopolymere

By Mahammedi Fatiha
Abu Bakr Belkaid University

Abstract- Dyes have long been used in dyening, paper and pulp, texstile, plastics, leather paint, cosmetics and food industries. This poses certain hazards and environmental problems. the objective of this study is to investigate the adsorption behaviour of metyl orange from aqueous solution onto chitosan. The effect of initial dye concentration, contact time, initial pH, and adsorbent dosage were studied. the Langmuir and Fredlich adsorption models were applied to describe the equilibrium isotherm.

Keywords: *adsorption, metyl orange, chitosan.*

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Mahammedi fatiha

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Keywords: adsorption, metyl orange, chitosan.

I. Introduction

Environmental pollution due to industrial effluents is of major concern because of their toxicity and threat for human life and the environment. the discharge of textile effluent with the entry of toxic components into the food chains of humans and animal. Synthetic dyes are extensivety used for dyeig and printing in a variety of industries [1]. the removal of colour from textile effluents has targeted attention over the last few years, not only because of its toxicity, but mainly due to its visibility. Conventional treatement facilities are often unable to remove certain forms of colour, particularly those arising from reactive dyes as a result of their high solubility and low biodegradability; thus, methods for decolourizing textile effluents are on the horizon [2]. Over 10.000 dyes with an annual production over 7x 10^5 metri tonnes worldwide are commercially available and 5-1% of the dye stuff is lost in the industrial effluent. therefore, there is a need to remove dyes before effluent is discharged into receiving water bodies.

The mehods of colour removal from industrial effluent include coagulation, flocculation, biological treatement, hyper filtration, adsorption and oxidation .Among these options adsorption is most preferred method and activated carbon is most effective adsorbents widely employed to treat wastewater containing different classes of dyes, recognizing the economical drawback of commercial activated carbon.

Special attention has been given to a natural amino polysaccharide called Chitosan. Chitosan is a partially acetylated glucosamine biopolymer, with mainly results from the deacetylation of chitin, which is a major component of arthropod and crustacean shells such as lobsters, shrimps, crabs and cuttlefishes [3]. As shown from figure 1, chitosan has three types of reactive functional groups, an amino group as well as both primary and secondary hydroxyl groups at the C-2, C-3andC-6positions, respectively .Its advantage over other polysaccharides is that its chemical structure allows specific modifications, especially at the C-2 position. These functional groups allow direct substitution reaction and chemical modifications, yielding numerous useful materials for different domains of application [4].

Chitosan is known as an ideal support material for enzyme immobilization because of its many advantages such as its hydrophilicity, biodegradability and anti- bacterial property [5]. Chitosan is widely used for the removal of heavy, transition metals and dyes because amine groupe (-NH_2) and hydroxyl group (-OH) on the polymer chain of chitosan can adsorb both cationic and anionic molecules [6].

II. Material and Methods

a) Adsorbent

Chitosan was purchased from the Sinopharm group Chemical Reagent Limited Company (china).The degree of deacetylation was 90% and the molecule weight was 100.000 g/mol.

b) Adsorbate

Methyl orange (MO) was supplied by Sigma chemical company, and used as adsorbate in the tests.

c) Equilibrium studies

Adsorption Experiment were carried by 0.5g of chitosan into 250ml Erlenmeyer flasks containing 200ml solution of different concentrations (5.10, 20,25mg/l) of MO. The temperature was controlled at 25°C. Agitation speed was kept constant 600 rpm for 120min. the effected pH, varied between 2,4 and 12 was studied by adjusting the pH of solution using dilute H_2SO_4 and NaOH solution. the dye concentration (50mg/l), the adsorption time120min, the striring speed 600(rpm) and at room temperature were used.

The solution and solid phase were separated by centrifugation at 150rpm for five minute .the dye adsorption capacity at equilibrium q_e can be calculated from the equation given below

$$q_e = v/m\ (C_0\text{-}C_e\text{-})$$

Where C_0(mg/l) is the initial dye concentration in liquid phase, C_e (mg/l) denotes the concentration in liquid phase at equilibrium, V(l) represents the total

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volume of the dye solution, and m(g) is the mass of the adsorbent.

III. Results and Discussion

a) Effect of contact time

Contact time in another important variable in adsorption process. figure 1 shows the effect the contact time on adsorption the MO. As ssen, the uptake rate of the dye was very high for the first 5 min, with increase in time until it approache the equilibrium loading capacity. Equilibrium was estabilished after 120 min smilar result was found for the adsorption kinetic of MO on chitosan [7].

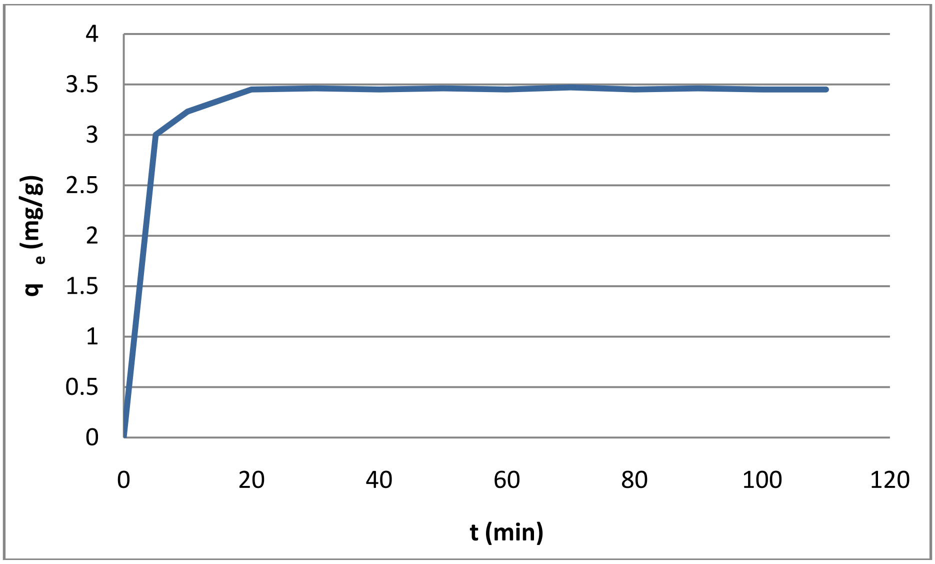

Figure1 : Effect of contact time on the adsorption process for MO (Temperature 25°C, adsorbent dose = 50mg/l, rotation per minute = 600rpm)

b) Effect of initial MO concentration

Figure2 shows the effect of contact time on adsorption for various MO concentration. As ssen, the uptake rate of the dye was very high for the first 5 min, with increase in time until it approache the equilibrium loading capacity. Equilibrium was estabilished after 120 min smilar result was found for the adsorption kinetic of acid dyes from aqueous solution by chitosan [7].

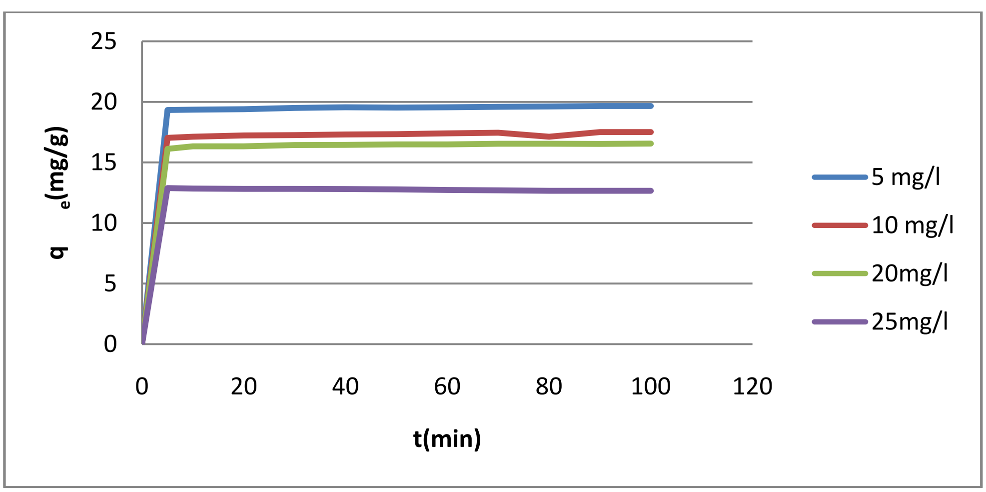

Figure 2 : Effect of MO concentration on the adsorption of MO on chitosan (Temperature = 25°C, agitation rate 600rpm)

c) Effect of pH on adsorption

pH is one of the important factors in controlling the adsorption process. To evaluate the effect of PH on the adsorption process, the adsorption of the dye with pHvalues from 2,4,12. It was observed after analyzing figure3 the amount of dye adsorbed per unit weight of adsorbent (q_e) increased with decreasing pH values. As the pH of the solution decrease, the surface charge density increase and the electrostatic repulsions between the adsorbent and the negatively charged cationic dye is high, thereby increasing the extent of adsorption.

Similar result was found for the adsorption kinetic of acid dyes from aqueous solution by chitosan [7].

However, this time the adsorption capacity is effected by the pH such that the amount of dye adsorbed increase in the order of pH 2›4›12 [8].

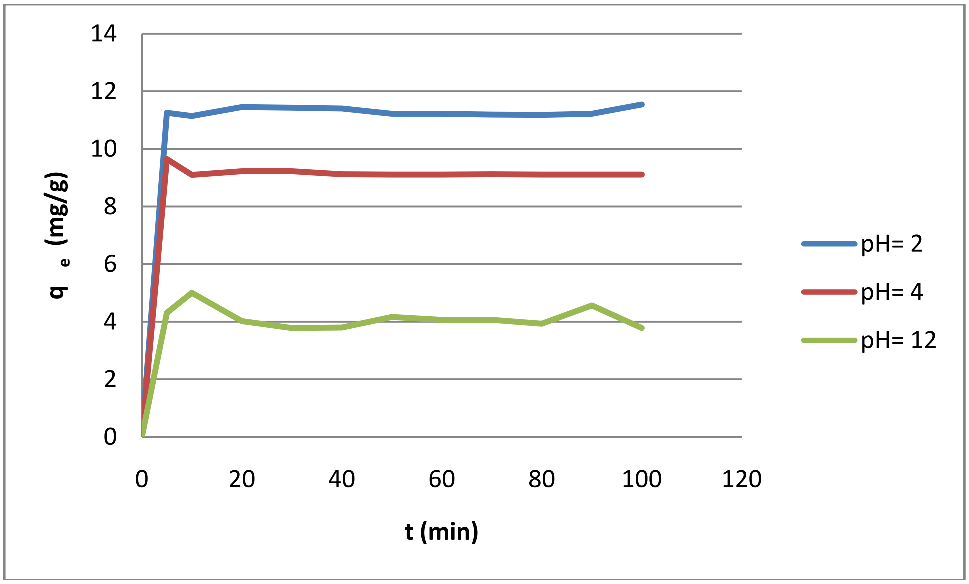

Figure 2 : Effect of PH on the amount of dye adsorbed per unit weight ($q_{e)}$ for adsorption of MO on chitosan (Temperature = 25°C, agitation rate 600rpm, adsorbet dose = 50mg/l)

IV. Conclusion

The adsorption of MO onto chitosan was dependent on solution pH, contact time and initial concentration.

Conclusion from this study can be represented as follows:

It was also concluded that pH marked affected on the adsorption and increased with the decrease in pH.

It was found that initial concentration of dye has a significant effected on the adsorption of dye.

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Seasonal and Spatial Analysis of Air Pollutants Emissions from Fuel-Wood Utilization in Selected Rural Communities within Odeda LGA, Nigeria

By Oyebanji, F. F., Oguntoke, O., Ojekunle, O. Z., Adeofun, C. O., Adedeji, O. H., Ekpo, U. F. & Adekunle, M. M.

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Abstract- The effects of fuel-wood utilization on spatial and temporal concentration of air pollutants were assessed in 12 purposively selected rural communities in Odeda Local Government Area of Ogun state. Carbon (II) oxide (CO), Carbon (IV) oxide (CO_2), Sulphur (IV) oxide (SO_2), Nitrogen (IV) oxide (NO_2), Methane (CH_4) and Particulate Matter of 2.5 ($PM_{2.5}$) and 10 (PM_{10})were monitored at 0, 2 and 5 m away from the cooking points using active air samplers in dry and wet seasons. Data collected were subjected to descriptive, ANOVA and Correlation statistics at 0.05 significant level.

Keywords: dirty energy, ambient environment, air quality, spatio-temporal concentrations.

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Keywords: dirty energy, ambient environment, air quality, spatio-temporal concentrations.

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I. Introduction

There had been a notion that rural air is free from contaminations because the areas are often devoid of fumes that is emitted from vehicle exhausts, the tiny particles released by diesel engines and majorly the various air pollutants released during industrial activities. This notion has been proved wrong by various authors.

However, either one lives in the rural or urban area, air in good quality and quantity is one of the necessities of life upon which man's existence and sustenance are pivoted. Meanwhile its availability and variability in space and time is dependent on the activities going on around such area and critical issues that must be taken into consideration are exposure and health related studies. This is because some epidemiological studies have used available ambient air monitoring data to predict exposure of the population of their interest (Briggs *et al*., 2000).

It should not be assumed that pollutants even when released from a point source would be homogenously distributed in terms of quality in space and time. According to Jerrett *et al*., 2005 and Miller *et al*., 2007, some epidemiological studies have shown the importance of intra-urban air pollution concentration variability, which often results in inconsistent comparisons for air quality data within different sites and consequently inconsistent actions to control.

In this study we investigated the rural air pollution distribution with respect to space and timeas it relates to air pollutants emitted during combustion of wood as fuel in the selected rural communities of Odeda, Ogun state, Nigeria.

II. The Study Area

Odeda is quite a large town and is one of the 20 local government areas within Ogun State, southwest of Nigeria. It lies on the North-eastern zone of the State, on longitude 7°12' to 7°31' and latitude 3°15'and 3°45'(Figure 1).This Local Government Area (LGA) shares boundary with Abeokuta south and north local government areas to the West, Obafemi-Owode local government to the South, whereas to the North and East, Odeda shares boundary with Akinyele and Ibarapa Local government of Oyo state respectively. The population figure is 109,449 (NPC, 2006) and covers a land area of about 1,554 km^2.

The mean monthly rainfall and temperature of the area are about 900.3mm and 33.3°C (Akanni, 1992). The LGA falls largely within the derived savanna vegetation which dominated the northernmost part of Ogun state. Nevertheless, pockets of forest vegetation which have not been degraded by human activities still exist. Generally, the floristic composition includes both true forest and savanna species. Important tree species found in this vegetation type include *Lophira lanceslate*, *Daniellia oliverri* and *Afzolia Africana* (Gbadegesin, 1992) among others. Odeda LGA is predominantly a rural community with numerous villages. Apart from farming which is the major occupation of the residents, people also engage in trading of farm produce, which is done on the periodic market days and hunting. Fuel-wood utilization still remains the highly patronized energy source in the study area where even people in the youthful age resides. The major occupation is farming and fuel-wood is used to prepare farm produce for sale. There is no preference for any particular specie of wood, the type of wood used depends on availability, and hence different species and sizes of woods are used in combination to generate an efficient heat needed and it is often collected from nearby forest (Oyebanji*et al.,* 2013). This local government has approximately 438 settlements/communities spread across the three zonal divisions in the local government namely Odeda, Opeji and Ilugun.

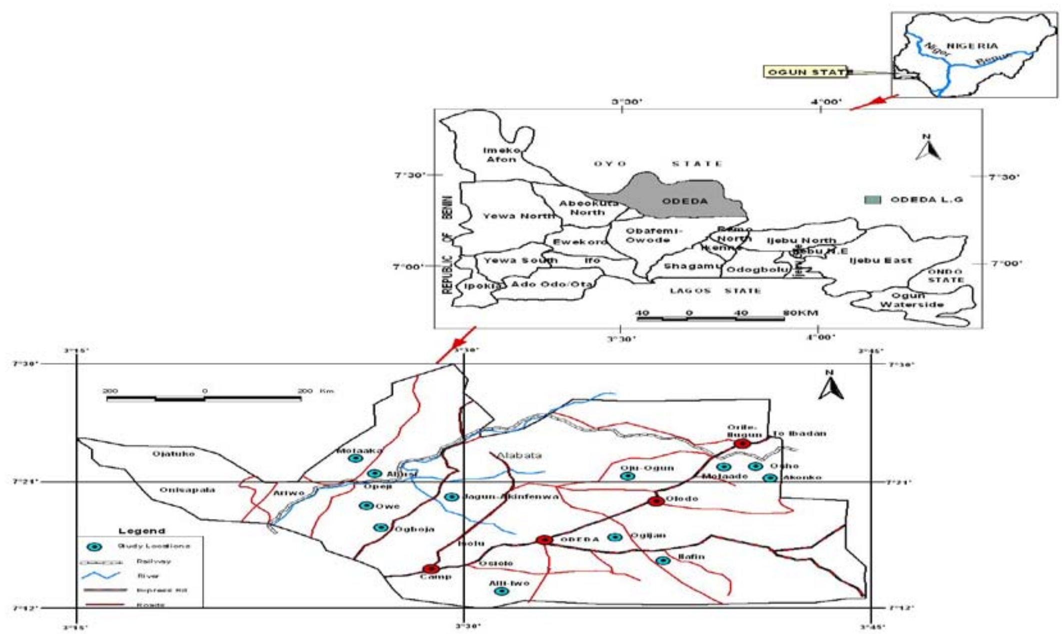

Figure 1 : Map of study area

III. Methodology

Communities sampled were drawn purposively and based on exclusion criteria that is: absence of social amenities (such as tarred roads, electricity supply and other modern facilities) and 2km distance from any known major road (these criteria were paramount in order to prevent interference from vehicular emission and allowance for pollutant dispersion respectively).

Odeda is divided into three (3) zones namely Odeda, Opeji and Ilugun. A total of 12 communities were selected after considering the criteria earlier mentioned. The 12 communities are Iwo-Alli, JagunAkinfenwa, Ilafin, Ogijan (Odeda zone), Ogboja, Abusi, Owe, Molaaka (Opeji zone), Molaade, Akonko, Osho and Oju-ogun (Ilugun zone).Ten (10) sampling points where fuel-wood is used for cooking were randomlyselected from each of the 12 sampled communities for air quality monitoring making a total of 120 points in all. Wind vane was used to determine the wind direction (in order to determine the best location for mounting air samplers); the MultiRAE lite QRAE systems multigas sampler was used to monitor the concentration of Nitrous oxide (NO and NO_2), carbon monoxide (CO), Carbon dioxide (CO_2), Sulphur dioxide (SO_2), Temperature (°C) and humidity (%); the QRAE$^+$ was used to monitor Lowest Explosive Limit (LEL i.e. CH_4), Kanomax Anemometer was used for measuring wind speed and velocity while Dust track II Aerosol monitor R11593 for measuring suspended particulate matter (PM_{10} and $PM_{2.5}$).

These gases were monitored in replicates, in each of the communities between November and January for dry season and June to October. Point source air quality monitoring was taken at the cooking points 0 m, 2m and 5 m away from the cooking points along the wind direction.

The data collected were subjected to descriptive (mean and standard deviation), ANOVA and Correlation analyses using the statistical package for Social Sciences (SPSS version 17.0.1 and Microsoft Excel, 2007).

IV. Results and Discussion

Figure 2 shows the mean values of meteorological data for both the wet and dry seasons. Temperature ranged from 29.67±3.82°C to 37.57±5.50°C and from 26.93±0.10 °C to 31.50±0.45°C for wet and dry season respectively. Humidity ranged from 70.00±0.70% to 85.00±0.12% and 56.37±0.75% to 68.13±0.84% for wet and dry season respectively, wind speed ranged from 1.98±0.31 to 2.91±0.61 and 2.13±0.15m/s to 3.86±0.19m/s for wet and dry season respectively. Various air pollution studies either in urban or rural areas has always taken into consideration major weather parameters, which include temperature, humidity and wind speed. This is because temperature and humidity affect the concentration of air pollutants in the atmosphere specifically; wind speed influences the rate of air pollutant dispersal as well as atmospheric mixing. High humidity and low wind speed will increase the concentration of air pollutants in the atmosphere with short and long term implications for human health according to Oin *et al.,* 1993.Research have shown that air pollution gets worse during the dry season as pollutants remain suspended and concentrated in the atmosphere due to lack of rain to wash and dissolve them (WMO, 1999; Gunnar *et al*., 2002). This may suggest the general increase noticed in the concentration of some pollutants during the dry season. Also, if there is a temperature inversion, dispersal of pollutants may be highly difficult concentrating the pollutants to a particular area.

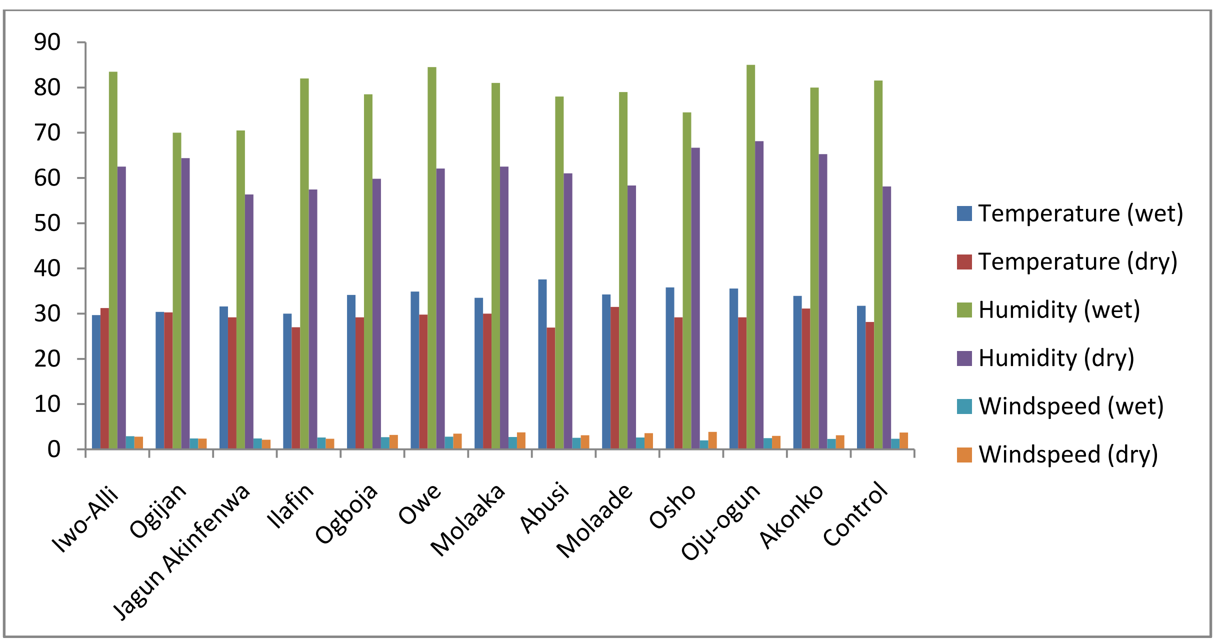

Figure 2 : Meteorological parameters monitored during wet and dry season

The change in mean concentration of air pollutants with 0, 2, and 5 m distances is shown on Figures 3 to 9 for CO, CO_2, NO_2, SO_2, CH_4, $PM_{2.5}$ and PM_{10}in the wet and dry seasons respectively. Naeher *et al*., (2007) states that inorganic gases including CO, O_3, inhalable coarse and fine particles are transported over a long distance. However, particles in micron size range are not easily removed by gravitational settling and therefore can be transported over long distances (Echalar *et al*., 1995). The transport of biomass combustion particles over hundreds of kilometers has been extensively documented (Andrae *et al*., 1988). Haze layers with elevated concentrations of CO, carbon dioxide (CO_2), Ozone (O_3), and Nitric oxide (NO) have been observed. During transport, many of the gaseous species are converted to other gases or into particles. As pollutants are dispersed, there is atmospheric mixing and hence concentration reduces as shown in this study. The "black carbon" from biomass emissions contributes to regional and global climate change as well as adverse health effects in some parts of the world (Venkataraman *et al*., 2005; Koch & Hansen,2005). All the air pollutants (smoke) tend to disperse away from the point source generation area especially on high wind intensity days (EPA, 2010 and Oren, 2001) and this suggests their dispersion.

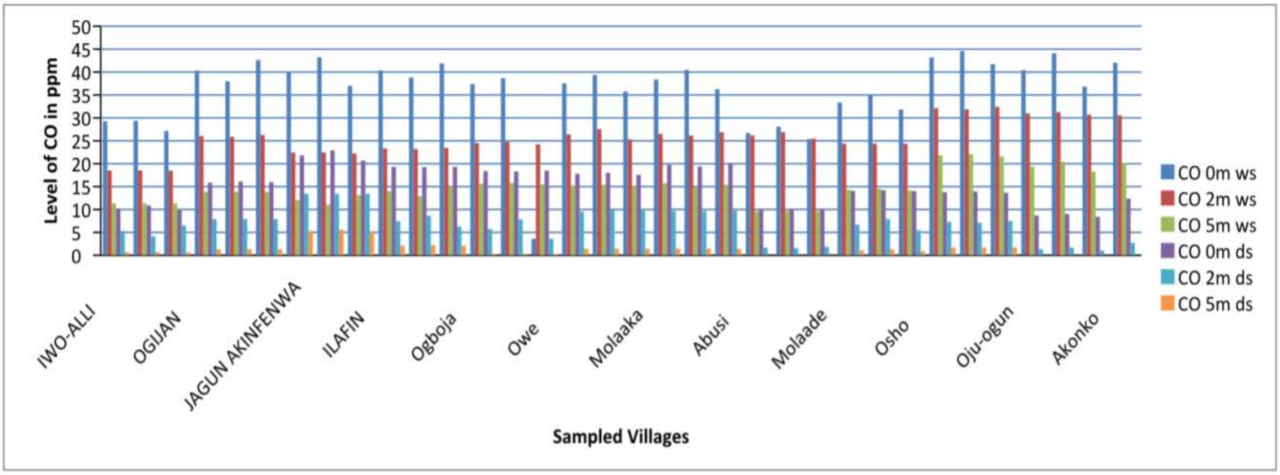

Figure 3 : Concentration of CO at distances to the cooking point between villages during wet and dry seasons

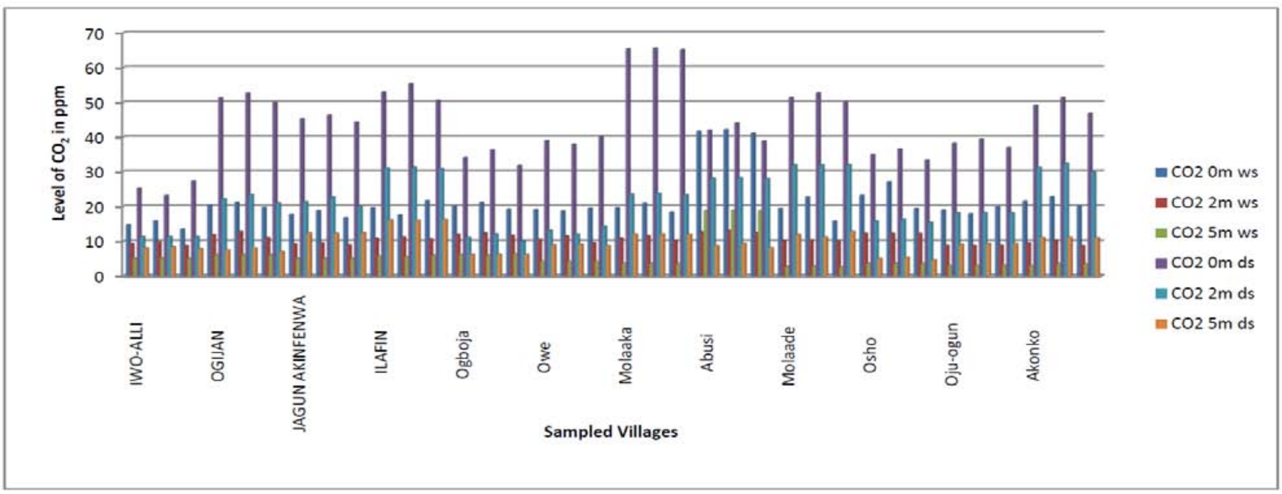

Figure 4 : Concentration of CO_2 at distances to the cooking point between villages during wet and dry seasons

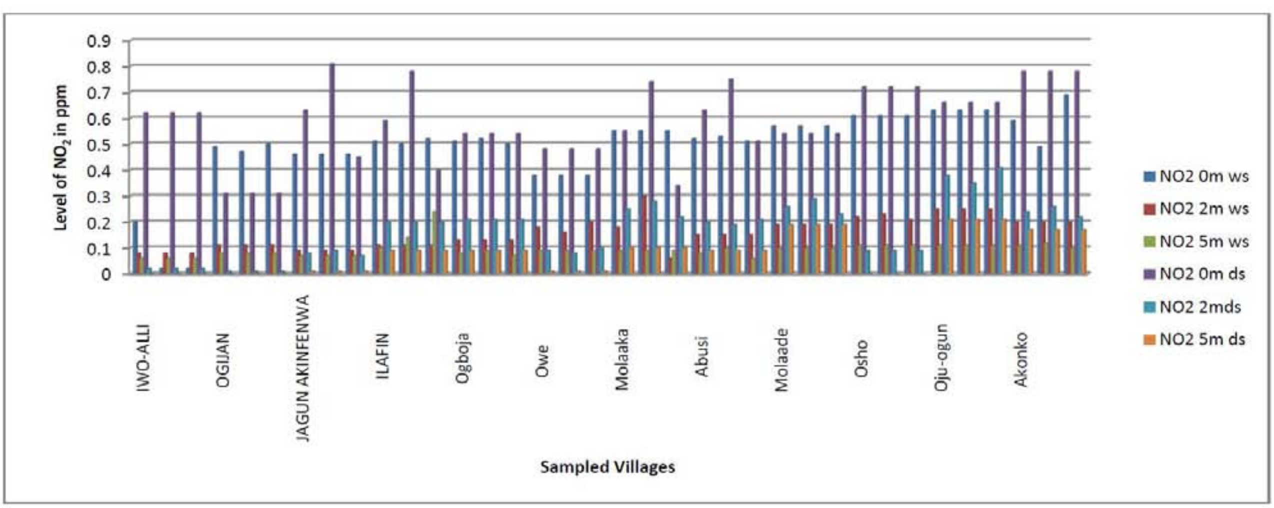

Figure 5 : Concentration of NO_2 at distances to the cooking point between villages during wet and dry seasons

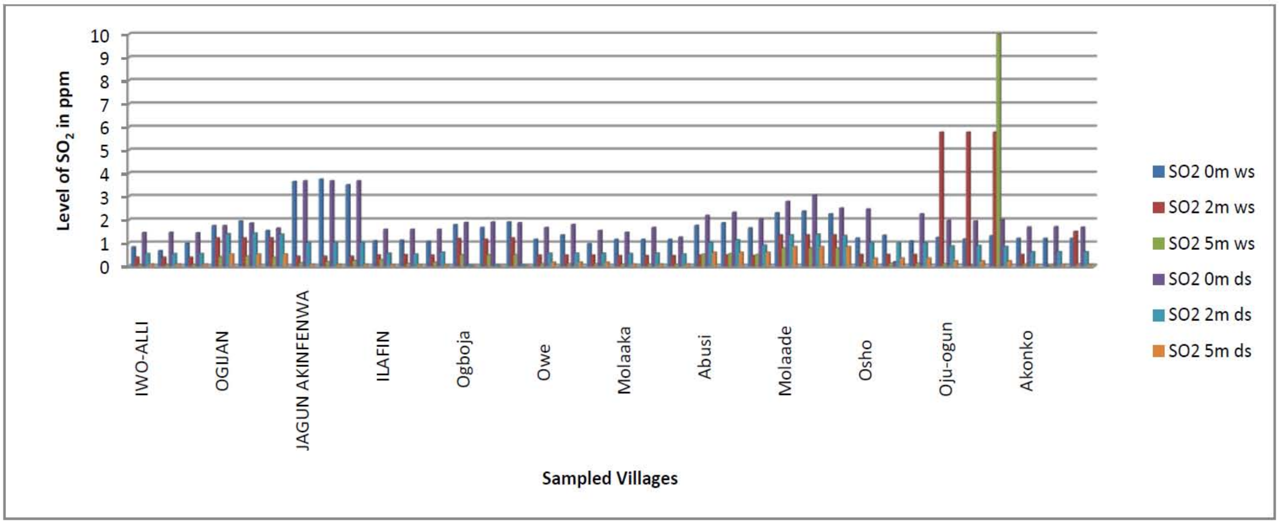

Figure 6 : Concentration of SO_2 at distances to the cooking point between villages during wet and dry seasons

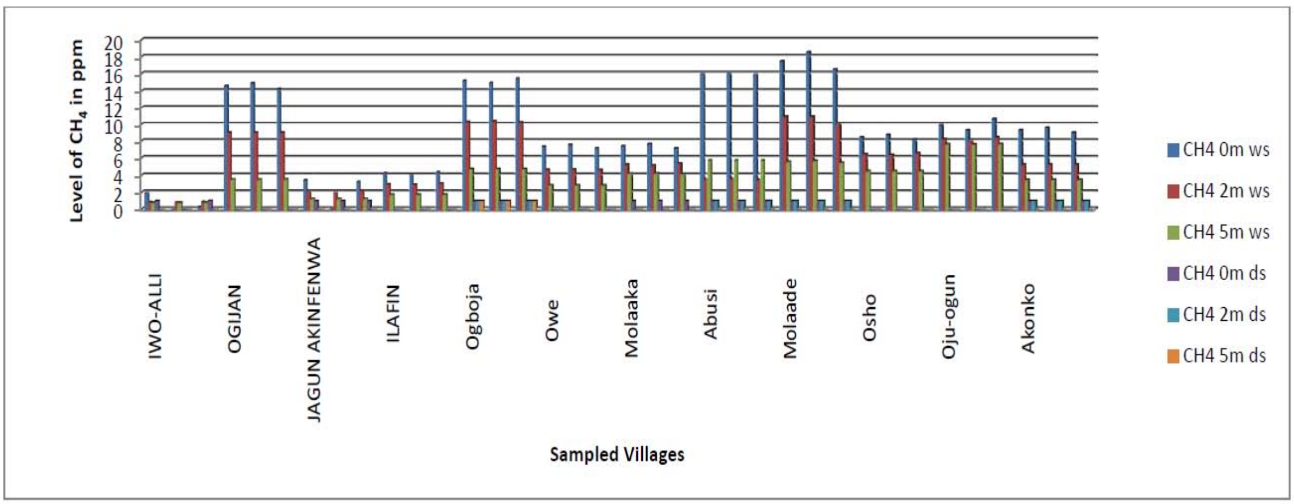

Figure 7 : Concentration of CH_4 at distances to the cooking point between villages during wet and dry seasons

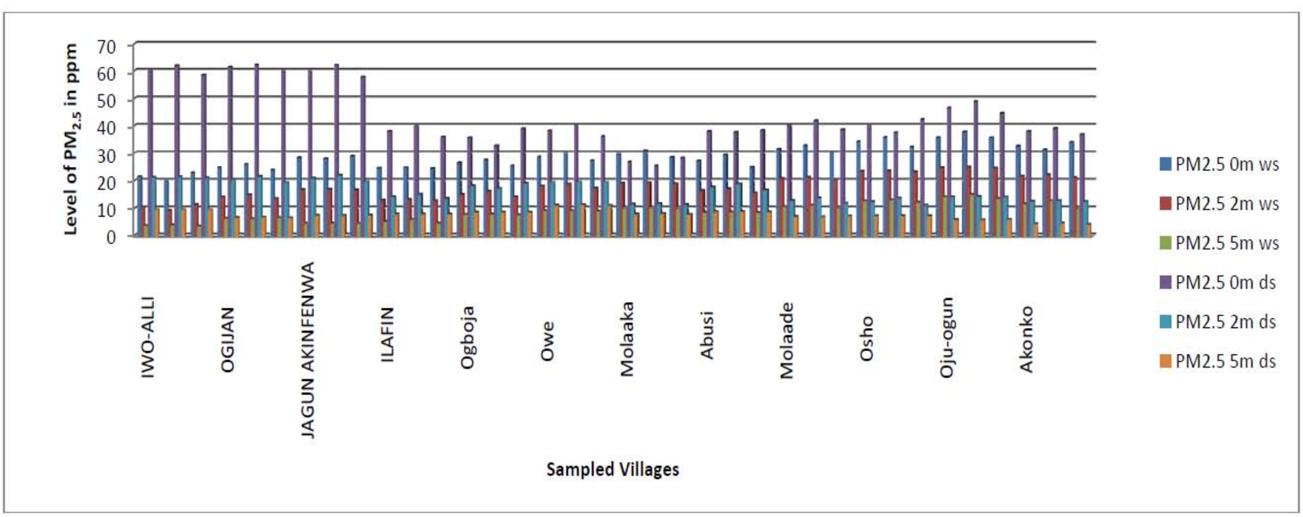

Figure 8 : Concentration of $PM_{2.5}$ at distances to the cooking point between villages during wet and dry seasons

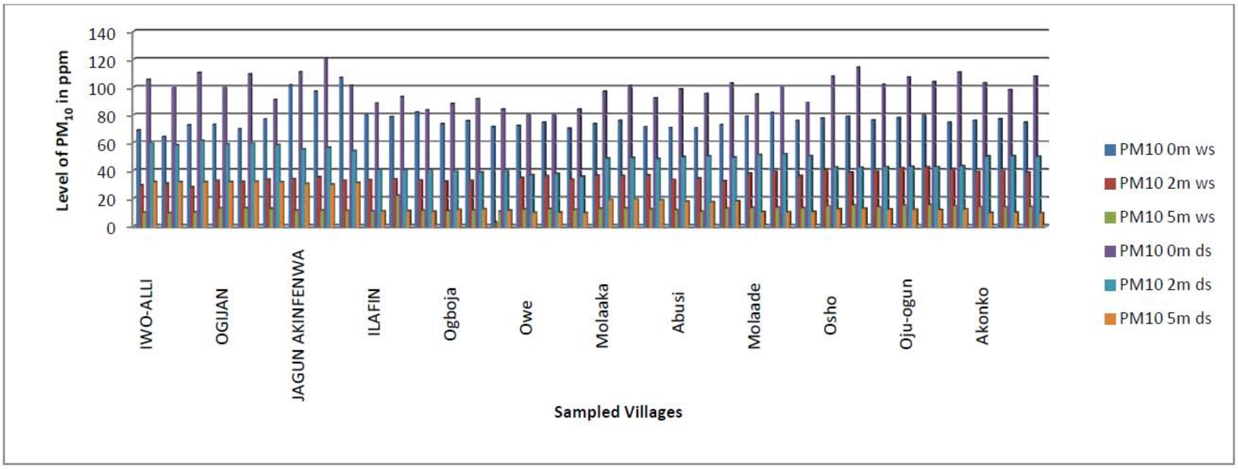

Figure 9 : Concentration of PM_{10} at distances to the cooking point between villages during wet and dry seasons

The disparity recorded in the concentration of CO between the two seasons may not be far from the fact that CO is yielded from incomplete combustion (Naeher, *et al*., 2007) and it is expected that wood during the wet season may have high moisture content which produces lower energy and heat output because the heat produced will be used to vapourize moisture thereby producing thick smoke with high CO concentration (DEC, 2009). In the dry season, wood are very dry and hence yield complete combustion and give high mean CO_2 concentration during the dry season as observed in thetable 3, but the atmospheric concentration of CO_2 has been a major concern in this era of climate change. The trees that are supposed to help sequester CO_2 were cut for fuel without replanting (Odii and Mokwunye, 2003). However, the mean concentrations for NO_2, SO_2, $PM_{2.5}$ and PM_{10} increased during the dry season except for CH_4 whose mean concentration reduced as shown by Figure 7.It is expected that during the wet season the mean concentration of the aforementioned air pollutants will be higher than that of the dry season because of the burning of supplement materials like polythene bags, plastic bottles, "iha", "oguso", "eesan" etc as explained by the respondents to compensate for the low amount of dry wood (Zafar *et al*., 2010). Gases that have been dispersed into the atmosphere would remain suspended and concentrated during the dry season until they are washed down onto the earth surface by rain and thereby react with rain water to form new compounds hence reducing the concentration of the pollutant gases in the air. Some weather parameters affect the ambient concentration and dispersion rate of air pollutants, depending on wind speed air pollutants can travel very far and respect no boundary. During the dry seasons the mean concentration of CO_2, NO_2, SO_2, $PM_{2.5}$ and PM_{10} increase but that of CO and CH_4 reduce and vice versa.

Table 1 shows the overall mean concentrations of air pollutants for both wet and dry seasons respectively. There is no significant variation ($p < 0.05$) between the mean concentrations of pollutants among the villages except for CH_4 which shows significant variation in the two seasons monitored.There is no significant difference between the mean concentrations of air pollutants measured in the selected communities except for CH_4($p < 0.05$), this may because most of them burn the same kind of wood for the same kind of activity and hours of cooking. However, only the kind of supplement material added may be different (Zafar *et al*., 2010).

Table 1 : Variation in air pollutants between villages during both seasons ($p < 0.05$)

VILLAGES	CO (wet)	CO (dry)	CO_2 (wet)	CO_2 (dry)	SO_2(wet)	SO_2(dry)	NO_2 (wet)	NO_2 (dry)	CH_4 (wet)	CH_4 (dry)	$PM_{2.5}$ (wet)	$PM_{2.5}$(dry)	PM_{10} (wet)	PM_{10}(dry)
Iwo-Alli	19.70 ± 9.02^{a}	5.40 ± 4.77^{a}	9.73 ± 4.83^{a}	14.89 ± 9.08^{a}	0.42 ± 0.39^{a}	0.69 ± 0.69^{a}	0.11 ± 0.08^{a}	0.21 ± 0.35^{a}	1.22 ± 0.68^{a}	0.33 ± 0.58^{ab}	23.11 ± 39.65^{a}	65.95 ± 37.04^{a}	12.05 ± 8.91^{a}	30.57 ± 26.47^{a}
Ogijan	28.74 ± 13.24^{a}	8.36 ± 7.28^{a}	12.86 ± 7.15^{a}	27.02 ± 22.29^{a}	1.12 ± 0.68^{a}	1.22 ± 0.63^{a}	0.23 ± 0.23^{a}	0.11 ± 0.18^{a}	9.12 ± 5.5^{bcd}	0.00 ± 0.00^{a}	24.96 ± 41.83^{a}	64.03 ± 34.43^{a}	15.27 ± 9.32^{a}	29.60 ± 28.49^{a}
JagunAkinfenwa	24.88 ± 14.18^{a}	13.53 ± 8.23^{a}	10.67 ± 6.45^{a}	26.36 ± 17.02^{a}	1.37 ± 1.95^{a}	1.59 ± 1.86^{a}	0.21 ± 0.22^{a}	0.24 ± 0.34^{a}	2.33 ± 1.1^{ab}	0.33 ± 0.58^{ab}	34.07 ± 58.61^{a}	66.00 ± 41.09^{a}	16.67 ± 11.84^{a}	29.59 ± 27.38^{a}
Ilafin	25.89 ± 13.38^{a}	9.63 ± 8.79^{a}	12.07 ± 6.97^{a}	33.43 ± 18.51^{a}	0.55 ± 0.52^{a}	0.74 ± 0.78^{a}	0.23 ± 0.24^{a}	0.29 ± 0.26^{a}	3.07 ± 1.24^{abc}	0.00 ± 0.00^{a}	27.14 ± 46.54^{a}	46.83 ± 38.98^{a}	14.35 ± 9.71^{a}	20.20 ± 15.94^{a}
Ogboja	25.84 ± 10.94^{a}	8.16 ± 9.27^{a}	12.79 ± 6.97^{a}	17.14 ± 14.86^{a}	1.16 ± 0.65^{a}	0.66 ± 1.07^{a}	0.24 ± 0.24^{a}	0.28 ± 0.23^{a}	10.14 ± 5.20^{cd}	1.00 ± 0.00^{b}	25.17 ± 42.14^{a}	46.70 ± 38.39^{a}	16.61 ± 9.53^{a}	20.91 ± 13.89^{a}
Owe	26.42 ± 11.14^{a}	9.60 ± 8.18^{a}	11.27 ± 7.44^{a}	20.38 ± 16.29^{a}	0.58 ± 0.54^{a}	0.80 ± 0.78^{a}	0.22 ± 0.15^{a}	0.19 ± 0.26^{a}	5.01 ± 2.29^{abcd}	0.00 ± 0.00^{a}	24.39 ± 41.75^{a}	42.82 ± 35.76^{a}	18.72 ± 9.65^{a}	23.17 ± 13.84^{a}
Molaaka	26.87 ± 13.33^{a}	10.28 ± 9.15^{a}	11.39 ± 8.00^{a}	33.66 ± 28.03^{a}	0.56 ± 0.54^{a}	0.70 ± 0.70^{a}	0.27 ± 0.24^{a}	0.30 ± 0.23^{a}	5.69 ± 1.63^{abcd}	0.33 ± 0.58^{ab}	24.79 ± 42.49^{a}	55.23 ± 38.90^{a}	19.77 ± 9.78^{a}	15.52 ± 10.12^{a}
Abusi	20.84 ± 9.72^{a}	3.94 ± 5.40^{a}	24.39 ± 15.23^{a}	26.27 ± 16.70^{a}	0.92 ± 0.73^{a}	1.27 ± 0.83^{a}	0.25 ± 0.24^{a}	0.31 ± 0.29^{a}	9.15 ± 7.78^{bcd}	0.67 ± 0.58^{ab}	23.97 ± 40.67^{a}	55.83 ± 40.75^{a}	17.47 ± 9.43^{a}	21.58 ± 15.05^{a}
Molaade	24.02 ± 9.53^{a}	7.30 ± 6.52^{a}	10.74 ± 8.28^{a}	31.81 ± 19.72^{a}	1.48 ± 0.77^{a}	1.66 ± 1.01^{a}	0.29 ± 0.25^{a}	0.33 ± 0.19^{a}	11.39 ± 5.98^{d}	0.67 ± 0.58^{ab}	27.00 ± 44.93^{a}	52.37 ± 42.16^{a}	21.18 ± 10.52^{a}	20.17 ± 17.84^{a}
Osho	32.37 ± 10.68^{a}	7.60 ± 6.06^{a}	13.06 ± 9.76^{a}	18.63 ± 15.17^{a}	0.61 ± 0.55^{a}	1.27 ± 1.08^{a}	0.31 ± 0.26^{a}	0.27 ± 0.39^{a}	6.56 ± 2.02^{abcd}	0.00 ± 0.00^{a}	26.05 ± 44.58^{a}	54.63 ± 48.83^{a}	23.49 ± 10.79^{a}	20.01 ± 17.67^{a}
Oju-ogun	30.27 ± 10.55^{a}	3.35 ± 4.68^{a}	10.26 ± 8.0^{a}	21.82 ± 14.88^{a}	0.71 ± 0.57^{a}	1.02 ± 0.89^{a}	0.33 ± 0.27^{a}	0.42 ± 0.23^{a}	8.68 ± 1.19^{bcd}	0.00 ± 0.00^{a}	27.92 ± 43.35^{a}	54.27 ± 48.29^{a}	25.16 ± 10.77^{a}	22.47 ± 21.64^{a}
Akonko	30.90 ± 10.92^{a}	5.03 ± 6.52^{a}	11.34 ± 9.32^{a}	30.49 ± 19.08^{a}	0.60 ± 0.56^{a}	0.79 ± 0.82^{a}	0.30 ± 0.26^{a}	0.40 ± 0.33^{a}	6.09 ± 2.97^{abcd}	0.67 ± 0.58^{ab}	25.51 ± 43.67^{a}	34.56 ± 59.36^{a}	22.13 ± 59.36^{a}	18.47 ± 17.54^{a}

Means with the same superscript column-wise are not significantly different according to Duncan Multiple Range test

On a general note, considering the relationship between all measured parameters during the wet season (using the Pearson's correlation at 5% significant level)were positive and significant relationship exist between air pollutants CO_2 at cooking point and 2 m, CO at 5 m and cooking point, NO_2 at point and 2 m, NO_2 at 5 m and CH_4 at 2 m, SO_2 at 5 m and CH_4 at 5 m, CO at 2 m and CH_4 at 5 m, SO_2 at 2 m and CH_4 at 5 m, CH_4 at 2 m and CH_4 at 5 m, CH_4 at 5 m and PM_{10} at 2 m, SO_2 at 2 m and PM_{10} at 5 m, CH_4 at 5 m and PM_{10} at 5 m, CH_4 at 5 m and $PM_{2.5}$ at point, CH_4 at 5 m and $PM_{2.5}$ at 2 m, whereas negative significant relationship exist between CO_2 at 5 m and CO at point and between CO at 5 m and CO_2 at 5 m ($p < 0.05$) as shown on Table 2.In the same vein, during the dry season some air pollutant measured both positive and negative significant relationship, however, the strongest positive relationships were displayed between CO_2 at all the points, CO_2 at 2 m and SO_2 at point, $PM_{2.5}$ at 2 m and PM_{10} and $PM_{2.5}$ at 5 m and PM_{10} at 2 m ($p < 0.05$). Negative significant relationships were displayed between NO_2 at 2 m, $PM_{2.5}$ at 5 m and PM_{10} at 2 m, and between NO_2 at 5 m and PM_{10} at 2 m as displayed on Table 3.

Table 2 : Correlation Matrix of air pollutants and particulates with five factor (Wet season)

VARIABLES	CO (P)	CO (2M)	CO (5M)	CO_2 (P)	CO_2 (2M)	CO_2 (5M)	NO_2 (P)	NO_2 (2M)	NO_2 (5M)	SO_2 (P)	SO_2 (2M)	SO_2 (5M)	CH_4 (P)	CH_4 (2M)	CH_4 (5M)	$PM_{2.5}$ (P)	$PM_{2.5}$ (2M)	$PM_{2.5}$ (5M)	PM_{10} (P)	PM_{10} (2M)	PM_{10} (5M)
CO (P)	1.00	0.55	0.747	-0.45	-0.14	-0.648*	0.50	0.32	0.43	0.01	0.18	-0.46	-0.22	0.24	-0.02	0.40	0.53	0.52	0.47	0.44	0.33
CO (2M)		1.00	0.820	0.26	0.17	-0.14	0.791	0.865	0.893	-0.24	0.39	-0.09	0.30	0.41	0.648*	-0.11	0.859	0.905	0.847	0.854	0.884
CO (5M)			1.00	-0.26	-0.10	-0.608*	0.606*	0.764	0.814	-0.35	0.35	-0.29	0.00	0.39	0.37	-0.04	0.803	0.792	0.768	0.763	0.774
CO2 (P)				1.00	0.628*	0.895	0.28	0.13	0.08	0.03	-0.14	0.39	0.50	-0.06	0.41	-0.24	0.02	0.05	0.06	0.07	0.15
CO2 (2M)					1.00	0.57	0.19	-0.06	0.00	-0.10	-0.38	0.44	0.52	0.26	0.21	-0.38	-0.20	-0.08	-0.18	-0.16	-0.03
CO2 (5M)						1.00	-0.08	-0.28	-0.35	0.10	-0.21	0.34	0.34	-0.25	0.14	-0.21	-0.39	-0.34	-0.34	-0.34	-0.26
NO2 (P)							1.00	0.701*	0.762	0.10	0.40	0.22	0.48	0.57	0.719	0.18	0.789	0.772	0.784	0.772	0.738
NO2 (2M)								1.00	0.968	-0.31	0.53	0.03	0.30	0.46	0.760	-0.19	0.922	0.895	0.921	0.937	0.993
NO2 (5M)									1.00	-0.18	0.48	0.11	0.38	0.576*	0.740	-0.10	0.939	0.948	0.941	0.957	0.976
SO_2 (P)										1.00	-0.08	0.31	0.16	0.08	-0.08	0.804	-0.09	-0.12	0.03	0.00	-0.28
SO_2 (2M)											1.00	0.03	0.20	0.44	0.676*	0.00	0.50	0.578	0.52	0.51	0.53
SO_2 (5M)												1.00	0.900	0.663*	0.49	-0.22	-0.09	0.01	-0.02	0.01	0.07
CH_4 (P)													1.00	0.793	0.720	-0.32	0.16	0.32	0.23	0.26	0.36
CH_4 (2M)														1.00	0.691*	-0.18	0.37	0.52	0.42	0.44	0.51
CH_4 (5M)															1.00	-0.26	0.622*	0.700*	0.679*	0.696*	0.796
$PM_{2.5}$ (P)																1.00	0.14	-0.01	0.18	0.12	-0.20
$PM_{2.5}$ (2M)																	1.00	0.941	0.974	0.972	0.918
$PM_{2.5}$ (5M)																		1.00	0.917	0.929	0.913
PM_{10} (P)																			1.00	0.997	0.928
PM_{10} (2M)																				1.00	0.944
PM_{10} (5M)																					1.00

**Correlation is significant at the 0.05 level*

Table 3 : Relationship between air pollutant concentration at the varied distances (Dry season) using Pearson's correlation co-efficient

VARIABLES	CO (P)	CO (2M)	CO 5M	CO_2 (P)	CO_2 (2M)	CO_2 (5M)	NO_2 (P)	NO_2 (2M)	NO_2 (5M)	SO_2 (P)	SO_2 (2M)	SO_2 (5M)	CH_4 (P)	CH_4 (2M)	CH_4 (5M)	$PM_{2.5}$ (P)	$PM_{2.5}$ (2M)	$PM_{2.5}$ (5M)	PM_{10} (P)	PM_{10} (2M)	PM_{10} (5M)
CO (P)	1.00	0.862	0.716	0.46	0.00	0.39	-0.36	-0.24	-0.35	0.22	-0.22	-0.36	0.02	-0.25	0.24	-0.36	-0.18	0.09	-0.13	0.11	0.19
CO (2M)		1.00	0.868	0.30	-0.14	0.26	-0.38	-0.51	-0.579*	0.39	0.07	-0.19	-0.04	-0.49	-0.07	-0.10	0.09	0.36	0.18	0.27	0.29
CO (5M)			1.00	0.20	0.01	0.38	-0.09	-0.41	-0.47	.662*	0.21	-0.19	-0.02	-0.47	-0.20	0.22	0.18	0.41	0.36	0.29	0.08
CO_2 (P)				1.00	0.712	0.648*	-0.24	0.30	0.31	-0.03	0.24	0.15	0.06	0.01	-0.29	-0.16	0.07	-0.08	-0.38	-0.48	-0.39
CO_2 (2M)					1.00	0.692*	0.14	0.39	0.52	0.14	0.42	0.41	0.17	0.38	-0.42	0.01	0.16	-0.23	-0.25	-0.50	-0.54
CO_2 (5M)						1.00	0.07	0.31	0.34	0.08	0.01	-0.12	0.12	-0.07	-0.36	-0.17	0.02	-0.10	-0.16	-0.25	-0.18
NO_2 (P)							1.00	0.37	0.33	0.18	-0.23	-0.29	0.26	0.21	-0.12	0.46	-0.15	-0.35	-0.24	-0.45	-0.34
NO_2 (2M)								1.00	0.936	-0.06	-0.16	0.04	0.12	0.39	0.12	-0.08	-0.42	-0.655*	-0.596*	-0.687*	-0.44
NO_2 (5M)									1.00	-0.04	-0.01	0.19	0.20	0.52	0.04	-0.03	-0.21	-0.590*	-0.44	-0.644*	-0.56
SO_2 (P)										1.00	0.50	0.30	0.22	0.10	-0.08	0.44	0.19	0.16	0.31	0.11	-0.18
SO_2 (2M)											1.00	0.808	-0.19	-0.06	0.00	0.43	0.49	0.29	0.43	0.00	-0.35
SO_2 (5M)												1.00	-0.02	0.34	-0.30	0.04	0.26	-0.03	0.06	-0.12	-0.11
CH_4 (P)													1.00	0.598*	0.25	0.15	0.42	0.20	-0.10	0.02	-0.02
CH_4 (2M)														1.00	0.43	-0.19	-0.04	-0.40	-0.37	-0.22	-0.21
CH_4 (5M)															1.00	-0.36	-0.35	-0.19	-0.22	0.14	0.15
$PM_{2.5}$ (P)																1.00	0.598*	0.49	0.53	-0.01	-0.53
$PM_{2.5}$ (2M)																	1.00	0.832	0.690*	0.37	-0.22
$PM_{2.5}$ (5M)																		1.00	0.784	0.673*	0.11
PM_{10} (P)																			1.00	0.720	-0.04
PM_{10} (2M)																				1.00	0.53
PM_{10} (5M)																					1.00

**Correlation is significant at the 0.05 level*

The implication of the positive significant relationship is that there exists direct proportional relationships between the parameters although at different significant level which corroborates the study of the associations between $PM_{2.5}$ and lung function decrements in children (Koenig *et al*., 1993), visits to emergency departments for asthma (Norris *et al.,* 1999), hospitalizations for asthma (Sheppard *et al*., 1999), and increases in asthma symptoms in children (Yu and Lumley, 2000), as well as increase in exhaled Nitric oxide (Koenig *et al.,* 2003, 2005). High PM concentrations results in the condensation of gases when they are combusted (Naeher*et al*., 2007) this may also explain the positive correlation shown by PM and almost all the other monitored gases.

V. Conclusions

Finally, the various values observed, meets with the World Health Organization (WHO), Air Quality Guidelines, 2005 but when compared with National Environmental Standards and Regulation Enforcement Agency (NESREA) standards for ambient air, SO_2 and NO_2 exceed the limit. It should be noted that Nigerian Air Quality Standards have notactually considered fuel-wood sources and there are no set standards and limits for this activity.

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The Early Earth

By Kasturi Bhattacharyya

Introduction- The several observations and scientific evidence suggests that the Earth at present has a layered structure. But the question arises how the layered structure of Earth has taken the present shape from the early Earth which was a product of condensation from the solar nebular. The Solar System is presumed to have begun after one or more local supernova explosions about 4.6 Ga ago. The planetesimals began to attain the proportions of planetary embryo as a result of collisions between them. The heat generated from the collisions must have melted substantial amount of the early planet resulting in the formation of a global magma ocean and the denser, refractory material which could not melt sank inwards. This discussion aims at illucidating the driving forces and the processes within the Earth which resulted in the present layered structure of Earth.

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THEEARLYEARTH

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The Early Earth

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I. Introduction

The several observations and scientific evidence suggests that the Earth at present has a layered structure. But the question arises how the layered structure of Earth has taken the present shape from the early Earth which was a product of condensation from the solar nebular. The Solar System is presumed to have begun after one or more local supernova explosions about 4.6 Ga ago. The planetesimals began to attain the proportions of planetary embryo as a result of collisions between them. The heat generated from the collisions must have melted substantial amount of the early planet resulting in the formation of a global magma ocean and the denser, refractory material which could not melt sank inwards. This discussion aims at illucidating the driving forces and the processes within the Earth which resulted in the present layered structure of Earth.

During the Hadean or the first 660 million years of the Earth's existence, the metallic core separated from the silicate mantle. Subsequently, the atmosphere and the hydrosphere were formed and melting of the silicate mantle produced the earliest crust. But there is no rock record of Hadean. Hence, theoretical modeling and geochemistry are the only tools to reveal the mechanisms of formation of the different layers in the Earth.

II. Heat Sources Necessary to Drive Planetary Differentiation

Planetary differentiation can be defined as a process by which planets develop concentric layering and each layer differ in chemical and mineralogical compositions. The generation of such layers results from a differential mobility of elements due to differences in their physical and chemical properties. When a rock is heated, different minerals within the rock will melt at different temperatures. This phenomenon is known as partial melting and is a key process in the formation of liquid rock or magma. Once the elements have been mobilized, they will begin to migrate under the influence of pressure or gravity.

If partial melting is the principal cause of differentiation, then the Earth needs to be heated before layering begins. The principal sources of heat are primordial heat source (accretional heat and heat generated due to core formation), tidal and radiogenic heating. They are discussed as follows:

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III. Accretional Heating

During the accretion, any planetesimal of mass 'm' falling towards the Earth will acquire a velocity because of the gravitational attraction towards the Earth and hence the body will acquire a kinetic energy $E=1/2mv^2$ due to its motion (where v is the velocity of the body immediately before impact). After collision, if all the kinetic energy of motion is converted into heat, then the increase in temperature ΔT can be calculated as follows:

$$\Delta T=mv^2/(2(m+M)C)$$

where m=mass of the body; M=mass of Earth; C= specific heat capacity of Earth material;

But all the impact material must not have arrived at the same time. Accretion took place over 10^7 years. Also, the entire kinetic energy would not be converted to heat as some of it was spent in excavation of craters and some radiated into space. Nevertheless, most estimates predict temperatures to have risen above the melting point of silicate minerals and Fe-Ni. This implies that Earth has gone through an early molten stage.

The metals and silicates got separated during the molten phase of the Earth. The 'falling inwards' of the Ni-Fe rich fraction to form the core would have released potential energy. The gravitational energy lost by the inward movement of Ni-Fe would have been first converted to kinetic energy and then into thermal energy. The core formation also contributed to the primordial heat source. However, if these primordial heat sources had remained the only way of heating the Earth, their intensity would have waned through time due to continual radioactive heat loss to space. The present day active volcanoes are indications of very large amount of Earth's internal heat. This requires additional processes of heat generation.

IV. Tidal Heating

One heat source known to be generated within the planetary bodies is tidal heating, which is created by the distortion of shape resulting from mutual gravitational attraction. This effect of tidal force is manifested as the ebb and flow of tides seen around the coast. The solid Earth is also distorted by these forces and produces tides that reach a maximum amplitude of about 1m on the rocky surface. This deformation causes heating within the planet, although precisely this kind of heating is dependent on Earth's internal property. Earth shows this kind of heating within the crust and mantle.

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V. Radiogenic Heating

The experiments conducted on primordial lead in meteorites demonstrated that the formation of the Earth occurred about 4.6 Ga ago. John Joly, an Irish physicist, was one of the first to suggest that radioactive decay, leading to radiogenic heating, was an important independent source of heat within the Earth that supplements that remaining from the primordial sources.

Most elements have different isotopes (that is atoms having same number of protons but different number of neutrons).Some of these isotopes are unstable and decay to stable forms. For example, isotopes deficient in protons decay by transformation of a neutron into a proton and an electron, which expelled from the nucleus. During this process known as beta decay, the mass of the nuclide does not change significantly. In alpha decay, heavy atoms decay through the emission of an α-particle (He^{2+}) which consists of two protons and two neutrons. This process reduces the mass of the nuclide. α- and β-particle collision with adjacent nuclei during decay causes heating through the loss of kinetic energy.

The rate of decay of a radioactive parent nuclide to form a stable daughter product is proportional to the number of atoms, n, present at any time, t:

$dn/dt = -\lambda n$ where λ=decay constant characteristic of the radionuclide which is decaying.

After integration from time t=0 to t=t, we get $n=n_0e^{-\lambda t}$ where n_0= the initial number of atoms present at time t=0.

An alternative way of referring to the rate of decay of a radionuclide is by its half-life (t1/2), which is the time required for half of the parent atoms to decay.

On substituting $n=n_0/2$ and t=t1/2 into the equation $n=n_0e^{-\lambda t}$, we get,

$t1/2=\ln 2/\lambda=0.693/\lambda$, where ln 2 is the natural log of 2.

The number of radiogenic daughter atoms formed (D*) is equal to the number of parent atoms consumed (Figure to be shown on transparency). So:

$D=D_0+D^*$

$\rightarrow D=D_0+n_0-n$ where $D^*=n_0-n$

$\rightarrow D=D_0-n+ne^{\lambda t}$

where $n_0=ne^{\lambda t}$

$\rightarrow D=D_0+ n(e^{\lambda t}-1)$

If radio nuclides have short half-lives and are not replenished by the decay of other isotopes, then they may be lost altogether. One such short-lived extinct nuclide is ^{26}Al, which has a half-life of 0.73 Ma.

All those with half-lives significantly less than the age of the Earth, that is 4.6 Ga, are extinct, namely: ^{26}Al, ^{129}I, ^{146}Sm, ^{182}Hf and ^{244}Pu. The others, principally isotopes of ^{40}K, ^{87}Rb, ^{147}Sm, ^{232}Th, ^{235}U, ^{238}U are still active today.

^{26}Al dacays to ^{26}Mg and hence anomalously high abundances of ^{26}Mg relative to other isotopes of Mg is observed in materials from the early Solar System. For example the carbonaceous chondrites show high ^{26}Mg/^{24}Mg ratios and this suggests that a significant proportion of Al present at the time of condensation of the solar nebula was the unstable isotope ^{26}Al. This was originally created during a supernova explosion pre-dating the birth of our Solar System, and cannot be replenished by the spontaneous decay of other radiogenic elements.

The half-life of ^{26}Al is only 0.73 Ma, so the time between the supernova explosion that generated the ^{26}Al and the accretion of the meteorite parent body must have happened on a similar timescale of a few million years.

While such short lived isotopes may have been important heat sources during early stages of terrestrial planet evolution, study of Earth material indicates that it is the isotopes of the elements U, Th and K that are responsible for the most of the radiogenic heating that has occurred throughout the history of the planet. These isotopes, which have particularly long half-lives are termed as long-lived radiogenic nuclides and were present in sufficient quantities after condensation and accretion to ensure that they have remained abundant within present-day Earth.

The elements U, Th and K (and their radiogenic isotopes) are particularly concentrated in the silicate-dominatedouter layers of the Earth as they are the incompatible elements. They are particularly concentrated in the continental crust and virtually absent from the core. As a result of the incompatibility of the heat producing elements, the radiogenic heat produced per unit mass of the continental crust is, on average, over one hundred times greater than that of the underlying mantle. But because the mantle is so much more massive than the crust, in effect this means the overall radiogenic heat budget is roughly split equally between the mantle and the crust despite much greater mass of the mantle material. Ti is the decay of the long-lived radiogenic isotopes that provides sufficient heat energy to keep the Earth geologically active. Therefore, the surface heat flux is not simply the slow cooling of a once molten body, as originally envisaged by Kelvin.

VI. Heat Transfer within the Earth

Accretion, core formation and the radioactive decay heated the Earth. This internal heat is transferred to the surface by three main mechanisms and these are; conduction, convection and advection.

VII. Conduction

This is the process of heat transfer experienced when the handle of a pan becomes hot. Heat is conducted from the stove to the pan and then to its handle. Different materials, such as rocks of various compositions, conduct heat at different rates, and the efficiency of heat transfer in this manner is known as conductivity. This form of heat transfer is the most important in the outermost layer of the Earth (that is the lithosphere).

VIII. Convection

This process involves the movement of hot material from regions that are hotter to those that are cooler and return the cool material to warmer regions. During this transfer the material gives up its heat. It is particularly a efficient method of heat transfer, the medium through which transfer takes place must be fluid. The mantle can also flow when subject to temperature differences in a process known as the solid state convection and the rates are no more than few centimeters per year. This is the most efficient form of heat transfer within all but the outermost part of the mantle.

IX. Advection

Advection is the final process of transferring heat when molten material (magma) moves up through fractures in the lithosphere and remains there. Advection operates when magma spreads out at the surface as a lava flow or if it is injected, cools and crystallize within the lithosphere itself.

X. The Age of the Earth and its Layers

Radioactivity allows absolute ages to be determined from measurements of long-lived radioactive isotopes and their daughters. Several isotope systems are used to date events and processes from throughout the Earth history, but three most commonly used are the K-Ar, U-Th-Pb and Rb-Srsystems. The isotope data is illustrated on an isochron plot (or isochron diagram or isotope evolution diagram) examples of which are to be shown in figure.

Rb-Sr isotope data from a series of ordinary chondrites that define an isochron age of 4.5 Ga. This age relates to the last time the Rb and Sr were fractionated from each other by a particular process. In case of Rb and Sr, both elements are lithophile, so it is unlikely that they are fractionated by the separation of a metallic phase from a silicate fraction. However, Rb being a Group 1 alkali metal, is significantly more volatile than Sr, a Group 2 element similar to Ca, which is one of the early condensing elements. Hence Rb/Sr fractionation may relate to the loss of a volatile phase; the age indicates when the Rb/Sr ratio in ordinary chondrites was last disturbed.

U-Th system has two parent isotopes, ^{235}U and ^{238}U decaying to ^{207}Pb and ^{206}Pb respectively. By combining these two, it is possible to eliminate the U/Pb ratio and determine an age from the plot of ^{207}Pb/^{204}Pb against ^{206}Pb/^{204}Pb. In this case, the ages represent the time at which U was fractionated from Pb and, as Pb is moderately volatile element and can be lithophile, siderophile or chalcophile in different environments, it is less easy to define the process that led to U/Pb fractionation. However, iron meteorites are rich in Pb and poor in lithophile U, so the age probably represents the timing of the separation of a metallic phase. Given that the chondrite isochron passes through the Pb isotope ratio of most iron meteorites, it adds further support to this idea.

Primitive carbonaceous chondrites are thought to be among the least differentiated material in the Solar System. Among other things, they contain chondrules and Ca- and Al-rich inclusions (CAIs). Chondrules are millimeter-sized spherical droplets believed to have been produced when mineral grain assemblages were flash heated and cooled quickly. CAIs are typically cm-sized and consist of the first minerals to condense at equilibrium from a gas of solar composition. A detailed study of CAIs and chondrules yielded a ^{206}Pb/^{207}Pb isotopic age for CAIs of 4567.2 ± 0.6 Ma, whereas that of chondrules(more primitive) is 4564.0 ± 1.2 Ma.

The data gives an interval of 3.2 ± 1.8 Ma between formation of the CAIs and chondrules-carbonaceous chondrites must have formed at or after the time of formation of the chondrules, that is 4564 Ma.

These data show that the oldest components of meteorites, and hence the Solar System, must be close to 4.57 Ga old, but how do we know that this age also applies to the Earth.

In the figure of Pb isotopes, the average Pb isotope ratios of Pacific sediments are compared with the data from the chondrules. The sediment data fall on or close to the meteorite isochron, implying ultimate derivation from a similar source or common parent.

XI. Radioactivity Applied to Dating

The number of ^{87}Sr daughter atoms produced by the decay of ^{87}Rb in a rock or mineral since its formation t years ago is given by substitution into the radioactive decay equation:

$$^{87}\mathrm{Sr} = {}^{87}\mathrm{Sr}_i + {}^{87}\mathrm{Rb}\,(e^{\lambda t}-1)$$

where $^{87}\mathrm{Sr}_i$ is the number of ^{87}Sratoms initially present.

But mass spectrometers can measure isotope ratios to very high presion and accuracy and so it is more convenient to work with isotope ratios.

$$^{87}\mathrm{Sr}/^{86}\mathrm{Sr} = (^{87}\mathrm{Sr}/^{86}\mathrm{Sr})_i + (^{87}\mathrm{Rb}/^{86}\mathrm{Sr})\,(e^{\lambda t}-1)$$

where ^{86}Sr=the stable isotope of the Sr and hence remains constant with time.

The above equation is in the form of $y=c+mx$ which is a straight line equation and the equation will be valid under the assumption the system has been closed to Rb and Sr mobility from the time t to the present.

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But it is difficult to measure the initial ratio. The $^{87}Sr/^{86}Sr$ at present is plotted along the y axis and the (^{87}Rb /^{86}Sr) is plotted along the x axis. Hence the intercept of the staright line gives the initial ratio. On such a diagram, a suite of cogenetic rocks or minerals having the same age define a line termed an isochron. The slope of the line gives the age of the rock or mineral.

XII. Core Formation and Magma Oceans

One potential mechanism for Fe-Ni metal separation or segregation is that the metal melts and forms an interconnected network. Whether or not this happens depends on a property known as the dihedral angle, θ. The dihedral angle is that formed by the liquid in contact with the two solid grains, which in the case of the mantle will be silicate or oxide grains. If $\theta \leq 60$, the melt will fill channels between the solid grains and form an interconnected network. If θ is greater than 60 degrees, the melt is confined to pockets at grain corners and cannot easily move unless the melt fraction is more than 10 percent.

If melt is able to connect, its rate of migration is quite rapid, and can be calculated using Darcy's law:

$$v=k/\eta\Delta\rho g$$

where v=velocity of melt relative to the solid matrix; k=permeability, η=viscosity of the melt measured in Pa s, Δρ=density difference between the melt and the solid, and g=acceleration due to gravity.

Permeability, $k=a^2\phi/24\pi$ where a=mean radius and ϕ=melt fraction.

There was more than 40 percent of silicate melting in which the dense metal droplets sank inward. But such high percentage of melt requires tremendous amount of heat for its generation.(possible source; the collisions during accretion+radioactive heat which is much greater than today).

XIII. Core-Mantle Equilibration

The core-mantle separation resulted in the separation of the metal-loving siderophile elements and their partitioning into the core. However, trace amounts of the siderophile elements are retained in the mantle and if metal segregation were an equilibrium process then these elements would provide information about the conditions of core formation.

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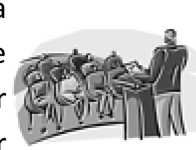

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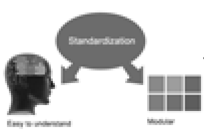

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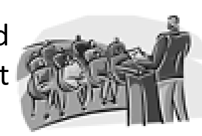

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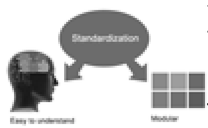

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"

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3. Submission of Manuscripts,

4. Manuscript's Category,

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10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

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.

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

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- 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.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

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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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