

# The suitability of domestic roof harvested rainwater as source of irrigation water for homestead gardening.



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## 1.0 Introduction

Homestead gardening could be a way of ensuring good quality foods in developing countries.

Contamination of surface and shallow water source is a big challenge. Domestic roof harvested rainwater (DRHRW) could be an alternative source.

Previous work had focused on quantity rather than quality of harvested rainwater.

Hence this study investigated the quality of DRHRW harvested under varying environmental conditions in relation to its use for irrigation of homestead garden.

## 2.0 Methodology

Study sites in Nigeria: Ibadan (7°23'47"N, 3°55'0"E, residential), Lagos (6°27'11"N, 3°23'45"E, industrial) and Port-Harcourt (4°45'0"N, 7°0'0"E, gas-flaring) (Fig. 1)

The samples were collected at twelve locations per city in three replicates from four different roof materials, and three ages of roofs in service conditions at about 1.5m above the ground surface.

Sample preparations and handling were done according to standard procedures viz John-De-Zuane (1990), APHA (1995) and WHO (2004).



Fig. 1. Site maps indicating sampling sites

## 3.0 Results

### 3.1 Microbiological Quality

*Escherichia coli* (*E. coli*) was isolated from almost all the samples considered. The value was observed to be below the infection dose of  $10^6$ cfu $ml^{-1}$  (Hazen and Toranazos, 1990). (Table 1).

It will only be of major concern if the water is used to irrigate fruit crops and the fruits are eaten without washing.

Table 1. Microbiological qualities of domestic roof harvested rainwater under investigation.

| No   | Age | Ibadan    |           | Lagos     |           | Port-Harcourt |           |
|------|-----|-----------|-----------|-----------|-----------|---------------|-----------|
|      |     | E.coli    | Part.1    | E.coli    | Part.1    | E.coli        | Part.1    |
| 1    | 1   | 1.02E+001 | 0.82E+001 | 2.00E+001 | 1.07E+001 | 1.75E+001     | 2.00E+001 |
| 1    | 2   | 1.57E+001 | nd        | 6.00E+001 | 0.50E+000 | 1.27E+002     | nd        |
| 1    | 3   | nd        | nd        | 3.87E+001 | 1.17E+000 | 1.94E+001     | 0.85E+001 |
| 2    | 1   | 2.50E+000 | nd        | 3.17E+001 | nd        | 1.07E+001     | 0.55E+000 |
| 2    | 2   | 1.17E+001 | nd        | 2.00E+001 | 0.23E+000 | 1.24E+001     | 0.84E+001 |
| 2    | 3   | 1.60E+001 | nd        | 1.78E+001 | nd        | 1.24E+000     | 0.83E+001 |
| 3    | 1   | 1.60E+001 | nd        | 3.83E+001 | 0.83E+001 | 1.57E+001     | nd        |
| 3    | 2   | 2.50E+000 | 1.00E+000 | 0.16E+002 | 0.50E+000 | 3.11E+001     | 1.17E+001 |
| 3    | 3   | 2.17E+002 | nd        | nd        | nd        | 0.48E+001     | 0.83E+001 |
| 4    | 1   | 1.27E+02  | nd        | 2.83E+001 | nd        | 1.24E+000     | 0.50E+000 |
| 4    | 2   | 2.50E+001 | 1.0E+001  | 0.58E+001 | nd        | 1.25E+001     | nd        |
| 4    | 3   | 1.60E+000 | nd        | 1.62E+001 | nd        | 1.24E+001     | 1.1E+001  |
| Comp |     | 1.62E+004 | nd        | 6.00E+001 | 1.83E+001 | 2.11E+001     | nd        |

Abbreviations: nd:Not detected  
 Part.1: Particulate matter  
 Age: 1 to 3 represent 0.5, 1-10 and 10-15 years in service condition  
 Comp: Control or compare samples collected without roof/harvested rainwater.

*Pseudomonas fluorescens* was detected in 25, 50 and 70% in the samples from residential, industrial and gas flaring regions respectively.

DRHRW that is "contaminated" with *P. fluorescens* can be a good source of irrigation water and may assist the farmer in curtailing the problem of nematode invasion thereby increasing crop yield (Anon., 2007).

Age of roof and roof type do not appear to have major impact on the distribution of *E.coli* and *P. fluorescens* (Table 1).

### 3.2 Chemical Quality

Lead was detected in 62% of samples from residential and all the samples from industrial and gas flaring regions.

Cadmium was detected in all the samples from Industrial area as well as in 69 and 84% of samples from residential and gas flaring areas.

Lead and Cadmium were detected from DRHRW in all the three locations in the range 0.01 – 0.13mg/L and 0.01 – 0.15mg/L respectively (Figs. 2 - 4). These were traced to anthropogenic factors.

Mean Cd value of 0.02, 0.06 and 0.05 (Fig. 5) for Ibadan, Lagos and Port-Harcourt respectively indicate almost 3 times Cd levels in rainwater samples between residential and industrial or gas flaring regions.

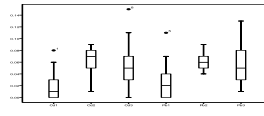


Fig. 2. Box and Whisker presentation of concentrations of Cd and Pb (mg/L) for Ibadan, Lagos and Port-Harcourt. Age 1 to 3 represent 0.5, 1-10 and 10-15 years in service condition respectively. The Pb refer to concentration of Pb in samples from step site roof.

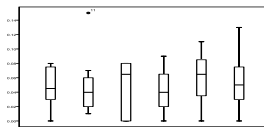


Fig. 3. Box and Whisker presentation of concentrations of Cd and Pb (mg/L) for Ibadan, Lagos and Port-Harcourt. Age 1 to 3 represent 0.5, 1-10 and 10 years in service condition respectively. The Cd refer to concentration of Cd for harvested rainwater. The Pb refer to concentration of Pb in samples from step site roof.

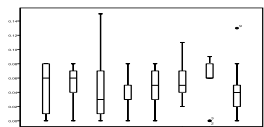


Fig. 4. Box and Whisker presentation of concentrations of Cd and Pb (mg/L) for Ibadan, Lagos and Port-Harcourt. Age 1 to 3 represent 0.5, 1-10 and 10 years in service condition respectively. The Pb refer to concentration of Pb in samples from step site roof.

This however does not pose any risk to its being used to irrigate homestead gardening. On the other hand, it is an indication of its suitability for irrigation purposes.

The concentrations of iron detected is also within the safe limit recommended for use by health authorities even for potable uses (WHO, 2004; USEPA, 1994).

Table 2. Concentrations of Fe and NO<sub>3</sub> in domestic roof harvested rainwater under investigation

| No   | Age | Ibadan    |                 | Lagos     |                 | Port-Harcourt |                 |
|------|-----|-----------|-----------------|-----------|-----------------|---------------|-----------------|
|      |     | Fe        | NO <sub>3</sub> | Fe        | NO <sub>3</sub> | Fe            | NO <sub>3</sub> |
| 1    | 1   | 1.67E+002 | 1.67E+001       | 0.8E+001  | 2.5E+001        | 0.8E+002      | 1.6E+001        |
| 1    | 2   | 0.36E+001 | 2.50E+1.21      | 0.57E+001 | 1.0E+1.00       | 0.73E+002     | 2.0E+001        |
| 1    | 3   | 0.46E+002 | 2.52E+1.00      | 0.8E+002  | 1.0E+1.00       | 0.93E+002     | 1.5E+001        |
| 2    | 1   | 0.85E+001 | 2.04E+1.21      | 0.5E+002  | 1.40E+1.00      | 0.71E+001     | 2.6E+000        |
| 2    | 2   | 0.71E+001 | 2.02E+1.00      | 0.5E+002  | 1.0E+1.00       | 1.15E+002     | 1.0E+1.00       |
| 2    | 3   | 0.77E+002 | 1.5E+1.00       | 0.5E+001  | 1.0E+0.01       | 0.4E+002      | 1.0E+0.01       |
| 3    | 1   | 0.73E+001 | 2.52E+0.00      | 0.87E+001 | 1.40E+0.00      | 0.3E+001      | 1.0E+0.01       |
| 3    | 2   | 1.15E+001 | 1.57E+0.00      | 0.8E+002  | 1.0E+0.01       | 1.0E+0.01     | 1.0E+0.01       |
| 3    | 3   | 0.55E+001 | 2.52E+0.01      | 0.5E+002  | 2.5E+0.00       | 0.73E+001     | 2.6E+0.00       |
| 4    | 1   | 0.57E+001 | 2.52E+1.00      | 0.5E+001  | 2.0E+0.01       | 0.9E+004      | 1.0E+0.00       |
| 4    | 2   | 0.75E+001 | 1.57E+0.01      | 0.8E+002  | 1.0E+0.00       | 1.0E+0.00     | nd              |
| 4    | 3   | 0.57E+002 | 2.52E+1.00      | 0.5E+002  | 1.0E+1.00       | 0.57E+002     | 1.0E+0.00       |
| Comp |     | 0.53E+001 | 2.6E+1.00       | 0.5E+002  | 1.0E+0.00       | 0.5E+002      | 1.0E+0.00       |

Fig. 5. Bar chart showing Cd concentrations (mg/L) for Ibadan, Lagos, and Port-Harcourt.

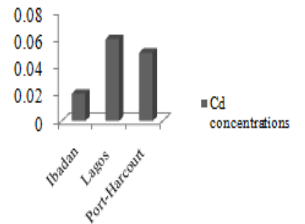


Fig. 5. Mean Cadmium concentrations (mg/L) for the three locations considered.

Iron and nitrate were detected in almost all the samples investigated in the range of 0.21 – 1.13mg/L and 51.05 – 305.93mg/L respectively (Table 2).

Nitrate content in DRHRW samples collected were higher than the WHO recommended standard of 45mg $l^{-1}$  for all locations.

## 4.0 Conclusions

Findings from this research work indicated that the quality of DRHRW in industrial and gas flaring environments are not suitable for irrigation of homestead gardening because of its chemical constituents.

It is contaminated with lead and cadmium which are suspected to be from anthropogenic source.

Those harvested from residential environment however proved to be suitable for irrigation purposes.

The presence of *Pseudomonas fluorescens* in all location indicated that DRHRW may also serve as a nematocide to some extent, if used to irrigate homestead garden.