BHARATI INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH & DEVELOPMENT (BIJMRD)

(Open Access Peer-Reviewed International Journal)

DOI Link : https://doi.org/10.70798/Bijmrd/04010011

Available Online: www.bijmrd.com | BIJMRD Volume: 4 | Issue: 01 | January 2026 | e-ISSN: 2584-1890

Insight into the Effects of Microbes on Environmental Health and Developments of Research in Environmental Health: A Mini-Review

Satabdi Acharya[1], Sunirmal Sheet[2] & Tarun Sasmal[3]

1. Department of Molecular Biology, Jeonbuk National University, Deokjin-gu, Jeonju-si, Jeollabuk-do, Republic of Korea
2. Animal Genome & Bioinformatics, National Institute of Animal Science, RDA, Wanju, South Korea
3. Corresponding Author, Department of Geography, Assistant Professor, Malda Women's College, West Bengal, India
Email: sasmal.geo@gmail.com

Abstract:

Environmental health is a science where it looks for the facts about biological systems which are associated to human health and wellbeing. The microbial community and biotechnology research have been considered as fundamental component of environmental health system. Therefore, the review deals with positive impact of microbes in environment applications such as contribution nutrient cycling, recycling wastes and detoxification, enzymes in bioremediation, food web maintenance and their diversification. Furthermore, a brief highlight has been given on the advancement of research in microbial biotechnology (bio-medical) on environmental health. In conclusion, the present information will help to understand the contribution of microbial factors to environmental health.

Keywords: *Environmental Health, Micro-Organism, Biotechnology, Gene Sequences, Food Web.*

Introduction:

Environmental health defines a broad subject area that includes everything social, chemical, biological, physical and psychosocial factors in environments. Environmental health pursues the knowledge of understanding about the interactions between environmental factors and biological systems. Moreover, Environmental health also addresses all facts of the extensive environment factors that may influence human health. Therefore assessment of environmental health is crucial for rigorous multidisciplinary strategies for understanding and solving environmentally effected health consequences. Several intrinsic and extrinsic features of environment can influence on our health. Table 1.

Environmental factors effects the Environmental Health		
Environmental factors		
Chemical	**Physical**	**Biological**
Antibiotics	Electromagnetic Fields	Harmful Algal Blooms
Disinfection by-products	Noise	Microorganisms
E-waste	Particular Matter	Zoonoses
Gases	Radiation	
Halogenated Hydrocarbons	Ultraviolet Light	
Metals & Trace Elements		
Nanoparticles		
Persistence Organic Pollutants		
Pesticides		
Petrols		
Pharmaceutical & Personal Care Products		
Solid Waste		

Table 1: Environmental factors effects the Environmental Health

Source: Smith, 2013

The environmental factors have been reported to contribute to a probable 23 % of all deaths in 2002 worldwide [Pruss-Ustun et al., 2006]. An important environmental factor such as biological factor is encounter in wide rages of work place. There are various types of biological agents which causes different type of health effects in terms of disease. The microbial community has been considering as important agent which has an important role in environment where they grow. It further affects the environmental health. The purpose of the mini review is to emphasize the importance of microbial community in environmental health as well as the advancement in research of bio-technology.

Classification of Microbes:

The extensive verities of microbes present in our biosphere can be classified depending upon their physical and other characteristics [Gupta et al., 2017]. Microbes are divided into two groups, prokaryotes and eukaryotes, based on whether they have nucleus or not. Prokaryotes defines that they are having lack of membrane around their genetic material, and this group includes viruses, bacteria, and related archaea. The other category of microbes includes algae, fungi, protists, and other microscopic animals, having cell nucleus [Gupta et al., 2017]. In 1980, Norman Pace and colleagues observed that non-culturable microbes can be identified through PCR amplification technique. They suggested that it needs the amplification of the rRNA genes of microbes using rRNA specific primers and total RNA isolated directly from the microbial cells present in environment [Hugenholtz et al., 1998]. The genetic diversity of organisms in a particular

community can be estimated by comparing the rRNA sequence using different online databases like GenBank, Blast; where it shows the evolutionary (phylogenetic) relationships among various unknown and known organisms. The organism's characteristics could be speculated from its closest cultivated relative on the basis of sequencing details [Apostolidis et al., 2001]. The classification microbial community is given in Table 2.

Table 2. Classification of microbial communities based on 16S and 18S rRNA gene sequences

Microbial Diversity		
Various microbial communities at levels of different domain		
Bacteria	**Archaea**	**Eucaryota**
Green filamentous bacteria	Halophiles	Entamoebae
Gram positives	Methanosarcina	Slim molds
Spirochetes	Methanobacterium	Animals
Proteobacteria	Methanococcus	Fungi
Cyanobacteria	*T. celer*	Plants
Planctomyces	Thermoproteus	Ciliates
Bacteroides Cytophaga	Pyrodicticum	Flagellates
Thermotoga		Trichomonads
Aquifex		Microsporidia
		Diplomonads

Contribution of Microbes to environment

Microbes are microscopic small creatures present everywhere in the biosphere. Microbes are the backbones of all ecosystems exist in environment. Different microbial habitats produce a vast diversity of biogeochemical and metabolic traits that have ascended by genetic deviation and natural selection in microbial populations. The beneficial impact of microorganism on their environment has been discussed in this review. The uniqueness of microorganisms makes them use for social, economic, and environmental benefits. The dynamic role played by microbes behind the sustainability of our planet can be ignorable. There are different application aspects of micro-organism in sustainable environment which is associated to human health (Table 3). Among the numerous beneficial roles of microbes, the nutrient cycling, recycling wastes and detoxification enzymes in bioremediation and food web maintenance have been highlighted.

In an ecosystem, microorganism plays a crucial role in recycling nutrients through biogeochemical systems. The important combined metabolic processes of microorganisms (including carbon fixation, methane metabolism, nitrogen fixation, and sulfur metabolism) efficiently regulate global biogeochemical cycling. For example, photosynthesis relay on the activity of microorganisms such as cyanobacteria. A cyanobacterium, also known as blue-green algae, and Cyanophyta, belongs to phylum of bacteria that

acquire their energy via photosynthesis process [Tanner, 1985]. Moreover, microbes can be able to remove or neutralize hazardous substances by secreting various enzymes; therefore, microbial processes are commonly used for biodegradation, and metal detoxification collectively known as bioremediation. Flavobacterium, Arthrobacterium, and Azotobacter microorganisms are widely used for bioremediation purpose. Microorganisms make their own food by breaking down dead organisms and waste materials into nutrients usable called primary producers. They are the always at the base of the food web.

Table 3. Microbial application to environment health.

Contribution of Microbes to Environment			
Nutrient Cycling	Recycling Wastes and Detoxification	Enzymes in Bioremediation	Food Web Maintenance
Carbon Cycle Methane Production Nitrogen Cycle Phosphorus Cycle	Biodegradation Metal detoxofication	Protease Cellulases Lipases Hydrolases Peroxidase Laccases Oxygenases Oxidoreductases	Interaction between different species in ecosystem

Biotechnology Research Advances and environmental health

The advancement in biotechnological research has had major effect on the perception of biomedical research associated to environment health and society [Tchounwou et al., 2011]. The biomedical research has introduced new technology like DNA microarray, transcriptomic technology which can provide us the insight of gene expression at the RNA level. These genomic, transcriptomic, and proteomic innovative approaches has given us a structure about how the human biology works at cellular and molecular level [Tchounwou et al., 2011]. Further, understanding the mechanisms behind the dysregulation of functional networks by environmental agents, and the biochemical processes associated with human diseases and environmental exposures is now possible due to these pioneering methods [Kupriyanov et al., 2010]. They are also assisting in developing novel therapeutic, diagnostic, and prognostic agents, and to formulate personalized medicine by disclosing the complex relationships among genes, gene products, and cellular and biological functions [Tchounwou et al., 2011].

In addition, with the scientific advances in biotechnology, specifically the areas like proteomics, metabonomics, genomics, and transcriptomics, environmental biotechnologists are capable of using microorganisms for prosperity of service to environment and human health [Mosttafiz et al., 2012]. For example, they can be useful in various terms like capturing renewable energy from biomass; sensing contaminants or pathogens; decontaminating contaminated water, wastewater, sludge, sediment, or soil; and protecting the public from dangerous exposure to pathogens.

Conclusion:

In conclusion, this mini review was assembled to focus on environmental health and microbial biotechnology, but essentially includes a different collection of complimentary areas. It emphasizes the microbes play an important role behind our environmental sustainability. It provides the knowledge about development of biotechnological technique. Independently or cooperatively, it is hoped that this review will facilitate understanding and efforts aimed at improving environmental health.

Acknowledgements

Not applicable

Funding

Not applicable

Competing interests

The authors declare that they have no competing interests.

References:

- Philip S, Environmental Health. References Module in Earth Systems and Environmental Sciences; 2013 Aug; doi:10.1016/B978-0-12-409548-9.05919-4.
- Pruss-Ustun A, Corvalán CF, World Health Organization. Preventing disease through healthy environments: towards an estimate of the environmental burden of disease. World Health Organization; 2006.
- English PB, Sinclair AH, Ross Z, Anderson H, Boothe V, Davis C, Ebi K, Kagey B, Malecki K, Shultz R, Simms E. Environmental health indicators of climate change for the United States: findings from the State Environmental Health Indicator Collaborative. Environmental Health Perspectives. 2009 Nov;117(11):1673-81.
- Gupta A, Gupta R, Singh RL. Microbes and environment. InPrinciples and applications of environmental biotechnology for a sustainable future 2017 (pp. 43-84). Springer, Singapore.
- Hugenholtz P, Goebel BM, Pace NR. Impact of culture-independent studies on the emerging phylogenetic view of bacterial diversity. Journal of bacteriology. 1998 Sep 15;180(18):4765-74.
- Mosttafiz S, Rahman M, Rahman M. Biotechnology: role of microbes in sustainable agriculture and environmental health. The Internet Journal of Microbiology. 2012;10(1):1-6.
- Tchounwou PB, Ndebele K. Biotechnology and Advances Environmental Health Research. 2011; 403-413.
- Kupriyanov AA, Semenov AM, Van Bruggen AH. Transition of entheropathogenic and saprotrophic bacteria in the niche cycle: Animals-excrement-soil-plants-animals. Biology bulletin. 2010 Jun 1;37(3):263-7.

- Apostolidis AP, Mamuris Z, Triantaphyllidis C. Phylogenetic relationships among four species of Mullidae (Perciformes) inferred from DNA sequences of mitochondrial cytochrome b and 16S rRNA genes. Biochemical systematics and ecology. 2001 Oct 1;29(9):901-9.
- Tanner AC. The role of bacteria in the cycling of nutrients within the maritime Antarctic environment. InAntarctic Nutrient Cycles and Food Webs 1985 (pp. 123-127). Springer, Berlin, Heidelberg.

Citation: **Acharya. S., Sheet. S. & Sasmal. T.,** (2026) "Insight into the Effects of Microbes on Environmental Health and Developments of Research in Environmental Health: A Mini-Review", *Bharati International Journal of Multidisciplinary Research & Development (BIJMRD)*, Vol-4, Issue-01, January-2026.