

Understanding Basics of Nature Based Solutions for Disaster Risk Reduction

Renu Bali

Abstract

Climate change and its impact in the past few years has necessitated that we adopt an alternate method or approach to tackle the impact of disasters. There is a need to focus on new solutions for Disaster Risk Reduction (DRR). Therefore, it is time to look and go back to nature for sustainable solutions. Grey solutions or construction of structures to reduce disaster risk alone are not sustainable and permanent solutions. Effective approach for DRR is to apply sustainable and cost-effective solutions which blend with nature. We should now learn from nature and look for solutions provided by nature itself. It is not a new approach but it has to be blended with present solutions. Nature Based Solutions are part of broad Ecosystem Based Approaches which focuses on working with nature to protect, restore and sustainably manage ecosystems. These approaches provide solutions to DRR while working with nature and maintaining the ecosystem in its natural state. In this paper we discuss benefits and application of Nature based Solutions (NbS) for effective Disaster Risk reduction.

Keywords: *Disaster Risk Reduction (DRR), Nature Based Solutions (NbS), Ecosystem Based Approach (EbA)*

I. Introduction

Last decade has been a decade (2000-2019) of some of the major disaster occurrences, majority of which were climate based. Extreme climatic activities have increased in terms of both frequency and intensity and it has affected more than 100 million people (EM-DAT, CRED 2022) worldwide during the last decade. Between 2000-2019 there were 7348 major recorded disaster events as compared to 4212 between 1980-1999. Climate related disasters have increased the most, accounting for 6681 events during 2000-2019. (UNDRR, 2020).

In the year 2023, India experienced massive physical destruction, environmental damage, loss of life and displacement of population due to erratic, heavy and unprecedented rainfall due to cyclones generating in Bay of Bengal and Arabian Sea. Heavy rainfall was experienced throughout the country from states of Himachal Pradesh, Uttarakhand, Punjab in the north to Gujarat, Maharashtra and Rajasthan in west, to Bihar and Assam in east. As a result of heavy rainfall and episodes of cloudbursts these states experienced widespread floods and landslides. Causing massive damages of property, loss of life as well as environmental destruction. Water logging in urban areas resulted in urban floods which were experienced by many urban centres /cities like Delhi, Noida, Gurugram of NCR, Mumbai and Chandigarh and landslides affected hill towns of Shimla, Kulu, Manali, Solan, Dehradun etc.

Many rivers crossed the danger mark and overflowed. Rivers like Hindon, Ghaghar and Yamuna overflowed and flooded after many decades and caused floods. There were disturbing visuals shown on TV of damages caused by these disasters like collapsing of houses, floating of cars and cattle, people getting drowned in overflowing rivers etc.

While the western ghats region, northeast and eastern states of the country experience floods and landslides each year due to heavy rainfall in monsoon season but this year it was northern states which experienced heavy rainfall even before the onset of monsoon. Northern Indian states of Himachal Pradesh, Uttarakhand, NCR experienced rainfall during the summer months of May and June because of western disturbances and in July the monsoon and western disturbances combined together to cause heavy rainfall in the region. There was not only a shift in rainfall season but also the characteristic or pattern of rainfall also has changed. Now most of the regions experience heavy rainfall in a short span of time like cloudburst and cause flash floods and landslides.

II. Context of the Problem

Since climate change related disasters have become more erratic and frequent. This requires an alternate method or approach to tackle the impact of disasters. There is a need to focus on new solutions for Disaster Risk Reduction (DRR). The challenges faced by changing climatic patterns are connected to human intervention in nature's plans. The incidents of landslides in Konkan region, Himachal Pradesh and Uttarakhand are direct result of not only heavy rainfall but also rapid construction activities going on in these hill areas for all types of commercial activities from building of roads, resorts, hotels and increase in tourism. Cutting of forests in upper slopes, construction of roads, and hotels on vulnerable slopes all have acted as triggers for the onset of disaster.

On the other hand, floods in urban areas due to heavy rainfall are the result of unplanned urbanisation. Water logging experienced in most cities every year after rainfall is the result of encroachment along flood plains and absence of proper drainage system for flow of rainwater based on slope of the area. Clogging of rainwater drains, no

annual desilting of rainwater drains before onset of monsoon, encroachment on rainwater drains results in surface flow of water and water logging in urban areas resulting in urban floods. Due to concretisation, there is no scope of water to seep inside the ground as a result the roads and basements get flooded, inundation of residential and commercial areas and water logging is experienced.

Since the last few years solutions to these problems have been focused on built infrastructure or grey solutions like construction of retaining walls along hill slopes, fencing along hill slopes, construction of embankments along rivers etc. But these structures get damaged due to heavy force of landslides and flow of water. A recent example is damage to Chungthang NHPC Dam on Teesta River in Mangan District of Sikkim on 5th October 2023 due to Glacial Lake Outburst Flood (GLOF) of Lhonak Lake (Chamei, 2023). These structures do not provide permanent solutions, have high cost of construction and maintenance and often involve outside agencies and workers to do the job who do not have any obligation of maintenance and repair.

In this backdrop, a need to look back to nature for sustainable solutions has been felt. Grey solutions alone or construction of structures to reduce disaster risk are not sustainable and permanent solutions. Effective approach for Disaster Risk Reduction (DRR) is to apply sustainable and cost-effective solutions which blend with nature. We should now learn from nature and look for solutions provided by it. A blended approach is required to deal with emerging challenges. The local level solutions can be relevant globally. Learning from nature and working with nature could be a solution for long term DRR. Another advantage of applying Nature Based Solutions (NbS) is that it would improve the health of our planet.

III. Literature Survey

There are many studies which highlight the successful implementation of NbS both at global level as well as regional level. In India we find many examples of how communities are participating in building green and blue infrastructures to reduce the impact of disaster.

World Research Institute (WRI) - India, and Kochi Municipal Corporation with help of local communities worked together to establish urban forests to reduce extreme heat and floods under the scheme “Kawaki” (to make a grove in Malayalam). Urban trees cool the surrounding air, mitigate urban heat island effect, hold soil in place to prevent erosion, and increase water absorption to alleviate flood risks. WRI - India applied a science-based approach to the Kawaki program. It started by involving community in participatory “mapathons” with local “citizen scientists” to map the city’s existing green space, identify areas where trees could be planted, and overlay areas also experiencing high heat and flood risk. WRI surveyed more than 600 households to assess climate adaptation needs, vulnerabilities and capacities. WRI staff held training sessions for local community groups to prepare land, plant trees, and nurture them as they grew. Many citizens now receive wages for their tree-planting and maintenance work through an employment program run by the local government. Community members have planted numerous urban forests throughout Kochi as part of the Kawaki initiative, and the program continues to expand. Urban trees are reducing extreme heat, lowering flood risks, providing employment for unskilled labourers and creating recreational areas in the city. (WRI, 2023).

Another example is NGO Industree which has started an ESG-compliant bamboo project in Maharashtra by encouraging women farmers to grow bamboo on unused areas of their land that will help sequester carbon dioxide in the atmosphere up to 20,000 tons

annually. Industree's work in bamboo projects helps in providing livelihood for women as well as impact of climatic disaster mitigation. Industree's other work with women include manufacturing various green products such as hand-woven baskets and *siali* leaf plates that replace single-use plastics. Akila Lean, Head, Industree project says "right now, we only seem to be focusing on women as passive recipients of climate change, but it's time to change the lens. They can, and are, playing a critical role in mitigation. More importantly, they have the potential to enhance their incomes and be part of the mainstream going forward," (Akila Lean, head of partnerships and communications at Industree, DASRA -IDR). The NGO Tarun Bharat Sangh from Rajasthan supports local women to rejuvenate the local water bodies for collection, storing and conservation of water to mitigate drought conditions, increase area under crop and have replenished forest cover by around 33%. (Suutari, 2005). In Andhra Pradesh, zero-budget natural farming, which relies entirely on using organic inputs to improve resilience of both crops and land, is being promoted at a large scale. (Galab S et al, 2014). Nature based solutions are being implemented for better management of natural water bodies and preventing encroachment of the floodplains in cities through the Asian Cities Climate Change Resilience Network (ACCRN) in Surat, Gujarat, Indore and Gorakhpur. (NIUA &ACCRN, 2014). Similar practices have been adopted by Burhanpur and Indore in Madhya Pradesh, where with the support of the Ministry of Environment, Forest and Climate Change (MoEFCC), community participation helped in conserving and managing traditional water sources (GoMP, 2020)

In east Kolkata, wetlands have been utilized for cleaning the city's wastewater. The wetlands have not only saved the cost of constructing a wastewater treatment plant, but also provided sustenance and livelihood opportunities to 50,000 people through

pisciculture and agriculture (RCS,2016).

All these case studies are examples of implementation of NbS at the local level. There is a need to include Nature based Solutions for DRR at national level. Make them part of disaster management policies and programs. This will help in finding sustainable solutions as well as conserve and maintain ecological balance.

IV. Nature based Solutions (NbS): Definition and Elements

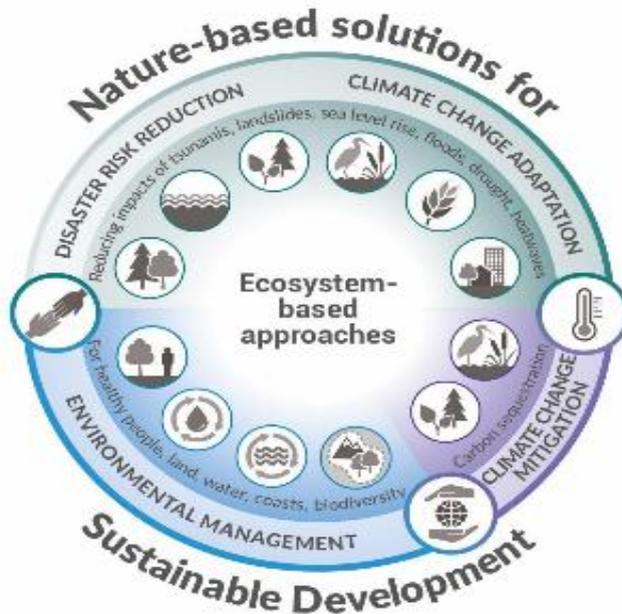
IUCN in 2016 in its report Global Standard for Nature Based Solution defined Nature based Solutions as:

Nature based solution are actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and actively, simultaneously providing human wellbeing and biodiversity benefit (IUCN,2016)

Nature based Solutions (NbS) come under broad ambit of Ecosystem Based Approach (EbA) to reduce impact of disasters and climate change. (Sudmeier-Rieux, K. et al). (2019). It focuses on:

- Green Infrastructure – planting trees, improving green cover by having parks, forest cover.
- Blue Infrastructure – refers to water elements like river, canals, ponds, wetland, flood plain, water treatment facilities. It includes cleaning and restoration of water bodies.
- Grey Infrastructure – refers to engineered or built structures like construction of fencing, slope retention walls, embankments, dams etc. Urban greening which helps in reducing the average temperature of urban heat islands

- Hybrid Infrastructure – include a combination of all the three grey, blue and green. It is combination of natural and non-natural structures
- Ecological restoration and recovery – include all of the above



Source: UNEP/PEDRR 2020



Figure 1. Elements of NbS for Sustainable Development

Source: <https://www.undrr.org/words-action-nature-based-solutions-disaster-risk-reduction>

Nature Based Solutions focus on working with nature to protect, restore and sustainably manage ecosystems. These approaches provide solutions to DRR while working with nature and maintaining the ecosystem in its natural state. Some of the major elements of Nature Based Solutions are shown in the diagram. (Figure 1.)

Nature based Solutions for DRR are aligned with Sendai Framework as well as will help in achieving SDG goals for nations particularly Goal no 15 - Life on Land mentions implementation of nature based and ecosystem approach for DRR and says “We must scale up implementation of and investment in terrestrial nature-based solutions and ecosystem-based approaches for DRR, and step up efforts to tackle desertification, land degradation, erosion, drought, flooding and biodiversity loss” (UNDRR).

Nature Based Solutions for DRR: Advantages

Advantages of applying Nature Based Solutions (NbS) for Disaster Risk Reduction (DRR) are

- These solutions are cost effective as they are based on locally available resources.
- Participation of local communities and indigenous knowledge is encouraged to find solutions for DRR.
- These solutions are sustainable for a long time.
- They can be applied to multiple problems (floods, landslides, coastal erosion, droughts)
- These approaches can be applied to tackle challenges being faced at local, regional and even global level.
- They can help in minimising impact of disasters by maintaining and improving natural defences already given by the nature
- These solutions apply traditional and indigenous knowledge for example for water conservation, social forestry

V. Nature Based Solutions: Aspects

Community Involvement - Participation of all stakeholders

One of the principles of NbS for DRR to be successfully implemented for any region is inclusivity which means participation of all sections of society at each stage of plan from designing, formulating, supervising to implementation and maintenance. It is important to involve women, children, youth and indigenous people.

It is well known that communities or local people are the first responders to any disaster in the area and they are not only the victims but also are first to reach to provide relief. It is therefore important to improve their capacities to respond and improve their resilience. Local communities have knowledge of local resources which can be used to build ecosystem based resilient structures. Local communities are familiar with the terrain and local conditions therefore they can be encouraged to participate in formulating NbS for their region. They should be part of the committees formed by the local government and administration looking into DRR.

Since local communities are the primary beneficiaries of the plan implementation, they can not only participate in plan formulation but they can also be given responsibility for maintenance of structures built. It is important to train youth, men and women, provide them with tools and knowledge on how to maintain the ecosystem and also how they can continue to protect the ecosystem. This will ensure the effectiveness of NbS over a long period of time.

Women are considered to be efficient users of resources while doing household work. They use each resource efficiently whether its water, energy or food. Therefore, it is pertinent to give them an important role in implementing NbS in the region which will give them a sense of ownership and empowerment. Youth and school children can also be encouraged to participate in EbA to reduce disaster risk reduction. Bringing youth close to nature, improving

ecological literacy among youth will encourage youth and school children to implement NbS in their region.

A global level survey was conducted by Global Network of Civil Society Organisations for Disaster Risk (GNDR) to understand the needs of communities as stakeholders bearing the impact of disasters all over the world. The survey was conducted in 50 countries comprising 750 communities which were at risk and a total of 119,000 people were covered. The result of the survey concluded seven important points, each focusing on the importance of Environment Based Approach (EbA) and Nature Based Solution (NbS) for Disaster Risk Reduction (DRR).

It is crucial to implement Nature Based Solutions as they are long term, sustainable in nature, and benefit communities. The seven concluding points of the above survey with their explanation as understood have been explained briefly in the table below. (Table 1).

CONCLUSION	EXPLANATION
Complex threats require participation of all government departments and all members of society	DRR requires involvement and participation of all stakeholders including local communities in a meaningful manner in decision making along with government departments.
Communities are still excluded from decision making and their participation is poorly planned	Local knowledge, capacities and decision making are essential for effective risk management and disaster prevention. The Sendai Framework for Disaster Risk Reduction specifically highlights this point (UNDRR). The seven targets identified and their guiding principles focus on how Governments should engage with relevant stakeholders, including women, children, youth, persons with disabilities, poor people, migrants, indigenous peoples, volunteers, the community of

	practitioners and older persons in the design and implementation of policies, plans and standards.
Poor governance means a lack of accountability for risk and low participation of local communities	There is a problem of resources not reaching local level. Local communities are not properly informed. Their convenience is not looked into. As a result, local communities in every region are not able to participate in interactions with government representatives in planning DRR strategies.
Lack of local funding for DRR	There is a lack of mechanisms for funds to be allocated and reach the local level. Eight out of 10 community members of 750 communities surveyed say they cannot access or have limited access to funds.
There is information gap on risk at the local level	Risk information generated by government bodies is not communicated properly to local people. The information does not reach most remote and vulnerable people. On the other hand, local knowledge also does not reach the government authorities.
Development is not risk-informed	DRR should be included in development policies and include risk assessment of the needs, vulnerabilities and capacity of communities at risk.
Nature-based solutions are not being prioritised	Views from survey data strongly affirms the importance of ecosystem-based approaches to disaster risk reduction. Well-managed ecosystems act as a natural structure to prevent hazards. But ironically DRR policies do not include NbS. There is a lack of awareness about the advantages that the ecosystems can offer.

Table 1: Importance of Nature based

SolutionsSource:https://www.gndr.org/wp-content/uploads/2022/10/GN012-Views-from-the-Frontline-Global-Recommendations-report_AW-WEB-lores.pdf

VI. Encouraging Involvement of Companies & Business Houses

To make Nature based Solutions more popular it is important that these solutions are implemented by private sector, business houses and companies. Companies and business houses worldwide have started adopting and investing in Nature-based Solutions to minimise the impact of their work and processes on climate and ecology. They have started investing in eco-friendly production processes and reducing their carbon footprints.

There are many ways business houses, industrial houses, companies and farmers can adopt Nature Based Solutions. Some of these measures could be:

- Understanding the impacts and dependencies on the nature of the business in order to make more informed decisions. One can take help of agencies doing Green Audit and advising companies to include NbS
- Consider the ecosystem service benefits and natural capital costs of the business
- Incorporate sustainability concerns at the initial phase itself and incorporate them in their planning phase.
- Responsible sourcing of raw material.
- Use of green building materials sourced from recycled bio waste material, powerefficient building material which saves energy etc.
- Responsible disposal of waste material. Waste can be recycled before disposing. Minimizing greenhouse gas emissions and avoiding disposal of harmful chemicals in water bodies and over land.

- Stopping deforestation and work towards zero natural habitat conversion for production.
- Sponsoring and supporting government measures to conserve the environment like saving soil, water conservation etc for the benefits of people and ecosystems.
- Encouraging farmers to not burn stubble, do mulching of crops in fields, multiple-cropping, organic farming etc.

It is estimated that globally there will be around \$10 trillion annual business opportunities and approximately 400 million jobs by 2030 with nature based economic developments (GNDR, 2022). There is a need to understand the economic value of resources and economic losses incurred when we mismanage these natural resources. It is important to understand the concept of natural resources in business terms as economic resources. One has to understand the concepts of Natural Capital and Natural Resources. Natural Capital is defined as the stock of renewable and non-renewable resources such as plants, animals, air, water, soils and the minerals that we use and consume in one way or another. Natural Services are services provided by these resources for example trees or forests provide various services by absorbing CO₂, they provide habitat for wildlife, roots of vegetation on hills protect slopes from landslides, act as barriers against floods and cyclonic storms. These different functions that trees and other natural assets perform are termed 'natural services.' (Bassi, IISD 2020).

Value of natural services provided by resources can be calculated in economic terms. The potential value of resources of a region can be calculated. On the other hand, the cost of over exploitation of resources and not properly managing the resources can also be calculated. There are a number of tools which help in calculating the value of natural resources and the services that they provide. Sustainable Asset Valuation (SAVi) is one such tool developed by

the International Institute for Sustainable development (Bassi, IISD 2020). SAVi has been used to estimate the value of natural resources and services in various regions. For example, the Saloum Delta region in Senegal according to the SAVi tool can provide ecosystem services such as wetlands for flood management worth approximately \$ 1.7 billion in total from 2019 to 2029. It will save local people \$ 1 billion as compared to the cost of developing built infrastructure for flood control. These kinds of exercises help planners and policy makers estimate the value of ecosystem resources and plan accordingly. By over exploiting our ecosystem resources we are increasing the risks and opportunities. Understanding Nature based Solutions can help in reducing the risks and improving the reputation of the company as Green Projects and reduce carbon footprints of companies.

Nature based Solutions can help in improving and regenerating the resources in the long run. For example, Hindustan Zinc Limited aims to integrate NbS into their bio diversity policy for sustainable development. HZL integrated nature-based solutions in their biodiversity policy of July 2022. In the policy, HZL noted that it would encourage "continuous improvements in biodiversity performance through specific target indicators and include key stakeholders for effective management and implementation and include 'Nature-Based Solutions' approach in the business decision making." (Misra,2022), (IUCN 2023).

Incorporating NbS in business will help in achieving Sustainable Development Goals by 2030 and improve the health of our planet by checking pollution and environmental damage. It will help in improving and regenerating the ecosystems.

VII. Nature Based Solutions: Planning and Policy

Global warming throughout the world is leading to climate change and increasing occurrences of climate related hazards. The problem of climate related hazards and occurrences is global phenomena. The policies for tackling the problems related to climate change and DRR exist from Global level to National and most importantly at local level in almost all countries. There is a need to integrate these policies of EbA and NbS at all levels from local to national and global level.

At global level, in the last two decades, the UN and its subsidiaries have held important conventions and come up with various frameworks of actions and declarations to tackle problems related to climate change like Global Warming and associated hydro climatic disasters. Some of the important outcomes of these conventions are:

- Sendai Framework for Disaster Risk Reduction, 2015
- 2030 Agenda for Sustainable Development Goals
- UN Convention on Climate Change
- Paris Agreement

Nature based solutions are important for achieving SDG goals most of which are related to climate change issues and DRR. By integrating NbS in environmental policies countries can achieve their SDG goals by 2030. In India also, various plans have been implemented for Environment Based Approach (EbA) and Nature Based Solution at national and local level. Ministry of Environment at national level and state level and various departments and organisations have implemented policies related to NbS.

NbS are currently implemented under different schemes and programmes in India including Mahatma Gandhi National Rural Employment Scheme (MGNREGA) and missions under the National Action Plan on Climate Change (NAPCC, 2021). For example,

almost 60 percent of the activities allowed under NREGA are related to natural resource management, which comes under the purview of NbS. Under its Nationally Determined Contributions (NDCs), India has set a target of creating an additional sink of 2.5 to 3 billion tonnes of CO₂ by increasing forest and tree cover by 2030 and identified 12 National Biodiversity Targets under its National Biodiversity Action Plan (MoEF, 2019).

A variety of ecosystem services under NbS ranging from cultivation of climate-resilient crops to restoration and management of wetlands will help India achieve these targets. The Government of India has taken actions to implement NbS as highlighted in the Union Budget of 2023. It has launched two new programmes, namely the ‘Mangrove Initiative for Shoreline Habitats and Tangible Income (MISHTI) and ‘Amrit Darohar’ to encourage the optimal use of wetlands and to build the livelihoods of the local communities and preserve such ecosystems. India has made significant progress in recognising the importance of NbS in tackling the impacts of climate change. (Wadhavan 2023)

Successful implementation of any policy includes participation of local people who are both victims and solution providers. Best policies are formulated at the local level. So, it is important to involve local people in policies related to NbS for their region. Grass root level planning involving local communities, making use of their knowledge and skills is the solution for EbA and Nature based solutions (NbS) both for climate change and Disaster Risk Reduction policies. It becomes easy to implement the plans if local communities are involved and better results are achieved.

VIII. Conclusion

Successful implementation of disaster mitigation and risk reduction from local to global level must include Nature Based Solutions. There are many examples where the approach has been implemented successfully at the local level. At Global level there are examples like the Great Sahara Wall and Sponge Cities of China. It's an inclusive approach where all categories and strata of society participate and thus make the implementation of NbS successful. Apart from the community, business houses and companies should also implement policies which include Ecosystem Based Approach (EbA) and Nature based solutions (NbS). Nature based Solutions NbS can be used to mitigate climate related disasters and environmental problems effectively in a sustainable, long lasting, cheaper manner using local resources thus reducing the dependency on outside help.

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Dr. Renu Bali is Associate Professor, Department of Geography, Kamala Nehru College.