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Impacts of tsunami on environment along the Indian coastlines: A comprehensive assessment

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ABSTRACT

An attempt is made to study the trends in research focusing mainly on the post-tsunami effects on the environment and their mitigation strategies thereof. These impacts are associated with both natural as well as anthropogenic aspects of the environment. Very few literatures are available online on the impacts on the physical or biological parameters of the environment over the Indian coast and there are very few baselines which are defined for environmental assessments. Assessment of the key impacts on the environment due to tsunami are found to be intrusion of salt water which may pose threats to the soil, vegetation, and salinization of freshwater resources. Solid waste and disaster debris (hazardous materials and toxic substances) are also the utmost critical environmental issue. There are many post-tsunami anthropogenic threats also, such as coastal pollution, excess resource use, erosion of beaches and changes in landscapes. The aim of the study is to bring out to the understanding of impacts on the environment that have not been reported sufficiently in the existing literature, hence it is needed to study specifically. Also trying to find out ways that might be useful for rehabilitation of coastal environmental habitats. To quantify such environmental impacts, there is a need for a more pronounced understanding of impacts of the tsunami on the coastal belts. A better understanding of such environmental impacts is very crucial in defining coastal environmental management and further mitigation plans.

Keywords: Tsunami, Indian coasts, Environmental impacts, Mitigation strategies, Earthquake.

INTRODUCTION

Several observations have been reported on the impacts of the tsunami on the environment in many research studies. Tsunamis are a severe threat to coastal environment, even though they do not occur very frequently and mostly with little or no damage. But, the areas closest to the tsunami's origin, typically experience the most extensive destruction and loss of life. Flooding, wave impacts, erosion, powerful currents, and floating debris (e.g., automobiles, trees, structures, etc.) causes majority of the damage and the destruction. Those impacts are associated with both natural and anthropogenic aspects of the environment. Some of these impacts are loss of life, property damage, and biodiversity loss, as well as potential environmental risks such as seawater flooding into the land causing salinization issues in soil and fresh water resources, sediment deposition, and salt injuries to crops. Large-scale damage to infrastructure (houses and industrial sites), buildings, electric poles, towers, and roads etc. have been reported by UNEP (2005).

An earthquake that occurred on December 26, 2004, led to the deadliest tsunami ever recorded. According to the moment magnitude scale, the earthquake's magnitude was 9.3. During last few decades, many studies have been done to understand the impact of tsunamigenic earthquake along different coastal belts namely Iran, western coast of India, Sultanate of Oman and Makran coast of Pakistan etc. Generally, tsunamis do not arrive as ocean waves but rather as a huge, powerful and rapid rise in water levels that leads to an intense flooding (Shukla et al., 2010; Singh et al., 2012). The impacts of a tsunami on a shoreline might range from insignificant to catastrophic. Some of these impacts after the Indian Ocean tsunami (2004) on the features/structures near coastal areas with possible reasons are shown in the Table 1. The extent of these impacts depends on various factors, including the magnitude of the earthquake, the coastal geomorphology, and the proximity of human settlements. Tsunami may also have its direct and indirect impacts on the environment. Some of the significant impacts are mentioned in Table 1.

Direct Impacts

When tsunami waves reach extremely high, they continue to strike coastlines, resulting in severe destruction of properties, biodiversity loss, and fatalities. Direct impacts of tsunami on the environment are intrusion of salt water which may pose threats to the soil (affecting fertility of soil of agricultural lands), vegetation (salinization and contamination due to debris, can impact on the production in the medium and long term) and salinization of freshwater resources (rivers, wells, lakes, and fresh water resources) (Shukla et al., 2010; Singh et al., 2012). The loss of human lives which is one of the major and worst consequence of a tsunami. Tsunamis kill hundreds of thousands of people. More than 4 lakh people died as a result of tsunamis since 1850 alone. The violent intensity of tsunami causes immediate deaths mostly from drowning.