

Ecological Restoration: An Overview

*An e-book intended to give the reader a broad overview of
the concepts and practice of ecological restoration
(Third edition: January 2021)*

JungleScapes



"Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed"

- Society for Ecological Restoration



UNITED NATIONS DECADE ON
**ECOSYSTEM
RESTORATION**
2021-2030

What is ecological restoration?

Ecological restoration is the exercise aimed at restoring an ecosystem that has been disturbed, degraded or impaired to as close its original state as possible. In most restoration situations, such disturbance or degradation is a direct or indirect result of human activities. In some instances restoration of ecologically important sites may be taken up after natural disasters like major floods or fires.

How is ecological restoration different from afforestation and reforestation?



The terms afforestation, reforestation and restoration are often used interchangeably. However these mean different things. Afforestation is the process of establishing

vegetation in an area that was not a forest earlier. Reforestation is growing vegetation back on what was previously a natural forest area, either since the original vegetation has been lost or with an intention to alter the species' composition. Both afforestation and reforestation generally involve the activity of planting tree saplings. The targeted outcome is often a plantation consisting of a mono-culture or a limited number of species, although exceptions are possible. Ecosystem integrity and species diversity are generally not a high priority, and most projects involve introducing plant species that are of higher utility to humans. For example, many natural forests in Europe have been reforested over the last two centuries using species of commercial value. Afforestation and reforestation, therefore, often do not create areas that represent native biodiversity.

Ecological restoration on the other hand is a holistic process aimed at reviving impaired ecological processes that are vital for an ecosystem to function normally and support the biodiversity typical of that ecosystem. The focus is on multiple aspects like soil alleviation, management of invasive species, assisting natural regeneration, reviving functional diversity, etc. Ecosystem and species integrity are high priorities in ecological restoration. The emphasis is on all vegetation strata and not just on tree species (e.g. grasses, shrubs, climbers, creepers, etc).

Does ecological restoration apply only to forest ecosystems?

Compared to the terms afforestation and reforestation that are used with reference to terrestrial forests with tree cover, ecological restoration can cover a wide variety of ecosystems that may or may not have tree cover e.g. marine, riverine, wetland, coastal, desert, etc. Further, ecological restoration could include areas outside designated forest areas e.g. abandoned mining or industrial sites, urban ecosystems including lakes, rivers and beaches, rural areas like village sacred groves, etc. It could even be carried out in privately owned lands e.g. erstwhile tea estates being restored to forests in South India.



Can ecological restoration restore an ecosystem to its original state?

Ecosystems are in a constant process of evolution and it is impossible to restore one to its original state. The objective of ecological restoration, therefore, is to put

an ecosystem back on its previous trajectory which existed before the disturbance or impairment took place.

Is restoration essential? Will not ecosystems restore themselves if left alone?

Whether restoration is required or not depends on the degree of impairment of ecological processes that an ecosystem has suffered from. A good analogy is the human body. Where the immune system of a person is reasonably intact, he or she can recover from a health setback. However where the immune system is compromised, medical intervention is needed. Similarly, where an ecosystem is mildly impaired, it may be able to recover on its own with merely the cessation of causes of the impairment. However where the degree of impairment or degradation is higher, intervention in the form of restoration would be needed in a majority of cases.

What are the risks of not restoring an ecosystem that is moderately or severely impaired?

Not restoring such an ecosystem could have three ecological consequences. Firstly, an ecosystem might not be able to recover by itself and therefore remain in a degraded state. A typical example is an area affected by invasive alien species like *Lantana camara*. Second, assuming an ecosystem can recover on its own, this process might take a very long time. For instance, an abandoned mining site may take centuries to regain even a part of its prior functional attributes. The capability of such an ecosystem to deliver ecosystem services may hence be deferred interminably. Thirdly, an ecosystem might recover on its own in a manner that does not reflect its earlier state. For example, a degraded grassland with tree species in the vicinity might recover into a woody forest with very different assemblages of flora and fauna.

What are the key principles of ecological restoration?

There are three key principles of restoration. The first is maintaining ecosystem integrity. One should not try to create an ecosystem that is different from the original ecosystem type. For instance, one should not try and create a grassland in place of a dry deciduous forest or vice versa. The second is species integrity. This is about ensuring that only the right types of species that are indigenous or native to the target

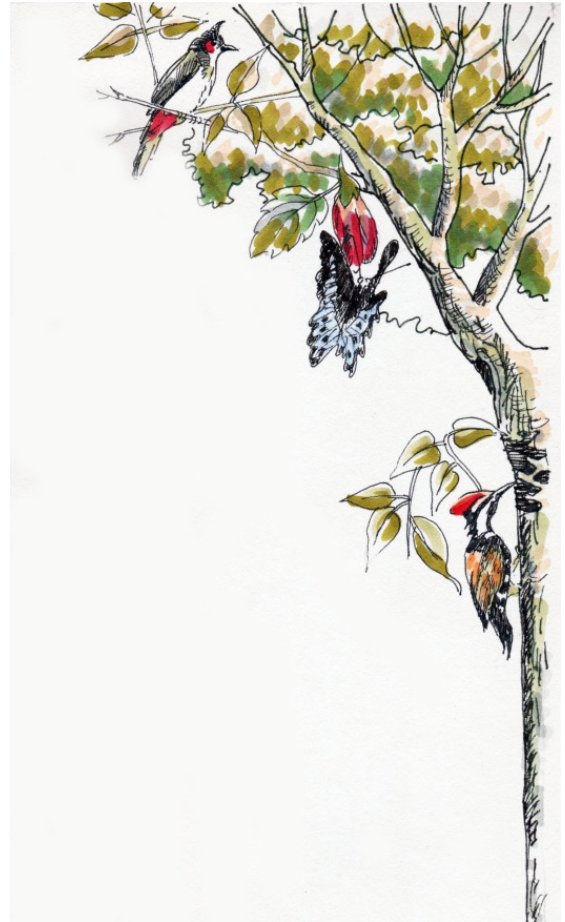


ecosystem are introduced in the restoration process. The third is the principle of least possible intervention. This involves using passive restoration techniques as far as possible and using active methods only where passive methods are not feasible. The focus is on reviving the ecological processes and bringing the ecosystem to a self-sustaining level from where the restoration process can be largely taken care of by natural mechanisms.

What do we mean by passive restoration methods?

Passive restoration involves the use of low-intensity techniques that aim at leveraging natural ecological processes for achieving the restoration goals. The terminology commonly used for passive restoration is “assisted natural regeneration”.

Let us take the case of a terrestrial forest. The focus of passive restoration would be on reviving the soil, water and natural vegetation regeneration cycles. A typical restoration effort would involve reversing soil erosion, improving water holding capacity and moisture availability, soil alleviation and assisting natural establishment of native plant species, etc. There is also emphasis on leveraging natural factors like seed dispersal by mammals and birds, which in turn help create a virtuous framework that accelerates ecosystem recovery. The objective is to create the right environment for revival of biodiversity including return of desirable flora and fauna. Introduction of outside plant material is kept to a minimum, to address species or spatial distribution gaps.



While the example given above is that of a terrestrial forest, similar relationships can be found in all ecosystems.

What are active restoration methods and when are these used?

Active restoration involves the use of moderate to high intervention techniques e.g. in a terrestrial forest this could include sapling planting, seed broadcasting, invasive species management, soil remediation, etc. These are generally used selectively where passive methods are infeasible or inadequate to achieve the restoration goals. A good example is correcting native plant species imbalances in

a degraded area. It is possible that over a period of time some of the key native plant species representative of the target ecosystem have disappeared or are at below self-propagating levels. In such a situation it might be necessary to re-introduce these species. Another example is a site that is severely disturbed by incidents like forest fires or by activities like mining where active management may be essential.

Does ecological restoration make use of biological or chemical agents?

Ecological restoration generally does not use biological or chemical agents. The use of biological agents to address ecological challenges has led to severe adverse consequences in many parts of the world and hence no longer adopted by serious restoration practitioners. The same is the case with chemical agents which are not used in natural ecosystems and are restricted to artificially managed areas like plantations. Further, the use of biological and chemical methods is prohibited in many designated wilderness areas.

How is the success of ecological restoration measured?

Like in any other conservation project, the success of a restoration project is measured against the objectives set out at its outset. These objectives generally consist of a combination of abiotic and biotic parameters drawn up with reference to what is called a “reference site”. Where evidence is available about the target ecosystem before its degradation, this could by itself be the reference site. Otherwise this could be a healthy site of the same ecosystem type in a comparable landscape. In a terrestrial forest ecosystem, the parameters could include nutrient recycling, presence of desirable species, rate of natural recruitment, soil quality, etc. Biodiversity, represented by richness and abundance of flora and fauna species, would be important parameters in such an assessment. The return of fauna to the site is generally a good overall indicator of restoration success as this means the ecosystem is able to provide the services that make it a healthy habitat.

What is the duration of an ecological restoration project?

Ecological restoration projects are long term in nature and could typically span many years. The duration of a project would depend on factors like the ecosystem type, extent of physical area being addressed, the degree of degradation, etc. For instance, restoring a thorn scrub forest of 200 hectares might take between 5 and 10 years of sustained effort. Many restoration sites may also need monitoring and maintenance for many years after the restoration project is completed.

Is scale important in ecological restoration projects?

An ecological restoration project can be of any size. It could vary from a project involving an entire river, to one of restoring a small lake. While large projects have greater impact, smaller projects have value in capturing learnings and fine tuning methodologies. It is generally recommended to start with smaller pilot projects and scale up gradually.

How do we ensure that a restored plot does not get degraded again?

This requires actions at three levels. First, anthropogenic influences that can cause re-degradation have to be managed. A good example is firewood collection, which can be minimised by distribution of LPG cook stoves. Second, there has to be continuous monitoring of the site for at least 4-5 years post completion of restoration, and maintenance actions identified and implemented. Third, ensuring active involvement of local community members in restoration projects is critical for sustainability. A restoration activity by itself could generate alternate livelihoods during its implementation, creating a collaborative relationship between people and the ecology. Future revenue streams linked to sustained conservation of restored sites through activities like eco-tourism might also be important.

How does ecological restoration address the challenge of ecosystem variability?

A common concern raised in the context of training of restoration practitioners is the high diversity of ecosystems. A question comes up whether training can equip practitioners to handle different ecosystems. The simple answer to this is that the fundamental principles, framework and processes of ecological restoration remain the same across ecosystems. The approaches and treatments required may vary from ecosystem to ecosystem, or even from site to site. The objective of training or education is to ensure a good understanding of the principles and standards to be adhered to in all restoration projects.

Are there specializations within the field of ecological restoration?



Ecosystems are unique and distinct. Therefore ecological restoration has also evolved as a highly specialised activity. There are restoration scientists and practitioners specialising in very diverse environments like oceans, peat swamps, sand

dunes, mangroves, urban landscapes, etc. Sub-specialisation based on the ecosystem type or the landscape is also common. An example of ecosystem type-based sub-specialisation within the classification of forest ecosystems would be rain forests and dry deciduous forests. An example of landscape-based sub-specialisation would be grasslands in Africa and North America, each of which

may require different approaches, knowledge and methodologies. As can be observed, there could be further sub-classifications based on degree of uniqueness of the target ecosystem.

What is the status of development of ecological restoration as a conservation discipline around the world?

Ecological restoration has emerged as a major discipline around the world. Significant bio-diversity and climate change programmes that have been launched in recent times, like the Rio Conventions, Aichi Targets and Bonn Challenge, have brought ecological restoration to the forefront in many continents. Leading restoration groups play a key role in policy formulation at a global scale. The declaration by the UN of the next decade (2021-30) as the 'Decade on Ecosystem Restoration' is expected to increase the focus on this discipline significantly.

Today ecological restoration has a number of active sub-disciplines like seed management, invasive species management, landscape-level restoration, restoration of severely disturbed sites, restoration of cultural landscapes, etc. The ecological restoration community now consists of multi-faceted participants e.g. policy makers, researchers, grassroots practitioners, communicators, etc.

What is the relationship between ecological restoration and wildlife conservation?

Ecological restoration addresses two of the main threats to wildlife around the world – habitat loss and habitat degradation. By improving the health of existing habitats and creating additional habitats, restoration plays both a direct and a complimentary role in wildlife conservation. The direct role arises from the fact that ecological restoration is holistic in nature and enables sustaining greater

biodiversity that represents a variety of species that are linked to each other. The



complimentary role is in activities like threatened species' conservation where success depends, among other factors, on healthier habitats. Improvement in habitat health also has the potential to reduce human-wildlife conflicts and scientific study is needed to validate this hypothesis. There is, therefore, significant potential for

collaboration between ecological restoration and other streams of ecological and wildlife conservation.

What is the interface between restoration science and practice?

There is active co-ordination and interface between restoration science and practice. In fact, restoration practitioners work closely with different research agencies and researchers (not necessarily limited to restoration science) to access knowledge on specific ecological and allied parameters. Similarly, researchers find it useful to work with restoration practitioners to get feedback on their hypotheses at a scale significantly larger than that of a laboratory.

Are academic courses on ecological restoration available?

Many universities and academic institutions in the developed countries offer Under-Graduate and Masters courses on ecological restoration. There is also an increasing trend of academic disciplines like environmental science, wildlife management, landscape architecture, etc. including ecological restoration in the course structure.

There is, however, an urgent need for ecological restoration to be included in academic curricula in developing countries in order to build capacity for restoration in these geographies as well.

The Society for Ecological Restoration (SER) provides certification for restoration practitioners based on their academic credentials and practical experience.

What are the socio-economic opportunities available through ecological restoration?

The most significant socio-economic benefit of restoration is enhancement of the capability of our natural environment to provide ecosystem services. This includes crucial elements like climate change mitigation, water security, improved air quality and agricultural productivity, etc. Ecological restoration also has a high potential to involve local communities and thereby generate alternate livelihoods. The extent of degraded ecosystems is high in many parts of the developing world. Significant human resources would be needed to restore these and this could be a good way to generate employments focused on sustainability goals. Importantly, ecological restoration has the ability to reconnect indigenous communities with their roots and thus help preserve their traditional ecological knowledge and conservation practices.

What is the significance of the UN decade on ecosystem restoration?

The United Nations has declared the decade of 2021-30 as the "Decade on Ecosystem Restoration". Coming close on the heels of the Bonn Challenge, this brings a much-needed focus on restoration across the world.

Ecosystem degradation is one of the major issues facing the world today, with the rate of degradation in many ecosystems outpacing the rate of natural recovery. This requires restoration actions not only on an urgent basis, but also on a large scale. This will need strong policy support from governments, funding and capacity building. The UN declaration provides a formal context and the impetus for these to aspects to be addressed.



Are there useful reference materials on ecological restoration?

There are a number of references available on ecological restoration. Some of them are mentioned below.

- **Society for Ecological Restoration (SER)** (<https://www.ser.org/>) is a leading global body on restoration and disseminates knowledge and information through conferences, chapters, magazines, webinars, etc. SER members also get access to an extensive restoration resource database.
- The “**International Principles and Standards for the Practice of Ecological Restoration**” provides detailed guidance to practitioners and can be downloaded from the SER website
- IUCN has published a booklet on “**Ecological Restoration for Protected Areas**” which is available online and gives detailed guidelines on the topic.
- **Island Press** publishes a number of useful books on the subject. For scientific papers and discussions on the topic, one can refer to *Restoration Ecology*, the journal published by Wiley.

ABOUT THIS E-BOOK

Author:

Ramesh Venkataraman

Certified Ecological Restoration Practitioner

Managing Trustee

Junglescapes Charitable Trust

Bangalore, India

www.junglescapes.org



Version 3

January 2021

Junglescapes is a grassroots non-profit based in Bangalore, India and has been working for the last 13 years on restoration of degraded scrub and dry deciduous forest ecosystems. This FAQ document is intended mainly to give an introduction to the concept of ecological restoration to the reader. The views expressed in this FAQ document are based on a combination of our own field experience and resources available on the topic in the public domain. Feedback comments may be emailed to info@junglescapes.org

Third edition of 2021

This overview document was first written in 2016 primarily to create awareness of ecological restoration among stakeholders in South Asia. It was observed that a number of students and researchers in various parts of the world were downloading and using this as a reference document. Hence it was updated in 2019 with a more global readership in mind. This third edition of 2021 coincides with the UN Decade on Ecosystem Restoration.

Reviews

This overview document has been reviewed favourably by the editorial office of the Restoration Ecology journal as a stand-alone FAQ document, with positive comments on its conciseness, readability and sophistication .

Acknowledgements

We wish to thank Ms Sugandhi Gadadhar and Mr Gopakumar Menon for their feedback comments at the draft stages. We also thank Ms Nayantara Karnik for the illustrations and Mr GT Anil Kumar for some of the photographs which appear in this document.

Copyright

All copyrights of this document shall remain with Junglescapes Charitable Trust, Bangalore, India. In case you wish to reproduce or utilise the contents of this document for non-commercial purposes like education or training, you may do so but please ensure that you give credit / citation to this document and Junglescapes.



A degraded forest patch recovering under restoration in the southern part of India