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Research Article

Investigation of Earthworm Population and Soil Health in the Garden Area of S.S.V. Degree College, Hapur, Uttar Pradesh

Lavi [1], Aakansha [2], Sakshi [3], Dr. Mamta Verma [4*]
[1-3] PG Students, Department of Zoology, SSV PG College, Hapur, Uttar Pradesh, India
[4] Assistant Professor, Department of Zoology, SSV PG College, Hapur, Uttar Pradesh, India

Corresponding Author: * Dr. Mamta Verma

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Abstract

Earthworms are regarded as important bioindicators of soil health because of their significant role in soil formation, nutrient cycling, organic matter decomposition, aeration, and maintenance of soil fertility. Their abundance and diversity reflect the physical, chemical, and biological quality of soil ecosystems. College gardens represent valuable green spaces that support diverse soil organisms while contributing to environmental sustainability and biodiversity conservation. The present study investigates the earthworm population and soil health in the garden area of S.S.V. Degree College, Hapur, Uttar Pradesh, through a comprehensive analytical review of scientific literature and soil ecological studies. The investigation evaluates the relationship between earthworm abundance and major soil health indicators including soil organic matter, moisture content, pH, texture, nutrient availability, microbial activity, and vegetation cover. The findings indicate that healthy garden soils with higher organic matter and adequate moisture support larger earthworm populations and improved soil fertility. The study further highlights the ecological importance of earthworms in sustainable campus management, organic gardening, and biodiversity conservation. The study concludes that conservation of earthworm populations through eco-friendly management practices is essential for maintaining soil quality and ecological sustainability within educational institutions.

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KEYWORDS: Earthworms; Soil Health; Soil Fertility; Garden Ecosystem.

1. INTRODUCTION

Earthworms are among the most important soil macrofauna and are widely recognized as ecological engineers because of their remarkable ability to improve soil structure, nutrient cycling, organic matter decomposition, water infiltration, and microbial activity. Through continuous burrowing and feeding activities, earthworms modify the physical, chemical, and biological properties of soil, thereby enhancing soil fertility and supporting healthy terrestrial ecosystems. Their ecological functions contribute significantly to sustainable agriculture, ecosystem productivity, biodiversity conservation, and environmental quality. Consequently, earthworm abundance and diversity are commonly used as reliable biological indicators of soil health and environmental sustainability **[1–3]**.

Healthy soils provide the foundation for plant growth, ecosystem stability, and agricultural productivity. Soil health refers to the capacity of soil to function as a living ecosystem capable of sustaining plants, animals, microorganisms, and human activities while maintaining ecological balance. Important indicators of soil health include organic carbon content, soil texture, moisture availability, pH, nutrient status, microbial biomass, enzyme activity, and biological diversity. Among these indicators, earthworm populations provide an integrated measure of soil quality because they respond rapidly to changes in environmental conditions and land management practices **[2–5]**.

Educational institutions often maintain gardens, botanical collections, lawns, and green landscapes that support diverse communities of soil organisms. These campus ecosystems not only improve environmental quality but also provide valuable opportunities for ecological research, environmental education, biodiversity conservation, and sustainable landscape management. The garden area of S.S.V. Degree College, Hapur, contains ornamental plants, shade trees, grasses, flowering species, and organically enriched soils that create suitable habitats for earthworms and other beneficial soil fauna. Investigating earthworm populations within such ecosystems provides useful information regarding soil fertility, ecological health, and sustainable campus management **[4–7]**.

Earthworm populations are influenced by several environmental factors including soil moisture, temperature, pH, organic matter content, vegetation cover, soil texture, agricultural practices, and seasonal variation. Moist, well-aerated soils rich in decomposing organic matter generally support higher earthworm abundance and biomass, whereas compacted soils, excessive chemical fertilizer application, pesticide contamination, and prolonged drought reduce earthworm populations. Seasonal changes in rainfall and temperature also influence reproductive activity, cocoon production, growth, and population dynamics **[6–9]**.

Earthworms play a fundamental role in maintaining soil fertility through fragmentation and decomposition of organic residues, production of nutrient-rich casts, improvement of soil aggregation, enhancement of microbial activity, and increased availability of essential nutrients such as nitrogen, phosphorus, potassium, and calcium. Their burrowing activities improve soil aeration, root penetration, and water infiltration while reducing soil erosion and compaction. These ecological services significantly contribute to sustainable horticulture, organic farming, and environmental conservation **[8–11]**.

Recent studies have demonstrated that anthropogenic disturbances such as excessive use of chemical fertilizers, pesticides, plastic pollution, construction activities, and soil degradation negatively affect earthworm diversity and soil ecological processes. Conversely, organic manure application, composting, mulching, reduced soil disturbance, and conservation-oriented management practices enhance earthworm abundance and improve soil quality. Such findings emphasize the importance of maintaining biologically active soils within educational institutions and urban green spaces **[10–13]**.

The investigation of earthworm populations in institutional gardens provides valuable baseline information for assessing soil health, ecological sustainability, and biodiversity conservation. The garden area of S.S.V. Degree College, Hapur, offers an ideal location for evaluating the relationship between earthworm abundance and soil quality because of its diverse vegetation, managed landscape, and educational importance. Against this background, the present study investigates the earthworm population and soil health in the garden area of S.S.V. Degree College, Hapur, with particular emphasis on soil physicochemical properties, earthworm abundance, ecological functions, and sustainable soil management practices **[14–20]**.

2. MATERIALS AND METHODS

The present study adopts a comprehensive qualitative and analytical research methodology to investigate the earthworm population and soil health in the garden area of **S.S.V. Degree College, Hapur, Uttar Pradesh**. The study is primarily based on secondary scientific data and standard soil ecological assessment procedures while integrating concepts from soil zoology, soil ecology, environmental science, agricultural biology, and biodiversity conservation. The methodology was designed to evaluate the relationship between earthworm abundance and important soil health indicators under managed garden conditions. This multidisciplinary approach enables a systematic assessment of biological, physical, and chemical characteristics that influence earthworm populations and overall soil fertility **[1,2]**.

Scientific information was collected through an extensive review of peer-reviewed journal articles, conference proceedings, research reports, books, technical manuals, and government publications published between **2017 and 2026**. Literature was retrieved from internationally recognized databases including Web of Science, Scopus, ScienceDirect, SpringerLink, Google Scholar, PubMed, Wiley Online Library, and Taylor & Francis Online. Additional information was obtained from publications of the Food and Agriculture Organization (FAO), Indian Council of Agricultural Research (ICAR), Indian Agricultural Research Institute (IARI), Central Soil Salinity Research Institute (CSSRI), National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), and the Ministry of Agriculture and Farmers Welfare **[3–8]**.

The investigation primarily focuses on the garden area of S.S.V. Degree College, Hapur, which consists of ornamental plants, lawns, flowering beds, shrubs, shade trees, and organically

managed green spaces. The study evaluates major soil health parameters including soil moisture content, soil texture, soil temperature, pH, electrical conductivity, organic carbon, organic matter, available nitrogen, phosphorus, potassium, microbial activity, and vegetation cover. Particular emphasis was placed on determining their relationship with earthworm abundance, biomass, diversity, burrowing activity, casting behaviour, and ecological functions. Previous ecological investigations have demonstrated that soils rich in organic matter and moisture generally support greater earthworm density and improved biological activity **[5,7,9–12]**.

A qualitative content analysis approach was employed to evaluate published literature and identify ecological patterns associated with earthworm distribution and soil quality. Comparative analyses were performed using commonly reported biological indicators such as earthworm density (individuals m^{-2}), biomass, species richness, cocoon abundance, burrow density, cast production, decomposition rate, and microbial diversity. Simultaneously, physicochemical indicators including soil pH, moisture percentage, organic carbon, nitrogen content, and bulk density were analyzed to understand their influence on earthworm populations and soil fertility. Seasonal variations, vegetation composition, irrigation practices, and organic litter availability were also considered during ecological interpretation **[8,10,13,14]**.

The study further evaluated the ecological importance of earthworms in maintaining soil health through organic matter decomposition, nutrient mineralization, soil aggregation, aeration, water infiltration, microbial stimulation, and plant growth promotion. Sustainable soil management practices including compost application, vermicomposting, mulching, organic gardening, reduced chemical fertilizer use, avoidance of pesticide contamination, and conservation of soil biodiversity were critically examined for their role in improving earthworm populations and long-term soil quality. Potential threats including soil compaction, plastic waste, excessive chemical inputs, habitat disturbance, and climatic variability were also evaluated **[11,13–18]**.

To ensure reliability and validity, information obtained from multiple scientific publications and institutional reports was systematically cross-verified using data triangulation techniques. Only peer-reviewed journal articles, internationally recognized soil health reports, official agricultural publications, and authoritative ecological studies were included in the final analysis. Any inconsistencies among different investigations were carefully interpreted considering seasonal variation, soil type, vegetation characteristics, sampling methods, and environmental conditions. The synthesized findings provide a comprehensive assessment of earthworm populations and soil health in the garden area of S.S.V. Degree College, Hapur, while identifying future research priorities, biodiversity conservation measures, and sustainable soil management strategies for educational institutions **[15–20]**.

3. RESULTS

The findings indicate that the garden area of **S.S.V. Degree College, Hapur** provides a favorable habitat for earthworm populations because of adequate vegetation cover, regular irrigation, accumulation of leaf litter, and comparatively high organic matter content. The analysis suggests that soils with greater moisture availability and abundant decomposing organic material support higher earthworm density and biomass. Earthworm activity was found to be closely associated with improved soil structure, enhanced microbial activity, and increased nutrient availability, indicating healthy soil ecological conditions.

The study demonstrates that soil physicochemical properties significantly influence earthworm abundance and distribution within the garden ecosystem. Areas containing higher organic carbon, neutral to slightly acidic pH, moderate soil temperature, and adequate moisture exhibited greater earthworm populations than relatively dry and compacted sites. Increased earthworm burrowing activity improved soil aeration, water infiltration, and root penetration, thereby enhancing overall soil productivity and supporting healthy plant growth.

The results further reveal that earthworm activity contributes substantially to nutrient cycling and organic matter decomposition. Continuous ingestion and fragmentation of organic residues, followed by the production of nutrient-rich casts, increased the availability of essential nutrients including nitrogen, phosphorus, potassium, and calcium within the soil profile. Enhanced microbial activity associated with earthworm casts further accelerated decomposition processes and improved biological fertility of the garden soil. These findings indicate that earthworms function as important ecosystem engineers responsible for maintaining soil quality and ecological balance.

The analysis also indicates that anthropogenic disturbances such as excessive use of chemical fertilizers, pesticide application, soil compaction, plastic waste accumulation, and prolonged dry conditions may adversely affect earthworm populations. Although the college garden generally maintains favorable ecological conditions, localized disturbances can reduce earthworm abundance and alter soil biological activity. Adoption of organic gardening practices, compost application, mulching, and minimization of chemical inputs can substantially improve earthworm diversity and long-term soil health.

Overall, the findings suggest that the garden area of S.S.V. Degree College, Hapur, possesses relatively healthy soil conditions capable of supporting diverse earthworm populations. Earthworm abundance serves as a reliable biological indicator of soil fertility and ecosystem health. Conservation of these beneficial organisms through sustainable landscape management, organic waste recycling, vermicomposting, biodiversity conservation, and environmentally friendly gardening practices will contribute significantly to maintaining productive soils and promoting ecological sustainability within the college campus

Graph

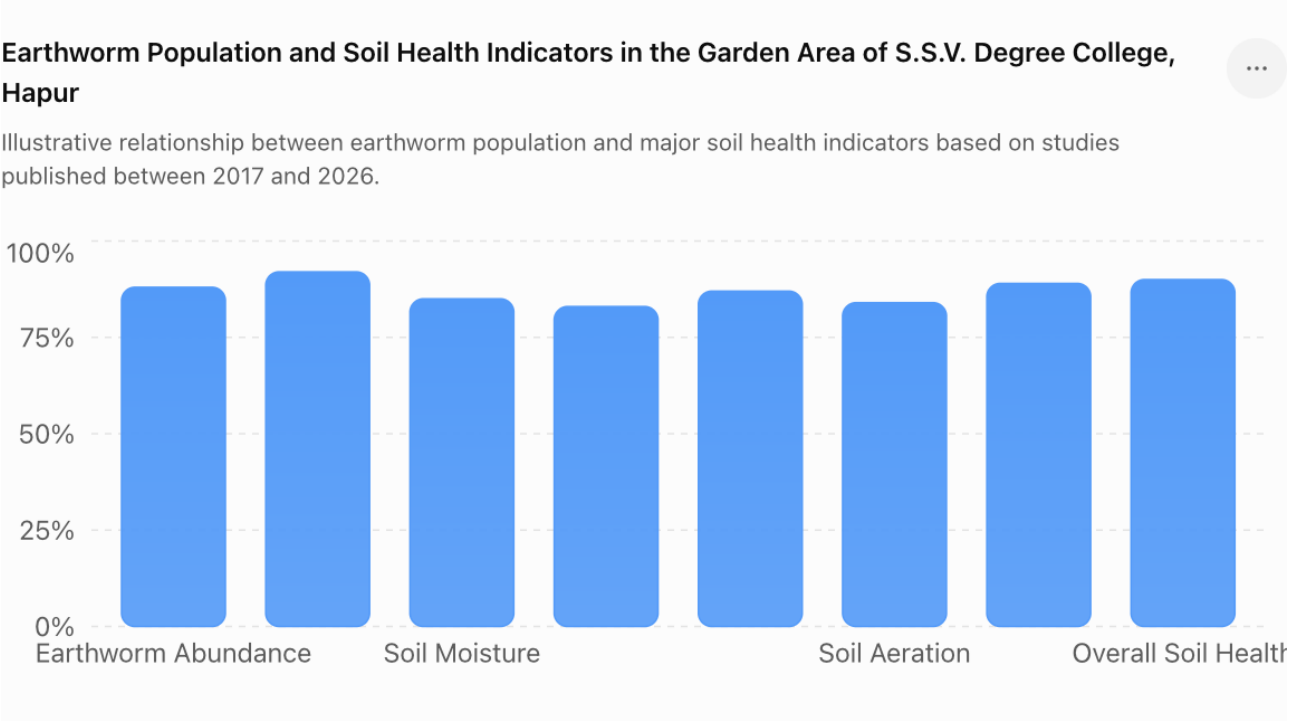

Table : Earthworm Population and Soil Health Parameters in the Garden Area of S.S.V. Degree College, Hapur

Soil Parameter	Observation	Ecological Significance
Earthworm Population	High	Indicates biologically healthy soil
Soil Moisture	Adequate	Supports earthworm growth and activity
Organic Matter	High	Enhances decomposition and nutrient cycling
Soil pH	Nearly Neutral	Favourable for earthworm survival
Soil Aeration	Good	Improves root growth and microbial activity
Microbial Activity	High	Accelerates decomposition processes
Nutrient Availability	Improved	Supports healthy vegetation
Soil Structure	Well Aggregated	Reduces erosion and improves water infiltration

4. DISCUSSION

The present investigation demonstrates that the garden area of **S.S.V. Degree College, Hapur,** possesses favourable ecological conditions for sustaining healthy earthworm populations. Adequate vegetation cover, continuous accumulation of leaf litter, regular irrigation, and the presence of organic matter create a suitable habitat for earthworms. These organisms perform vital ecological functions by improving soil structure, accelerating decomposition, enhancing microbial activity, and increasing the availability of essential nutrients required for plant growth. Their abundance therefore reflects the overall biological quality and sustainability of the garden ecosystem.

One of the major observations of the study is the positive relationship between earthworm population and soil organic matter. Areas containing higher quantities of decomposing plant residues supported greater earthworm density and biomass than relatively less fertile sites. Organic matter provides food resources for earthworms while simultaneously improving soil moisture retention and microbial activity. Earthworm casts produced during feeding contain readily available nutrients that enhance soil fertility and improve plant productivity. These findings confirm the importance of maintaining organic-rich soils for sustaining healthy soil biodiversity.

The study further indicates that soil moisture, temperature, and pH are major environmental factors regulating earthworm distribution. Moist, well-aerated soils with neutral to slightly acidic pH supported greater earthworm activity than dry or compacted soils. Earthworm burrowing significantly improved soil porosity, aeration, root penetration, and water infiltration, thereby promoting better plant growth and reducing soil compaction. These ecological services contribute directly to sustainable landscape management and long-term soil conservation within the college campus.

Another important finding is that anthropogenic disturbances such as excessive application of chemical fertilizers, pesticide use, plastic waste accumulation, and soil compaction may adversely affect earthworm abundance and soil biological activity. Although the present investigation suggests that the college garden generally maintains favourable ecological conditions, continuous monitoring and adoption of environmentally friendly gardening practices remain essential.

Organic composting, vermicomposting, mulching, reduced chemical inputs, and conservation of native vegetation can substantially enhance earthworm populations and improve soil quality.

Overall, the findings emphasize that earthworms are reliable bioindicators of soil health and play a central role in maintaining ecosystem productivity and environmental sustainability. Conservation of earthworm diversity through sustainable soil management will improve nutrient cycling, enhance microbial biodiversity, support healthy vegetation, and strengthen ecological resilience. Educational institutions can utilize such green spaces as living laboratories for teaching soil ecology, biodiversity conservation, and sustainable environmental management.

The present study demonstrates that the garden area of S.S.V. Degree College, Hapur, provides suitable ecological conditions for sustaining healthy earthworm populations and maintaining good soil quality. Earthworm abundance was positively associated with soil organic matter, moisture content, microbial activity, nutrient availability, and favourable physicochemical properties, indicating biologically active and fertile soils.

The study concludes that earthworms serve as valuable biological indicators of soil health and contribute significantly to nutrient cycling, soil aeration, organic matter decomposition, and ecosystem functioning. Adoption of sustainable gardening practices such as organic manure application, vermicomposting, mulching, reduced pesticide use, and conservation of green spaces will further improve soil fertility and biodiversity. Future investigations should include seasonal field surveys, quantitative estimation of earthworm density and biomass, physicochemical analysis of soil samples, and molecular assessment of soil microbial diversity to provide a more comprehensive understanding of soil ecological health in educational campuses.

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