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Integrated Ecosystem Service Rehabilitation in Great Britain

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Abstract

Sustainable management of ecosystem plays a vital role in the well being of society. Human activities related to developments have caused significant damages to the normal functioning of the environment. This coupled with the current issue of climate change; it puts ecosystem services of the environment even under stronger pressure. In the recent times the government of UK has been making considerable efforts to restore degraded areas at grass root level to ensure its sustainability. The main objective of the initiative is to enhance ecosystem services of the landscape. Ecological benefits such as provisioning, regulation and cultural services have given prior attention. In this study seven sites across Great Britain were visited to observe the performances of projects working on the rehabilitation of degraded areas and conservation of forest landscapes. Field observation and discussion with stakeholders and managers of the respective projects were the main sources of data. The result of the study shows broad achievements of the projects and strong commitments of the stakeholders.

1. Introduction

Earth's ecosystems play a vital role in the development and wellbeing of man kind. People rely on their surrounding ecosystems for their basic needs such as food, shelter, cloth and other benefits [13]. This service of our ecosystem is commonly referred to as ecosystem services [2] [4]. The intensity and the way of utilizing these resources highly determine the availability of these resources at any time in the future. In the Great Britain considerable environmental damages took place during the industrial revolution. Mining of minerals, coal and intensive farming have created considerable areas unsuitable for other development works [14] [3]. Besides this, the current high growth rate of demand for ecosystem services in developed countries and sky rocketing increase in the population of developing countries have a detrimental impact on the sustainable utilization of the ecosystem resources [10]. Furthermore, current economic development and climate change pose greater risk on the sustained supply of future ecosystems services [8]. Sustainable management of ecosystems is required to enhance the contribution of ecosystems to human well-being without affecting their long-term capacity in providing these services.

In this regard there have been various efforts being undertaken in the Great Britain to enhance the potential of various landscapes in providing ecosystem services. As such this study aims to highlight the works implemented so far and the achievements of environmental projects in Britain at selected sites. The study areas include national parks, networks of woodland across wide geographic areas, forestry research station and private forest companies.

2. Methods

2.1. Study Area

The study areas are located in Great Britain particularly in North Wales, North West England, South and South East England. The studied sites consist of National Parks, public forests, networks of woodland, forestry research station and private forests. The study sites were selected based on the suitability of the projects towards the achievement of ecosystems service enhancement goals of the particular projects. The details of the study areas can be found on Appendix A.

2.2. Data Collection

Discussion with the stakeholders and the local managers of the projects, field walk observation, group discussion and key informants were the main source of data. Peer reviewed literatures, bulletin and websites of the studied projects were also consulted for further information. The study was undertaken in the early weeks of May, 2011.

3. Results and Discussions

3.1. Bryn Muerig Private Forest

Bryn Muerig forest is owned by Cadwalder Family in Bethesda, Gwynedd, North Wales. The surrounding area of Bryn Muirig used to be a mining place for coal and slate. However, due to the progressive development of woodland and proper conservation of riversides and pasture by this private company, the surrounding area is now well recovered from the mining damages in most parts of the landscape and now it is very attractive to visit and stay in. The company's forest land is the major contributor of income to the family by providing timber and fuel wood. In addition, the company use tree products for fencing material and also sale for chip processing company. Pasture is also another provisioning service that this woodland supplies for the family. On the other side, the contribution of this woodland towards soil and water conservation, water purification, microclimate amelioration and wildlife conservation is very high. Carbon sequestration is also another function of this forest as it continuously supplies wood which is carbon neutral and can be used as energy source or substitute high energy materials like metal products [6].

The forest company sale its product by adding value to the forest product using its own machinery. This helps the family to get more value for their products and also to create job opportunity [5].

Bark stripping of trees by squirrels, vandalism and fire are threats to the management of the forest.

The manager of this forest is well knowledgeable about ecosystem service of forest and highly enthusiastic to contribute to the area's environmental quality.

3.2. The Newborough Forest

The Newborough Forest is a plantation forest established for the purpose of protecting wind blown sand problem in the Isle of Anglesey in North Wales. Planting of trees were taken as a measure to protect damage caused by wind blown sand on the surrounding settlement and farmlands. The problem is now almost solved after a lot of efforts have been made in establishing the forest. In addition to serving as shelter from wind, the forest provides multiple services by creating a special area for conservation of red squirrels, raven herds and other bird species. The establishment of the forest also creates greater opportunities for public enjoyment of the countryside.

The forest is mainly established from single tree species of Corsican pine. The plantation of this tree species seem performing well except on the areas bordering with the sea which is prone to high salt and sand laden wind.

Despite the different roles this forest plays in sheltering the island from strong wind and conservation of wildlife, some environmentalists are criticizing the establishment of forest in this area. The major reasons they mention are the lowering of groundwater table of swamp areas in the forest which are used by migratory birds, and artificial sand dunes created on the shore of sea to shelter trees from direct wind blow.

However, it seems that the establishment of this forest in the area is benefiting the local community more than when it was not there as it is able to stop the strong sandy wind. So, conservation of this forest in more environmentally friendly way has paramount importance in improving the environmental conditions of the area to the welfare of local community and the wildlife as well [12].

3.3. The Mersey Forest

The Mersey forest is an extensive network of community woodland and green spaces spread across Cheshire and Merseyside in the North West England. The woodland offer diverse ecosystem services to farmers, local people, visitors and to the mitigation of climate change.

The creation of this forest primarily helps farmers to obtain benefits from planting trees and orchards on their unproductive land, woodland grant scheme, and diversifying their income sources.

Secondly, the management of the forest and its products create job opportunities for local people, improves the scene of settlement areas and also serve as recreational and educational destination. Currently annual visits to the area by people from different places exceed 500,000.

Thirdly and more importantly, the forest is functioning in reclaiming highly degraded lands by mining, creates wild life habitat, and highly counteracts the impacts of climate change through sequestering carbon, serving as a sink of waste and source of clean water and air. Since the forest covers large geographic areas and contains diverse habitats (forest, stream, wetland and pond), it plays paramount importance in

conserving biodiversity of the country through connecting large number of habitats and favouring wide distribution of wild animals [7].

The stakeholders of the Mersey forest include local and national organizations. The involvements of those organizations highly help in realization of different ecosystem functions of the forest. Moreover, since the development programme is mainly participating local communities at grass root level it can highly secure the sustainability of the forest management [11].

3.4. The National Forest

The National Forest is a network of woodland in Central England for the purpose of mining site reclamation, woodland and habitat creation, biodiversity and environmental conservation. Woodland creation has been undertaken on farmers and public land through active participation of farmers and local communities. The involvement of local community in the forest management and wide geographic coverage of this forest will highly help to achieve sustainable wildlife conservation [11].

The park delivers multiple ecosystem services including timber production, wildlife habitat (forest, ponds and streams), recreational services and biodiversity conservation. The planning and management activity of the forest were fairly well designed and implemented as it was observed on site. The park management places higher attention on the reclamation of degraded land due to mining. Intensive management efforts made in the past has reclaimed the degraded areas and now changed to an attractive and life supporting environment. The other focuses of the park management are habitat creation, recreation and timber production. In these regard the park management has achieved an exemplary work. There are a variety of habitats in the park including forest, wetland, pond, stream, cliff and meadow which have significant importance to conserve the biodiversity of the region. There are a variety of birds, reptiles and insects in recently reclaimed small lake and woodlands. For the easy movement of wildlife among woodlands tree corridors (hedgerows) fairly planted and managed at different lengths with a variety of tree and orchid species. The area has also attractive recreational sites. The woodlands are well connected by trails of 8km which is very important for visitors and management purposes. Different tree species are planted in the forest at landscape level which will be a source for quality timber. There are also patches of woodland planted with different plant species to mimic a natural forest condition.

The forest management has also placed reasonable fire control mechanisms. The measures put in place to reduce and control fire incidence includes: planting space between trees, trails in between woodlands and small water lakes in the area.

3.5. David Burchell Private Farmland

David Burchell private farmland is a 65 ha field found in

The National Forest which actively supports the farmland in management activities. The farmland is managed under a variety of land uses including woodland, cropland, cover crops, shelterbelts (riparian trees), hedgerows, aquaculture and pasture.

The woodland consists of diverse species of old to recently planted trees. The trees are planted in different parts of the field mainly for the purpose of conservation (along rivers and hills) and to use unproductive lands (acidic and old farms). The woodland is a source of income for the farmer as timber and fuel wood source. The farmer owns small wood processing machinery which enables him to add values on forest products and to sale in better price as a result.

Furthermore, the forest has outstanding benefit beyond creating income. Due to its appropriate location for conservation purposes in the area, the woodland contributes significant role in erosion control in hill areas and reduce pollution and siltation in the river and downstream water bodies [6] [7]. The forest also serves as habitat for different wildlife like birds, insects and squirrels. In particular, the farmer also uses the forest as habitat for game birds.

He charge 18 to 40 pound per bird. Similarly, in the river and open areas of the farm different income generating activities are being taking place. In the river passing through this farm almost every watercourse bank is planted with different tree species. Inside the water fish production and along the river side timber is some of the income generating activities practiced by the farmer. Wide field in the open land area is used as pasture for sheep, horse and dairy production. There are also areas used for crop production. Poultry production activity is also practiced in a very attractive and modern way with only facilities made from cheap local materials. The farm manager is well knowledgeable about the contribution of forest and different land use systems towards sustainable development and biodiversity conservation. The objectives of the farm land have been very well achieved as can be observed on the field.

3.6. The Alice Holt Forest

The Alice Holt Forest offers a variety of ecosystem services in South East England which is highly industrialized part of the UK. The majority of forest stand is mature whereas the forest is diverse in its species composition. The contribution of this forest towards carbon sequestration, soil and water conservation, climate amelioration and pollutant assimilation is very high as it covers wide geographic ranges [1][6]. Other land use systems like pond, wetland, meadow and streams are also located in the area which is very essential for biodiversity conservation. The species composition of the forest is diverse, but the dominant tree stand is conifer which has significant income source for the park from the sale of timber. The other and the most important ecosystem service in generating income for the park is its recreational services. Alice Holt forest has got the most sophisticated and diverse recreational facilities than the other forests visited. The recreation facilities in place are very unique in their design and most of them are made from

local materials like wood and live standing trees. The trails in the forest are also well connected to important visiting sites. Wide car parking places are also available. A lot of people visit the forest from local areas and big cities like London. The fee to visit the park is very attractive as it only charges for car parking. The flow of tourism to this area per annum is over 350,000 people and the visit number is highly growing in the past 4 years. Income from the payment of filming by film companies is also high as most film industries use this forest. High prosperity of society in this region seems contributed to the development of recreational facilities in the forest.

Alice Holt Forest management team has wider experience in demonstrating and training students and visitors in the forest. As a result, it has got a certificate for '*Learning Outside the Classroom Quality Badge*'. It acts as an assurance that the Quality Badge holder meets a good standard of provision, both in terms of Health and Safety and in the quality of the education experiences on offer. Therefore, students at different levels of studies visit the forest for practical learning purposes.

3.7. Alice Holt Research Station

Alice Holt Research Station is one of the members of *environmental change network* in the UK. The research station undertakes forest researches in the South and South East England. The research objectives of the station mainly relate to climate change studies. The major ones include:

- i. How woodland can cope with climate change?
- ii. How woodland help in reducing climate change effect?
- iii. Tree growth and yield to estimate carbon sequestration.
- iv. Tree pest and disease

The research station carries out these studies by integrating a combination of monitoring, experimentation and modelling based heavily on a large infrastructure of environmental science. The research station undertakes monitoring of tree growth rate (stem diameter and biomass), soil organic matter, the exchange of greenhouse gases in soil and atmosphere, the hydrology and incidence of pests and diseases in the forest. The research facilities are aimed to better understand and find possible solutions to climate change effects through identifying adaptable tree species and to predict the strength and rate of climate change occurrence.

In the research station there are enclosed old growth oak trees, other plant and animal species. The forest provides significant ecosystem services like biodiversity conservation, research and educational purposes, soil and water conservation services [1]. And also it provides regulation service by sequestering carbon and climate amelioration.

There is also nursery management works, urban greening and research activities in urban and peri-urban areas across southern England.

3.8. The New Forest

The New Forest National Park has been delivering different ecosystem services since the time of King William I

(in the 11th century). At the time some part of the forest was used for game hunting by the Royal family and also accessible by local people for fuel wood collection, cattle grazing and cultural services. In the current time the forest provides diverse ecological services [9].

The forest and its landscape offers timber, fuel wood, pastures, games and freshwater to the local community. The park makes considerable revenue especially from the sale of timber and fuel wood. Pasture and fresh water on the other hand provides great benefits to the local people. Currently more than 5,000 animals graze in the park with other wild animals.

Regarding regulating services of the forest, it is playing positive role towards climate change regulation through carbon sequestration and extreme weather regulation [1] [6]. It has also a significant contribution for soil and water conservation as the forest mostly found on marginal land and hill sides. Waste decomposition and water purification are also another function of this forest as it is found in highly populated areas [12].

The most important cultural services provided by this forest are recreational and educational services. The area is fairly accessible from different directions of the country and the number of visitors to the site is substantially high. Recreational facilities and trails in the forest are well placed for easy visits in the forest. High tourist flow in to the area encourages business activity of the area besides direct income to the national forest. The forest has also high potential for educational visits and researches. It contains ancient, mature and young forests with diverse landscapes, plant species and different habitats which is ideal for comprehensive studies.

The forest ecosystem service towards supporting service is also considerable as it contains different plant species of different age and animals distributed over wide area. This condition would fairly help in facilitating soil formation, nutrient cycling and primary production [1]. The park also makes income from the preparation of compost from bracken plants.

As the forest has diverse habitats the park implements different management approaches. In heath land areas controlled fire is used to encourage grass growth where as forests are usually harvested when mature for timber or fire wood. In a stream of Black Water the park is restoring the stream from its modified flow direction. The park experts believe that it has considerable contribution towards biodiversity conservation if its natural condition is restored.

The New Forest management objective fairly covers the management of different ecosystem services and the park has achieved its objectives very well. The major focus of the managers is towards timber production and recreational services. They have also given greater attention towards biodiversity conservation as it can be seen from the restoration activities in Black Water stream.

4. Conclusions

In the recent times there is a growing awareness of the UK government towards the issue of environmental problems

that have been caused from decades of development works and more recently in relation to global climate change. As a result, there have been wide projects planned and undertaken on the reclamation of degraded land, reforestation and development of woodlands on marginal and hilly areas to enhance ecosystem services of those areas. To achieve these goals national parks, research stations, communities and farmers are being highly involved. Specifically the management objectives of national parks and private farmers are directed to ecosystem service enhancement through landscape reclamation and development. As a result, ecosystem services of the environment such as timber production, recreation and tourism, habitat or biodiversity conservation and rural income diversification have been considerably enhanced. On the other hand, the objective of research station is concerned with the research of trees adaptable to the changing climate, the response of forest in the changing environment, disease and pests. In this regard, the research station at Alice Holt has been contributing on the

science of climate change and in the enhancement of ecosystem services of forest areas at the station and in greening urban and peri-urban areas.

The commitment and determination of stakeholders to achieve these development goals appears very strong. In general the objectives of the project sites visited were well addressed with strong participation of local community.

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Appendix

Table 1. Visited forests profile summary.

Name	Location	Total area	Ownership	Objectives	Forest type and age
Bryn Meurig	Bethesda, Gwynedd, North Wales	25 ha	Privately owned by the Cadwalder Family	<ul style="list-style-type: none"> Timber Production Firewood production Biodiversity enhancement Recreation Stabilize sand dunes 	High Forest (mixed oak woodland), Old field succession and open ground for horse grazing
Newborough Forest (Niwbwrch)	Anglesey, North Wales	951 ha	Welsh Assembly Government	<ul style="list-style-type: none"> Timber production Conservation Recreation 	Pine: Mostly Corsican (93%) Broadleaf: Sycamore, Birch, Alder Age: 40 – 60 yrs
The Mersey Forest	North West England (Cheshire and Merseyside)	1,190 km ²	Partnership of seven local authorities (Cheshire West and Chester, Halton, Knowsley, Liverpool, Sefton, St. Helens & Warrington), landowners, the Forestry Commission, Natural England and businesses including United Utilities.	<ul style="list-style-type: none"> Land reclamation Health and recreation Forest school sites Biodiversity recovery Community capacity building 	Age: from 1 to 20 years Plantation forest Mixed Conifer and Broadleaf Species include: oak, pine, cherry, beech and birch.
The National Forest	Central England across the counties of Derbyshire, Leicestershire and Staffordshire.	512km ²	Diversity of ownerships (private, public, only minority owned by National Forest Company)	<ul style="list-style-type: none"> Landscape enhancement. Habitat creation and management Recreation and tourism resource Growing high quality timber, Rural diversification Stimulating economic development Community involvement 	84% broadleaves 16% conifer Major tree species include: oak, ash and birch 3,000ha forest cover is older than 20 years 6,500ha of woodland from one year to 20 years old.

Table 1. Continued.

Name	Location	Total area	Ownership	Objectives	Forest type and age
David Burchell Farmland	Central England	65ha	Private	<ul style="list-style-type: none"> Enhancement of property value Timber production Creation of diverse habitat for conservation purposes Water quality improvement Multipurpose Forest 	16,000 new planted trees some mature woodland Mixed species with emphasis on native broadleaves Farm Building dated back to 1677
Alice Holt	Farnham, Surrey	850ha	Forestry Commission	<ul style="list-style-type: none"> Recreation and tourism resource Forest schools Team/ leadership training Habitat/ Biodiversity management 	Ancient semi-natural woodland 90-120 years containing beech; conifer stands; mixed broadleaf; mixed conifer and broadleaf
Alice Holt Research station	Farnham, Surrey	90ha	Forestry Commission	<ul style="list-style-type: none"> Climate change research on forestry Research on forest disease and pests 	Ancient semi-natural woodland 90-120 years predominantly oak and ash

Name	Location	Total area	Ownership	Objectives	Forest type and age
New Forest	SW Hampshire to SE Wiltshire	376km ²	The Crown, a number of private landowners, local authorities, private trusts	<ul style="list-style-type: none"> • Nature and landscape conservation and enhancement, • Protect and enhance the large-scale cultural landscapes, • Encourage sustainable land management • Plan for the likely impacts of climate change on the special qualities of the New Forest 	<p>Ancient forest (400 yrs)</p> <p>Pasture Woodlands mainly broadleaves (oak, beech, birch).</p> <p>Open forest habitats (heath land communities and valley mires)</p>

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