THE EFFECT OF IRRIGATION BY DOMESTIC WASTEWATER ON SOIL PROPERTIES IN KOFAR KWARE IRRIGATION FARMS, SOKOTO-NIGERIA

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ABSTRACT

This research work presents the effect of irrigation by domestic wastewater on soil properties in Kofar Kware area in Sokoto State, Nigeria. Soil samples were collected at different point interval in the study area. The parameter such as pH, Soil salinity, Chloride, nitrate, and organic matter, was used to carry out various analyses in the laboratory. The results obtained from pH in domestic wastewater was 8.6 and might cause problem for the crops planted on such soil, likewise other parameters: soil salinity, chloride, nitrate, and organic matter were very low in content which might cause the crop yield improperly. It was concluded and recommended that the domestic wastewater should not be used for irrigation activities in Kofar-Kware Irrigation farm, Sokoto. Alternatively, adequate clean and portable water should be supplied to the irrigation farms to dilute the rate of acidic content in the farm.

Keywords: Irrigation, Domestic, Wastewater, Properties

INTRODUCTION

The growth of towns and cities and the development of industries by 19th century lead to problems of sewage disposal which encouraged the use of sewage water in irrigation. The practice of use of domestic sewage in farming is becoming prevalent as the demand for water is increasing. In due to fast industrial development and the growth of population, the availability of water decrease day today. In this increase in the population has led to increased demand for water and the increased generation of wastewater. The high-quality water is preserved and the lower quality is used for agriculture purpose. The use of wastewater by farmer will not go away. It can't be ignored or dealt with by imposing bans on its use. Municipal policymakers and planner need to comfort reality and face the challenge in innovative way (Scott et al, 2004). Irrigation is an excellent use for sewage effluents because it is mostly water with nutrients. For small flows, the effluent can be used on special, well-supervised "sewage form," where forage fiber or seed crops are grown and can be irrigated with standard primary or secondary effluent. Flower, aromatic aspect relocated to crops and soil must also be taken in to account (Bouwer andIdelovitch, 2007). Irrigation plays a vital role in increasing crop yields and stabilizing production. In arid and semi-arid regions irrigation is essential for economically viable agriculture while in semi-humid and humid area; it is often required on a supplementary basis (Oron et al, 2009). The analysis carried out for this research was limited to PH test, soil salinity, chloride, Nitrate, organic matter permeability and temperature of the soil irrigated by domestic wastewater.

The aim of this research is to investigate the effect of irrigation by domestic wastewater on soil properties in Kofar-Kware irrigation farm Sokoto-Nigeria. The following objectives are designed to achieve the aim of this research work:

1. To carry out a reconnaissance survey of the area
2. To investigate the short term impact of reclaimed wastewater Irrigation on soil physical and chemical properties
3. To explore the adverse effects on the groundwater quality as a result of short term irrigation by reclaimed wastewater
4. To identify the most significant impact resulting from the use of reclaimed wastewater from irrigation in the agriculture sector and crop production.

Justification of the Study

Due to the increasing demand and fixed supply of the groundwater system in Kofar-Kware strip, it became urgent to look for new nonconventional water resources to fill the gap in the water budget. As a result, the groundwater level is falling and the salinity is increasing making the water unsuitable either for human consumption or irrigation purposes. The uncontrolled discharge of untreated sewage and excessive use of fertilizer level led to high nitrate concentration in certain areas, thus creating additional pollution of the groundwater resources. Using treated domestic wastewater could be one of the main options to develop the water resources in the Kofar-Kware strip as it represents an additional renewable and retable water sources.There is a major potential use of treated wastewater in Kofar-Kware. However, the development of water reuse in agriculture (irrigation) is based on scientific pieces of evidence of its effect on environment. Deposits meeting the regulation and guidelines of the use of wastewater are not entirely risk-free. Continued research will result in developing new technologies or improving the existing methodologies used for assessment of risk associated with trace contaminants evaluation of the fate microbial quality, treatment system and evaluation of the fate of microbial, chemical and organic contaminant. Moreover, while many wastewater reuse projects have been practiced in Kofar-Kware need to be better assessed with applied research for specific application a compressive short term impact analysis on groundwater, soil and fruit properties.

LITERATURE REVIEW

The use of wastewater for irrigating agricultural soil was shown to be associated with a number of potential beneficial changes such as an increase in organic carbon, available nitrogen, phosphorus, potassium, and magnesium contents in the soil as compared to the clean groundwater irrigated soil. Wastewater is a valuable source of plant nutrient and organic matter needed for main earning fertility and productivity levels, of the soil irrigation with wastewater has been shown to results in increase in growth yield and plant constituents

Wastewater contains a significant amount of organic and inorganic nutrient. There is a potential for nutrient present in recycled water to be used as a fertilizer source when the water is recycled

for irrigation. Soil micro-organisms showed increased metabolic activities under sewage effluent irrigation. Organic carbon total nitrogen, microbial biomass C and N Microbial activities increase with increase in time duration of wastewater irrigation another factor that may also influence ion exchange capacity are the presence of calcium in high concentration organic material and soil texture, calcium, for example, is preferentially exchanged at higher concentration in comparison with iron, manganese, and Phosphorus (FAO, 2008). The cat-ions exchange – capacity depends mainly on the texture and the organic matter content of the soil (Olivera M, et al. 2012) the purpose of this study was to determine the impact of prolonging irrigation with treated domestic wastewater on the physical and chemical characteristics of different soils.

METHODOLOGY

The methods employed in this research work include the reconnaissance survey, sample collection and laboratory analyses as in 3.1 and 3.2 below:

RECONNAISSANCE SURVEY OF THE STUDY AREA

The reconnaissance survey was carried out in order to assess the feasibility of one or more best way of the effect of irrigation by domestic wastewater on soil properties in Kofar-Kware irrigation area. The visitation to the study area was carried out using procedural maps and was carefully studied. The topography of the area was observed to be sloppy and makes the area easier for water to be a channel to the irrigation field. According to Abu Nada(2009), Infiltration and field verification can be known to evaluate the effect of domestic waste on the soil and the soil condition. Much can be gained from inspection of the study of the soil geological exposures. The study area was located beside the western bye pass road and there was a runoff of water coming towards the site of the study area. Kofar-Kware is located in Sokoto North, with a good vegetation site for farming practice.The Kofar-Kware is situated at latitude 13.0639ºN, longitude 5.2162ºE. (GPS coordinate.net.).The occupations of Kofar-Kware are farming and animal rearing, which comprises most Hausa and Fulani ethnic. The main vegetation cover is Sudan Savanna.

SAMPLE COLLECTION AND LABORATORY ANALYSES

The soil sample was collected from the farm irrigation area of the study area. A 50kg bag was used to collect the soil sample from the irrigation farm randomly at 15m intervals. The soil PH was measured by a set of electrodes dipped in a suitable soil water paste. The PH of the suspension was read on a device known as PH -meter. Calcium chloride was used in place of water to simulate the salt concentration of the soil solution to which plant root is exposed. This may minimize the variation in soil PH due to fluctuation in the amount of soluble salt. Standard apparatus and reagents such as PH meter, $CaCO_3$, H_2SO_4, KCl, conical flasks, beaker, measuring cylinder, burette, $AgNO_3$, etc. and procedures recommended by WHO was used in carrying out the analysis for PH, chloride, nitrate, salinity, and organic matter. The plant takes up chloride as CL-10 from soil solution. It plays some important role in plant including in photosynthesis, osmosis adjustment and

suppression of plant diseases. However, high concentration of chloride can cause toxicity problem in crop and the yield.

PRESENTATION OF RESULTS

The tables below present the experimental results of parameters of domestic wastewater on soil properties in Kofar-Kwareirrigation farm.

Table 4.1: Result of sample 1 of domestic wastewater on soil properties in Kofar-Kware irrigation farm

S/N	Parameters	Result
1	P H	8.7
2	Salinity (%)	0.6
3	Chloride (mg/kg)	0.2
4	Nitrate (mg/kg)	0.8
5	Org- matter %	1.18

Table 4.2: Result of sample 2 of domestic wastewater on soil properties in KofarKware irrigation farm.

S/N	Parameters	Result
1	P H	8.6
2	Salinity (%)	0.65
3	Chloride (mg/kg)	0.15
4	Nitrate (mg/kg)	0.70
5	Organic matter %	1.15

Table 4.3: Result of sample 3 of domestic wastewater on soil properties in Kofar Kware irrigation farm

S/N	Parameters	Result
1	pH	8.4
2	Salinity (%)	0.62
3	Chloride (mg/kg)	0.25
4	Nitrate (mg/kg)	0.9
5	Organic matter %	1.20

Source: Laboratory work (2017)

3.1 Calculation of average value of parameter results of both sample

i. $pH = \frac{8.7 + 8.6 + 8.4}{3}$

$$= 8.56 \approx 8.6$$

ii Salinity $= \frac{0.63 + 0.65 + 0.62}{3}$

$$= 0.63\%$$

iii Chloride $= \frac{0.2 + 0.15 + 0.25}{3}$

$$= 0.2 \text{mg/kg}$$

iv Nitrate $= \frac{0.8 + 0.70 + 0.9}{3}$

$$= 0.8 \text{mg/kg}$$

v Organic matter $= \frac{1.18 + 1.15 + 1.20}{3}$

$$= 1.18\%$$

Table 4.4: Comparison of the average laboratory parameter result of the sample with standard value

S/N	Parameters	Result	Standard value
1	P H	8.6	6.5 -8.5
2	Salinity (%)	0.63	0.7
3	Chloride (mg/kg)	0.2	70
4	Nitrate (mg/kg)	0.8	30
5	Organic matter %	1.18	45

DISCUSSION OF RESULTS

The pH value of 8.6 in the Kofar-Kware domestic wastewater is higher than standard value for drinking water of 6.5-8.5 as specified by World Health Organization which might cause the crop yield improperly. The higher value of the pH in soil can reduce the germination of crops planted on such soil.

Salinity in irrigated soil by domestic wastewater at Kofar-Kware is 0.63%, which is along with level of standard value, irrigation by domestic wastewater has no negative effect on salinity in the obtained soil sample.

Chloride, Nitrate and organic matter present in the soil sample obtained are of low content compared with standard value,these might also affect the proper germination of plant on the field. Nitrate (NO_3) is a form of inorganic nitrogen (N) naturally occurring in soil. Sources of soil NO_3 include decomposing plant residue and animal manure compost, chemical fertilizer, exudates from living plant, rainfall, and lighting. Eventually, nitrate irons immobilized by micro-organisms (nitrate taken up by microorganisms) are converted into organic form and released back to the soil in plant-available form when dead soil organism is fed upon or decompose, (Cabrera, et al, 2008). This nutrient present might be used as a fertilizer source when the water is recycled for irrigation. Soil micro-organisms showed increased metabolic activities under sewage effluent irrigation.

CONCLUSION

In this research work, "the effect of irrigation by domestic wastewater on soil properties" in Kofar-Kware area of Sokoto-Nigeria has used to analyze the effect of domestic wastewater on soil properties. For the laboratory practical, carried out the effect of parameters such as PH, Salinity, Chloride, Nitrate and organic matter was determined.In conclusion from the result obtained in the parameter such as Salinity, Chloride, nitrate and organic matter, the PH value was found in the laboratory practical. Is 8.6 which is above the normal Ph value in soil as a result of effect of domestic wastewater. The higher value of the PH in soil can reduce the germination of crops planted on such soil, other parameters tested: Soil salinity, Chloride, Nitrate, and organic matter was found within the acceptable limit but in low amount, these might also affect the proper germination of plant on the field, in conclusion, the domestic wastewater should not be used for irrigation purposes

RECOMMENDATION

Based on the tests carried out for: PH, Soil salinity, chloride, nitrate and organic matter, the following recommendations were made

1. The irrigation wastewater should be properly disposed of out irrigation farm in Kofar Kware
2. The domestic wastewater should keep away and not been used for irrigation
3. Alternatively, the domestic wastewater in so far Kware should be treated against acidity before it is used for irrigation purposes.

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