Review on Recycling Of Waste Water by Using Vermifilter

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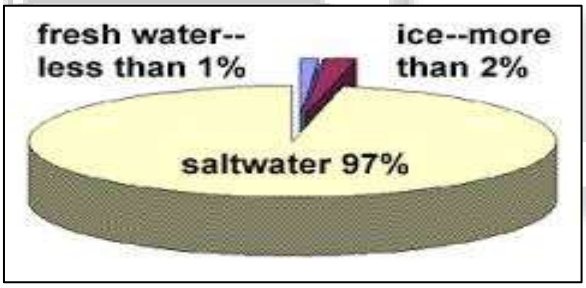
Abstract — Present situation of water, nearly 97% of water is present in the form of sea, which is salty and cannot be used for domestic or municipal use.2% of water is present in form of ice and glaciers. And only 1% of water is present for domestic use. Therefore there is scarcity of water in nature. Nearly 80% of the water supply used by society returns as municipal wastewater in the sewer system as sewage. Water is becoming a rare resource in the world. It is therefore essential to reduce surface and ground water use in all sectors of consumption, to substitute fresh water with alternative water resources and to optimize water use efficiency through reuse options. These alternative resources include rainwater and greywater. Greywater is commonly defined as wastewater generated from bathroom, laundry and kitchen. Due to rapid industrialization and development, there is an increased opportunity for greywater reuse in developing countries such as India.

Keywords: Recycling, Waste Water, Vermifilter

I. Introduction



A. *Necessity of recycling:-*

Water is becoming a rare resource in the world. In India alone the International Water Management Institute (IWMI) predicts that by 2025, one person in three will live in conditions of absolute water scarcity (IWMI, 2003). It is therefore essential to reduce surface and ground water use in all sectors of consumption, to substitute fresh water withalternative water resources and to optimize water use efficiency through reuse options. These alternative resources include rainwater and greywater. With increase in population, there will be anincrease in stress on sanitation and wastewater disposal, system. Gupta et al., (2004) predicted that recyclable wastewater will meet 15% of total water requirement in 2050. While the world's population tripled in the 20th century, the use of renewable water resources has grown six-fold. Within the next fifty years, the world population will increase by another 40 to 50 %. This population growth - coupled with industrialization and urbanization – will result in an increasing demand for water and will have serious consequences on the environment. Already there is more waste water generated and dispersed today than at any other time in the history of our planet: more than one out of six people lack access to safe drinking water, namely 1.1 .billion people, and more than two out of six lack adequate sanitation, namely 2.6 billion people (Estimation for 2002, by the WHO/UNICEF JMP, 2004). 3900 children die every day from water borne diseases (WHO 2004). One must know that these figures represent only people with very poor conditions. In reality, these figures should be much higher.

As the per capita use increases due to changes in lifestyle and as population increases as well, the proportion of water for human use is increasing. This, coupled with spatial and temporal variations in water availability, means that the water to produce food for human consumption, industrial processes and all the other uses is becoming scarce.

II. Properties Of Earthworms

Earthworms, belonging to the class Oligochaeta, possess a range of unique properties that contribute to their ecological significance and make them valuable in various fields such as agriculture, waste management, and soil health. Some key properties of earthworms include:

1) Burrowing and Aeration: Earthworms are skilled burrowers, creating tunnels in the soil as they move. Their burrowing activities facilitate soil aeration, allowing oxygen to reach plant roots and promoting beneficial microbial activity.
2) Decomposition and Nutrient Cycling: Earthworms play a crucial role in the decomposition of organic matter. They consume dead plant material and organic waste, breaking it down through their digestive system. This process results in the production of nutrient-rich castings or vermicompost, which improves soil fertility and nutrient cycling.
3) Soil Structure Improvement: Earthworms help improve soil structure by creating channels and aggregates through their burrowing activities. These channels enhance water infiltration, root penetration, and the movement of nutrients within the soil, leading to improved soil drainage and fertility.
4) Biochemical Activity: Earthworms secrete enzymes and mucus that aid in the breakdown and digestion of organic matter. Their activities stimulate the growth of beneficial soil microorganisms, resulting in enhanced nutrient availability and the suppression of harmful pathogens.
5) Soil Mixing: Earthworms actively mix organic matter with mineral soil particles, facilitating the breakdown and incorporation of organic material into the soil profile. This process improves soil porosity, moisture retention, and nutrient distribution.
6) Bioindicator Role: Earthworms are considered bioindicators of soil health and ecosystem quality. Their presence and abundance can indicate soil fertility, organic matter content, and the overall well-being of the soil ecosystem.
7) Environmental Remediation: Certain species of earthworms have the ability to accumulate heavy metals

and organic pollutants in their tissues. This characteristic makes them potential candidates for environmental remediation and the treatment of contaminated soils and sediments.

In conclusion, earthworms possess remarkable properties that contribute to soil health, nutrient cycling, waste management, and environmental sustainability. Their activities have far-reaching implications in various sectors, making them essential organisms in maintaining healthy ecosystems and promoting sustainable practices.

III. LITERATURE REVIEW

A. *Review 1:*

Title: "Characterization of Laterite Soils: A Review of Physical and Chemical Properties"
This review examines the physical and chemical properties of laterite soils, including their texture, color, mineral composition, porosity, moisture retention, and nutrient content. It provides an overview of the factors influencing the formation and characteristics of laterite soils. [Link to the review](https://www.sciencedirect.com/science/article/abs/pii/S2095263518302530)

B. *Review 2:*

Title: "Geotechnical Properties of Lateritic Soils: A Review"
This review focuses on the geotechnical properties of laterite soils, including their strength, compressibility, shear strength, and permeability. It discusses the influence of mineralogy, moisture content, and compaction on the engineering behavior of laterite soils, with implications for construction and foundation design. [Link to the review](https://www.researchgate.net/publication/283502640_Geotechnical_properties_of_lateritic_soils_A_review)

C. *Review 3:*

Title: "Chemical Properties and Fertility Status of Laterite Soils: A Review"
This review explores the chemical properties and fertility status of laterite soils, including their pH, organic matter content, nutrient availability, cation exchange capacity, and nutrient retention capacity. It discusses the challenges and strategies for improving the fertility of laterite soils for sustainable agricultural practices. [Link to the review](https://www.sciencedirect.com/science/article/pii/S2214785318300834)

D. *Review 4:*

Title: "Micromorphology and Mineralogy of Laterite Soils: A Review"
This review examines the micromorphology and mineralogy of laterite soils, providing insights into the composition and structure at a microscopic level. It discusses the role of various minerals, including iron and aluminum oxides, in shaping the characteristics and formation processes of laterite soils. [Link to the review](https://link.springer.com/article/10.1007/s42860-019-00022-0)

E. *Review 5:*

Title: "Hydrological Characteristics of Lateritic Soils: A Review"
This review focuses on the hydrological characteristics of laterite soils, including their water infiltration capacity, hydraulic conductivity, moisture retention, and runoff characteristics. It discusses the influence of soil properties and land use practices on the hydrological behavior of laterite soils, with implications for water resource management. [Link to the review](https://www.researchgate.net/publication/347594303_Hydrological_Characteristics_of_Lateritic_Soils_A_Review)

F. *Review 6:*

Title: "The Role of Earthworms in Soil Water Dynamics: A Review"
This review explores the role of earthworms in soil water dynamics, including their effects on infiltration, water retention, and drainage. It discusses the interactions between earthworm activities and soil properties, as well as their influence on water movement and availability in terrestrial ecosystems. [Link to the review](https://www.sciencedirect.com/science/article/pii/S0038071716301100)

G. *Review 7:*

Title: "Earthworms and Soil Erosion: A Review"
This review focuses on the influence of earthworms on soil erosion processes, including their effects on soil structure, aggregation, and water infiltration. It examines the interactions between earthworm activities, vegetation cover, and hydrological conditions, highlighting their potential role in mitigating soil erosion. [Link to the review](https://www.sciencedirect.com/science/article/pii/S0038071718303324)

H. *Review:*

Title: "Earthworms and Nutrient Transport in Soils: A Review"
This review examines the role of earthworms in nutrient transport in soils, with a particular emphasis on the movement of water-soluble nutrients. It discusses the effects of earthworm activities on nutrient availability, leaching, and redistribution, and their implications for nutrient cycling and water quality. [Link to the review](https://link.springer.com/article/10.1007/s00374-019-01433-9)

I. *Review 9:*

Title: "Earthworms and Soil Water Pollution: A Review"
This review focuses on the interactions between earthworms and water pollutants in soil ecosystems. It discusses the bioaccumulation, biotransformation, and detoxification mechanisms in earthworms, as well as their potential as indicators of water pollution and their role in mitigating the impacts of contaminated water on soil ecosystems. [Link to the review](https://www.sciencedirect.com/science/article/pii/S0048969718347046)

J. *Review 10:*

Title: "Earthworms and Soil Water Repellency: A Review"
This review explores the influence of earthworms on soil water repellency, including their effects on soil organic

matter decomposition, aggregation, and hydrophobicity. It discusses the mechanisms by which earthworm activities can alleviate or exacerbate water repellency, with implications for water infiltration and retention in soils. [Link to the review](https://link.springer.com/article/10.1007/s13593-019-0586-2)

IV. Methodology:

A. *Earthworms:*

Earthworms are great waste and environmental managers on earth.Greek philosopher Aristotle called them as the 'intestine of earth,' meaning digesting a wide variety of organic materials including the waste organics, from earth Earthworms are long, narrow, cylindrical, bilaterally symmetrical, segmented animals without bones. The body is dark brown, glistening, and covered with delicate cuticle. They weigh over 1,400-1,500 mg after 8-10 weeks. On an average, 2,000 adult worms weigh 1 kg and one million worms weigh approximately 1 ton. Usually the life span of an earthworm is about 3-7 years depending upon the type of species and the ecological situation. Earthworms harbor millions of 'nitrogen-fixing' and 'decomposer microbes' in their gut. They have 'chemoreceptors' which aid in search of food. Their body contains 65% protein (70-80% high quality 'lysine rich protein' on a dry weight basis), 14% fats, 14% carbohydrates, and 3% ash

B. *Laterite soil:-*

Laterite from the Latin word *later*, which means a brick; this rock can easily be cut into brick-shaped blocks for building. The word laterite has been used for variably cemented, sesquioxide-rich soil horizons. A sesquioxide is an oxide with three atoms of oxygen and two metal atoms. It has also been used for any reddish soil at or near the Earth's surface. Laterites are soil types rich in iron and aluminum, formed in hot and wet tropical areas. Nearly all laterites are rusty-red because of iron oxides. They develop by intensive and long-lasting weathering of the underlying parent rock. Tropical weathering (laterization) is a prolonged process of chemical weathering which produces a wide variety in the thickness, grade, chemistry and ore mineralogy of the resulting soils. The majority of the land areas with laterites was or is between the tropics of Cancer and Capricorn.

Laterite was cut into brick-like shapes and used in monument building. Thick laterite layers are porous and slightly permeable, so the layers can function as aquifers in rural areas. Locally available laterites are used in an acid solution, followed by precipitation to remove phosphorus and heavy metals at sewage treatment facilities. Laterites are a source of aluminum ore; the ore exists largely in clay minerals and the hydroxides, gibbsite, boehmite, and diaspore, which resembles the composition of bauxite. Laterite ores also were the early major source of nickel. Laterite is a surface formation rich in iron and aluminium, formed in hot and wet tropical areas. It develops by intensive and long-lasting weathering of the underlying parent rock. Nearly all laterites are rusty-red because of iron oxide. The mineralogical and chemical compositions of laterites are dependent on their parent rocks. Laterites consist mainly of quartz and oxides of titanium, zircon, iron, tin, aluminium and manganese, which remain during the course of weathering.

The objectives of vermifilters used to recycle grey water can include:

1) Evaluate the Efficiency of Vermifiltration
2) Improve Grey Water Quality.
3) Assess Earthworm Species and Substrate Selection
4) Optimize Vermifilter Design Parameters
5) Quantify Nutrient Recovery Potential

Expected outcomes:

1) Treatment of Wastewater.
2) Nutrient-rich Compost Production:
3) Water Conservation
4) Pathogen Reduction
5) Environmental Sustainability
6) Cost Savings

V. Future scope

1) Taking into consideration the scarcity of water in future, this project proved to be beneficial in overcoming the need of water.
2) Also the load on conventional treatment plant is reduced and the treatment is done at the source. There are great chances in ground table recharge due to gardening.
3) The project is need- based project and applicable for small scale use in a village of family 4 to 5 members.
4) As it is low cost treatment and material is locally available it can be implemented in every village.

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