# Chapter 14
# Contribution of Earthworm to Bioremediation as a Living Machine:
## Bioremediation

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## ABSTRACT

*The literature regarding the benefits of earthworms is fairly ancient. Aristotle, the Greek philosopher, referred to them as 'intestines of earth' because of their habit of ingesting and ejecting the soil. In the subtropical regions of Egypt and India, the success of the ancient civilization of the Nile and the Indus Valley was partly due to the fertile soils created by the activity of the earthworms and by the continual renewal of the land by the alluvium process. During the Cleopatra era (69-30 BC), the earthworm was declared a sacred animal in the ancient Egypt. Later Darwin remarked the earthworms have played more roles throughout the history of the world than any other animal. Besides to contribute in physical structure and nutritive value of the soil by burrowing and feeding they can also be a potential pollution hazard. They are useful tool in environment monitoring and are good indicators of condition of soils. This chapter reviews soil contamination that influences earthworms and how they cope-up in contaminated environment.*

## INTRODUCTION

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DOI: 10.4018/978-1-5225-2325-3.ch014

more roles throughout the history of the world than any other animal. Besides to contribute in physical structure and nutritive value of the soil by burrowing and feeding they can also be a potential pollution hazard. Earthworms (Annelida: Oligochaeta) ranges in length from 2 centimeters to over 2 meters, and found in boreal to tropical, sea level to 5000 meters elevation, semi-arid to extremely humid, aerobic to nearly anoxic and even aquatic. Some are predatory but majority feed on forms of organic matter in or above soil (Yadav, 2016a). Beyer (1981) have reported that earthworms can take up and accumulate heavy metals such as cadmium, mercury and gold in their tissues, when living both in non-contaminated and contaminated environment (Helmkeet al., 1979). They have potential to bioremediate soils by reducing the pollutants concentration through a bioaccumulation mechanism within the body of earthworm and the chemical changes in their alimentary tract that may render various metals more available to plants (Oberdoster et al., 2005).

As earthworms occupy major invertebrate biomass (>80%) in terrestrial ecosystem and have over 600 million years of experience as environmental managers in the ecosystem as 'waste managers' as 'soil managers', 'fertility improvers' and 'plant growth promoters' for long time (Sinha et al., 2010). But relatively new discoveries about their role in bioremediation or detoxification mechanism of industrial wastes, chemically contaminated soil, dairy industry waste material, and detergent industries have revolutionized the understanding of functioning of this unheralded soldier of mankind. Earthworms are the consumers of many detritus food chains while, carnivorous animals (depends on their assimilation efficiency), may accumulates these toxicants by preying on contaminated earthworms. The digestive system of earthworms is capable of detaching heavy metal ions from the complex aggregates between ions and humic substances (Dominguez et al., 2005. Various enzyme- driven processes seem to lead assimilation of the metal ions by the worms so they are locked up in organisms 'tissues rather than released back to soil (Yadav 2016a). Mineralization of dead earthworms' releases less toxic form of metals –accumulated metals in the environment. Chemical changes in alimentary tract of earthworms may render various metals more available to plants, and mineralization of dead earthworms' releases metals–accumulated, metals in the environment. They have also been reported to host microbes in their gut which can biodegrade chemicals (Edwards &Bohlen, 1996). They can tolerate high environmental concentrations of toxic heavy metals anddo not absorb metal, accumulate it in a non-toxic form or excrete it efficiently (Ireland, 1979). Yet, the mechanism of detoxification in earthworms is poorly understood. It varies with the metals concerned, but metal accumulation moderately high levels reasonably short periods may appears to have little deleterious effects on their biomass or growth. Long-term sub lethal concentrations of heavy metals may reduce their fecundity.

## ENVIRONMENTAL BENEFIT OF EARTHWORM

Soil biodiversity has both direct (the organisms themselves and/or their metabolic products) and indirect (the long-term outcome of their activities) benefit on the economy basis. It is estimated that the value of ecosystem services provided each year by soil biota in agricultural systems worldwide (e.g., organic waste disposal, soil formation, $N_2$ fixation, bioremediation and biocontrol) may exceed US$1.5 trillion (by AGL/FAO as modified from Pimentel et al., 1997). Earthworms are the main governors of soil biology and as such they rightly deserve special attention for without them the soil diversity is poor and the soil-food-web interactions may be weak. Earthworms are ubiquitous in soils capable of supporting higher plants. They are found only in refugee in arid and frozen regions, but in most other terrestrial

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