Environmental Effects of Application of Fertilizers and Pesticides on Water and Soil in Ibadan, Nigeria

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INTRODUCTION
Agriculture as a domestication of plants and animals, appeared only about 10,000 years ago, started from peasant farming that generates little or no hazardous waste. But with the mounting demands of growing populations, agriculture has been undergoing accelerated change over the last century to sophisticated mechanized farming system, which has resulted to uncontrollable waste to the environment causing a lot of pollution to air, water and soil (Rocket, 2007). In addition, it has allowed more plants and animal production per unit area of land; all this was achieved with the application of required amount of chemicals such as fertilizer, herbicides and pesticides which have harmful effects on the environment (Ecobichon, 1995). Pesticide is a composite which consist of all chemicals that are used to kill or control pests. In agriculture, this includes herbicides (weeds), insecticides (insects), fungicides (fungi), nematocides (nematodes), and rodenticides (vertebrate poisons) (FAO, 1993). The application of pesticide and herbicides for the control of wide variety of insectivorous, herbaceous pests and green leaves since chemical age, has contributed enormously to the success of Green Revolution program globally, but with some noticeable pollution effects on ecosystem and human health (FAO, 1993).

Also, many other agricultural activities such as dairy farming, livestock farming, fish farming, tree and vine crop processing industries, animal slaughtering and operation of field lots as generated a lot of uncontrollable waste that beyond imagination (Beseler et al., 2008). Most farmers in developing world are not aware of the environmental impacts of using agro-chemicals on their farms, human being and wildlife (Jeyaratnam, 1990, Jaga and Dharmani, 2003; Kamel and Hoppin, 2004.) The exposure of farmers to pesticide and herbicides during their application may increase the risk of giving birth to a child with limb defect (Daniels et al., 1998 and Engel et al., 2000). However, many are ignorant of incidences of person health being affected by chemical spraying although available data at hospital in Nigeria has confirmed this and likewise globally.

Keywords: environmental pollution, pesticides and fertiliser, water.

Abstract
Protection of natural resources is of priority to government, non-governmental organizations and individuals. Effort had been made and financial resources had been expended on researches that examine and investigate point-and non-point-source pollution. This article presents the outcome of field investigations carried out on a stream that passes through Institute of Agricultural Research and Training (I.A.R & T) Moor Plantation, Ibadan, Nigeria. The analysis of water samples shows that there is an environmental pollution due to the high concentration of potassium and phosphate. The amount of phosphate in the water and in the soil was found to be 14.2 and 11.19mg/l respectively, which are beyond the tolerable limit of 30µg/l. This will support the aquatic growth such as algal boom. In extreme cases, it will result to methemoglobinemia with bluish discoloration of infant referred to as ‘Blue baby’. Chlorinated pesticides being used at Institute of Agricultural Research and Training (IART) has released chlorine of 151.2 mg/l to the water course that runs through the villages, making use of this surface water course that runs through the villages, for their domestic purposes at the downstream. This will create health challenges such as persistent hemolytic anemia and dialysis for the inhabitants of the area. However, such effluent from I.A.R.&T must be biodegraded before discharging into the watercourse in order to prevent environmental pollution.

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both small and large-scale, as well as the consumer sector. When these amounts of these wastes are beyond tolerable limits they constitute pollution to
land and water resources and the environment at large. These wastes can be classified as hazardous, non-hazardous (McCauley, 2006). Environmental pollution management is a major global concern to
the level that agricultural waste that posed no much problem of recycling in nature into a composting or
feeds such as bone and blood meal has become a problem in environmental degradation (Graeme and
Murphy, 2007). The volume generated has increased
tremendously with the spread of intensive
mechanized agricultural practices in developed and in developing countries (Ongley, 1994). This has been
the subject of European and North American legislation on environmental control in 2003). Such
control legislation has been instituted in Nigeria, regulated by some government agencies: Federal
Environmental Protection Agency, National Environmental Standards and Regulation Enforcement Agency tackled environmental pollution menace.

Hence it is obvious, that the proliferation of toxic chemicals in many walks of life is one of the major sources of hazard from wastes generated today work-
wide. However, many people come in contact with chemicals at the working place during application. More so, in agriculture alone around one billion
workers are employed world-wide accounting for
50% of the total world work force (International Labour Organization (ILO), 1988). It was reported
that more than 50% of applied fertilizer are lost to leaching, while more than 90% of pesticides do not
reach the target pest. It was reported more emphatically, that Millions of tons of pesticides are applied annually, but it is estimated that less than 5%
of these products reach the target organism, with the remainder deposited into the air, soil, and
groundwater (Primental,1986). There are implications
for human health arising, from the presence of high
levels in drinking water with the occurrence of methemoglobinemia in infants (European

In addition, nitrate in lakes, rivers, estuaries, and coastal water has contributed to high nutrient levels
leading to the formation of algal blooms and to oxygen depletion in water. The increased in use and
misused of pesticides has led to the build-up of
resistance in insect pests, a problem that has led to the build-up of resistance in insect pests, a problem
that has grown enormously over the last two decades (Trappe et al., 1984). Over application of fertilizers,
application at a time when the ground is waterlogged or the crop is not able to use the fertilizer, can lead
to run-off in groundwater. This can enrich lakes and
streams in a process called eutrophication and lead to
algal blooms. It is possible to over apply organic
fertilizer as well, but their nutrient content, solubility, and release rate are typically lower, like the type
being practice in I.A.R.&T, research field in Ibadan,
Nigeria. In other word if artificial fertilizers are used
without considering actual nitrogen requirement, the
cumulative effect can be endemic. Storage and
application of fertilizers in particular weather or soil
conditions can also cause emissions of the
greenhouse gas nitrous oxide (N₂O). Ammonia gas
(NH₃) may be emitted following application of
mature or slurry or due to inorganic fertilizer. Besides, supplying can increase soil acidity lower
PH, or souring)

Due to the increasing negative environmental effects
occurred as result of misapplication of agricultural
chemicals such as fertilizer, pesticides, herbicides
e.t.c.. The objective of this article is to determine the
effects of pesticides and fertilizers on water at the
stated location and suggest possible measures to
avoid environmental and health hazard in the area.

MATERIALS AND METHODS
Institute of Agricultural Research and Training,
(I.A.R&T) Moor Plantation, Ibadan, Nigeria, is
located on the latitude 7°23′ N, 3° 51′E. The institute
is on a tropical sub-humid climate region which has
annual rainfall approximately 1289.2 mm, with
annual temperature between 28.6- 40°C. The relative
humidity ranges between 83 % and 95 % during the
rainy season and less than 55 % during the soil
sample collected has been zoned as IWO series as
stated by (Montgomery et al., 1998). The institute
has many research plots, where arable cropping on
yearly basis have been practiced with the application
of bio-organic fertilizer to improve the soil nutrient
value and likewise pesticides application. This arable
cropping field has a total area of 432 m², which had
been used continually for maize cultivation for the
past 20 years. The soil samples were taken randomly
from different points while the water samples were
taken from the upstream where the chemicals were
applied and downstream locations of the adjacent
seasonal river. Standardized materials were used to
obtain and store polluted water to ensure that element
or compound was admitted into the polluted water
other than that in it already. Water samples from the
downstream and upstream were well labeled. The
water and soil samples were subjected to chemical
analysis in accordance with the guideline of United
State of America Environmental Protection Agency
in 2002.

RESULTS AND DISCUSSIONS
The data obtained was examined in order to
determine the concentration of some micro elements
on the collected water samples and the concentration
of macro elements was determined from the collected
soil samples. The volume of concentration in each of
the analysis was compared with the recommended
tolerance limit values.
Concentration Analysis
The results of macro element concentration, micro element and other parameters analysis are shown in Table 1, 2 and 3 respectively. The World Organization (WHO) classifies the extents of chemical levels in water for the drinking purpose as either inoffensive or unobjectionable when it is within acceptable range for human consumption. Table 2 shows that the water course has been highly polluted. At I.A.R & T organ chlorine pesticide is usually applied which released chlorine of 151.2 mg/l to the water course that runs through many villages. Nearly all the communities use this water for drinking and other domestic purposes, these communities cannot be free from health hazard, such as hemolytic anemia in dialysis. Bio-organic fertilizer applied to control environmental pollution, still contain some significant amount of phosphate in the sampled water and in the soil. 14.2mg/l and 11.19mg/l of phosphate were determined from the polluted water and soil respectively, which are beyond the tolerable limit of 30µg/l.

Table 1. Macro elements concentration in polluted water compare with Standard Tolerance Limit

<table>
<thead>
<tr>
<th>S/No</th>
<th>Parameters</th>
<th>Average Value (Mg/L)</th>
<th>Tolerance Limits (Mg/L)</th>
<th>Environmental Impact/Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phosphate</td>
<td>14.2</td>
<td>30ug/L</td>
<td>Support heavy aquatic plant growth that usually leads to algal blooms in phosphate</td>
</tr>
<tr>
<td>2</td>
<td>Potassium</td>
<td>1047</td>
<td>88-99</td>
<td>The same effect as in phosphate</td>
</tr>
<tr>
<td>3</td>
<td>Calcium</td>
<td>530</td>
<td></td>
<td>No negative effect</td>
</tr>
<tr>
<td>4</td>
<td>Nitrate</td>
<td>0.014</td>
<td>1.0</td>
<td>No negative effect</td>
</tr>
<tr>
<td>5</td>
<td>Sulphate</td>
<td>12.88</td>
<td>250</td>
<td>Metallic taste to water</td>
</tr>
<tr>
<td>6</td>
<td>Magnesium</td>
<td>0.86</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Micro elements concentration in polluted water compare with Standard Tolerance Limit

<table>
<thead>
<tr>
<th>S/No</th>
<th>Parameters</th>
<th>Average Value (Mg/L)</th>
<th>Tolerance Limits (Mg/L)</th>
<th>Environmental Impact/Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Iron</td>
<td>1.76</td>
<td>0.1-0.3</td>
<td>Turbidity, unpleasant taste and reddish pipe deposit</td>
</tr>
<tr>
<td>2</td>
<td>Cadmium</td>
<td>0.02</td>
<td>0.005</td>
<td>The same effect as in phosphate</td>
</tr>
<tr>
<td>3</td>
<td>Zinc</td>
<td>1.4</td>
<td>5.0</td>
<td>No negative effect</td>
</tr>
<tr>
<td>4</td>
<td>Chlorine</td>
<td>151.2</td>
<td>4</td>
<td>Hemolytic anemia in dialysis</td>
</tr>
<tr>
<td>5</td>
<td>Sodium</td>
<td>8.47</td>
<td>1.25</td>
<td>Cancer risk is loamy by drinking this water</td>
</tr>
</tbody>
</table>

Table 3: Other analytical parameters concentration in polluted water compare with Standard Tolerance Limit

<table>
<thead>
<tr>
<th>S/No</th>
<th>Parameters</th>
<th>Average Value (Mg/L)</th>
<th>Tolerance Limits (Mg/L)</th>
<th>Environmental Impact/Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temperature</td>
<td>30.7°</td>
<td>18.29-8.5°</td>
<td>It will increase transpiration and decomposing of organic materials</td>
</tr>
<tr>
<td>2</td>
<td>pH</td>
<td>6.7</td>
<td>6.5-8.5</td>
<td>It support aquatic life</td>
</tr>
<tr>
<td>3</td>
<td>Acidity</td>
<td>0.15</td>
<td>No guideline</td>
<td>Corrosion of pipes</td>
</tr>
<tr>
<td>4</td>
<td>Alkalinity</td>
<td>258.7</td>
<td>30-100</td>
<td>This lead to hardness of water, more detergent is required for washing</td>
</tr>
<tr>
<td>5</td>
<td>Dissolved oxygen</td>
<td>20.25</td>
<td>2.5-30</td>
<td>It can support aquatic life and good for irrigation</td>
</tr>
<tr>
<td>6</td>
<td>Biochemical oxygen demand</td>
<td>346.5</td>
<td>80-90</td>
<td>It required treatment before using it for domestic use and irrigation as times goes on.</td>
</tr>
<tr>
<td>7</td>
<td>Chemical oxygen demand</td>
<td>698</td>
<td>Not more than 80-90</td>
<td>It required treatment before using it for domestic use and irrigation.</td>
</tr>
</tbody>
</table>

This will support heavy aquatic plant growth such as algal blooms, entrophication of Entrophic lake. In extreme cases it will have the same effect like that of nitrate, which is methemoglobinemia it has a symptom of bluish dis-colouration of the infant referred to as “Blue baby”. The Do value is good enough to support aquatic life, livestock and dairy farming but it requires treatment to reduce the COD and BOD values to 20/30mg/l standard before diverting the farm run-off to the adjacent watercourse. In lieu of this, the water cannot be used for irrigation or domestic purpose, because it is turbid, colored and with offensive odour.

Table 4: Soil macro element concentration compare with Standard Tolerable Limits

<table>
<thead>
<tr>
<th>S/No</th>
<th>Parameters</th>
<th>Average Value (Mg/L)</th>
<th>Tolerance Limits/Standard Level</th>
<th>Environmental Impact and Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phosphorous</td>
<td>11.2</td>
<td>No guideline</td>
<td>This value is of high side. It leads to algal blooms</td>
</tr>
<tr>
<td>2</td>
<td>Potassium</td>
<td>0.84</td>
<td>No guideline</td>
<td>No negative effects</td>
</tr>
<tr>
<td>3</td>
<td>Calcium</td>
<td>1.33</td>
<td>No guideline</td>
<td>No negative effects</td>
</tr>
<tr>
<td>4</td>
<td>Nitrogen</td>
<td>0.58</td>
<td>No guideline</td>
<td>No negative effects</td>
</tr>
<tr>
<td>5</td>
<td>Magnesium</td>
<td>1.19</td>
<td>No guideline</td>
<td>No negative effects</td>
</tr>
</tbody>
</table>
Table 5: Soil micro element concentration compare with Standard Tolerable Limits

<table>
<thead>
<tr>
<th>S/No</th>
<th>Parameters</th>
<th>Average Value (Mg/L)</th>
<th>Tolerance Limits/Standard Level</th>
<th>Environmental Impact And Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Iron</td>
<td>0.19</td>
<td>No guideline</td>
<td>No negative effects</td>
</tr>
<tr>
<td>2.</td>
<td>Zinc</td>
<td>0.15</td>
<td>5.0</td>
<td>Below expectation</td>
</tr>
<tr>
<td>3.</td>
<td>Copper</td>
<td>0.18</td>
<td>1.0</td>
<td>Below expectation</td>
</tr>
<tr>
<td>4.</td>
<td>Manganese Others</td>
<td>0.13</td>
<td>0.5(WHO)</td>
<td>Acceptable</td>
</tr>
<tr>
<td></td>
<td>Analytical Parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>pH</td>
<td>6.56</td>
<td>6.5-8.5</td>
<td>Acceptable</td>
</tr>
<tr>
<td>2.</td>
<td>Hydrogen ion</td>
<td>0.082</td>
<td>0.19</td>
<td>Acceptable</td>
</tr>
<tr>
<td>3.</td>
<td>Organic carbon%</td>
<td>0.49</td>
<td>0.65</td>
<td>Acceptable</td>
</tr>
<tr>
<td>4.</td>
<td>Organic matter</td>
<td>0.89</td>
<td>1.1</td>
<td>Acceptable</td>
</tr>
</tbody>
</table>

The results in Table 4 and 5 shows that there is no visible environmental pollution due to nitrogen elements on soil because accurate proportion of nitrogen was added to the soil. This met with plant requirement without excess of bio-organic fertilizer being leached into the soil by precipitation and infiltration to the underground water. At 0.05 level of significance, the concentration of macro elements did not have negative effect on the soil. The concentration of Zinc and Copper are below expectation with average 0.15mg/l and 0.18 mg/l respectively. In addition, Manganese concentration has an average value of 0.13 mg/l which is acceptable by WHO standard. The concentration of other parameters such as pH, Hydrogen iron, Organic carbon % and Organic matter are acceptable as shown in Table 5.

**CONCLUSIONS**

A number of water pollution and health hazards have been associated with application of pesticide and fertilizer, when adequate regulations guiding the application are not observed by the applicators. Therefore pesticides of high percentage of chemical content of chlorine, lead and sodium, should be avoided. The water course on the research plot has been polluted. This will not support aquatic life or good for human being consumption, likewise not too well for irrigation. It should be subjected to treatment before diverting to adjacent water course. In particular, the outputs of the research study shown that soil management, in terms of fertilizer application, is no way related to soil properties as less than 30 % of the farms had done soil testing. Perhaps this is a necessary area for intervention, to ensure excess fertilizers are moderately applied to the soil.

**REFERENCES**


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