Forest Research

UK - India Forest Landscape Restoration

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and Sandeep Tripathi
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The Research Agency of the
Forestry Commission

Foreword

When we met at the 18th Commonwealth Forestry Conference in 2010 we recognised the importance of our shared interest in forest restoration and agreed the first step in a new UK–India collaboration on forestry. This unique collaborative approach gained further support during the visit of David Cameron, the UK Prime Minister, and led to an agreement to deliver a joint forest restoration project, focusing on several priority areas, by 31 March 2011.

One of the objectives of this initial project was to identify an Indian contribution to the three main elements of the current work programme of the Global Partnership on Forest Landscape Restoration. This project would also support India's priorities to help secure benefits for its most marginalised communities and to demonstrate, through leadership, how this approach could benefit other developing countries within their region. As this project spanned the International Years of Biodiversity and Forestry, the project would also demonstrate how to maximise the benefits to biodiversity through forest landscape restoration.

At the same time, the aim of this collaboration is primarily to develop knowledge exchange between the UK and Indian forest sectors. This will lead to an increased understanding of the broad-ranging contribution forest restoration can make to biodiversity, ecosystem services, climate change mitigation and adaptation, people and economy. This summary report shows how Forest Landscape Restoration can safeguard biodiversity by taking a landscape approach using appropriate technologies and practical applications and produce real benefits for communities by working in partnership with them. This project has resulted in India becoming more engaged in the Global Partnership on Forest Landscape Restoration.

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INTERNATIONAL YEAR OF FORESTS • 2011

Introduction

The loss of forest resources and their functions has wide-reaching effects: from contaminated water and reduced land productivity, to micro-climate change and rural energy challenges. There are also consequences for wildlife and biodiversity as their habitats, the forests, are cleared for agricultural expansion, construction and industrial demands, and to supply energy needs. Increasingly, it is being recognised that more sustainable approaches to forest resources should be adopted at all levels.

Past efforts for massive tree planting have not worked as expected. This is, in part, due to a lack of understanding of the true functions of forests and their influence on the diversity of ecological, social–cultural and economic landscapes. In particular, an understanding of this diversity is crucial to forest restoration and this has been lacking in the past.

A practical approach known as Forest Landscape Restoration (FLR) can be used. FLR relies on demonstrating the viability of other forms of income generation that don't have a negative impact on the forest's resources. The term was developed by a group of forest restoration experts who met in Segovia, Spain, in 2001 and defined it as: a process that aims to regain ecological integrity and enhance human well-being in deforested or degraded forest landscapes. Since then the concept has been further developed under the umbrella of the Global Partnership on Forest Landscape Restoration (GPFLR). The GPFLR is a proactive network that unites governments, organisations, communities and individuals with a common goal to restore degraded landscape. The partnership was initiated with the purpose of 'catalysing and reinforcing a network of diverse examples of restoration of forests and degraded lands that deliver benefits to local communities and to nature, and fulfil international commitments on forests.' The GPFLR approach builds on a number of existing and proven rural development, conservation and natural resource management principles and approaches. As there is no blueprint for successful FLR, since each situation will develop from local circumstances, it has the benefit of providing an approach that is gradual, iterative, adaptive and responsive.

Forest Landscape Restoration: How and why?

Objectives

The objective of this area of work is to provide an overview of forest restoration activities in India and the UK – small and large scale, public and private – that have the potential to deliver benefits for biodiversity and people. This is supported through case studies. This work can then provide the basis for a more co-ordinated approach to restoration initiatives and can help to:

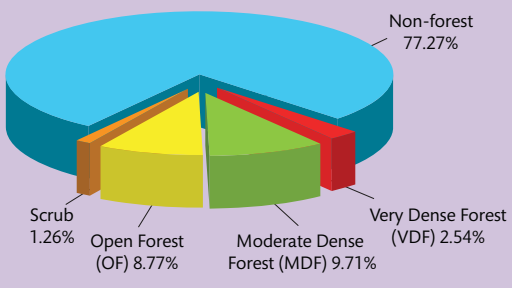
- develop common concepts and guidance
- promote, document and monitor exemplar projects
- identify funding sources/build partnerships
- plan future projects strategically.

Status of Forest Landscape Restoration in India

The first phase of developing a strategy for supporting FLR in India aims to produce a general overview of the country's current forest restoration activities, including specific initiatives in the states of Madhya Pradesh Orissa and Uttarakhand. This review will then provide material for the development of a methodology which can support the implementation of the FLR approach across the whole country.

Class	Area (Million Hectares)	% of Geographical area (GA)
Forest Cover		
Very Dense Forest (VDF)	8.35	2.54
Moderately Dense Forest (MDF)	31.90	9.71
Open Forest (OF)	28.84	8.77
Total Forest Cover	69.09	21.02
Tree Cover*	9.28	2.82
Total Forest & Tree Cover	78.37	23.84
Non-forest		
Scrub	4.15	1.26
Non-forest	255.49	77.27
Total GA	328.73	100

* tree patches less than 1 ha with less than 10% canopy density
Source: Forest Survey India



Forest and tree cover in India in 2007

In India, the management of forests is undertaken with working plans which are prepared using a uniform code for each forest division, an administrative unit, for a period of ten years at a time. Although scientific management of forests in India is over 100 years old, the focus

Causes of degradation of forest landscape

Reduction in forest area:

- diversion of forest land for non-forestry purposes
- encroachment of forest area

Degradation of forest area:

- anthropogenic pressure
- poor management
- disease and other calamities
- overfelling

Fragmentation of forest area:

- infrastructure development
- natural calamities
- encroachment

has been on silviculture rather than landscape. The forest is divided into working circles, on the basis of crop composition, geographical features and socioeconomic requirements, for prescribing management to different species and different kinds of forests.

Status of Forest Landscape Restoration in the UK

In the UK, natural forest once covered 80% of the land area, but most was lost before the industrial revolution through exploitation and conversion to agriculture, so that by 1900 forest cover was only 5%. Large-scale reforestation programmes were led by the state forestry department and undertaken from 1920, taking forest cover to 12%; an increase of 140% in 80 years.

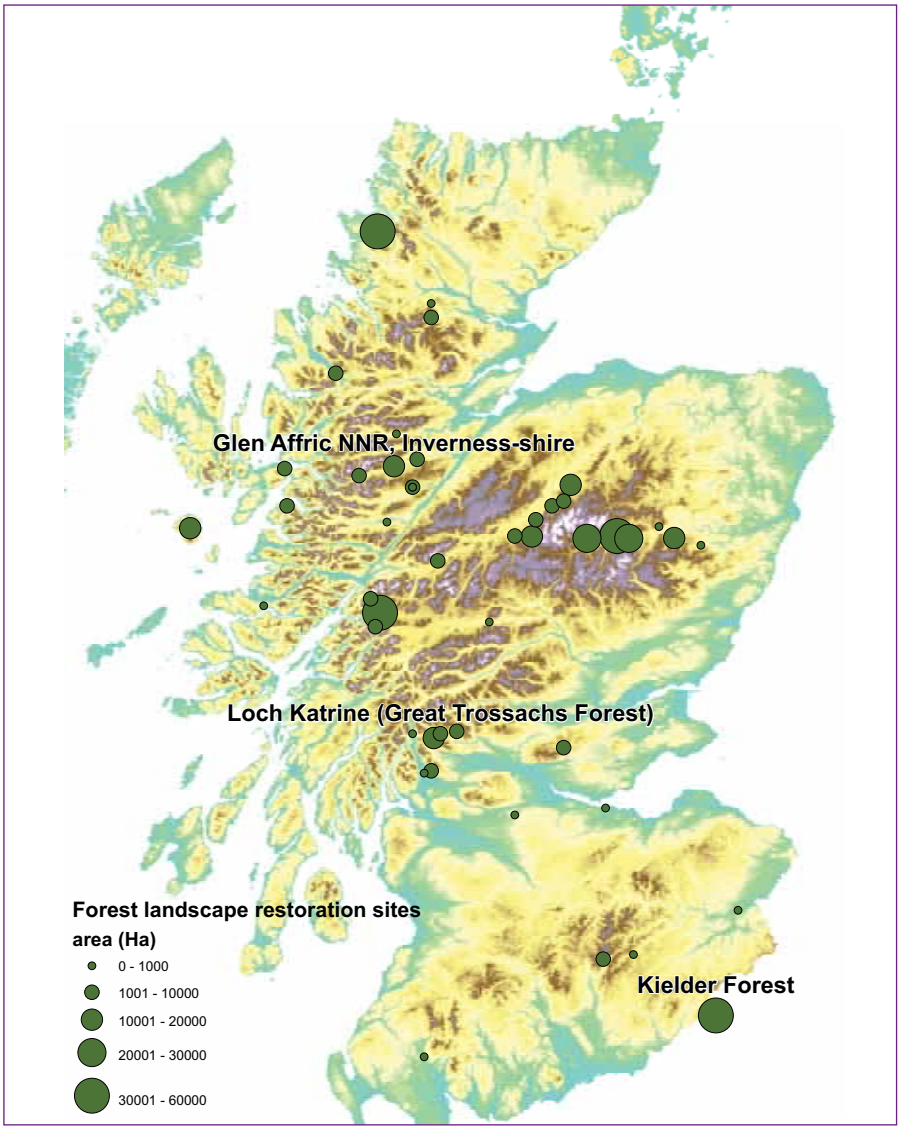
Case studies

Glen Affric is a recently designated National Nature Reserve in the north-west Highlands of Scotland, and is the largest area (22,000 hectares) of Caledonian forest managed by the Forestry Commission.

Great Trossachs Forest is a landscape-scale partnership organised through the Scottish Forest Alliance and covers an area of 16,650 hectares, including the land around Loch Katrine.

Kielder, the UK's largest man-made forest, is being transformed into a resource that is rich in wildlife and recreational opportunities as well as timber.

The objectives of UK reforestation have evolved from being largely strategic (increasing timber reserves) through economic, to the modern multiple-function forests that aim to provide the public with environmental, social and economic benefits. The UK has few native softwood species and most new forests were created using exotic softwoods on poor land, much of which had not been forested for centuries and had considerable technical problems. However, these pioneer plantation forests are already being converted into more diverse and attractive forests with recreational, biodiversity, timber and aesthetic values to meet modern sustainable forestry policies.



Modern forestry policy in the UK is based on the Forest Principles agreed at the Earth Summit in Rio de Janeiro in 1992 and the Helsinki Guidelines for sustainable forest management and for biodiversity conservation, which were agreed by European forestry ministers in 1993. Social, economic and environmental benefits are fundamental and interrelated aims, and forestry is increasingly being integrated with other sectoral interests.

Forestry is regulated by means of legislation, guidelines and standards published within the UK Forestry Standard. The responsibility for forestry is devolved to the different governments within the UK (England, Scotland, Wales, Northern Ireland), which are therefore able to develop distinctive policies and programmes within the framework of the UK's overall approach. As a result, each country has developed its own forestry strategy.

Biodiversity

Safeguarding biodiversity requires the implementation of policy into practice and a number of existing conservation initiatives in both India and the UK would benefit from the FLR approach. The success of FLR projects requires that their outcomes are measured in order that the benefits to biodiversity can be monitored.

Policy into practice

Management of biodiversity and land use change requires consideration of how landscape elements – habitats and species – interact with human land uses, such as forestry, agriculture, urbanisation and infrastructure. This approach provides a framework that describes the interactions between an area's ecology, ecosystem services and human activities, based on evidence provided by study of the real world context. The benefit of this approach is that it would allow individual proposals or options for land use change to be considered with a fuller understanding of the impacts of any changes across a wide area, including effects on biodiversity and ecosystem services, and potential trade-offs or conflicts with forest land resources.

The biodiversity benefits of FLR can be maximised by ensuring that options for land use change contribute to the development of ecological processes and functions and that this is applicable across the range of representative habitats, communities and species at a range of scales. This approach should also facilitate the creation of circumstances under which the effects of habitat fragmentation could be reversed. To assess whether these ecological processes are functioning will require monitoring of the habitats, communities and species at the tree, stand, forest unit and landscape scales. This, in turn, will require cost-effective methodologies that are easily implemented. While it is impractical to monitor all aspects of biodiversity, a careful selection of methodologies is required to adequately reflect the state and changes in forest ecosystems and diversity.

Indian biodiversity conservation projects using Forest Landscape Restoration

- Project Tiger
- Biosphere reserves
- Project Elephant
- Biodiversity Conservation and Rural Livelihood Improvement Project (BCRLIP)
- Integrated development of wildlife habitats
- India eco-development project

Forestry projects in India helping Forest Landscape Restoration

- River valley projects/catchment area treatment projects
- Watershed development projects
- Externally aided forestry projects, including joint forest management, treatment of waste/degraded land, afforestation/reforestation and assisted natural regeneration

Biodiversity conservation

The UK's native woodland cover declined throughout the late 20th century and the majority of this was due to human influence, particularly through clearance and fragmentation, silvicultural management and grazing. The re-afforestation of the 1920–1980 period using exotic species masked a continuing loss and degradation of native woodlands. However, from the mid-1980s the emphasis changed. The planting of native species and the restoration and expansion of native woodlands became increasingly commonplace as biodiversity and other public benefits became more important.

Biodiversity monitoring

It has been widely recognised that biodiversity indicators can be grouped into three non-mutually exclusive categories.

Structural indicators are usually easily quantifiable through forest inventories and can be described as: physical pattern, spatial pattern and temporal pattern.

Compositional biodiversity indicators are usually developed through gathering data in the field relating to: species diversity, genetic diversity and biotype diversity.

Functional biodiversity indicators inform our understanding of ecosystem function of forest biotypes in terms of: ecological processes, natural disturbance and nutrient cycling.

To enable monitoring of complex ecological phenomena and processes, the indicators should combine the structural and compositional elements of forest biotypes and the ecological processes that drive them and work effectively with the different management alternatives applied to them.

The three indicator categories are then related to the different scales at which they operate.

Tree: The building blocks of woodland ecosystems. Their growth and development is crucial in assessing woodland development.

Stand: The ways trees interact with each other across a site and over time will determine aspects of woodland development.

Forest unit: How the different wooded stands and open spaces interact with each other in terms of their ecological function.

Landscape: The context and distribution of the forest units within the matrix of other habitats and landcover.

Case study

Glen Affric is a recently designated National Nature Reserve in the north-west Highlands of Scotland and, at 22,000 hectares, is the largest area of Caledonian forest managed by the Forestry Commission. The current Forest Design Plan states that management should be for the primacy of nature and the return to more natural woodland. However, between 1945 and the 1980s large areas of non-native tree species were planted in the forest. Recently, the focus has been on the removal of non-native species, however a management plan is now needed to direct the restoration process.

The challenge of developing a management plan which conveys a vision of the desired forest structure for the next 150–200 years can be met using landscape ecological tools. These identify silvicultural options that may foster the transition of the forest to more natural dynamics, while maintaining biodiversity and landscape values.

Landscape approach

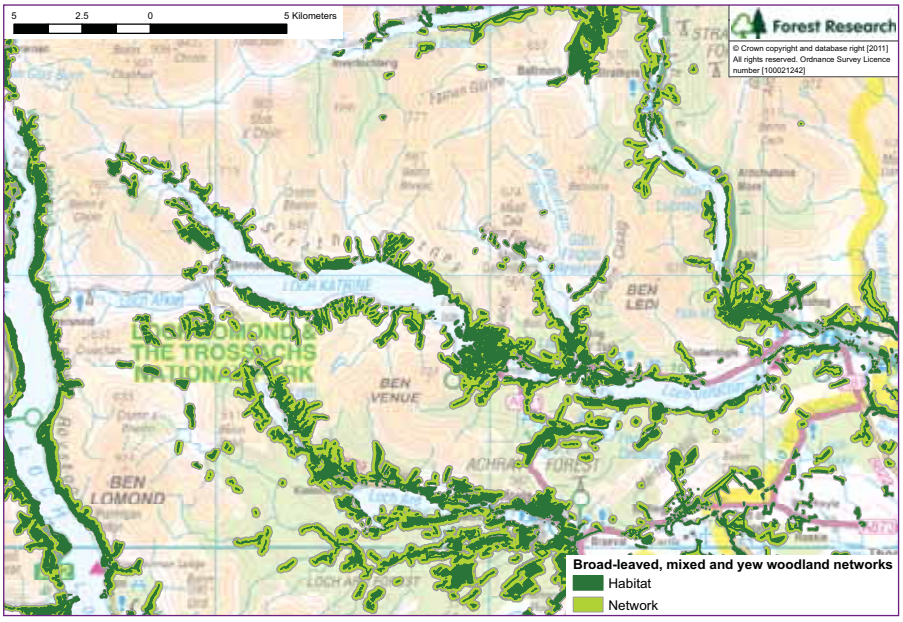
The landscape approach aims to improve biodiversity by getting the right activities in the right places in order to conserve biodiversity and enhance options for people's livelihoods at the landscape level. It is based on the key principles of landscape ecology: 'the interactions between the temporal and spatial aspects of a landscape and its flora, fauna and cultural components'. (Dover and Bunce, 1998[1])

Principles of landscape ecology

- Development and dynamics of spatial heterogeneity
- Interactions and exchange across heterogeneous landscapes
- Influence of spatial heterogeneity on biotic and abiotic processes
- Management of spatial and temporal heterogeneity

Forest habitat networks

This is the concept of planning for integrated woodland networks at landscape scales. The vision is to combine native and planted woodlands to optimise ecological and biodiversity using landscape ecological principles. It is expected that the development of habitat networks will not only benefit biodiversity but also deliver a range of other environmental benefits, such as enhancing local landscape character, providing ecosystem services and creating more opportunities for public access and recreational enjoyment of the countryside The approach recognises that each place is distinctive and that biodiversity needs to be balanced with other benefits within the local context.



Forest habitat networks in the Great Trossachs Forest

[1] Dover, J.W. and Bunce, R. (1998). (Eds) *Key Concepts in Landscape Ecology*. IALE (UK), Preston.

Indian watershed approach

This approach implies harmonious management of soil, water and other natural resources, within the watershed for sustainable and optimum production. Watershed development projects are implemented on the basis of planning for micro-watersheds. On average, a micro-watershed has an area of around 500 hectares. A cluster approach has been introduced in an integrated watershed management programme covering an area of 5000–6000 hectares.

River valley projects/ catchment area treatment projects

There are some excellent examples of the restoration of forest landscape related to multi-purpose power and irrigation projects, some of which started as early as the 1960s, for example Ram-Ganga dam. Their sustainability was ensured by community participation and integrated watershed management. There is currently a large number of river valley projects developing in the Hill States, each of which has a sizeable amount of resources allocated to catchment area treatment. The production of common guidelines, reinforcing the principles of FLR, and an integrated catchment area treatment plan could also help the restoration process in these areas.

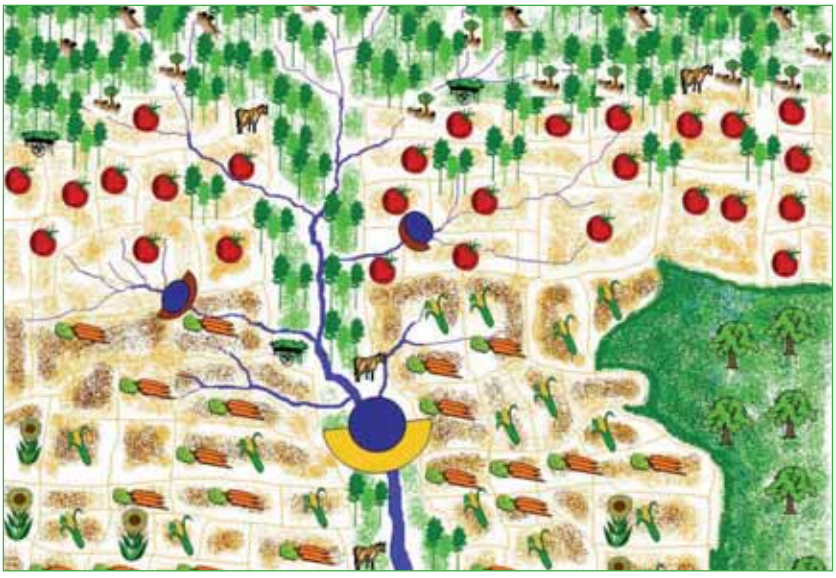
The 1990s saw the introduction of various centrally sponsored schemes, including participatory approaches to the implementation of watershed programmes. The schemes saw the replacement of stand-alone water harvesting structures by holistic natural resource management initiatives. Significant emphasis was placed on community mobilisation, participatory planning and implementation and user groups. Self-help groups and other institutions were integrated into the watershed approaches.

Land Use Patterns And Watershed Development

* **Very high slopes**
* **Rocky and boulder strewn**
* **Very little soil remaining**
* Only grasses and shrubs can be grown
* High velocity of water to be impeded by boulder checks, vegetative filter strips
* Diversion drains to be dug to save arable lands

* **Medium slopes**
* **Degraded shallow soil**
* **Reasonable soil depth**
* Orchard horticulture or agro-forestry on private lands
* Forestry on govt or community lands
* Small brush-wood dams, small check dams
* Terracing of farms

* **Very little slope, almost level land**
* **Good soil**
* **Good soil depth**
* Agricultural crops, high-density horticulture or commercial forestry
* Contour cultivation and contour bunds
* Large check-dams, water-harvesting structures and farm-ponds
* Mixed cropping

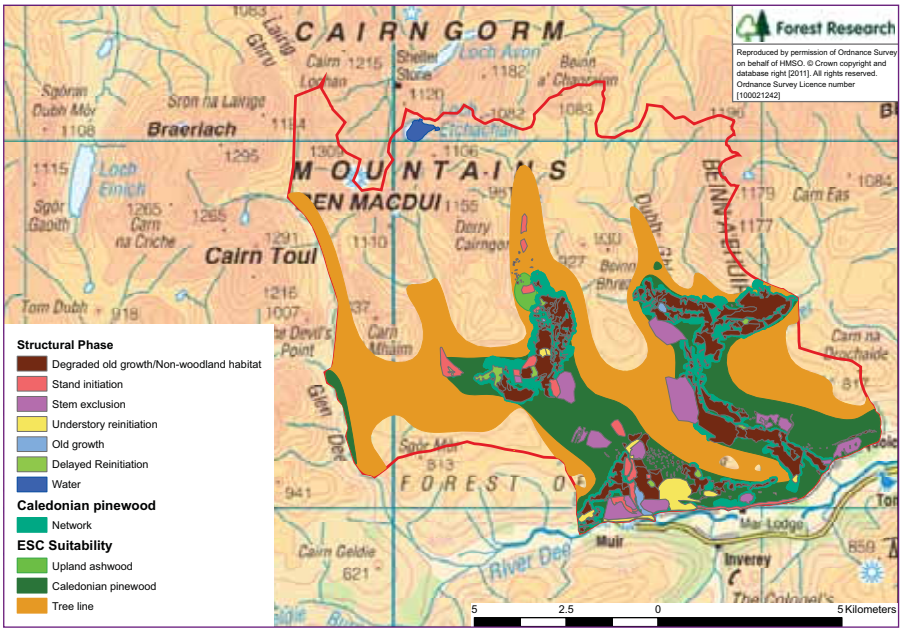


Technology: tools and practical applications

Understanding the spatial distribution and function of landscape components can help target where practical conservation will have maximum impact. The use of appropriate technology to support FLR can aid the implementation of the landscape approach.

Landscape connectivity modelling

The use of spatial tools to inform sustainable forest management opportunities is a key part of the forest design planning process, aiding the delivery of management objectives and improving the objectivity, transparency and accountability of the decision-making process. The tools provide forest managers with the ability to address a landscape scale approach to habitat management, to select ecologically suited species to sites, and to estimate the probability of wind damage. This is essential in relation to the improvement of habitat for the long-term viability of priority and protected species. The lessons from a number of UK case studies are now being used to explore the implications of a landscape approach to Sustainable Forest Management in other forest types in the UK.



Landscape modelling to help prioritise forest restoration

Participatory planning

Informed participatory spatial planning and the delivery of the FLR approach are key to a landscape approach are habitat and resource management and to selecting land uses and habitats that are ecologically suited to sites. They can also help to ensure that relevant restoration projects are located where they can provide most benefit for people and biodiversity.

The implementation of the FLR approach involves large and complex interactions with many possible solutions. Heuristic approaches can be used to assess different opportunities and identify key land use or planning units. This can be coupled with sustainability indices and landscape-based models to reflect the multiple challenges in land use planning. There will need to be a set of integrated hierarchical planning tools:

- Strategic – mainly at the policy level;
- Tactical – mainly at the level of landscape governance; and
- Operational – at manager level.

One key development is that of a Stakeholder Planning and Learning Platform (SPLP) that can operate on laptops or touch-tables to calculate ecosystem service indicators for multiple scales based on the arrangement of land use components in a landscape. New open source technologies offer accessible ways to build such systems and make them available to all at low cost. The use of such tools within FLR areas can be used to calculate and demonstrate to stakeholders various indices and measures of how the spatial configuration of land use and land cover impact on biodiversity and ecosystem service delivery. The process will help stakeholders agree trade-offs to secure the local or regional mix of ecosystem services that communities need. This is fundamental, as forests provide crucial resources for the livelihoods of communities in both the UK and

India through sources of employment, building materials, maintaining soil and slope stability, attenuating flood peaks, and improving water quality.

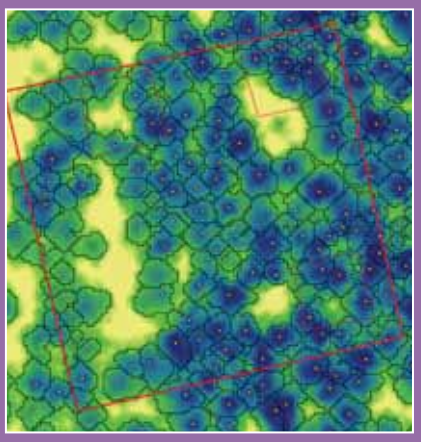
Mussoori mines

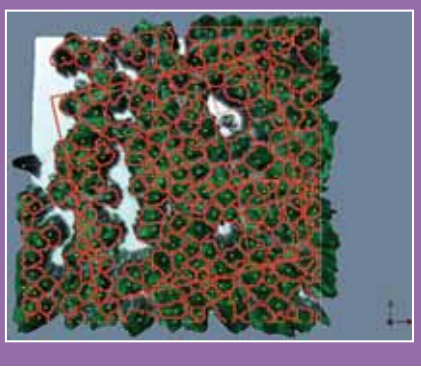
In India, the restoration of mining areas is largely carried out through the use of Central or State Government funds. These projects are very important as far as the connectivity of forest areas is concerned and also help in restoring the badly scarred and eroded forest areas. In many cases, the help of Eco Task Force, a special unit of the Indian Army, is also sought to rehabilitate the areas more quickly and in these cases the funding is generally provided by mining agencies. The restoration of mining areas requires the use of mechanical measures, including the construction of dams, gabion structures and retaining walls.

Work in the Mussoori Hills, in the outer hills of the Himalayas, demonstrated the role of forest restoration in improving the environmental and ecological impact of mining. This area has seen significant mining activity, particularly for high-quality limestone, with 27 active mines and quarries in operation prior to 1980. A change in legislation by Prime Minister Indira Gandhi in 1980 led to the start of restoration of forests in this area.

Remote sensing

Satellite imagery is being used to assess the forest stand condition in India. Fourteen forest zones have been described from analysis of 4,000 plots per annum and 16 forest type groups have been described in India, with a sub-division to 200 unique forest types. Satellite imagery can also be used to assess the condition of forest stands and identify degraded forest suitable for restoration. When linked to connectivity modelling, the use of remote sensing will aid a landscape approach through the spatial targeting of conservation efforts in order to reduce forest fragmentation and improve biodiversity.





It was thought that the mining activity had disturbed springs in the hills, on which local communities are extremely dependent for water. Mining had also affected the water quality of streams and rivers draining the area. The Indian Government gave the environmental restoration task to the Eco Task Force. Their work and the subsequent 28 years of environmental respite have resulted in significant changes to the area.

The project has brought about the restoration of 10,900 hectares of formerly degraded land that used to contain 25 mines; the 10 millionth tree was planted at a ceremony in July 2010. The Indian Forestry Department and the Forest Research Institute helped provide expertise and some of the supplies for the operation. However, in consultation with the Forestry Department, the army and village community were involved in some aspects including planning, choosing tree species and some techniques such as soil chemical analysis. Planning the restoration work began in March; planting took place during the monsoon season of July to September, and October marked the preparation of nursery plants for the following year.

The involvement of the local community was such that soil and trees were carried by the army and local people to the restoration sites. The chosen species were of importance for longer-term use by the local community, such as for fodder, fuel and food.

Communities

Engagement with communities through collaborative learning ensures that stakeholders are involved in making informed choices about the type and configuration of forest establishment they wish to see in their landscape. This can be achieved through a number of initiatives. Moreover, local involvement need not stop there and it is essential that communities are given a meaningful role in shaping and benefiting from the management of future forest resources.

Rural communities

Joint forest management (JFM) initiated under various projects in India has been successful in many states. Owing to a change in the legal status of forests, allowing communities to use and benefit from them, the forests have been maintained and improved. The best results have been achieved by committees which have been properly formed. For example, in Uttarakhand, the community forests, known as 'Van Panchayat', are very old institutions backed by legal instruments and they are working well in many areas. In many places it is traditional to maintain sacred groves in the name of a village deity and some of these have been documented by organisations working in the area. It has also been demonstrated that community groups are very good at making links to take advantage of the local infrastructure; for example, one group used harvested grass as fodder for newly introduced hybrid cattle with higher milk yield, and took advantage of an existing regional milk collection route that came past their village. Women of one community group also started a tree nursery to raise plants for the restoration and to sell to other communities.

Process of community Forest Landscape Restoration

The process of community FLR begins with the decentralisation of decision making from the department to the community. This is achieved with the help of a forestry department forester as the secretary. The community can also be given increased confidence in the venture through the generation of resources, but the community must discuss and find its own solutions. The development of plans on the ground is aided by legislation; the National Rural Employment Guarantee Act (2005) provides 100 days' paid work per year for every adult in a rural household to do public-related work. Not only does this help the planning process, it also helps the poorest families in the community.

Effective public forums

One essential component of landscape management is the use of effective public forums. This enables stakeholders with diverse interests in landscape to debate and negotiate land development and conservation options. It also helps achieve a common understanding of the consequences of various land use action and activities, and the need for tradeoffs associated with each option. For public forums to be successful and fully participative, public debate must be integrated into the hierarchy and sequence of the landscape planning process.

Gaining public support

Gaining and maintaining public support is fundamental to the success of landscape management. This can be done by clearly defining what landscape management is, and making sure that its multiple goals and benefits, such as for human health and environmental issues, are understood, particularly by decision makers. Innovative technologies using remote sensing and geographic information systems (GIS) supporting Stakeholder Planning and Learning Platforms can also aid this process.

Urban communities

While much of the focus of enhancing biodiversity is within rural areas, urban areas can also contain strategically important species and habitats. Losses in habitat at crucial points could adversely affect the ability of species to disperse in response to climate change. It is important to identify these 'pinch points' so that planning decisions do not compromise maintenance and enhancement of FLR. Community engagement in these urban situations is equally as important as in rural communities. The Barren Hills project on the outskirts of Bhopal in the State of Madhya Pradesh is one such example. In this area, integrated management for water resources, biodiversity and recreation is taking place within the urban fringe, as well as grass harvesting for fodder.

Community forests in the UK

During the 1990s a series of 12 visionary schemes were developed for new large-scale community forests in England, primarily to become a recreational resource in poorly wooded lowland areas within easy reach of urban centers. Although a lot has been done to engage local people and manage existing woodlands, progress with planting was slow initially, mainly due to low availability of land. Farmers have been reluctant to plant their arable land and widespread public land purchase was considered too expensive or politically undesirable.

Community forests and The National Forest of England are now gathering momentum and being joined by a host of smaller community woods of different types, such as those on derelict and reclaimed land in former industrial areas. Here the emphasis is on 'social forestry': the benefits should be measured not by trees planted but by the experiences which people take from these woods. Even small woods in and around towns are more important to most people than remote tracts of semi-natural forest.

Forest restoration to promote ecotourism in Dhanolti, Uttarakhand

- Dhanolti, 7,800 ft above sea level in Uttarakhand Province
- Population of 2000 people
- Ecotourism Park established in 2008; 50,000 rupees income from ticket sales in first year, 1.7 million rupees in 2009, and 2.5 million rupees in 2010
- 30% of income used for site maintenance, 10% for the community fund, 20% to the state, 40% for the park employees
- Committee made up of 18 executive members, 100 other stakeholders – these include mule owners, store holders, hotel owners, restaurants etc.
- New forest lodges built to house 6 holiday groups; campsite also being established
- Tourism has increased dramatically in Dhanolti since Ecotourism park established

Conclusions

An FLR approach brings people together to identify and put in place a mix of land use practices that will help restore the functions of forests across a whole landscape, such as a water catchment. FLR focuses on restoring forest functionality at a landscape level rather than at site level, which translates into gaining the optimal quantity and quality of forest resources necessary for improving and maintaining people's well-being and ecological integrity. In addition to restoring forest functions, the aim of the approach is to strengthen the relationship between rural development, forestry and other natural resource management and conservation approaches. It shifts the emphasis away from simply maximising tree cover on individual forest sites, to optimising the supply of forest benefits within the broader landscape.

Forest Landscape Restoration: the way forward

Over the past three decades large numbers of externally aided forestry projects have been implemented in almost all the states of India. In some states, the revised and improved versions have been taken up for the second and third times. Most of these projects had components addressing FLR with stakeholder participation, such as joint forest management. Though the successes during the project phase were remarkable, the question remains as to their sustainability in the post-project phase, which has not been encouraging. The maintenance of assets created during the project phase, including FLR components with the help of village communities, could be the key factor for their sustainability. Compensatory afforestation (CA) is a condition in land transfer cases where forest land is diverted for non-forestry purposes.

Objectives will change in response to society and it is important to take a flexible approach to adapt our forests. Exotic monocultures have acted as a pioneer phase to re-establish forest ecosystems: now it is possible for them to be developed in almost any direction. It is hard to identify clear ecological restoration goals in a country with a long history of massive human intervention, but this legitimises a greater range of options and mixes of social, environmental and economic outputs. Although the full 'natural' forest ecosystem may never develop, or will take centuries, a woodland ecosystem supplying most other functions can develop in just a few decades.

It is still hard to achieve truly landscape-scale restoration projects, because of the pattern of land-ownership and complex overlapping interests in India. Wall-to-wall forest is not the goal, but rather mosaics of woodland and other habitats or land uses, which must be integrated with sectoral plans. A strong state forest sector acting as a catalyst has been important, together with regulatory, planning and funding mechanisms which encourage co-operation and integration.

Community science:

Linking technology and communities

Community science encompasses the idea of giving science to communities and stakeholders, in order that they can best meet the social and technical challenges of delivering Forest Landscape Restoration. The development of integrated land use, decision support tools in collaboration with key stakeholders can be used to enhance their capacity to plan strategic and tactical Forest Landscape Restoration interventions at regional and local scales. In turn, the use of planning tools can support assessments of the impacts of land use change, and of the ability of the landscape to support these changes. A better understanding and a comparison of these impacts at the landscape level in India and the UK will improve targeting of habitat restoration projects. It will also relate these projects to policy objectives such as Green India Mission and UK Forestry and Biodiversity strategies. Additionally, it will provide a platform for diverse stakeholders to participate in planning and decision-making processes, thereby enhancing opportunities for collaborative learning and institutional adaptation.

A measure of success: monitoring and evaluation

In future we need to develop better evaluation and monitoring of projects. This will foster a clearer understanding of the many forms of Forest Landscape Restoration that are possible, and enable us to achieve a more precise balance of objectives for projects, suited to the circumstances of people and place.

Valuation of the landscapes:

Social valuation: participatory mapping for livelihood outcomes, historical, national, ethical, religious and spiritual values

Economic valuation: direct use, indirect use, option value

Ecological valuation: rapid ecological assessment that includes biodiversity monitoring

Cost-effectiveness: estimating the net value of ecosystem service benefits under different reforestation scenarios (passive versus active restoration)

Sensitivity: discount rate and market value

Future research questions

What are the key ecosystem services provided by forests and wooded landscapes and how should they be measured? Which methods are appropriate, and what are the limitations and benefits of such measures/indicators of ecosystem services for use in different types of landscapes? What can we learn from applying these measures/indicators to different situations and various spatial/temporal scales?

Forest Research

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