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The Role of Sustainable Remediation in the Preservation of Biodiversity: Areas of Opportunities

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Introduction

Biodiversity is defined as the concentration and variety of plant and animal life forms on earth [1]. According to Emani [2], "it is a vital corner stone for both the survival and welfare of our existence". This is so because biodiversity provides an array of ecosystem services such as production of oxygen, sequestration of carbon, fixing of nutrients (nitrogen and phosphorus), purification of air and water, stabilization of soil, and provision of biomass for food and energy. Biodiversity also supplies cultural benefits such as locations for recreation or aesthetic appreciation, societal feast, religious and ceremonial events. Moreover, biodiversity has economic value such as provision of food, fuel, fibers, pharmaceutical and building materials. All these serve as a source of income for those that harvest them [1]. In other words, biodiversity has ecological, economic and sociocultural benefits.

Biodiversity and Human Economic Activities

Although there is recognition that biodiversity has many benefits but our developmental attitude to biodiversity preservation does not match the attached value of biodiversity. Our economic activities involving infrastructural development and various industrial activities have caused losses of biodiversity in various places all over the world. Some of the human activities that cause much damage to the biodiversity include land clearing for transport infrastructure such as roads and railways as well as dredging for waterways. Others include logging and construction activities. These activities disrupt the food web and causes ecosystem imbalance. Many industrial activities such as oil exploration and refining as well as chemical manufacturing also cause environmental contamination. For instance, open pit mining of oil sand strips the soil of vegetation and topsoil thereby destroying important habitats and impoverishing geographical areas in question. Moreover, these industrial activities also generate toxic wastes in the form of solid waste, effluents and air emissions. Furthermore, they also cause spillages on land and in aquatic environment. Consequently such environmental releases and spills have caused losses of several important species and reduction in biodiversity in many places all over the world, especially where there are intensive oil exploration, mining, logging and construction activities.

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Increasing awareness of these losses and environmental consciousness spurred development of regulations by governments in various countries and regions that industry must remediate contaminated soil and water to their original state. This resulted in the development and use of remediation techniques, many of which simply transfer pollutants from one medium to another rather than neutralizing the contaminant.

Close examination of the "so-called" remediation techniques such as "dig and haul", "pump and treat", "air sparging", "capping", and many others revealed that they make high demand on the environment. Some of the impacts of such techniques include high resource consumption, environmental releases like greenhouse gases, transferring contamination to another medium and low technical efficiency. In other words they create problems where there was no problem. Consequently there is a need for a new approach to remediation.

Sustainable Remediation

The new remediation approach would have to technically eliminate the contamination at a reasonable cost without disrupting the way of life or comfort of people in the vicinity of where the remediation project is taking place. In addition, the resource consumption of the remediation technique employed must be comparatively lower than the conventional ones. This is where the concept of sustainable remediation comes in. Therefore, sustainable remediation is the remediation practice that simultaneously considers technical, environmental, economic and socio-cultural impacts of contaminants removal, reduction or neutralization at every stage of the process in order to maximize the net benefit of a clean-up. It is different from green remediation which considers only ecological issues in remediation. A remediation system may be ecologically sound but economically and socio-culturally unsustainable.

Potential Roles of Sustainable Remediation in the Preservation of Biodiversity

Neutralization of contaminants, resource use minimization, and minimum disruption of human and ecosystem welfare are among the main goals of sustainable remediation. Sustainable remediation therefore relieves species, habitats and ecosystems from stresses induced by contaminants and disruptive remediation processes. Consequently, such remediation approach would result in food web preservation and save some species from unfair competition and extinction.

Areas of Potential Opportunities

The concept of sustainable remediation is still new and unfamiliar to many researchers, practitioners, and policymakers. There are many areas of research that are yet to be explored. The initial concept of sustainable remediation was presented by the author at the Remediation Technology Symposium in Banff, Alberta Canada in the Fall of 2004 [3]. Subsequently, the Council of Sustainable Remediation Technology Initiative (SRTI) was formed in March 2005 to articulate the criteria and indicators of sustainable remediation. The SRTI group

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consists of environmental professionals, regulators at municipal and provincial level, and environmental professionals from oil and gas as well as the manufacturing industry. SRTI produced the first reviewed report on criteria and indicators of sustainable remediation in 2007. The report consists of sixteen indicators grouped into four criteria. Presentations on sustainable remediation were made by the group at Canadian Brownfield Network in 2008 and 2009 [4]. Research on the decision framework for the use of sustainable remediation was also carried out by the author. Progress on criteria and indicators of sustainable remediation as well as the associated decision framework was presented by the author at the 2010 CIGR International conference in Quebec, Canada [5,6].

Another group in UK called Sustainable Remediation Forum (SURF) started their work on sustainable remediation in 2007. SURF UK developed a framework document on why sustainability issues associated with remediation needs to be factored in right from the outset of a project. It also identifies opportunities for considering sustainability at a number of key points in a site's redevelopment or risk management process [7]. Soon after that, a number of affiliates of SURF UK sprang up in US, Australia, and Canada. The groups have produced white papers and made presentations at various conferences.

Although the involvement of some corporate organizations' employees has made those organizations to think of adopting sustainable remediation, clear evidences are yet to emerge on their developing and using sustainable remediation technologies. A number of gaps have to be filled before this can be achieved. The following are some of the identified areas where more efforts are needed with regard to sustainable remediation propagation and on the role of sustainable remediation in the preservation of biodiversity:

- Creation of more awareness about sustainable remediation,
- Development of sustainable remediation techniques
- Evaluation of sustainability profile of current and emerging remediation technologies,
- Development of sustainable remediation policies and their incorporation into remediation practices,
- Research on the sustainable remediation impacts on biodiversity, and
- Development of metrics for assessing progressive changes in sustainable remediation practices and biodiversity

Filling these gaps will lead to a better understanding of sustainable remediation and its role in the preservation of biodiversity. On a long run, when many practitioners and policy makers imbibe the doctrine of sustainable remediation, there would be a high reduction in loss of biodiversity and preservation of our all important ecosystems from destruction.

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