

Review Paper: Approaches to Post-disaster Environmental Recovery

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ABSTRACT

Background: Environment and its ecosystems are affected by various natural and man-made disasters. The environmental management in disasters tries to protect ecosystems, sustain development, reduce disaster risk, and adapt to or decrease the impact of climate change. This study aimed to investigate the impact of disasters on the environment and methods of reducing these effects.

Materials and Methods: This review study was conducted by searching PubMed, Google Scholar, Elsevier, UNEP, SID, and Magiran databases using keywords of “environment”, “disasters”, “recovery”, and “lessons learned” from 1999 to 2015.

Results: Decrease in surface and groundwater resources, pollution of water resources, deforestation, desertification, soil erosion, air pollution and extinction of animal species are among post-disaster environmental damages. As a result of such changes in the environment and ecosystem, water shortage and drought, loss of vegetation, and food insecurity will ensue. Due to these destructive incidents, the people’s ability to provide necessary resources for living decreases and their very lives are threatened. Consequently, they are forced to immigrate to save their lives.

Conclusion: Environmental recovery is one of the effective strategies for achieving sustainable development. In this regard, public and private organizations as well as international ones and people should work together. Responsible organizations, the stakeholders at different levels, and the public must be trained in this area and introduced to the latest international standards. Rules and policies should be reviewed and revised in accordance with today’s needs and international standards.

1. Introduction

Natural disasters often occur unexpectedly and cannot be prevented [1, 2]. Our environment and its ecosystems are affected by various natural and man-made disasters. Environment directly impacts communities, human health, and quality of life [3-5]. For example, following domestic war and drought in Liberia and Afghanistan, several environmental changes such as sur-

face and groundwater resources depletion, pollution of water resources, deforestation, desertification, soil erosion, air pollution, and extinction of some animal species occurred in these 2 countries [6, 7]. As a result of 2011 tsunami in Japan and subsequent nuclear reactor meltdown, nearby residents living in an area of 600 km² were forced to evacuate their homes and leave their cities. Water, soil, sea, and marine resources, surface and groundwater water resources and food were contaminated with radioactive materials. Upon examining the

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residents of this area, internal and external radioactive contamination was observed, which can cause mutations and cancer in the future [8].

Due to these destructive incidents, the people's ability to provide necessary resources for living decreases and their lives are threatened. Consequently, human populations are forced to move and immigrate to save their lives [3, 6, 7]. By taking effective measures, these negative and harmful effects can be reduced or eliminated. In the post-disaster response phase, appropriate actions must be taken to prevent harmful impacts of the disasters on the environment. Furthermore, in recovery phase, proper and timely measures must be taken to restore the affected community and the environment to its previous conditions. All these measures require proper planning and preparation prior to the occurrence of the disaster. In the recovery phase, authorities should also consider secondary disasters and be prepared to control such events as well [9].

Therefore, environmental management is a top priority in disasters. The purpose of environmental management is to protect ecosystems, sustain development, reduce disaster risk, and adapt to or reduce the impact of climate changes [10]. In this regard, the best strategy is to design a plan for disaster recovery so that after the incident, normal conditions be restored [6, 7, 11]. To achieve sustainable development, the ultimate goal has to be protection of health and the environment [12]. Sustainable development is meeting the needs of the present without compromising the needs of future generations. In this regard, sustainable development creates a balance between capabilities of environment and economic growth and provide a suitable solution for the inhabitants of the earth without destroying the global ecosystem. Using sustainable development, mankind tries to achieve a better and healthier life [13, 14]. This study aimed to investigate the effects of disasters on the environment and ways of reducing these effects.

2. Materials and Methods

The present review study was conducted to evaluate the environmental impacts of disasters, post-disaster environmental recovery process, and sustainable development. To this end, PubMed, Google Scholar, Elsevier, UNEP, SID, and Magiran databases were searched for relevant articles in English or Persian from 1999 to 2015 using the following keywords: "environment", "ecosystem", "disaster", "crisis", "emergencies", "lessons learned", "recovery", "strategy", "approach", and "sustainable development". Article and reports that only their abstracts were available were excluded. To investigate the articles, a form fitting the objectives of the study

was designed. In the initial search, 35 articles and reports were collected and in the survey at a later stage, reduced to 23 articles and reports to be studied.

3. Results

In order to survive, all human beings interact with the environment. For example, safe water supply and wastewater management have been controversial issues affecting community health in the world from time immemorial. Provision of safe water and the wastewater, produced as a result of human activities, can impact the environment. For instance, sludge remains after treatment of domestic sewage [15, 16]. And after disasters, water supply networks and sewage systems got damaged. Given the importance of water for people's health, providing safe water supply during early hours after the occurrence of disasters is one of the top priorities [17].

In addition, relief and recovery efforts affect the environment in a way that threatens human life, health, livelihood, and security. Failure to consider these risks can weaken the recovery process and cause more damage to life, displacement, and aid dependency and also increase vulnerability. To meet the recovery needs of affected areas, natural resources are required. Unsustainable use of these resources can create new risks. Air pollution following sending humanitarian aid by air (which is costly), scattering of hazardous chemical waste in the environment, using trees to provide fuel for survivors (to meet their basic needs such as cooking and staying warm) are some of these harmful effects. In some cases, disposal of the remaining international aids damages the environment. For instance, some relief items are outdated and eliminating them pollutes the environment [10].

Furthermore, after some disasters, a lot of debris and garbage is left, which must be addressed in the response and recovery phases. The objective of waste management is to reduce the impact of disasters on the environment. Mismanagement of debris and waste can eventually lead to the failure of the disaster management system. Failure to collect the debris can cause road closures in relief operations. Similarly, organic wastes spread infectious diseases and endangers the health of the environment. Lack of proper waste management in the long term leads to exorbitant costs in the recovery phase. However, proper management can turn the waste and debris into a valuable social and economic source in the recovery phase. Also pollutants such as arsenic and asbestos may be in debris. The proper management of this type of debris in the recovery phase is necessary to prevent health threats [18].

To protect the environment in times of recovery, environmentally friendly resources and solutions should be implemented. Available groundwater resources should be used to supply water for the survivors and the relief teams. For this purpose, an initial assessment of the quality, quantity and process of replacement of groundwater resources should be conducted. At the same time, educating the community about the importance of groundwater resources and optimized water use is necessary. As an alternative fuel for daily activities, renewable and clean energy sources such as solar energy can be used. Another solution is using low consumption stoves, better cooking methods, and quickly-made foods. In order to manage waste resulting from relief operations, it is necessary to use products with the least amount of packaging, especially containers that can be reused or recycled. Products should be obtained from local or national markets so that the traveled distances and the amount of released carbon are minimized. In this regard, recycled materials are preferable. Required items should be obtained from local suppliers [10].

Following the disasters, tangible and intangible outcomes such as the destruction of infrastructures and stress in affected people are expected. Tangible and intangible impacts of the disasters on the environment and ecosystems are short term and long term. Water shortage and droughts, loss of vegetation, reduction of food production and food insecurity are some of these impacts [6, 7, 19]. Due to these problems, people in the affected area are forced to abandon their land and immigrate to other places. The Hyogo Framework emphasizes sustainable use and management of ecosystems through better planning for land use and developing measures to reduce risk and vulnerability. Environment management and disaster risk reduction is achievable through 3 strategies: 1. Policy making, planning, and operational decision making, 2. Providing a guidance to improve decision making process, and 3. Building the required capacity for environmental management [11].

In recent years, governments have realized the importance of post-disaster environmental recovery and try to use the experience of international organizations and other countries in this regard. In the early stages after a disaster, national and international specialized teams must be present in the scene to protect the environment and prevent secondary disasters as well as water, soil, and air pollution, and manage waste and sewage. UNEP [1] international organization expects local governments to increase their capability in the field of post-disaster environmental management and conduct necessary planning. To achieve this goal, this organization provides

technical support for the applicant countries and with the help of international experts and trains local forces [20].

During post-disaster environmental recovery, for reducing the risk of disasters, community involvement should be increased. By taking advantage of community involvement, measures can be taken and implemented using a proper method. For example, after Indonesia tsunami, it was decided to plant mangrove trees in coastal areas to create a natural barrier to prevent future damages. However, due to lack of familiarity of the team with the area, these trees were not planted in the right area and all withered. By increasing the participation of the affected community in the recovery process, the people will feel more relaxed and gain a sense of belonging and will be more satisfied with the taken measures, which will facilitate recovery and reconstruction measures [21].

4. Discussion

The topic of disasters impact on the environment and recovery from it has been seldom considered in the conducted studies. However, the environment has a causal relationship with human health. Disasters have direct and indirect effects on the health systems. Death, injury, psychological damages, disability, acute and chronic diseases, infectious diseases, the loss of active work force, destruction of health centers and infrastructures, loss of traditional ways of life and work are among these effects [22]. After disasters, the process of achieving sustainable development changes. These changes can be positive or negative. Unfortunately, due to negative changes, the development programs of countries stop and sometimes due to underlying conditions, affected countries may experience setbacks in their development. Disasters and sustainable development have a mutual relationship. People's harmful economic activities provide the context for increase in natural disasters and disasters are in turn obstacles to the development of communities [23].

Healthy community is an essential component of economic development. The poor people suffer from health problems more than other people and are exposed to all types of hazards such as air and water pollution. Sickness and disability caused by polluted environment slow down the process of economic development. Protecting and creating a healthy environment is a critical component of sustainable development. By using proper policies, practices, and technologies, sustainable development and economic development can be achieved and unwanted effects of human activity on the environment are reduced or prevented [24].

One of the objectives of the recovery phase is to achieve sustainable development. Environment recovery is one of the effective strategies in achieving this goal. In this regard, public and private organizations, international organizations, and people should work together. Sustainable management of environmental resources is achieved when local and national organizations are committed to it and have an effective, integrated structure, skilled technical personnel, and financial resources. The media can have an effective role in public education. The purpose of this education is to help the public and policymakers understand the effect of conservation of the environment on disaster risk reduction [6, 7, 11]. In environmental recovery, the important issue is reduction of future risks. Policymakers, planners, and the public should be encouraged to use innovative and green technologies. Technologies which can be used in energy production and consumption, management and use of water resources, defensive structures against risks and designing environmentally friendly structures should be considered in environmental management and recovery by authorities and the public [11].

Aimed at disaster risk reduction, environmental management should be undertaken by governments. For this purpose, the department of environment should determine its national environmental priorities in the field of environmental management and disaster risk reduction. In the post-disaster recovery, paying attention to integrated planning aimed at determining high-risk areas and vulnerable populations is necessary. The next step in environmental management to reduce disaster risk is monitoring and evaluation of the environment. The purpose of this monitoring is to determine the risks and vulnerabilities and increase resilience. Policymakers will use the information obtained from this phase to make decisions in the field of environmental management. Rehabilitation of the environment after disasters can reduce underlying risks and their effects on the ecosystem. To this end and for environmental recovery, in some cases, it is necessary to declare the affected area as a protected area. A wide range of activities like environmental clean-up of oil spills to water or replanting trees in devastated forest areas are taken to restore the environment [11].

This study has some limitations. As it was conducted for the first time in Iran and focused on the environment and post-disaster recovery, there were few studies and reports considering the environmental effects of disasters and its immediate and long-term recovery. Therefore, the researchers tried to use a wider range of relevant articles to resolve this problem.

5. Conclusion

According to the results of this study, after a disaster, using proper planning is necessary to restore the condition of affected population to the normal status. The aim of the recovery phase is achieving sustainable development. Environment recovery is one of the effective strategies in achieving this goal. In this regard, public and private organizations, international organizations, and people should work together. One of the methods of organizing and restoring the environment is educating the public and raising their level of awareness. Also, responsible organizations, the stakeholders at different levels, and the public should be trained in this area and be introduced to the newest international standards. Rules and policies should be reviewed and revised in accordance with today's needs and international standards. The responsible organizations should provide appropriate, sufficient, and up-to-date equipment to monitor the environmental conditions after the disasters and through raising public awareness, increase public participation in environmental recovery.

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