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Forests

Celebrating:

H.M. The Queen's Platinum Jubilee

The Queen's Commonwealth Canopy and the Queen's Green Canopy

World Environment Day and the Commonwealth Heads of Government Rwanda Meeting

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(Cover picture "Tropical rainforest and a sediment-laden river after a storm at the Maliau Basin Field Centre, southern Sabah, Malaysia" (The field centre is one of three rainforest educational and research stations operated by Yayasan Sabah in their forest concession in north-eastern Borneo) (photo Ian Douglas).

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CHEC Journal 32 Forests Special Issue

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Introduction: our precious forests and their protection and enlargement

Ian Douglas

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The vital importance of forests

Forests support a huge proportion of the world's life and keep our world in balance. They are the vital 'lungs' of the planet, taking in carbon and breathing out oxygen. They are the habitat for countless species, most of which are not found elsewhere. In a warming world they provide our best chance for survival (Brindley, 2022). Forests help to mitigate climate change. Trees can be seen as nature's carbon-capture technology. Forests thus helping to mitigate climate change.

Forests cover one third of the earth's land mass and perform vital functions, supporting the livelihoods of 1.6 billion people who live in and around the forest or use and transform forest products, including many highly significant medicines. Forests, like the oceans, are key elements in the global climate system, regulating not only atmospheric chemistry, but also atmospheric water vapour.

Trees help to make rain by releasing water from the soil and forest to the atmosphere. They uptake moisture from of the soil through their roots and release it from their leaves to the air during the day helping to create rainclouds and shaping global weather patterns. In Sabah, north-east Borneo about 30% of the rainfall is returned to the atmosphere from the trees by these processes of evaporation and transpiration (Douglas, 2022). This release of water to the atmosphere accounts for most of the afternoon thunderstorm rain in the humid tropics. Some writers describe these tropical rainforests as 'water towers' that regulate the flows of great rivers such as the Nile, Congo, Amazon and Mekong. Just as the reduction of mountain glacier volumes in the Himalaya, Andes and the highest African mountains threatens the flows of rivers, so do forest loss and forest degradation.

Protection of forests

Many international organisations and some major corporations are now expressing concern for the future of the world's forests. The World Economic Forum, which engages the foremost political, business, cultural and other leaders of society to shape global, regional and industry agendas, has set out eight reasons why we need to protect our forests:

1. Healthy forests mean healthy people
2. Forest food provides healthy diets
3. Restoring forests will improve our environment
4. Sustainable forestry can create millions of green jobs
5. Degraded lands can be restored at huge scale
6. Every tree counts
7. Empower people to sustainably use forests
8. We can recover from our planetary, health and economic crises.

Despite the great importance and value of forests for humanity and the rest of the world's biodiversity, forests are still being lost at an alarming rate (Figure 1). Every minute, 35 ha are destroyed (https://www.rainforest-alliance.org/insights/our-mission-to-protect-the-worlds-forests/). Nevertheless, a glimmer of hope has emerged since 1990. Small gains in forest cover have occurred in some parts of the world. The Great Green Wall Project in Africa aims to restore 100 million hectares of currently degraded land in the southern Sahel region by 2030, and to sequester 250 million

tonnes of carbon and create 10 million jobs in rural areas. 15 million ha of forest have already been established (*Great Green Wall — 2030 Ambition*).

The Chinese Great Green Wall, officially known as the Three-North Shelter Forest Program, was begun in 1978, with the proposed end result of raising northern China's forest cover from 5 to 15%, thereby reducing desertification. About 1,700 km^2 per year of desert margin land are being planted with trees (*How China Turned the Desert into Green Forests - YouTube*).

To these huge projects must be added the vast number of national, local and community afforestation and tree-planting initiatives, including The Queen's Commonwealth Canopy programme and The Queen's Green Canopy in the United Kingdom.

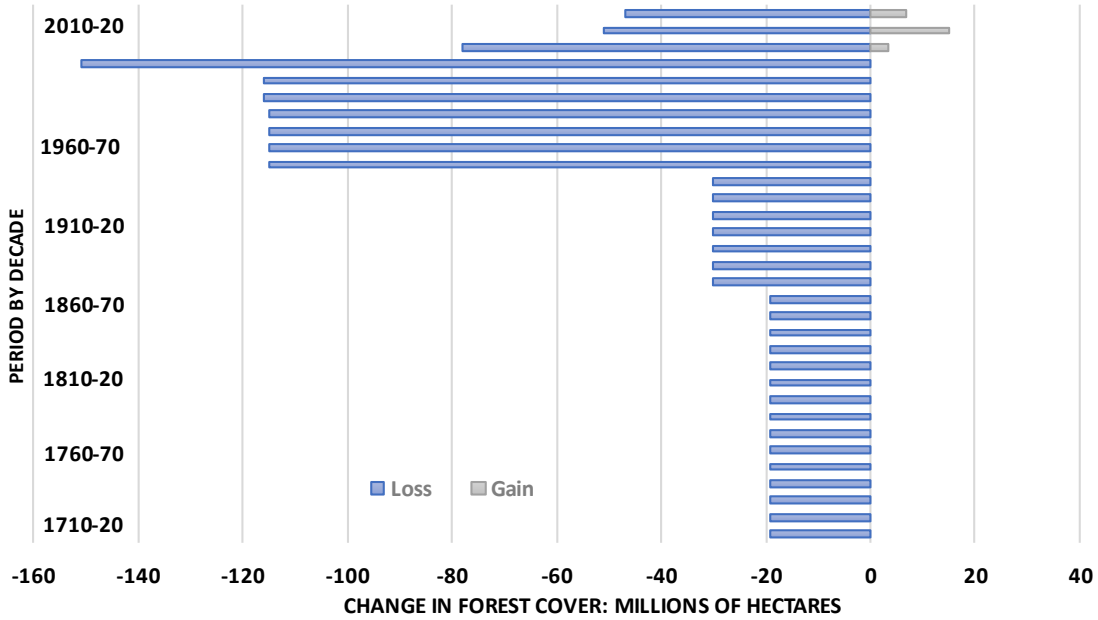

Figure 1. Losses and gains by decade in global forest cover since 1700

Many people warn that these Big Green Wall projects may not be totally successful as long - term care of the new forests is difficult to sustain. In Africa, for example, desperately poor people are often tempted to cut down young trees to make charcoal to sell in urban markets as fuel for cooking. Many city dwellers will know of local parks and urban woodlands where young trees have been damaged and neglected. For such reasons it is important to be constantly aware that **protection of forests is more important than tree planting** (Thomas, 2022).

Many governments and media outlets have been urging us to plant trees and protect forests, especially in the months before COP26 in 2021. The UK Government has committed to increasing tree planting rates across the UK to 30,000 hectares per year by the end of 2024. It also acknowledges that we must protect the precious ancient woodlands and veteran trees which have stood for hundreds of years (UK Government 2021).

Existing forests continue to suffer the direct and indirect effects of human action, whether from deliberate forest clearance, damage due to the many conflicts and undeclared wars in several parts of the world, to the careless actions of mining companies and illegal

poachers, or legal and illegal logging damage (often destroying over 70% of the canopy). Across the globe, severe wildfires have not only shown the combined effects of careless human activities in and around forests and of global heating, but have demonstrated how quickly forests can be lost. However, fire has been a management tool for many First Nations, indigenous people. Forests were a sustainable resource for such people for thousands of years, unlike the European colonists who either saw the trees as a timber resource to be exploited or as "scrub" to be cleared to provide cattle pasture or to create tree-crop plantations for bananas, coffee, cocoa, pineapples, rubber or oil palm. Books written in the 1950s were still suggesting that the 'development' of forested areas such as the Amazon was hampered by lack of capital and people, rather than indicating the values of the tropical rainforest for biodiversity, the stability of the climate, and regulating other components of the Earth system.

However, concerns for the future of our forests have been around for a long time. By the early 1960s, concerns about protection of large mammal species in rainforests were growing and national parks were being established. For example, the Malayan Forest Department had established small jungle reserves in many of its state forests and was beginning to be concerned about plans for forest clearance for agriculture (Wyatt-Smith, 1961). Ecologists were saying 'Now is the time to ensure that a representative sample of the best that Malaysia has to offer is available for posterity' (Poore, 1964). Things began to change when global publicity was given to new works explaining the state of the environment, especially Rachel Carson's *Silent Spring* and the Passing of the *US Environmental Policy Act*, 1969.

A surge in environmental action occurred in the early 1970's. For example, a presentation on the pressures on Australian rainforests in 1973 (Douglas, 1975) attracted wide media and academic interest and indirectly led to an evaluation of wilderness areas in eastern New South Wales that ultimately led to large areas of forest becoming National Parks (Helman et al, 1976). Successful campaigns in Australia to protect rainforests from logging and other developments continued through the 1970's and by mid-1980's much of the remaining rainforest was given World Heritage Status and logging ceased.

It is taking longer to develop extensive rainforest protection elsewhere in the tropics. Massive land cover changes occurred in the lowland areas of Malaysia in the years up to 1991 when it was noted that 'Only a very small fraction [of the lowland dipterocarp rainforest area] that once existed is currently left in any pristine or partially disturbed state' (Lim, 1991). However, by the Rio Earth Summit (the 1992 UN Conference on Environment and Development) an international consensus was developing on such issues as:

1. The role of forests in maintaining biological diversity and climate;
2. The driving forces behind deforestation;
3. The criteria and indicators for sustainable forest management;
4. The need for cross-sectoral frameworks to confront deforestation (Bryant, 1996).

Although the clearing of tropical rainforests for mining and oil extraction as well as for grazing and plantations continues, and has even accelerated, especially in the Amazon and Congo Basins, and on the islands of SE Asia, gradually elsewhere, in small areas within these regions, rainforests began to recover from logging (Figure 2). Some areas cleared for cattle grazing were abandoned and forest plants invaded the grasslands (Figure 3). Forest protection, especially of areas that had been selectively logged one or more times, has increased, as in Sabah, Malaysian Borneo (Figure 4) and in Queensland and New South Wales, Australia.

Thus, today's emphasis on tree planting and forest protection and restoration although not at all new, is fully warranted because of the consequences of the increasing global population, continuing global heating, greater demands on oil and mineral extraction, and expanding tourism developments. Even more than ever, we all need act, as individuals, families, and communities locally, national and internationally to ensure that trees and people can survive together and keep this planet liveable for future generations.

Figure 2. Views over subtropical rainforest in the Dorrigo National Park, New South Wales Australia in 2018. This forest was logged in the first two decades of the twentieth century. (Photo Ian Douglas)

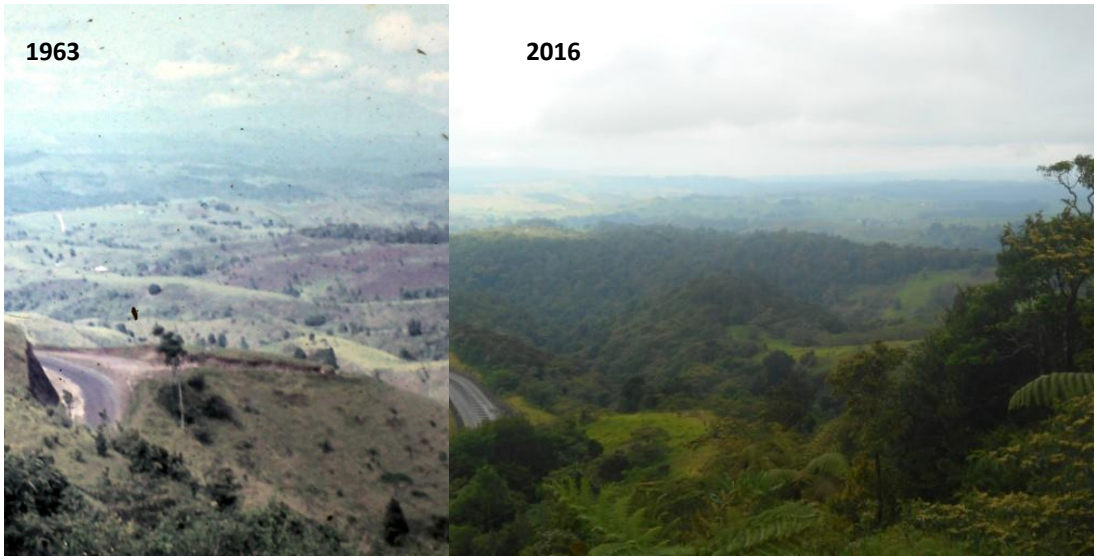

Figure 3. Images of the southern Atherton Tableland, North Queensland, Australia from a hill near Tarzali in 1963 and 2016 showing the increase in forest cover (Photos Ian Douglas)

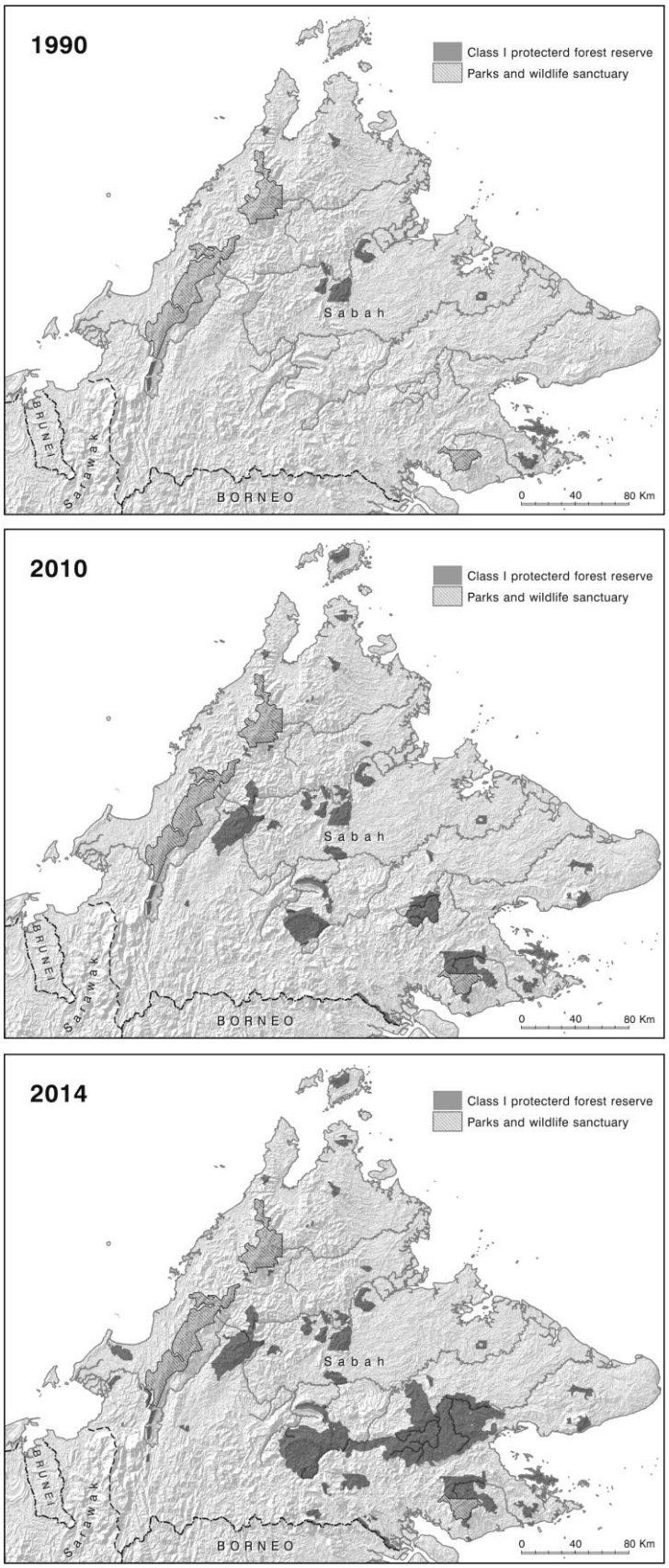

Figure 4. Expansion of protected forest areas in former logging concession areas of Sabah, Malaysia (after Douglas, 2022)

The purpose of this special issue

Details of the state of the world's forests and brilliantly set out and mapped in the May 2020 issue of the National Geographic Magazine. However, that analysis is prepared by journalists with a global view. In this special issue of the CHEC Journal 'Human Ecology' attention is devoted to what is happening in various parts of the Commonwealth: the work of local organisations, and communities. We begin with a report on the Queen's Commonwealth Canopy (QCC) which both explains the goals of the programme and provides examples of the varied activities being undertaken in countries from New Zealand to Namibia and from Antigua and Barbuda to Sierra Leone. The QCC is a pan-Commonwealth network which existing projects can join to help in saving forests for future generations, act together to ensure forest conservation and create a legacy for future generations. This special issue is thus a further contribution to the QCC, embracing contributions from Aotearoa (New Zealand) to British Columbia (Figure 5).

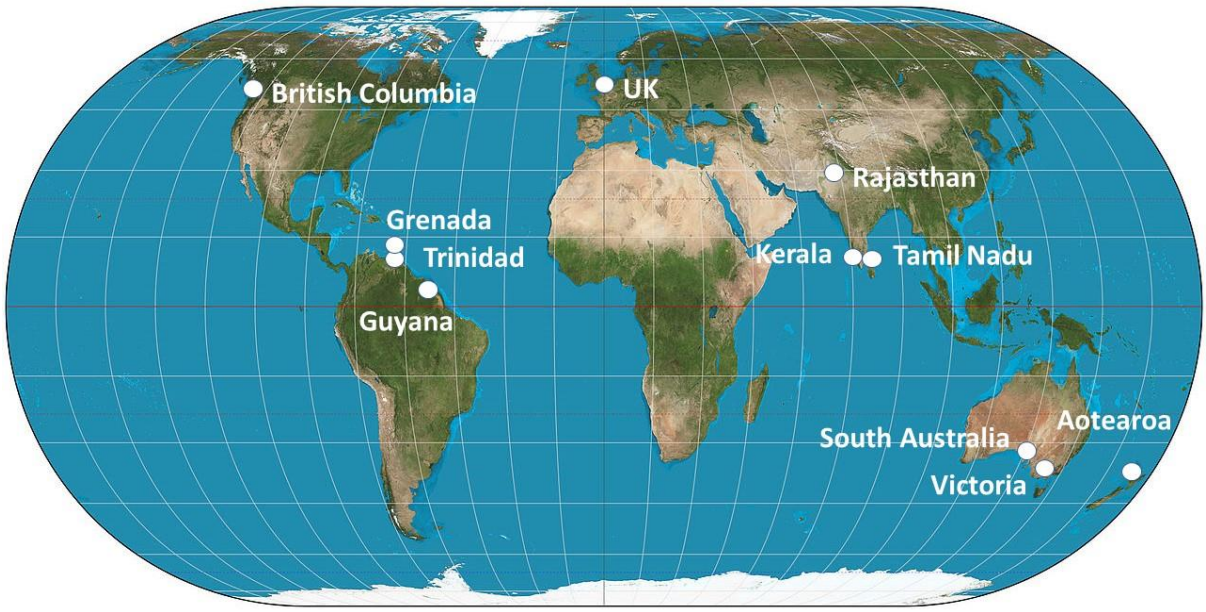

Figure 5. Locations in the Commonwealth covered by this Special Issue on Forests (Base Map from Wiki Commons: By Strebe - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=161152010)

The second article is from Rajasthan, India, where CHEC-India has long held special activities of World Environment Day, which this issue also celebrates. It refers to some of the lessons the COVID-19 pandemic has taught us about the value of forests and the many threats to biodiversity conservation from both large-scale commercial projects and the actions of individual and communities whose poverty drives them to exploit forest resources. Such destructive practices are further considered in the third paper which clarifies the differences between natural and planted commercial forest. It also addresses the lessons to be learnt from indigenous forest dwellers, emphasising the importance of both documenting and passing on traditional indigenous knowledge about caring for forests. A general plea is made that we create a better future for forests and through that for all humans and other living creatures.

As an example of the modern challenges facing forests in small island developing states, Zoya Buckmire and her colleagues show the

problems created by trying to improve incomes and employment by tourism developments on Grenada. Tourism depends largely on visiting beautiful environments and over development of coastal site tends to reduce both marine and terrestrial biodiversity and eventually the beaches and wetland forests visitors hope to see. In Grenada, the chance to reduce the environmental impact of developments may be missed if there is insufficient consultation with all parties concerned before planning permission is granted.

The next section of the journal turns from the threats to forest to examples of how forest management could be improved to provide greater benefits to society. From Victoria, Australia, a scientific case, based on decades of detailed research in the magnificent Mountain Ash eucalypt forests, demonstrates that these forests would more economically valuable by being kept for watershed protection rather than logged for timber production. From Tamil Nadu, India, the forest restoration work at Auroville shows how it is possible the restore dry tropical forest by a multi-decade planting programme.

From Trinidad, a consideration of the need for wetland forest protection demonstrates how effective campaigning by NGOs led to a major wetland with coastal forest being places on the RAMSAR list. (The UNESCO Convention on Wetlands of International Importance especially as Waterfowl Habitat ('Ramsar Convention' or 'Wetlands Convention') was adopted in Ramsar, Iran in February 1971 and came into force in December 1975). Grenada's Navira wetland was threatened by drainage canal digging that would eventually allow saltwater penetration into the brackish and freshwater habitats.

The next four articles deal with interactions with communities and particularly with how First Nations, indigenous peoples are adapting to modern challenges. From the Western Ghats of India, a tribal community still living in a traditional way with nearly total dependence on hunting and gathering in the forest is described: As elsewhere, the people's livelihoods are challenged by plantation development and quarrying.

Colonialism deprived many First Nations people of the free access to the forests that their forefathers had enjoyed since early humans first crossed from Africa to other continents. On Vancouver Island, British Columbia, First Nations people have negotiated control of their traditional forests and participation in forest industries, creating greater security and job opportunities for their people. Their sense of belonging to the land and responsibility for keeping its biodiversity and productivity forever is likely to ensure it continues to function for the good of their community and the Earth System as a whole.

Somewhat similar colonial impacts in Aotearoa led most of the forest area being commercial monoculture pine forests that are unsatisfactory from many viewpoints. Instead, the next paper suggests that a much more nuanced approach based on land use decisions on the capability of land, ideally led by the people living on that land and informed by the urgent need to heal the climate and deliver social, cultural, environmental and economic value for the people living there, is required.

From Guyana (in collaboration with a university team in Scotland) comes the utterly modern technological use of computer gaming to understand the Iwokrama Forest. Such an approach is totally appropriate for a generation that has had mobile phone use since childhood. It is a means of giving city-dwellers who are not likely to see the forest for themselves a way of understanding the plants and wildlife.

This emphasis on communities runs through the final three papers which all deal with the United Kingdom, but particularly with systems in England which is becoming increasingly ethnically diverse. That human diversity means that different people have varied feelings

about forests and different ideas on using the forest. That is explored by Judy Ling Wong, someone who has greater experience than most of bringing nature to urban communities and by increasing understanding of, and accessibility to, nature for them. A different perspective is given by Sue James whose mission is to influence planning and design decisions about trees in the urban landscape. In low rise suburban areas, trees are often highly prominent if the landscape viewed from higher floor windows, but the view from street level has become increasingly less green as old trees are removed, sometimes replaced by fast growing young trees that take years to provide similar heat reduction benefits. Trees have to be an integral part of planning, not merely an ornament.

The final paper deals with forests for urban people, within cities and between towns, with special reference to old industrial areas in northern England. Again, it shows how communities become involved in improving their surroundings and nearby open space through tree planting schemes. It illustrates the working one of the organisations engaged in delivering outcomes for the *UK England Trees Action Plan 2021-2024.*

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The Queen's Commonwealth Canopy – people and trees coming together

Alan Pottinger*, Executive Director of the Commonwealth Forestry Association*

Introduction

People and forests need each other, and it is this concept that lay at the root of a project devised by the veteran Labour politician, The Rt. Hon. the Lord Field of Birkenhead CH DL, to harness the potential of the Commonwealth to conserve its forests. Out of his initial idea grew The Queen's Commonwealth Canopy (QCC), a unique network of forest conservation initiatives, co-ordinated by three international NGOs in collaboration with Buckingham Palace, which involves all 54 countries of the Commonwealth and which was launched at the Commonwealth Heads of Government Meeting (CHOGM) in Malta in November 2015.

What is the QCC?

The Queen's Commonwealth Canopy (QCC) is an opportunity for the Commonwealth family to unite to help conserve one of the world's most important natural habitats - forests. It seeks to create a pan-Commonwealth network of forest conservation projects, marking Her Majesty the Queen's service to the Commonwealth over 70 years and conserving forests for future generations.

It will use the Commonwealth network to facilitate a programme of knowledge exchange activities, share best practice and to create new, collaborative initiatives that contribute to forest conservation across the globe.

Partners

The partners in the QCC are: the *Commonwealth Forestry Association* – whose objective is to promote wise forest management; the *Royal Commonwealth Society* - a network of individuals and organisations committed to improving the lives and prospects of Commonwealth citizens; and *Cool Earth* – an NGO that works alongside indigenous communities to halt rainforest destruction.

Objectives

The QCC:

- is committed to ***raising awareness within the Commonwealth of the value of indigenous forests*** and to saving them for future generations;
- will create a unique ***network of forest conservation projects*** that brings collective credibility and integrity to individual Commonwealth initiatives;
- will ***raise the profile of the Commonwealth***, demonstrating the capacity of its 54 member countries to act together as one to ensure forest conservation;
- will use the Commonwealth network to facilitate ***knowledge exchange***, share best practice and create new, collaborative initiatives for forest conservation; and
- will create a physical and lasting ***legacy of The Queen's commitment as Head of the Commonwealth***.

What makes the QCC different from other forestry projects?

The following elements make the QCC distinct from other conservation programmes:

- ***Reach*** The QCC is a pan-Commonwealth forestry conservation initiative encompassing all 54 countries of the Commonwealth.
- ***Cost-free commitment*** The QCC utilises existing forestry resources and projects. As such, participation is free and comes without regulatory obligations for accredited projects beyond adherence to basic principles of forest conservation and the participation of local populations in forest management.
- ***Rapid impact*** The dedication of existing forestry projects means that there will be an immediate impact from the QCC.

How countries become involved

Every Commonwealth country has decided to participate in the QCC by nominating and dedicating existing or future conservation

projects that meet with the broad objectives of the project. Participation does not impact on the ownership, sovereignty or management of dedications.

There are two options for the creation of dedicated QCC projects, to either ***dedicate*** an existing forest or ***plant*** a new area of trees.

Criteria to join the QCC

Proposed projects should have the endorsement of the relevant government and forestry or conservation authority, contain clear objectives that include sustainable forest conservation and encourage, in one form or another, the participation of local people in the management of the project.

Where we are now

In March 2022, we are drawing close to all 54 countries of the Commonwealth joining the QCC. Forest types included in the QCC range from tropical rain forest to temperate woodland, and from project sizes varying from those covering millions of hectares to those covering just a few.

Case Studies

1 The Great Bear Rainforest, Canada

Figure 1. The Duchess and Duke of Cambridge at an opening ceremony with First Nations people in the Great Bear Forest

The Great Bear Rainforest (GBR) (Figure 1) covers 6.4 million hectares on British Columbia's north and central coast, and is home to 26 separate First Nations. It is globally recognized for its unique biodiversity and is one of the largest intact tracts of coastal temperate rainforest in the world.

The GBR was originally established through land-use decisions first announced in 2006. In early 2016, after extensive discussions with First Nations and stakeholders, a final ecosystem-based management system was agreed, and additional new areas were protected. Under the GBR land use order, 85% of the forest is now protected and 15% will be available for logging, supporting local jobs. Ecosystem-based management in the area is defined as "concurrent achievement of high levels of ecological integrity and high levels of human well-being", and the area available for logging is under the strictest logging rules in North America.

To commemorate the achievement and celebrate the endorsement by The Queen's Commonwealth Canopy, the Province established a $1-million Great Bear Rainforest Education and Awareness Trust.

2 Botanic Gardens, Singapore

Figure 2. Part of the Singapore Botanic Gardens

In the Singapore Botanic Gardens (Figure 2), the nation's first UNESCO World Heritage Site, lies a six-hectare forest fragment known today as the Gardens' Rainforest or, in older days, the Gardens' Jungle. Known to contain more than

500 species of plants within its small confines, this was a site of many discoveries for botanists during the 19th century, who were only starting to explore and describe the flora of the region. This patch of forest has been largely preserved through various developments undertaken at the Gardens, and even today, surveys of the rainforest are still resulting in surprising plant discoveries.

Lying within the boundary of Singapore's first World Heritage Site, the Rain Forest has thus been incorporated into the Gardens' larger efforts to protect and manage the site. As part of these efforts, members of the local community work with staff to monitor rare species for seed production and collection, take part in propagation and replanting efforts, and help to remove invasive species. They also help to conduct regular guided tours for the larger public, with the aim of advocating the awareness, appreciation and conservation of this Rain Forest for the benefit of generations to come.

3 Dolphin Head Forest Reserve, Jamaica

Figure 3 Queen's Commonwealth Canopy sign at the Dolphin Head Forest Reserve, Jamaica

Dolphin Head Forest Reserve (Figure 3) is approximately 1167 hectares, covering six forest estates in the north-western part of Jamaica. Historically, the Reserve was part of lands owned by slave masters and the slaves were used to cut the roads through the mountains and to rear cattle and other livestock on the land. Commencing in 1950, the Government started to declare various parcels of land as forest reserves to ensure the conservation of the forest resources in these areas.

The Dolphin Head mountain range is recorded as having a higher density of local endemic plant species and rare or threatened plants per unit area than anywhere else in Jamaica. The effective mitigation of threats and conservation of the biodiversity of this ecologically fragile ecosystem remain a priority in Jamaica.

In April 2009, the Forestry Department launched the Dolphin Head Local Forest Management Committee (LFMC), which effectively became the community group that works with the Agency to establish and develop conservation based activities to support sustainable forest management. Since the LFMC's establishment, it has secured grant funding to reforest sixteen hectares of denuded and degraded forest lands and has also established an apiary in the area, which serves as a thriving honey business for its members.

4 N/a'an ku sê Forest Conservation Revegetation Project, Namibia

Figure 4 The N/a'an ku sê Forest Conservation Revegetation Project, Namibia

The N/a'an ku sê Foundation's mission includes the need to conserve the land, cultures and wildlife of Namibia. Through the acquisition of land of various vegetation types across central and southern Namibia and managing them for

conservation purposes the Foundation is working to conserve the various landscapes of Namibia (Figure 4).

The N/a'an ku sê Forest Conservation Revegetation Project takes such landscape conservation efforts to the next level, from passive management to active rehabilitation of degraded areas where indigenous forests once thrived. The project involved the construction of an economically viable and ecologically sustainable nursery that utilises recycled water at N/a'an ku sê Lodge and Wildlife Sanctuary in central Namibia. With the nursery as a foundation, the project involves the collection and propagation of indigenous seed and the planting of propagated seedlings to reverse land degradation and restore indigenous forests.

The project provides employment opportunities and associated training for the local community in nursery operations, plant propagation, forest revegetation and conservation and volunteer coordination. The project is endorsed by the Namibian Ministry of Environment and Tourism as its objectives and outcomes align with the country's National Action Plan to combat ongoing desertification in southern Africa.

5 Epping Forest, United Kingdom

Figure .5 Long-horn cattle in Epping Forest, UK

Epping Forest is a 2476 ha ancient woodland stretching 12 miles from east London to just north of Epping in Essex. The practice of grazing livestock in the Forest goes back over 1000 years and, alongside other management practices such as pollarding, created the distinctive woodland landscape seen today. These ancient traditions have helped create the rich and unique biodiversity found within Epping Forest, earning much of the Forest its designation as a Site of Special Scientific Interest and a Special Area of Conservation.

Forest grazing almost ceased following a steady decline and the impact of the 1996 BSE crisis. A ten-year Wood-pasture Restoration Project was initiated to re-establish grazing across 600 ha along with re-establishing traditional pollard management over more than 300 ha (Figure 5). With over 4.2 million visitors each year to the Forest and situated in a busy urban setting pioneering technological solutions, such as invisible electric fencing and GPS tracking of cattle, have proved invaluable in finding practical sustainable solutions.

Community involvement in the Project has been vital and has involved extensive consultations on expanding cattle grazing and traffic management within the Forest along with practical support from volunteers. Future aims of the Project include expanding the grazing herd to consolidate habitat improvements and to reengage with the lapsed 'commoners' to encourage them to again graze livestock within the Forest.

6 The 20 million Trees Program, Australia

Figure 6. Volunteers preparing seedlings for the 20 Million Trees Program in Australia

The 20 Million Trees Program was an Australian Government commitment under the National Landcare Program to deliver 20 million trees by 2020 to re-establish green corridors and urban forests, providing habitat

to support threatened species and sequestering carbon from the atmosphere.

The program, established in 2014, spent $61.775 million working cooperatively with local communities to undertake projects throughout urban and regional Australia (Figure 6). Native trees and other native plants were planted on both public and private land, providing community and environmental benefit at the local level.

The program was delivered through a combination of competitive grants for individuals and organisations, procurement which delivered larger-scale tree planting projects and non-competitive discretionary grants.

Key statistics and achievements of the program as at 30 June 2021, include:

- 29,508,062 trees over 2 metres established
- more than 30,000 hectares revegetated
- over 2,500 species planted
- 17,958 hectares treated for weeds
- 96,654 people participating in project activities as volunteers
- 141 Indigenous people employed through the program in ranger and non-ranger positions
- the program could indicatively sequester on average 1.47 to 2.95 million tonnes CO2 over the decade from 2021 to 2030, based on 29.5 million trees over 2 metres in height.

7 Victoria Park Botanical Gardens, Antigua and Barbuda

Established in 1893, Victoria Park Botanical Gardens (VPBG) (Figure 7) have remained at the forefront of cultural history in Antigua & Barbuda as one of few open spaces in the capital city of St John's. The gardens cover 2.4 ha of the city, with numerous species of trees. Within the bustling capital city, the gardens provide an escape for citizens and tourists; established as a green space to relax and exercise.

Figure 7. Prince Harry with project personnel at the Victoria Park Botanical Gardens, Antigua & Barbuda

The aims and objectives of The Victoria Park Botanical Gardens are to establish a family friendly green space for the public use, create a hub for the display of environmental projects, establish a secure and aesthetically pleasing environment able to accommodate educational and recreational activities and provide an alternative tourist destination for visitors.

In support of environmental awareness through community engagement, the Department of the Environment (DoE) has implemented various outreach activities within VPBG such as: 'Movies in the Park', 'Yoga in the Park' and 'Art in the Park'. Additionally, during Arbour Month, nursery staff exchange with the general public 4,000 – 5,000 fruit-bearing trees for plant bags, which are used the following year for propagation.

The forty-foot-high and fifty-foot-wide African Cloth Bark Tree or Zulu Tree (*Ficus nekbuda*) is one of the more notable species located within the VPBG; others include the Cuban Royal Palm (*Roystonia regia*), Lignum Vitae (*Guiacum officinale*), Yellow Poui (*Tabebuia glomerata*), Devil's Ear (*Enterolobium cyclocarpum*), and Hazel Sterculea (*Sterculea foetida*).

8 The Queen Elizabeth II National Trust, New Zealand

Figure 8. One of many landscapes protected by the Queen Elizabeth II National Trust

The Queen Elizabeth II National Trust (the National Trust) was established 40 years ago to help permanently protect precious forest remnants (Figure 8) and other significant natural and cultural heritage sites on farms and other rural land in private ownership within New Zealand. By working in partnership with private landowners, the National Trust establishes legally binding agreements, called open space covenants, which protect privately owned sites, in perpetuity, for the benefit of current and future generations.

In support of The Queen's Commonwealth Canopy (QCC), the New Zealand Government has allocated NZ$1 million to the National Trust to extend, in partnership with private landowners, the network of open space covenants over a three-year period. Each of these additional covenants will be dedicated to the QCC.

9 Eastern Highlands, the Ramu-Markham valleys and the Madang region, Papua New Guinea

The Australian Centre for International Agricultural Research (ACIAR) has commissioned a four-year forestry research project to support PNG's Forest Policy Medium Term Development Plan to increase the area of planted forests in PNG from 62,000ha to 150,000ha by 2025.

Figure 9. Seedlings for community forestry in Papua New Guinea

The program, managed through the University of the Sunshine Coast (Australia) as a collaboration with various government, NGO, private sector and community partners in PNG, aims to identify how community forestry in PNG (Figure 9) can be enhanced and scaled up to achieve better economic, social and environmental outcomes. Its activities currently focus in three areas: the Eastern Highlands, the Ramu-Markham valleys and the Madang region.

10 Tacugama Reserve, Sierra Leone

Figure 10. Western Chimpanzee in the Tacugama Reserve, Sierra Leone

The Tacugama Reserve - Western Area Peninsula National Park (Figure 10) covers an area of 17,075 hectares, located in the middle of the Western Area Peninsula. The reserve

was upgraded to its National Park status in 2013, after being protected as a Forest reserve since 1916. It is one of the eight biodiversity hot-spots in Sierra Leone and hosts 80-90% of the country's terrestrial biodiversity. The reserve cradles vital watersheds such as Guma Dam and Congo Dam; they supply water to 1.5 million people living around the park. At a National Level, the project aims to sensitize the public, advocate for strengthened wildlife and conservation policies, and encourage communities to stop wildlife poaching and hunting

Figure 11 Buckingham Palace, London, UK, floodlit to highlight the Queens Commonwealth Canopy

> *Preserving the world's green corridors, forests, jungles and botanic gardens is the simplest and most effective way to keep breathing life into planet earth. Over my nine decades, I have witnessed the devastating effect of the destruction of our forests and disregard for the importance of trees. I do believe that we have an obligation to nurture and replenish our natural environment for the benefit of our children and grandchildren*
> Sir David Attenborough (from his speech at the reception at Buckingham Palace to mark the first anniversary of the QCC's creation)

The next steps

Highlighting the role of the QCC throughout the Commonwealth will be a major focus of our work in the coming years. We are just at the beginning. Our work to highlight the value of the Commonwealth's forests is an enormous challenge that will continue.

For more information visit the QCC website at *www.queenscommonwealthcanopy.org*

Time for conservation of Biodiversity in Rajasthan: Post COVID-19.

T.I. Khan

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Introduction

Biodiversity is the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, encompassing diversity within species, between species and among ecosystems. The distribution and magnitude of present-day Biodiversity is a product of over 3.5 billion years of evolution, involving speciation, migration, extinction and, more recently, human influences.

The adverse effects of human impacts on Biodiversity are increasing dramatically and threatening the very foundation of sustainable development. Loss of Biodiversity resources threatens our food supplies and sources of wood, medicines and energy; reduces opportunities for recreation and tourism; and has great impacts upon all the ecosystem services on which human society depends. The conservation and sustainable use of Biodiversity need to become integral components of economic development.

World Environment Day 2022

It is appropriate to discuss Biodiversity in the context of World Environment Day, which was established in 1972 by the United Nations on the first day of the Stockholm Conference on the Human Environment, where the integration of human interactions and environment was discussed. Two years later in 1974 the first World Environment Day was held with the theme "Only One Earth". Even though World Environment Day celebrations were held annually after 1974, it was not until 1987 that the idea for rotating the centre of these activities between different host countries begun to be implemented

The theme for World Environment Day 2020 was 'Time for Nature', and it was hosted in Colombia in partnership with Germany. Columbia is one of the largest 'Megabiodiversity' nations in the world, housing 10% of the planet's biodiversity. Since its territory includes part of the Amazon rain forest, Colombia ranks first in bird and orchids species diversity and second in diversity of plants, butterflies, freshwater fish and amphibians.

The World Environment Day 2021 theme was 'ecosystem restoration' - a global mission to revive billions of hectares, from forests to farmlands, from the tops of mountains to the depths of the sea, sustaining and enhancing biodiversity everywhere.

World Environment Day 2022 will be held in Stockholm again, with same theme: There is **#OnlyOneEarth** together we can protect it. The global meeting will commemorate the 50 years since the 1972 conference and its outcome documents, mostly notably the **Stockholm Declaration**.

COVID-19

COVID-19 is the infectious disease caused by the most recently discovered corona virus. This new virus and disease were unknown before the

outbreak began in Wuhan, in China, in December 2019. COVID-19 is now a pandemic affecting many countries. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease and cancer are more likely to develop serious illness.

The COVID-19 virus spreads primarily through droplets, of saliva or discharge from the nose when and infected person coughs or sneezes. Rigorous lockdown programmes in most countries constrained human interactions for varying lengths of time. However, the arrival of new variants later caused upsurges in the numbers of people infected, but the great scientific work leading to the development of vaccines cut the death rates and slowed the growth of hospital admissions.

However, the distribution of, and access to, vaccines between countries was uneven and inequitable. By March 30th 2022 a third of the world's population had yet to receive a single dose of COVID-19 vaccine, including a shocking 83% all Africans. The UN Development Programme (UNDP), reported that only a tiny proportion of COVID-19 vaccines had been administered in developing countries. leading to a widening gap between rich and poor.

Based on its phylogenetic relationships and genomic structures the COVID-19 belongs to Betacoronavirus. Human Betacoronaviruses (SARS- CoV-2, SARS-CoV and MERS-CoV) have many similarities, but also have differences in their genomic and phenotypic structure that can influence their pathogenesis. COVID-19 is containing single stranded (Positive Sense) RNA associated with a nucleoprotein within a capsid comprised of matrix protein.

Implications of COVID-19 for biodiversity. The appearance of COVID-19 has shown that when we destroy biodiversity, we destroy the system that supports human life. The more biodiverse an ecosystem is, the more difficult it is for a pathogen to spread rapidly or dominate. Loss of biodiversity provides an opportunity for pathogens to pass between animals and people.

The COVID 19 virus has lessons that apply to the global crisis of biodiversity loss. For this reason, our best vaccine for the future is to protect nature and biodiversity. It is no longer just a matter of ecology but of being aware that if we want to reduce the occurrence of pandemics, we must have a healthy nature.

Loss of biodiversity also means that before we discover their medicinal value, we are losing many varieties of nature's chemicals and genes, others of which have already provided humanity with tremendous health benefits. Traditional medicine, using such natural products, continues to play an essential role in health care, especially in primary health care.

The COVID-19 pandemic has the potential to trigger enormous effects on biodiversity and conservation outcomes. The risk of new diseases increases with environmental degradation. The COVID-19 virus is thought to have its origin in bats in Asia. Rapid deforestation in South East Asia has created new habitats compatible with bat roosting, often concentrating bat numbers and species near human dwellings and livestock.

Past disasters have also triggered quantifiable environmental changes. We can learn from events such as pandemics, wars, and financial crises to guide effective conservation strategy. National governments and intergovernmental organizations should adopt clear strategies to safeguard both biodiversity and human health throughout the COVID-19 recovery.

Biodiversity in India

India occupies 2.4% of the World's land surface but contributes 8% of its fauna and flora. At the global level only 1.74 million species are known with 80% of the biotic world still unknown. However, in India, with its diversity of ecosystems from mountain glaciers to hot deserts and tropical rainforests, 45,000 species of plants and 91,000 species of animals have been recorded.

Biodiversity in Rajasthan

The state of Rajasthan has many diverse ecosystems, from forests (Figure 1), aquatic regions and wetlands to deserts. Human pressures, particularly intensive deforestation, on the forests of Rajasthan have led to widespread ecological problems. The deserts form an interesting habitat (Figure 2), as both fauna and flora in deserts need special adaptations for their life cycles. The wetlands include large areas of brackish water, fresh water, reservoirs, lakes and backwaters. The fauna and flora of the wetlands are extremely vulnerable to people-driven changes.

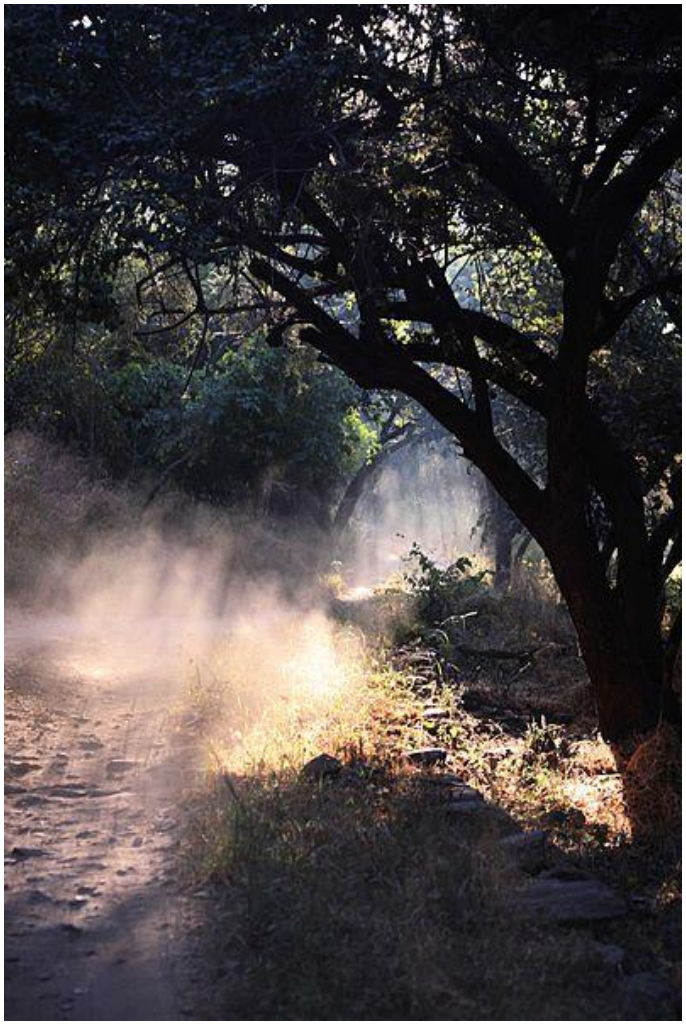

Figure 1. Kumbalgarh Forest, Rajasthan, Obtained through the Creative Commons CC0 1.0 Universal Public Domain Dedication

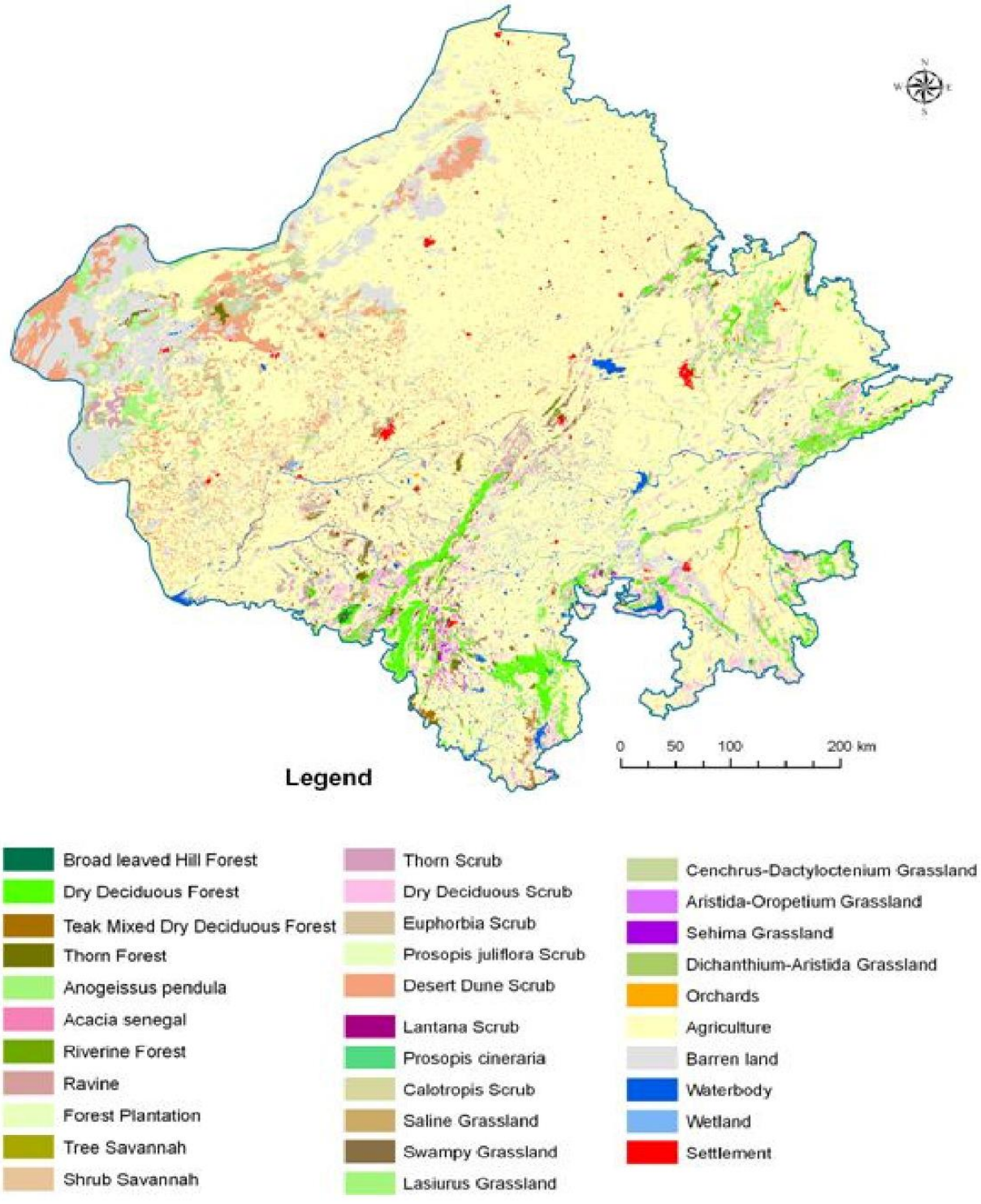

Figure 2. Vegetation type and land use map of Rajasthan

There is high Biodiversity of plants and animals in Rajasthan's forest and desert ecosystems. The maintenance of Biodiversity is of prime importance to conserve the great heritage which nature has provided to a state like Rajasthan.

Forest Biodiversity (Figure 3). Forests exists in the Aravalli Hills which extend for in about 692 km stretching across 18 districts of Rajasthan. There are 12 gaps (as wide as 10 km) in the Aravalli Hill Ranges. *Anogeissus pendula* (Dhonk), *Boswellia serata* (Salar), *Albizzia lebbek* (Siras), *Tectona grandis* (teak), *Shorea robusta* (sal), *Terminalia tomentosa* (sadar), Miliusa tomentosa (Umbia), *Mangifera indica* (Aam), *Terminalia arjuna* (Kohra), *Acacia catechu* (Khair) and *Acacia nilotica* (Babool), *Butea monosperma* (chhila), *Dendrocalamus strictus* (Bamboo) Nilotica are important plant species of Aravalli Hill Ranges.

The wildlife of Aravallis includes *Panthera pardus* (leopard), *Hyaena hyaena* (striped hyaena), *Canis aureus* (golden jackal), *Tetracerus quadricornis* (four horned antelope), *Grazella bennettii (*chinkara, also known as the Indian gazelle), *Hystrix indica* (Indian crested porcupine), *Cervus unicolor* (sambar deer).

Figure 3. Ranthambore national park, Rajasthan which is famous for its tigers, The view is of the entrance and river from the top of the fort situated inside the park. Obtained through the .

Desert Biodiversity. 682 plant species belonging to 352 genera and 87 families have been identified from the Indian Thar Desert. 6.4% plant species are endemic. Almost 10% plant species have become endangered.

*Tecomella undalat*a (desert teak or rohida), *Calligonum polygonoides* (Phog), *Lasiurus sindicus* (Sewan grass) *Capparis deciduas* (ker, or karira shrub) *Prosopis cineraria* (Khejri, or ghaf), *Commiphora wightii* (gugal), *Zizyphus nummulaira* (Bordi), Maytenus emarginatus (kikar), *Acacia senegal* (Kumat: the gum Arabic tree), *Leptadaenia pyrotechnica* (Khimp), and *Withania somnifera* (Ashwgandha or winter cherry) are the important plant species of the desert. All of these are endangered species. There are about 200 known species of plants of medicinal uses in the desert and the medicinal values of many other plants have yet to be identified.

Threats to biodiversity in Rajasthan. The original ecosystems are well adapted to the harsh environments (e.g., arid and dry semiarid). The major changes in these ecosystems include: grasslands degradation, grass composition and livestock dynamics; neglect of surface water bodies (nadis) and rainwater harvesting systems (khadins); overexploitation of groundwater; disappearing community driven traditional protection approaches (*Orans*); loss of species (e.g., the *Great Indian bustard*) due to either greed or other activities like mining, urbanization and modernization in agricultural activities. For example, the introduction of massive irrigation through Indira Gandhi Nahar Project (IGNP) and tube wells, mechanization and extensive cultivation, also drastically affected the biodiversity. Introduction of IGNP which covers an area of 1.869 Mha in Rajasthan resulted in considerable loss in biodiversity, be it through

land use (crops, grasslands etc) or be it natural impediments leading to water logging or be it the consequent changes in soil biota.

There are 390 species of animals identified from desert. 90 animal species are mentioned in Red Data Book as rare, threatened or endangered species. Bustard (Great Indian Bustard), Chinka, Black Buck are examples of these endangered animal species.

Many of the people worst hit by the consequences of the COVID-19 pandemic are those living in and around protected areas and the forests and wetlands of highest biodiversity value. These local people have been largely reliant for cash income on small-scale agriculture and fisheries and, increasingly in much of state, tourism. Faced with a lack of income and no safety net, people in these situations have little to turn to but poaching, illegal fishing, logging and clearing forest. Unless these most vulnerable people receive immediate financial support, much of the region's rich biodiversity and many of the conservation successes of the last two decades risk being lost in just a few months.

Conclusion

Many significant changes are required after COVID-19. Specifically, there is a need of providing **in-situ** and **ex-situ** conservation of species of plants and animals in Rajasthan. Some species are identified as of great use for treatment of influenza, coughs, and respiratory ailments and for immunity enhancement. These are as follows: *Centella asiatia* (Brahmi or Gotu Kola), *Tinosphora cordifolia* (Gloy or heart-leaved moonseed), *Cymbopogon martini* (lemon grass or Palmarosa Grass*), Piper longum* (Pipli or long pepper), *Ocimum canum* (Tulsi or hoary basil.), *Withania somnifera* (Ashwgandha or winter cherry). The potential of these plant materials to treat COVID-19 must also be explored. Traditional medicinal knowledge can possibly assist in this process.

*Figure 4. Urban trees in Jaipur as seen from the Palace of the Winds. Even in cities, high biodiversity can be found among both cultivated and wild plants (Photo: Ian Dougl*as).

Forests: An Ecological Perspective

Dr Janine Pierce,
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Forests have great value to the planet for diverse reasons. Mitigating climate change impacts by storing carbon has had great attention since 1970. Other benefits contribute to the capital value of forests estimated to be around $150 trillion, as a source of income and life support through wood and other forest related produce, in breaking down wastes, pollination, seed dispersal, as an assistor for drought and flood control, and other services. Forests are also of value for Indigenous people who reside there, for tourists, for cultural reasons, for those wanting a nature experience (Figure 1) and also forests, especially sacred groves, have spiritual value (Moore, 2007). At the global scale, forests are of three main types: temperate, tropical, and boreal.

Forests are also a haven for sustaining biodiversity. Richard Attenborough has highlighted that forests are, along with many other earth eco environments, experiencing 'the greatest tragedy of our times' (2020, p.6) in declining biodiversity. Deforestation has occurred for thousands of years, but increasingly so in recent times (Figure 2). The advent of modern farming, mechanised logging and commercial hunting has often resulted in a new relationship between humans and nature, in which humans have imposed their wishes in dominating and so modifying the natural environment that the risks from climate change were aggravated (Cogger et al, 2003).

Figure 1. Rainforest canopy walkway, Maliau Basin, Sabah, Malaysian Borneo (Photo Ian Douglas)

Environmentally destructive strategies included planting or cutting down trees for farming food and income generation, logging income, dam building, species extinction by eliminating 'pests' whether plant based, or animal based, redirecting water impacts on hydrological cycles, in turn changing water tables and mobilising salt in the soil (Walker et al,1993), and extractive industries for fossil fuels and minerals. The expansion of the human population in this finite planet leads to constant forest loss and damage for new housing and urban growth and for places to grow food, especially in poorer countries.

Figure 2. Scenes of Amazonian Rainforest deforestation (*Foto: Bruno Kelly/Amazônia Real/09/08/2020: Creative Commons Attribution 2.0.)*

Impact of deforestation

Deforestation has occurred at intervals, mainly through events such as volcanic eruptions and extreme hurricanes ever since the first forest appeared on earth approximately 380 million years ago. Early settlers in New Guinea and Australia were clearing small patches of forest for fuel and shelter 35,000 years ago, but since 1900 forest loss has equalled all that in the previous 9000 years (Williams,2003). Despite all the urban expansion, mining and industrial development, agriculture and grazing remain biggest reasons today for land clearance, as urban land only occupies 2% of the world's habitable land (Richie,2021). The impacts of forest destruction impacts on the surrounding ecosystems have been estimated as at least 40% of birds, amphibians and lizards in the Amazon, although actual numbers may be greater (Hance,2008).

Nigeria has lost more than half its original forests; the Amazon more than 20%; Australia over 27% of forests, with Brazil, other South American countries, Laos, and Indonesia experiencing large forest loss. The earth is now at a point where one third of world forests are now gone, not just due to logging but often due to agriculture (Figure 3).

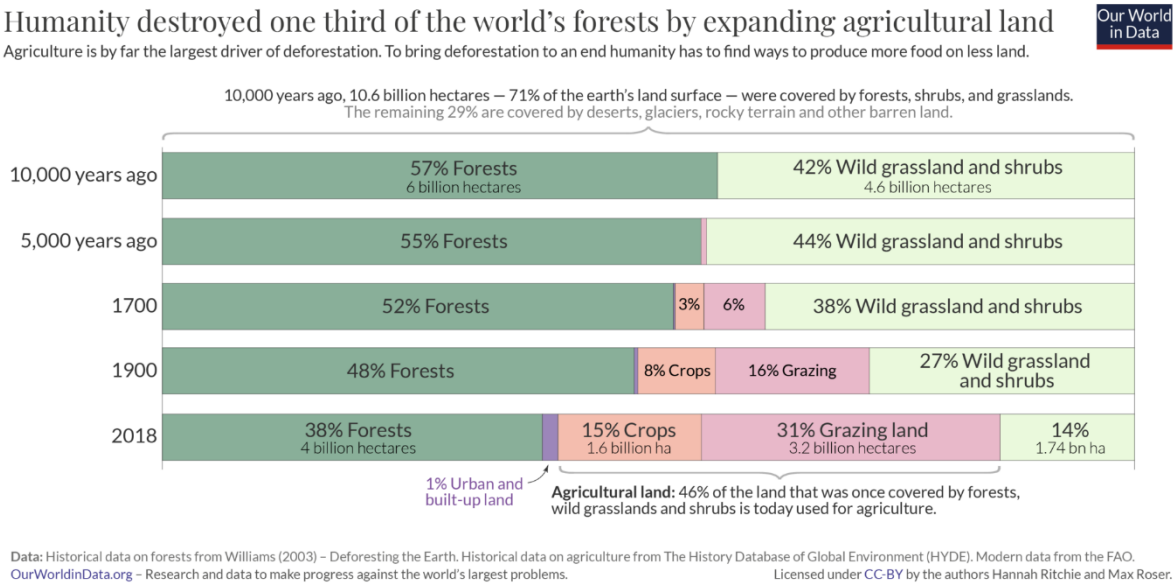

Figure 3. Historical data on agriculture (after Williams, 2003)

The perspectives of those cultivating forests for trees for economic gain, and those taking an ecological perspective differ. As Wuerthner (2018) explains many foresters cultivating trees for profit see wildfire, insects, droughts and other living creatures as being intrusive and negative forces. In contrast, the ecological perspective views these events and creatures, such as bark beetles, as part of the cycle of forest life and recognises and values integrated coexistence with living creatures. Wuerthner (2018) has set out the contrasted world views of benefits of forests (Table 1):

Table 1: Forester versus Forest ecologist perspectives

Foresters	**Forest Ecologists**
Economic value of wood fibre	Trees as a source of carbon storage
Tree farm for economic gain	Ecosystems for many wildlife species
Culling of tree density to hasten growth of surviving trees	Value of maintaining tree density as slower growing trees last longer
Ecological intrusion of insects, plant diseases, wildfire etc. is seen as undesirable	Sustaining the forest nutrient cycle and natural habitat
Careful logging can help reduce occurrence of high-level fires	High strength fires are a naturally occurring part of the ecosystem

Natural forests versus forest plantations

Forest plantations represent a human-monoculture imposed on a space where the former forest symbiotic relationships have been destroyed. Such loss of forest for plantation development has affected many S.E. Asian countries. The development of new symbiotic relationships among the plantation is constrained by widespread use of fertilisers and pesticides that remove many life forms from the monoculture areas. These added people-made chemical compounds enter the soil and the groundwater, eventually polluting the surrounding rivers and adjacent land areas.

Monoculture plantations often reduce opportunities for indigenous people, who rely on hunting and gathering in the natural forest and who often have shifting cultivation plots in the forest. Local concern and care for the forest is displaced by the new commercial forests run by large corporations, whose concerns are for profits and development in distant cities and faraway countries. Such prevail in many tropical countries, such as Indonesia, Columbia and Mozambique. The impacts of introduced man-made plantations are well documented for palm oil, rubber, pine, eucalypt, and other commercial forest trees (Hance, 2008). In contrast to old natural forests that store carbon for hundreds of years, tree plantations and young forests store only a fraction of the carbon per km^2 retained by old forests, with the 'carbon debt' from cutting down old forests taking a long time to repay (Waring et al., 2020).

In contrast to the plantation forests, old natural forests have evolved and changed over time, renewing their own structure, in an integrated relationship with climate, the soil, water, and surrounding living parts of the ecosystem, all operating in symbiotic relationships between plants and animals. There is new discussion and research that finds trees to be living sentient and communicating life forms. Wohlleben (2015) describes the social and community existence of naturally

formed forests where there is high interdependence between living and dead trees, tree stumps, and all the life forms in, on and around them with communication through soil fungi (mycorrhiza) that transport messages. In contrast, Wohlleben (2015) also argues that the human created forests do not have the connections through mycorrhiza between trees that natural forests have This cutting-edge tree research has begun to change our thinking about forests as living communities of living beings, rather than seeing them as a commodity, with lessons to learn about what is a community and a functional ecosystem.

Learning from Indigenous people on local wisdom values for forest management

Indigenous traditional knowledge and approaches to forests integrate the interconnectedness of all living things in the forest ecosystem and respect the spiritual value of the forest. the responsibility of Indigenous people sustain and protect the forest, being part of the land, and are not seeking dominion over it (Toth, 2019). Indigenous knowledge may be old, but it is still highly relevant in terms of seeking ways of sustaining forest ecosystems. In this approach, the earth provides us with care, and in turn we care for it. In contrast the predominant Western cultural approach has been to view the earth as being there for us to exploit for what we want from it (Vaughan-Lee, 2013). Indigenous knowledge in the areas of resource management practices, water management, knowledge about forest life at all levels, and the role of cultural connection and the spiritual values relating to forests, can benefit us all in formulating forest knowledge and forest management (Tanyanyiwa and Chikwanha, 2011). However, indigenous knowledge has not always been accurately related to sustainable practices, as sometimes excessive grazing, hunting, and shifting cultivation have occurred.

Often governments have failed to protect forests and the indigenous people living in or near them. In countries like Brazil and Indonesia, indigenous people sometimes have neither been consulted or protected before being forcibly displaced for land clearance for grazing land, mining development or oil palm plantation development. In the process of displacement, forests and homes and traditional ways of living in harmony with forests has been lost, along with the trees. In Indonesia 24 Mha of forests along with the traditional peoples' communities and homes have been lost (Human Rights Watch,2019).

Indigenous wisdom relating to forest preservation is passed down from generation to generation in indigenous cultures throughout the world. For example, in West Sumatra, the value of preserving rainforests for economic benefit, for ecosystem protection, and for social benefits, is well understood (Yantu et al,2018). In this part of Sumatra, the Government brings the indigenous people into forest-related decision-making. Such consultation and indigenous forest stewardship is a positive approach to adopt for forest care. However, elsewhere, indigenous young forest-dwelling people are no longer receiving the knowledge from elders, formerly was communicated in face to face conversation, as it has not been written down (Tanyanyiwa and Chikwanha,2011)

The forests most valued by Indigenous peoples are the sacred forests (Figure 4) which exist throughout Asia, Africa, Europe, Australia, and America (Lowman and Pallaty, 2017). These forests are parts of natural forests that are protected by social laws and have cultural value. These constantly protected forest areas help to reduce climate change impact and

formas areas of biodiversity conservation (Maru, Gebrekierstos and Haile, 2022),

Figure 4. Sacred Grove Osogbo, Osun State, Nigeria. Creative Commons Attribution-Share Alike 4.0

Addressing the challenges of sustaining forests

The first premise that needs to be shifted in our views of forests, is to move from the approach of the human as conqueror and decider of what to do with nature, which has often included cutting down forests. The path has been lost in sustaining nature and forests in this strategy, because human beings have not been seen as being a part of nature. When we cut down a tree from a forest, we are also disconnecting a part of ourselves. It can be argued that the reason so much deforestation has occurred is due to ignorance about human impact of intervening in the natural ecosystem. Greenpeace has highlighted that a UN report has identified the increasingly urgent challenges relating to land and climate crisis in and strong actions needed for the protection and restoration of forests. The global food system accounts for 37% of global human related greenhouse gas emissions. Deforestation to create pasture for cattle to provide meat for humans, is a key part of this (Greenpeace international, 2019). Less meat consumption is a strategy being publicised by Greenpeace in their 'Less Meat-Less Heat' Climate Action NOW' campaign (Figure 5).

Figure 5. Greenpeace lobbying the public to eat less meat to reduce climate change impact

Policy makers and land managers have to decide whether to put money and resources into maintaining existing forests, or to plant new forests, and whether timber harvesting or carbon sequestration is the desired goal (Waring et al, 2020).

Time to listen to indigenous wisdom around forests

Article 8 of the UN Declaration on the Rights of Indigenous Peoples sates, among other things that:

‘States shall provide effective mechanisms for prevention of, and redress for:
(a) Any action which has the aim or effect of depriving them of their integrity as distinct peoples, or of their cultural values or ethnic identities;
(b) Any action which has the aim or effect of dispossessing them of their lands, territories or resources;
(c) Any form of forced population transfer which has the aim or effect of violating or undermining any of their rights.’ (UNDRIP_E_web.pdf)

Indigenous people are acting as stewards of the forests where they have been living sustainably for thousands of years. Better consultation with indigenous people on forest management and more equitable land dispute resolution mechanisms are needed (Human Rights Watch,2019).

Inclusion of indigenous people in forestry management should involve awareness raising and sharing of wisdom between community members, across generations and with representatives of government and the general public. This awareness raising process should involve all citizens. Preserving the forest environment involves peaceful ways of living in harmony with the natural environment.

We cannot continue to undervalue the benefits (ecosystem services) we gain from forests, such as for climate control, building materials, carbon storage, maintaining clear waterways, home for biodiverse forms of life ecosystems, shade, water, energy production, soil conservation, or spiritual substance. Already 57% of pre-industrial revolution forests have gone, almost entirely through human intervention.

Global heating is becoming ever-more serious. The global human population is estimated to continue increasing up to an estimated 10.8 billion by 2100 (Ritchie,2021), with attendant needs for food, living space and resources. Our knowledge forests and their volution, growth and natural change is sufficient for them to be better managed and safeguarded. However, we continue to lose both individual trees and large sectors of forest.

Lawrence (2022) makes the critical point that we have become alienated from our unity with nature, and our role as part of the mutually sustaining ecosystem. We can believe we love trees, but we use them in their cut down products, and do not always reflect on this, as where we live and how we live are often alienated from the forest itself.

We cannot change the past but can learn from it. We can create the future. To do this we must see ourselves as not separate but as connected to, all parts of the earth ecosystem. The British Prime Minister Boris Johnson at COP26 articulated this needed perceptual shift around forests in stating:
[we need to] ‘*end the role of humanity as nature's conqueror, and instead become nature's custodian’ {*Rannard and Gillard, 2021).

The positive news is that deforestation is slowly declining since the peak time of deforestation in the 1980s (Ritchie, 2021). Humans are innovative, and many are responsive in the face of climate change risks, adopting new technologies, and environmentally considerate strategies. One example is the reduction of the need to clear land for cattle by consuming more vegan food, meat substitutes, such as laboratory produced meat grown from cell-lines of meat (although the process still generates greenhouse gas from fossil fuels and uses water).

COP26: A call to action on Forests

In 2021 at COP26 Climate Change Summit, more than one hundred world leaders (including those of including Brazil, Russia, China, the USA, Canada and the Democratic Republic of Congo) committed to both end and reverse deforestation by 2030. 28 countries and some large international companies made financial commitments to provide funds and to stop investment in deforestation related activities. Funds will help land restoration after deforestation, support Indigenous peoples living in or close to the forests, and help work on strategies to address wildfire risk (Rannard and Gillett, 2021). An allocated fund of £ 1.1 billion agreed at COP26 to help protect and restore the vast tropical rainforest of the Congo Basin, will involve the indigenous people in consultation and the management of forests.

It is to be hoped that these new commitments will be more realistic and effective than that made in 2014 to conserve and restore forests, which was voluntary and not legally binding, Since that commitment, the deforestation of the Amazon Basin has continued, reaching its highest rate in 2020.

What is possible for the future of forests

Our present knowledge on the roles of trees in the environment and in relation to ecosystems and climate change, provides wonderful opportunities today. Remote sensing from space and local information from drones enables us to count the number of trees on earth (estimated to be around three trillion, with Russia, Canada and Brazil having the largest national numbers) and helps us to assess the health of forest, the effects of wildfire, and the amount of carbon stored in the forest (Lowman, 2021). Today we can also scientifically assess how old a tree is and determine its state of health through cell analysis. We are able to predict future temperatures and assess the state of forest preservation around the world. Through the internet and online lobbying groups we can campaign for tree preservation.

There new methods of forest analysis and protection and awareness raising, funding promised by governments and the activities on UN bodies and many local and international NGOs have helped to stop deforestation and implement reforestation strategies. Better decisions are being made about where new tree plantings should be, which species should be used; how the trees should be managed; and what will be happening to the wood (Waring et al., 2020).

It is time to preserve what we have left of our forests, although climate change and resultant bushfires and increasing wildfires may see nature dancing to its own tune. As humans are often powerless to control such occurrences, in the way we have tried to control nature in the past. Because it is unrealistic to maintain every pre-existing forest tree, the TRIAD approach of Paquette and Messier (2010) seeks to ensure survival of an area of totally protected natural forest, allow a degree of carefully selected logging of natural forest, and allow some intensively managed plantation forest. This is one strategy for developing sustainable forest management, whilst meeting human needs.

Documenting of traditional indigenous knowledge, if agreed to by indigenous peoples, should be carried out and communicated to Indigenous youth (to ensure intergenerational knowledge transfer), and also to researchers and other interested parties with a concern for indigenous forest management ways and wisdom. There is more need for integrated forest management, with indigenous consultation and more Indigenous forestry roles, which can involve indigenous adults and

youth, and keeps them close to their traditional land. This indigenous employment strategy is already in place in Australia (Figure 6).

Figure 6. Indigenous workers in forestry in Australia

Citizen science with a forest focus is another way communities can become involved: to observe the state of forests; to keep statistics and photos (Figure 7); to maintain records to share with others; to build community walkways through forests, to write and share with others; to identify trees at risk; to be a steward; to share with others in relation to forest health; and to teach others about the value of preserving forests. We can become lobbyists for forest preservation, including in urban areas. We can write about forests, not just in often insular academic journals in preaching to the converted and operating in a narrow sphere; but we can give talks on forests; and we can raise awareness in the wider community where action happens.

Figure 7. A Citizen Scientist discovers a new species of (old) mangrove in Australia in Queensland

First and foremost, in raising forest awareness as a key to gaining commitment to sustaining forests into the future, we need to educate the young, including in particular Indigenous youth living in or near forest areas, and bring them into forest management in Indigenous communities. Whether in taking the young for educational forest walks (Figure 8), planting and caring for trees, adding to the educational curriculum, which is already being implemented, lobbying in our community to create areas of trees, even if not a large forest, a small community of trees, reading them stories about forests, or writing books or making films for children. Such participatory activities all increase children's understanding. We will not care for something if we do not know about it or its value, or if we do not feel strongly about it. It is not just about knowledge and awareness raising, forest experiences feed the spirit, and connect children and the child in all of us to nature, of which we often do not realise we are part.

Figure 8. Children in the Daintree Rainforest on a walk in Queensland (Australia)

There is hope if humans work together that we can recreate some forests, In Ethiopia more that 352 million tree seedlings were planted in a 12-hour period in one day in 2019. In Uttar Pradesh in India, one month later, 220 million seedlings were planted in one day (Lowman, 2021). Not all of these seedlings will eventually grow into big trees, as they face the challenges of fire and drought, flooding or predators, rising temperatures and being trampled. It takes decades for these seedlings to become trees, and effectively part of a forest, adding to carbon storage, and supporting high biodiversity.

In Costa Rica, the decimated tropical rainforests that had been reduced by the 1980's to only 25% of their previous extent, have now, through financial incentives from the government to landowners, been increased to cover half of the Costa Rican land area (Attenborough, 2020). These are positive reforestation strategies, but the real answer is to be proactive in stopping cutting down so many old trees, rather than reactively planting back seedlings (Greenpeace International, 2019).

'And into the forest I go, to lose my mind and find my soul.' (John Muir)

Approaching caring for forests from the Gaia principle of viewing the Earth as being one living being has gained more momentum over recent decades. The ecological approach of Gaia is that all organisms on the earth interact to regulate the biophysical environment, including temperature and humidity. Excessive activity by any one organism disrupts the stability of the earth system as a whole. Because of their immense numbers and technology, humans are now that disruptive organism and have to reposition themselves as responsible guardians of the Earth. This ecological approach has value, but it lacks a spiritual dimension. The key concluding premise from this article is that it is time to step back and align with Indigenous wisdom approach to the Earth, in the understanding that it is sacred. There are points to take also from the Sacred Groves discussed earlier, as if we value something we want to care for it and preserve it. From this perspective, the physical and the spiritual are connected, honoured, respected and cared for. We have seen the results of our destruction of forests from the Amazon to Indonesia, Africa, and other countries, with flow on impacts of climate

change, extinction of species, water pollution and visual butchering of the aesthetically and spiritually uplifting experience of forests.

It is time to shift to honouring the spiritual in the earth and the forests, and in the process ideally the spirit in humans will also align with this respectful and interconnected world view. We need to take from nature in a moderate and sustainable way, and live in a more harmonious way with nature, for the ecosystem of Earth to survive. It is time to take a leaf out of the tree book of wisdom on how natural forests live in their social communities (Wohlleben, 2015). These goals can be approached in a more sustainable way and in assessing how much we need, how much should we leave, and how much we should replace from what we take. We can make responsible choices, for example around no palm oil products, or reducing meat consumption. We can remind ourselves of nature by connecting with trees or planting trees. We need to connect with others in honouring and caring for forests both in our own communities, countries and internationally, in our lobbying for forest maintenance, and to support those in governments and business with this ethos. We also need to lead by example in educating the next generation, in leaving a legacy that forests and trees are central to our earth and our existence as a shared planet.

We are now both at the global heating tipping point and at a crossroads for the world's forests and the Earth System as a whole. Millions of individuals, NGOs (such as the Rainforest Trust, Greenpeace, and the Commonwealth Human Ecology Council), organisations (such as the International Council for Science and the World Wildlife Fund), the United Nations and its Agencies, and national, regional and local governments are working to create a better world, and to protect, enhance and restore forests. Their various activities, from funding or lobbying, to policy-making and action on the ground can achieve abundant forests, clean air, and ecological stability for our grandchildren, or, if unwise, make conditions for our descendants ever more difficult.

We cannot change the past in what has happened to the forests, but we can create a better future for forests, and thereby for humans and all on earth:

'We must not give up hope. We have all the tools we need, the thoughts and ideas of billions of remarkable minds and the immeasurable energies of nature to help us…. we have …an ability…. To imagine a future and work towards achieving it (Attenborough, 2020, p.220).

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Mangroves for Money: ecological and social impacts of recent development projects in the mangrove forests of Grenada, West Indies

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Introduction

Grenada is a Small Island Developing State (SIDS) located in the southern Caribbean with a population of ~113,000 (CIA 2021). The nation of Grenada includes three inhabited islands—Grenada, Carriacou, and Petite Martinique—and several uninhabited islands, comprising the southernmost islands of the Grenadines archipelago. With its highest peak at 840 m above sea level, the volcanic island of Grenada supports varied forest ecosystems, including evergreen forest, cloud forest, dry forest, and mangrove forest (CANARI 2020).

The most recent country survey found 298 ha of mangrove forest across Grenada and its constituent islands (Moore et al. 2015), with most of this area being on the main island, Grenada, followed by the second largest island, Carriacou. The largest mangrove forest sites are Levera on Grenada (46 ha) and Lauriston and Tyrrel Bay on Carriacou (35 and 33 ha respectively; Moore et al. 2015). There are three species of true mangroves in the country—red (*Rhizophora mangle*), black (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*)—as well as the mangrove associates buttonwood (*Conocarpus erectus*) and mangrove fern (*Acrostichum aureum*).

Ecosystem services are benefits that people obtain from ecological capital (Costanza et al. 1997). Throughout the tropics and subtropics, mangroves provide a suite of ecosystem services, including but not limited to: coastal protection, carbon storage, and support of industries like tourism, fisheries, and timber production (Flint et al. 2018). Many Grenadians live along the coast (Jessamy & Rothenberger 2018), benefiting directly and indirectly from mangroves and their associated ecosystem services. For a small country (344 km^2 in area) with such an extensive coastline (121 km; CIA 2021), mangroves are particularly important for climate resilience and food security.

The most destructive of the natural and anthropogenic threats to mangrove forests is coastal land-use change (FAO 2007; Goldberg et al. 2020). This degradation and loss due to rapid coastal settlement development exacerbate the increasing impacts of climate change and associated rising sea levels and extreme weather events (Goldberg et al. 2020). Climate change and sea level rise will alter coastlines and change mangrove extent, disrupting coastal hydrology, and changing both sea temperatures and weather conditions (Moore et al. 2015). While Grenada is comparatively protected from regular hurricanes by its southerly location, major hurricanes in 1955, 2004, and 2005, as well as

numerous storms and sea surges, have affected the extent and health of mangroves within the country. Only a few of the sites affected by these hurricanes (Layman et al. 2006; Moore 2004), had recovered at the time of the 2011 countrywide survey (Moore et al. 2015).

Development projects continue to be approved in the delicate coastal zone in and around mangroves in Grenada, especially for large-scale resorts, which will cause sustained disturbance throughout both construction and subsequent resort operations. Many of these projects are linked to Grenada's budding Citizenship by Investment (CBI) programme, which provides an avenue for foreigners to gain Grenadian citizenship and its associated benefits through economic investment (Government of Grenada 2013; 2021). While there are options to invest in general infrastructure and non-tourism industries, most income from the CBI programme is funnelled into resort and hotel development, citing "growth of the tourism industry" and "rising demand" for housing (Government of Grenada 2013; 2021). Globally, CBI programmes have been criticised for their inherent risks of corruption and money laundering (OECD 2019), yet they have been embraced by Grenada and several other SIDS as a panacea for slow or stagnant development. Since the CBI programme's inception, over twenty development projects have been approved by the Planning and Development Authority (Government of Grenada 2021), many of which are near or within important mangrove forests, including the three considered herein (Figure 1). Environmental and Social Impact Assessments (ESIAs) for these three projects are either incomplete or have not been made public, raising concerns over the current state of land governance in Grenada.

Local conservation NGOs—including Local and regional conservation NGOs—including BirdsCaribbean (BirdsCaribbean, 2020), Grenada Fund for Conservation, Gaea Conservation Network, Grenada Land Actors, and Friends of the Earth—are working together to document Grenada's mangrove ecosystems and advocate for their importance to the broader public. Herein, we provide a brief overview of the recent developments that threaten Grenada's mangrove forests and discuss their ecological, economic, and cultural impacts.

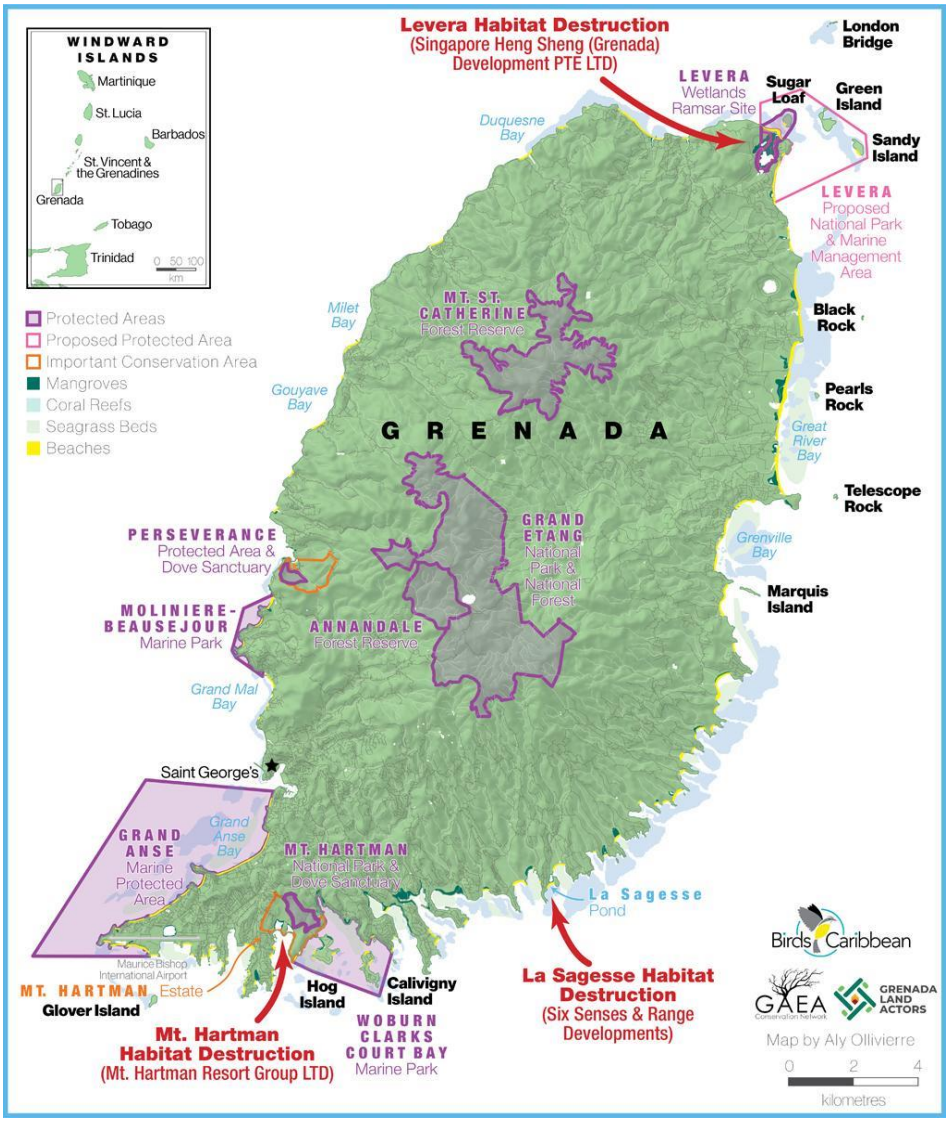

Figure 1. Map of Grenada with recent development projects indicated in red. Map credit: Aly Ollivierre, courtesy of BirdsCaribbean.

Recent Developments

Mt. Hartman

At Mt. Hartman, a 12-ha mixed mudflat and mangrove forest located on the southern coast, plans are underway for a combined resort, medical hospital, and university by Hartman Resort Group LTD. The resort plans include a 500-room hotel, villas, university complex, football stadium, and marina (Hartman Hotel Development LTD 2022). This development threatens one of the largest expanses of black mangrove in Grenada, as well as mangrove area identified as important for finfish production (Huber et al. 1988). Neither of the two mangrove forests, separated by a headland of dry forest, are protected. They are also adjacent to the Mt. Hartman Dove Sanctuary, established to protect the critically endangered Grenada Dove (*Leptotila wellsi*), which is Grenada's national bird (Rusk 2010; 2017). Planning permission for this site was originally granted in 2016, and initial clearing of land took place before permission lapsed due to inactivity. Construction began anew at this site in August

2020, and will continue for another ten years (Figure 2). The ESIA has yet to be made public.

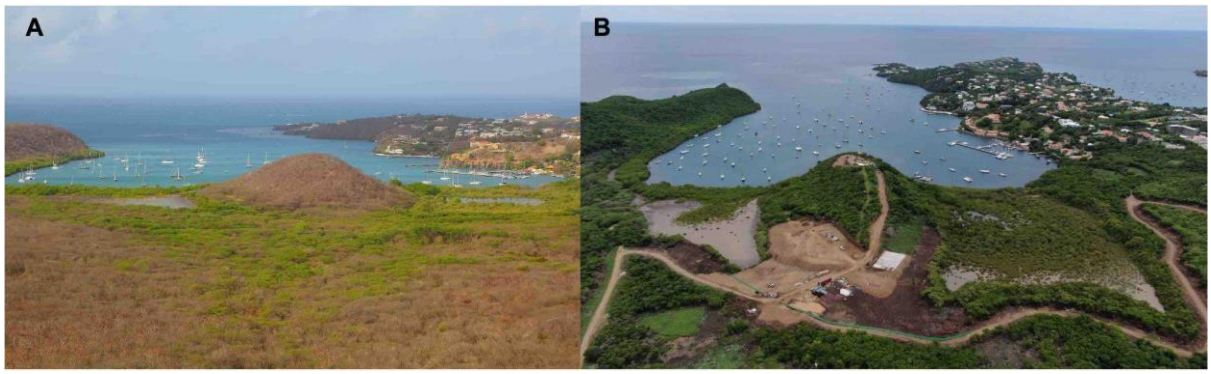

Figure 2. Photos of mangrove and dry forest in Mt. Hartman before (A: June 2014) and after (B: August 2020) clearing for hotel development. The boundary for the Dove Sanctuary lies just below the road in the foreground — the eastern mangrove is on the left of the headland and western mangrove is on the right. Image credits: Greg Homel (A); Reginald Joseph (B).

La Sagesse

Beginning in July 2019, a 1-ha mangrove forest surrounding a large seasonal pond at La Sagesse, St. David, was completely cleared by Range Developments to construct the Six Senses Resort (Range Developments 2022). Expert review found the ESIA to be incomplete, with inadequate consideration of impacts on marine life, water quality, birds, plants, and land access for fishing and recreation (Gaea Conservation Network 2020). The area also adjoins the remains of an early parish town (abandoned in the 19th century) and contains two distinct Amerindian settlements, all of which should have triggered archaeological mitigation in the ESIA. While the developer ultimately supported limited archaeological investigations (see Cultural Impacts below), this information was not included in the ESIA , further highlighting major gaps in Grenada's land governance. The 100-room resort is currently under construction and scheduled for completion in late 2022 (Figure 3).

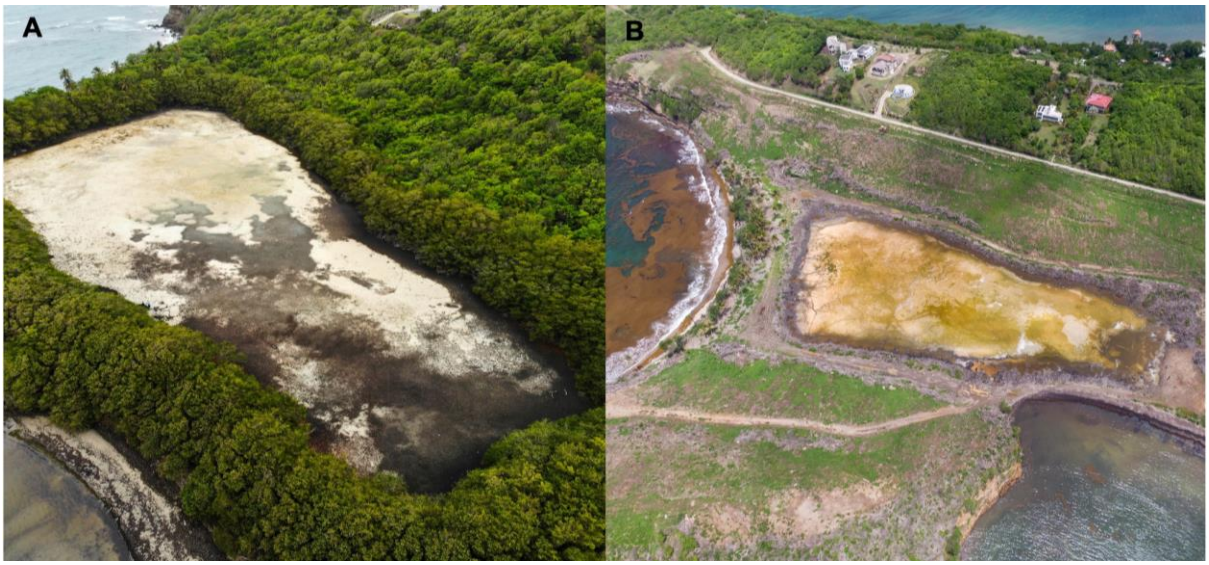

Figure 3. Photos of mangrove forest in La Sagesse before (A: June 2019) and after (B: August 2020) clearing for hotel development. Image credits: Reginald Joseph.

Levera

On the north-eastern coast, at Levera, the single largest mangrove forest in Grenada (46 ha) has been targeted for the construction of Grenada National Resort by the Singapore Heng Sheng (Grenada) Development company. The plans for this mega-resort have yet to be finalised, but the most recent plan spans 187 ha and includes a yacht terminal and pier, professional golf course, amusement and water park, 43 private villas, aquarium museum, power plant, sewage plant, desalination plant, and three high-rise hotel towers (10–16 floors each) with over 500 guest rooms in total (Heng Sheng 2022). This plan threatens both the long-proposed site of Levera National Park and a designated Wetland of International Importance (Ramsar Convention Secretariat 2012). The beach, a regionally important nesting site for leatherback turtles (*Dermochelys coriacea*; Maison et al. 2010), is protected under legislation during the nesting season. While there have been several unsuccessful proposals for the area, this is the largest ever made. Disturbance related to the current plans began with the creation of temporary worker housing by the contractor China Railway Construction in August 2020 (Figure 4) and hundreds of small excavations for use in geotechnical analysis. The ESIA has yet to be made public.

Figure 4. Photos of mangrove forest in Levera before (A: June 2019) and after (B: August 2020) clearing for hotel development. Image credits: Reginald Joseph (A); Orlando Romain (B).

Ecological Impacts

Mangrove forests are hotspots of biodiversity with high rates of primary production (Alongi 2002). They are dense and structurally complex, with abundant microhabitats ranging from trunks and canopies housing reptiles, birds, insects, and mammals; to root systems providing substrate for gastropods, crustaceans, sponges, and other marine invertebrates; to underwater spaces between roots serving as shelter and nursery habitat for fishes and crustaceans; to leaf litter and soft sediment supporting epifauna and infauna (Alongi 2002; Lee et al. 2014). Mangrove forests support higher abundance of juvenile species than other nearshore habitats, offering decreased predation risk and increased food availability for developing organisms, including species important to subsistence and commercial fisheries. Even smaller areas of non-estuarine mangroves, typical of Caribbean islands, are critical at the island scale for the

health of fish populations associated with adjacent coral reefs and seagrass beds (Nagelkerken et al. 2008).

The varied taxa found in Grenada's mangroves include species found only in the Caribbean (regional endemics) and others only found in Grenada (endemic):

1) Reptiles: Grenada Bank tree boa (*Corallus grenadensis*) (**endemic**), which use mangroves for rest and foraging (Henderson & Sajdak 2003);
2) Birds: Caribbean Martin (*Progne dominicensis*), Grenada Flycatcher (*Myiarchus nugator*), Lesser Antillean Tanager (*Stilpnia cucullate*), Green-throated Carib (*Eulampis holosericeus*) (**regional endemics**), and the Critically Endangered Grenada Dove (*Leptotila wellsi*) (**endemic**), which has been heard near the mangroves in Mt. Hartman adjacent its sanctuary;
3) Invertebrates: mangrove oysters (local name for both *Crassostrea rhizophorae* and *Isognomon alatus*; Moore 2003), crabs (including *Uca* spp., *Goniopsis cruentata*, and *Aratus pisonii*; University of the West Indies 2016), and Caribbean spiny lobsters (*Panulirus argus*; Ministry of Carriacou and Petite Martinique Affairs 2015) (**regional endemics**).

Birds are the best-studied taxon in Grenadian mangrove ecosystems with many foraging guilds that exploit different microhabitats, including canopy gleaners, ground foragers, coastal scavengers, mud probers, and dabblers (Billerman et al. 2020). Since 2017, citizen-science observations logged through the eBird platform have identified ~110 species of birds using mangroves and nearby coastal ecosystems (eBird Basic Dataset 2021) in Grenada, including both wetland specialists and generalist land birds. Many of the birds recorded are migratory (~40%; Gerbracht & Levesque 2019; eBird Basic Dataset 2021), highlighting the importance of Grenadian mangroves as a stopover and overwintering habitat for vulnerable migrating birds that are highly sensitive to habitat changes, which can result in higher mortality and lower fitness (Azimah & Tarmiji 2018). Maintenance of these habitats is critical for migratory bird conservation. Commercial developments will adversely affect birds in these mangroves through habitat loss, fragmentation by roads, noise, and pollution (Enshassi et al. 2014; Thompson 2003).

Mt. Hartman

In August 2020, Hartman Resort Group LTD commenced the first phase of their 10-year hotel development plans by clearing areas of the coastal forest at Mt. Hartman. The vegetation removal was initially to permit the widening of an access road. Later, the vegetation on the headland between the eastern and western mangrove forests and most of the remaining mangroves in the eastern wetland were cleared (Figure 2B).

Past surveys of the eastern and western mangrove forests suggested that they support diverse biological communities. Based on eBird records prior to August 2020, 32 bird species were observed at the larger western mangrove forest, while as much as double that number (66 bird species) were sighted at the smaller, eastern mangrove forest (*NB*: this difference is likely driven by the lower detectability of birds in the western mangrove forest, since it is more densely vegetated and larger). Because mudflats are prominent features of both mangrove forests, they disproportionately support waders—birds that feed by probing the sediment for arthropods. Unfortunately, surveys in 2020 do suggest that the loss of dry forest around these wetlands make these

foraging and nesting birds more vulnerable to invasive mammalian predators: camera traps placed along the edge of the wetland had a high prevalence of cats and mongoose, while those in the interior of the wetlands were devoid of mammals (Gaea Conservation Network, unpublished data 2020).

In addition to wetland birds, mangrove forests at Mt. Hartman may provide key habitat for the critically endangered Grenada Dove. The Grenada Dove's primary habitat, though protected by Mt. Hartman Dove Sanctuary, borders the land under development. The Grenada Dove Conservation Program indicates that nesting pairs have been observed on the headland between the eastern and western mangroves, and their calls have been reported within the wetland itself. Even if limited to the fringes of the mangrove forest, this disturbance is likely to have severe impacts on the dove population.

The red mangroves on the seaward side of these wetlands are a nursery for juvenile fish. In the bay of the western mangrove forest, the 18 observed fish species belong to two main functional groups—grazers and predators (Gaea Conservation Network, unpublished data 2020). Informal conversations with fisherfolk in the area confirm that nearly all the species observed in the bay are critical for local fisheries.

La Sagesse

Prior to the clearing of vegetation, La Sagesse supported areas of white mangrove and buttonwood, with a few mature black mangrove trees in the northeast of the wetland (Gaea Conservation Network, unpublished data 2019). The loss of this vegetation has increased run-off to the pond and neighbouring beach. eBird records up to 2019 show that the mangrove forest at La Sagesse supported the most functionally-diverse bird community on Grenada. To accommodate the building of the Six Senses Resort, Range Developments clear-cut the mangrove forest and reduced the size of the pond by backfilling the sides, causing numerous impacts on associated biota (Figure 3B). With the loss of vegetation and alteration of pond topography, we expect birds that require upland vegetation to nest or forage (e.g., Tricolored Heron [*Egretta tricolor*]) or those that wade (e.g., Greater Yellowlegs [*Tringa melanoleuca*]) or dabble (Blue-winged Teal [*Spatula discors*]) will no longer use this site.

Along both beaches bordering the cleared area are seagrass beds comprised of turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*), with coral reefs comprising hard corals (e.g., stony coral [*Porites* spp.], brain coral [*Diploria* spp.], fire coral [*Millepora* spp.]) and soft corals (e.g., sea fans [*Gorgonia* spp.]). Prior to the clearing, these areas supported a diverse community of bony fish (e.g., families Scaridae, Pomacentridae), sponges, anemones, and urchins (e.g., white sea urchins [*Tripneustes depressus*] and black sea urchins [*Diadema setosum*]; Gaea Conservation Network, unpublished data 2020). Although no known surveys have been conducted since 2020, reports of increased sedimentation at the neighbouring beaches herald accompanying changes in the taxa of these nearshore ecosystems, as sedimentation has negative and potentially lethal effects on seagrass beds (Cabaço et al. 2008) and coral reefs (Rogers and Ramos-Scharrón 2022). La Sagesse was also a known nesting site for critically endangered hawksbill turtles (*Eretmochelys imbricata*; Ocean Spirits, unpublished data 2019), which are no longer observed nesting in this area.

Levera

At Grenada's sole Ramsar site, Singapore Heng Sheng was granted permission to build temporary workers housing at the southern edge of the mangrove forest by the Planning and Development Authority in August 2020. Though minimal dry and mangrove forest area was cleared to accommodate the units, extensive areas of coastal vegetation were removed to allow the construction of access roads.

Though clear-cutting of coastal forests in Levera to accommodate failed hotel developments occurred in 2004 and 2016, the mangrove forest continues to provide habitat for a wide array of fauna. As a mangrove forest with one of the largest ponded areas on Grenada, the wetland in Levera is possibly the most species-rich for birds on the island. Citizen science records prior to the 2020 development suggest that as many as 76 species of birds had been observed, and these birds span various functional groups (eBird Basic Dataset 2021). Though similar species were also observed in the La Sagesse wetland, abundances of bird species at the wetland in Levera were typically higher (eBird Basic Dataset 2021). As the northernmost mangrove site on Grenada, Levera is a critical part of the stopover network for migratory birds, and so measures must be taken to ensure this site continues to provide seasonal habitat for these visiting species.

The draft of a recent Marine Management Plan for Levera reported data from marine surveys along three transects, which found 18 species of fish, spanning 14 families, in nearshore coral reefs (Grenada Coral Reef Foundation 2018). Surgeonfish (26%), wrasses (18%), parrotfishes and groupers (13%), and grunts (11%) were the most abundant taxa (Grenada Coral Reef Foundation 2018). These marine surveys found 13 species of coral, spanning 11 genera, among the 211 colonies (Grenada Coral Reef Foundation 2018). The Grenada Coral Reef Foundation also surveyed biota in the mangrove forest. Lesser Chapman's opossum (*Marmosa robinsoni*), greater Chapman's opossum (*Didelphis marsupialis insularis*), and nine-banded armadillos (*Dasypus novemcinctus hoplites*) were reported in stakeholder consultations, and Burmese mongoose (*Herpestes auropunctatus*) were observed in visual surveys (Grenada Coral Reef Foundation 2018). A more recent survey suggests cats and dogs also occupy the mangrove forest (Gaea Conservation Network, unpublished data 2020). Additionally, the beach adjacent to the mangrove forest is the third largest nesting site for vulnerable leatherback turtles in the Caribbean region and also supports nesting of critically endangered hawksbill turtles (Charles 2018; Maison et al. 2010).

Economic Impacts

Ecosystem services are valued globally at US$125 trillion per year in 2011, of which marine and coastal ecosystems provide two-thirds (Flint et al. 2018). Ecosystem services from mangroves alone are worth US$33,000–57,000 per hectare per year (Flint et al. 2018). By extension, the 298 ha of mangrove in Grenada (Moore et al. 2015) provide between US$9.8–16.9 million in ecosystem services *annually*. These include:

Blue Carbon Storage

Blue carbon is carbon stored in marine and coastal ecosystems, particularly vegetated habitats like mangroves and seagrasses (Nellemann et al. 2009). These systems sequester carbon at higher rates than terrestrial forests (Flint et al. 2018), and mangroves can store more carbon per unit area than any other marine or terrestrial

ecosystem (1,000 tonnes of carbon per hectare of mangrove; Flint et al. 2018; UNEP 2014). Preventing the destruction of mangrove ecosystems is critical to carbon mitigation strategies (Global Commission on Adaptation 2019), particularly in countries with extensive coastlines (Taillardat et al. 2018) like Grenada. Under a Business-as-Usual scenario, with limited protection of Grenadian coastal ecosystems, a net release of 12,450 tonnes of carbon from mangrove is predicted between 2020 and 2070, representing a loss of US$0.41–1.62 million (McHarg et al. 2022).

Coastal Protection

Mangroves, which have complex above- and below-ground root systems, are natural coastal defences against waves, storm surges, and flooding, thereby reducing storm damage by 40% to 60% (Flint et al. 2018) and playing an important role in coastal risk reduction (UNEP 2014; World Bank 2019). By a recent estimate, they provide global flood protection benefits exceeding US$65 billion annually (Menéndez et al. 2020), and mangrove protection is a more cost-effective solution for coastal protection than construction of seawalls and breakwaters (Flint et al. 2018; World Bank 2019). Most of Grenada's population and infrastructure is located on or near the coast and is thus vulnerable to flooding and erosion impacts, with an average annual loss approaching US$20 million or 1.7% of GDP before climate change impacts (CARIBSAVE 2012; IMF 2019).

Shoreline Stabilisation

Mangroves reduce coastal erosion by minimising wave energy and preventing sediment from being carried away from shore, as well as slowing water flow and increasing sediment accumulation (Himes-Cornell et al. 2018; UNEP 2014). In addition to increasing resilience of human communities to sea level rise, these processes also afford protection to seagrass and coral reefs, which are damaged by sedimentation resulting from coastal erosion (UNEP 2014). Grenada's coastal infrastructure faces significant risk of erosion due to sea level rise (IMF 2019), and mangrove protection is key to ameliorating this risk.

Supporting Fisheries

Mangroves provide nursery habitat and support subsistence and commercial fisheries for finfish and shellfish species that are important for local livelihoods and food security (Himes-Cornell et al. 2018; Flint et al. 2018; UNEP 2014). The fishing industry in Grenada employs 4,000 individuals, equivalent to nearly 10% of the labour force (St. Louis 2017). Grenada exported US$6.6 million of fish in 2018 (Government of Grenada 2022a), making it the most valuable domestic export sector. Additionally, the per capita consumption of fish in Grenada exceeds regional and international averages (St. Louis 2017). Other species, such as the blue land crab (*Cardisoma guanhumi*), are also harvested from mangrove sites in Grenada on a commercial basis. One case study in northeast Grenada found harvesting of crabs had a value of US$1.48 million per year at a 7.65-ha site (Koester 2014).

Water Quality Maintenance

Mangroves serve as a natural filtration system for runoff from land, removing contaminants, debris, nutrients, and sediments that would have negative impacts on the marine environment and water quality (Flint et al. 2018; UNEP 2014).

Timber Products

Mangroves provide local sources of charcoal, fuelwood, and wood for construction (Flint et al. 2018; UNEP 2014). Mangrove forest in Grenada is valued for charcoal production (Huber et al. 1988), which continues to provide an important source of fuel and income for nearby communities. Charcoal harvesting at a 7.65-ha mangrove site on the northeast coast of Grenada was valued at US$357,318 per year (Koester 2014).

Recreation & Tourism

Opportunities for recreation and ecotourism provided by mangroves are valued at US$3,526 per hectare per year on average (Himes-Cornell et al. 2018). In Grenada, mangroves support bird watching, kayaking, snorkelling, and other nature-based activities and have a meaningful impact on local wellbeing and livelihoods. The tourism sector is central to Grenada's economy, contributing 40.7% of Grenada's GDP and 42.0% of total employment in 2019 (World Travel and Tourism Council 2021). In an effort to increase these benefits, Grenada's tourism product has been branded "Pure Grenada" to appeal to "the eco-chic visitor" seeking "the unspoilt characteristics of an eco-tropical paradise" (Government of Grenada 2022b).

Table 1. Estimated tonnes of carbon released and value of ecosystem services lost with complete destruction of mangrove area at three sites targeted for development in Grenada.

Site	**Mangrove area at site (hectares and percent of total mangroves)[1]**	**Carbon released by mangrove destruction (tonnes)[2]**	**Value of mangrove ecosystem services lost per year after mangrove destruction (USD)[3]**	**Cost of mangrove restoration (USD)[4]**
La Sagesse	1 ha (0.34%)	1,000	$33,000–$57,000	$14,000
Levera	46 ha (15.44%)	46,000	$1,518,000–$2,622,000	$644,000
Mt. Hartman	12 ha (4.03%)	12,000	$396,000–$684,000	$168,000
Total	**59** ha of mangrove, or **19.8%** of total mangroves under threat	**59,000** tonnes of carbon released to atmosphere	**$1,947,000–$3,363,000** in value lost annually	**$826,000** mangrove restoration cost

[1] Based on published values for mangrove area mapped in Grenada and the Grenadines in 2011 (Moore et al. 2015, p. 160).
[2] Based on 1,000 tonnes of carbon per hectare of mangrove (UNEP 2014, p. 56; Flint et al. 2018, p. 25).
[3] Based on US$33,000–US$57,000 per hectare per year value of mangrove ecosystem services (UNEP 2014, p. 61; Flint et al. 2018, p. 23).
[4] Based on US$14,000 per hectare cost of mangrove restoration in Grenada (World Bank 2019, p. 66).

The mangrove areas under threat by ongoing development projects in Grenada amount to nearly 20% of Grenada's mangroves, which store a combined 59,000 tonnes of carbon and provide US$1.95–3.36 million in total ecosystem services each year (Table 1). The value and quality of these services decrease or disappear when ecosystems are degraded by

development (van der Geest et al. 2019). Development projects in Grenada that degrade mangrove ecosystems therefore lead to a significant loss of valuable local resources and put vulnerable communities at greater risk of climate-related disasters.

Cultural Impacts

Although cultural ecosystem services—including spiritual, aesthetic, and existence values—are challenging to quantify, they represent important components of mangrove value (Himes-Cornell et al. 2018). This is also not a modern phenomenon, and recent research on the environmental variables associated with well-studied archaeological sites in Grenada has revealed a strong correlation with wetlands of all kinds (Hanna 2018). The explanation for this strong association between ancient Caribbean peoples and wetland areas remains unclear. Wetlands are not ideal places to live, of course. Seasonal flooding can damage houses and crops, and the increased biodiversity in these areas means many unwanted insects and pests as well. However, some of the worst pests (e.g., mosquitoes like *Aedes aegypti*) arrived after the "Columbian Exchange" and were not present prior to European arrival, nor were many of the diseases they carry (Crosby 2003). As biodiversity hotspots, wetland habitats support unique flora, many of which have ethnobotanical value (Newsom & Wing 2004). While some (freshwater) wetlands have highly productive soils that are still prized in the Amazon Basin today (Junk et al. 2011), there is currently little evidence that such soils were being planted in the Caribbean. More likely, then, the attraction was natural (or semi-managed) plants with psychoactive and medicinal uses and uses as palm thatch and timber/firewood. Such ecological knowledge derived, initially, from cultural developments that first occurred in South America, and were retained and revised as ancient groups migrated into the Caribbean.

Notably, *all* of the 89 Pre-Columbian sites currently recorded in Grenada are within 500 m of a wetland (55 are within 100 m), including inland sites far from the coast (Figure 5). This makes wetlands an ideal variable to include in predictive models for mitigating destruction of undiscovered sites (de Waal et al. 2019). Indeed, such a model was successfully extrapolated northward to St. Vincent and the Grenadines (Hanna & Giovas 2019), demonstrating the association between Pre-Columbian settlements and wetlands is not unique to Grenada.

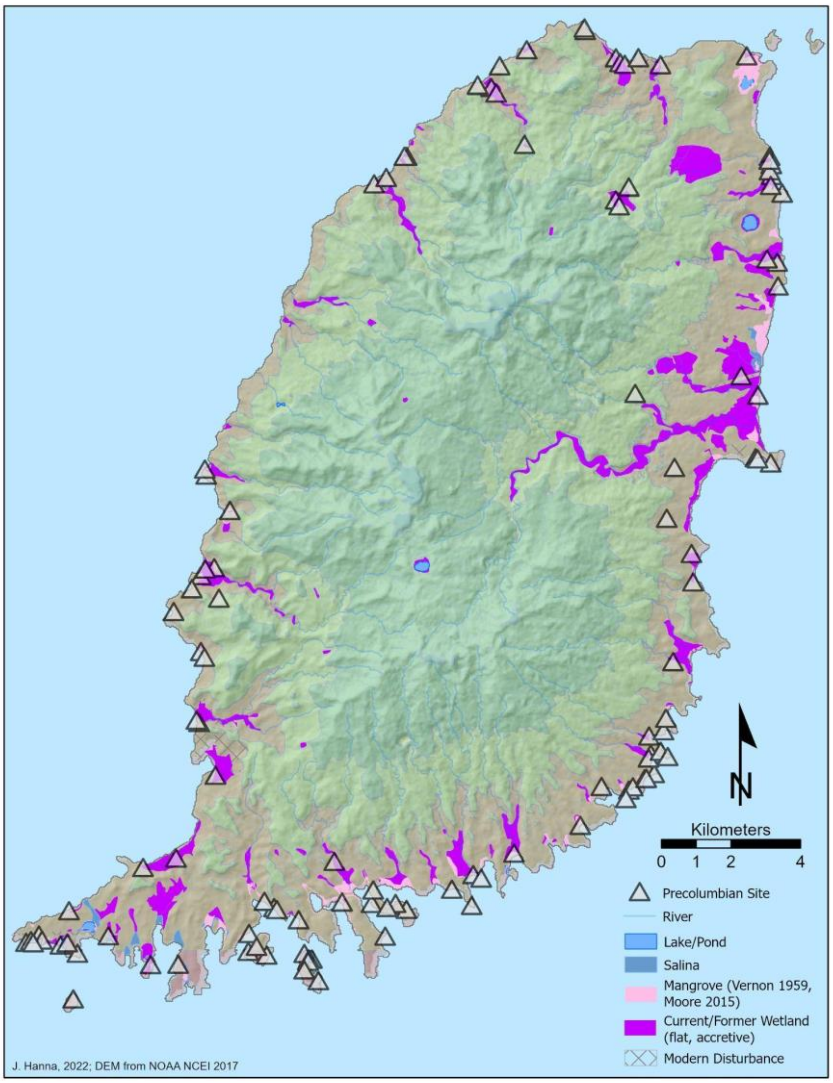

Figure 5. Map of Grenada showing the association between Pre-Columbian sites and mangroves and wetlands, with likely current or former wetlands based on low slope and alluvial/accretive soils. Combined mangrove data from Vernon et al. (1959) and Moore et al. (2015).

The vast majority of these sites are also in the coastal zone where increased commercial development heightens the likelihood of destroying irreplaceable archaeological resources. This includes the three mangrove forests discussed herein. Two of these three areas contained well-documented archaeological remains prior to the projects, with the third (Mt. Hartman) having high probability but never surveyed archaeologically. Only the developer of the resort at La Sagesse agreed to pay for archaeological investigations prior to construction, which revealed a previously unknown settlement, complete with extensive ceramic middens, several ancient postholes, and a partial human burial dating between AD 1475–1635 (LCAP 2021). This is a small example of what can be lost to poorly-regulated development. While several laws are in place to protect archaeological sites from destruction, such findings are typically destroyed and never reported.

The Future of Mangrove Forests in Grenada

In light of the ecological and social importance of mangrove forests in Grenada and the mounting threats they face, the future of Grenadian mangroves and the benefits they provide to local communities depends on improving land governance in Grenada. We recommend the following approaches to ensure sustainable land management:

Policy and Legislation

Grenada lacks any overarching environmental or natural resources management legislation. Dozens of legislative acts include protections for natural resources, environmentally sensitive areas, coastal and wetland areas, and cultural resources, most notably the Fisheries Act of 1986, the Physical Planning Act of 2016, the Museum Act of 2017, and the Coastal Zone Management Act of 2019. Older legislation, such as the Birds and Other WildLife (Protection of) Ordinance of 1964, appear to be ignored, and provisions of the Forest, Soil and Water Conservation Act of 1984 appear to be largely unenforced. The Integrated Coastal Zone Management Act of 2019 (Government of Grenada 2019a) makes first strides towards more sustainable management of coastal zone development, but implementation has stalled. A regional study found that, for Grenada, the lack of Environmental Impact Assessment regulations to implement the necessary provisions of the Physical Planning Act was a glaring omission (Toppin-Allahar 2018). The development process in Grenada greatly needs improvement, starting with an overhaul of land use legislation and policy (a draft policy exists) to include zoning that incorporates multi-user needs and coastal zone conservation obligations.

Transparency

The project proposals of large-scale developments and accompanying Environmental and Social Impact Assessments (ESIAs) should be publicly available information and reliably disseminated for public awareness. Allowing for constructive feedback from communities and local experts on social and environmental concerns in a transparent and timely feedback loop benefits developers as much as local communities. This may require more time and effort upfront, but proactive engagement encourages project buy-in and assists developers in avoiding costly pitfalls due to lack of foresight and planning in the project design phase. Ecological factors like mangrove protection and common livelihood and recreational uses of sites by nearby communities must be considered, with related mitigation measures effectively incorporated into planning.

Public Engagement & Consultation

To foster a more transparent and inclusive development process, public engagement and consultation must be prioritised. Currently, nearby communities are too often the last to hear about a proposed development (and in a SIDS like Grenada, the entire population is within a few miles of the affected area). Public consultation and participation for projects of a certain scale should be required early in the process, not conducted as an inconvenient afterthought. Lack of public consultation tends to create distrust among communities, developers, and government authorities, as well as disenfranchise affected communities and increase the risk of overlooking negative social and environmental impacts. Well-facilitated public consultations need to take place prior to project approval by the Planning and Development Authority and throughout the development process.

In response to the lack of public engagement and transparency in the development process, the Grenada Land Actors filed a case against

the Planning and Development Authority, focusing on the three recent developments described herein (Eastern Caribbean Supreme Court 2022). Though the case is ongoing, the organisation is requesting that planning documents be made public and that the Court review the Authority's decisions and determine whether those decisions accord with law and the provisions of the Physical Planning Act of 2016 (Grenada Land Actors 2021).

Oversight

Developers require greater oversight in following the guidelines of their own ESIAs. Under Grenada's current system, ESIAs are reviewed by a committee of civil servants with expertise relevant to the terms of reference that guide the ESIAs. This committee can make recommendations on what conditions should be placed on approval or whether additional work is needed to support the planning approval. Because the minutes of these meetings are not public, nor the conditions of the planning approval, knowledge of when a developer is in violation of their planning approval is limited to the Planning and Development Authority, which in recent years has had insufficient human resources to monitor these projects following approval. The lack of regulations to guide the ESIAs under the Physical Planning Act will only continue to hamper the process.

Conclusion

Grenada is a small country with limited land resources and a growing risk of climate-related disasters. In addition to being part of Grenadian natural and cultural heritage, mangrove forests contribute to food security and livelihoods, increase resilience to climate change, reduce disaster risks, and support biodiversity and the health of other valuable coastal ecosystems. Protecting these benefits aligns with the primary goals of Grenada's National Sustainable Development Plan (Government of Grenada 2019b). Yet, ongoing development projects disregard the ecological, economic, and cultural value of mangrove forests in Grenada. The current approach to physical planning and development in Grenada is in direct conflict with any reasonable National Sustainable Development Plan and commitments Grenada has made to ensure a sustainable future for its citizens. While profits from loss and degradation of mangrove forests may be appealing in the short-term, they are small compared to the accompanying long-term losses of Grenada's natural capital.

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When forest management needs to transition to forest protection to conserve biodiversity and provide key ecosystem services: a case study from south-eastern Australia

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Introduction

The world's forests play critical roles in water cycles, carbon storage, wood production, and biodiversity conservation (Bormann and Likens 1979, Lindenmayer and Franklin 2002, Perry et al. 2008). How forests are managed can have profound impacts on these values, particularly where uses such as wood production conflict with other values like the protection of biodiversity (Watson et al. 2018), the maintenance of carbon stocks (Keith et al. 2014) (Ceccherini et al. 2020), or the supply of water for human consumption (Taylor et al. 2019). Long-term maintenance of the range of values of natural forests is a key part of ecologically sustainable forest management (Lindenmayer and Franklin 2003) (Angelstam et al. 2021), where ecologically sustainable forest management can be broadly defined as: *Forest management that perpetuates ecosystem integrity while continuing to provide wood and non-wood values. In this context, ecosystem integrity can be considered to be the maintenance of forest structure, species composition, and the rate of ecological processes and functions within the bounds of normal disturbance regimes.*

In some cases, attempts to implement ecologically sustainable forest management have not succeeded, with the impacts of forest management activities like industrial logging having marked negative impacts on a range of other ecological, economic and social values. In these cases, an important land management option is to move toward large-scale forest protection. Indeed, there are an increasing number of case studies highlighting the critical values of intact forests globally (reviewed by (Watson et al. 2018)). In this short article, I highlight a key example of when forest management needs to transition to forest protection to conserve biodiversity and provide key ecosystem services. I use the native Mountain Ash (*Eucalyptus regnans*) forests in mainland south-eastern Australia as a brief case study. A suite of studies of biodiversity values, water values, fire dynamics, wood supply, and economic accounting all point toward an urgent need for greater forest protection in this ecosystem and, in turn, the need to source wood products from areas other than Mountain Ash forest.

Case study of Mountain Ash forests in mainland south-eastern Australia

This case study focuses on the 140 000 ha of Mountain Ash forests of the Central Highlands of Victoria, south-eastern Australia (Figure 1). These forests have been the focus of detailed ecological, silvicultural, economic, and social science studies for over four decades (Ashton 1975) (Lindenmayer 2009) (Keith et al. 2017) (Lindenmayer et al. 2022). Mountain Ash forests are spectacular and support the tallest flowering trees on earth (approaching 100

metres in height) (Ashton 1975) (Figure 1). These forests generate most of the water for the 5+ million inhabitants of Melbourne (Viggers et al. 2013, Taylor et al. 2019), the second largest city in Australia. Mountain Ash forests are important for biodiversity, including a range of threatened, endangered and critically endangered species (Lindenmayer 2009) (Taylor and Lindenmayer 2019). Old growth Mountain Ash forests store large amounts of carbon and are among the most carbon-dense forests in the world (Keith et al. 2009). The Central Highlands region in which Mountain Ash forests are located is also important for tourism (Keith et al. 2017).

Figure 1. A stand of old growth Mountain Ash forest with an image of the author highlighting the diameter and height of the trees. (Photo by Esther Beaton).

Mountain Ash forests have long been exploited by extensive and intensive logging operations. The ash-type forests of the Central Highlands of Victoria (which include Mountain Ash forests) support approximately 65% of all wood production in the State of Victoria producing timber and pulpwood (Lindenmayer et al. 2022). The primary silvicultural system is clearcutting in which: (1) all merchantable trees are removed offsite for subsequent processing as sawn timber or for pulpwood, (2) logging slash is left on the forest floor for one or more years to dry, (3) a high-intensity regeneration burn being applied to consume the logging slash and create a bed of ashes in which Mountain Ash seed is aerially dropped on the cut block to instigate stand regeneration (Flint and Fagg 2007) (Figure 2). The typical size for cut blocks ranges from 15-40 ha (Figure 3); such cut blocks can be aggregated up to 120 ha over a five-year period (DELWP 2021).

Figure 2. Clear-felled stand of Mountain Ash forest. (Photo by David Lindenmayer).

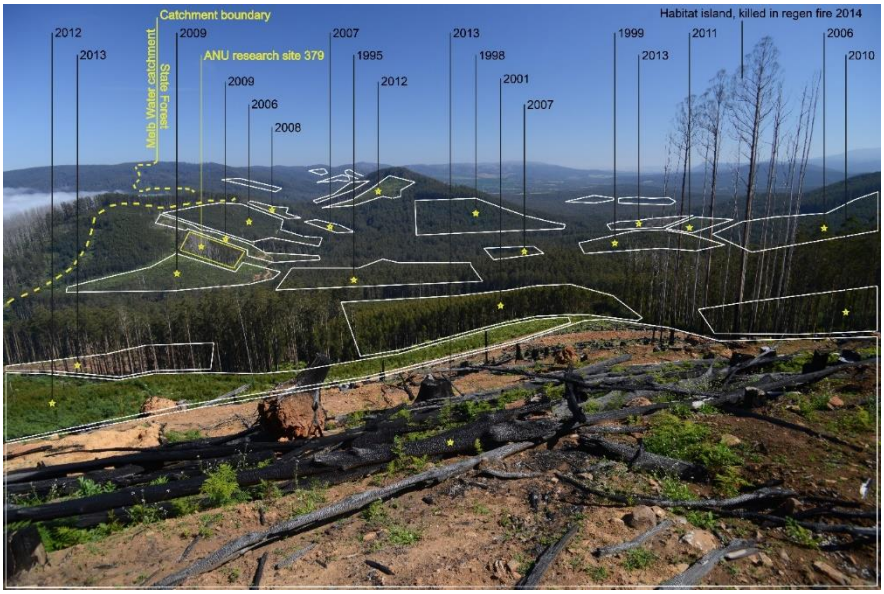

Figure 3. Network of clearcut harvest units in part of the Central Highlands of Victoria. (Photo by David Blair).

Although clearcutting is relatively efficient in producing large quantities of timber, it also has a number of negative environment impacts. These are: (1) eroding biodiversity such as reducing populations of arboreal marsupials and birds as well as some resprouting native plants like tree ferns (Lindenmayer et al. 2019, Lindenmayer et al. 2021), (2) simplifying stand structure such as through promoting the losses of large old trees which are key habitat attributes for cavity-dependent fauna (Lindenmayer et al. 2018), (3**)** generating carbon emissions, including creating smoke pollution as part of the regeneration burning component of the silvicultural system (Lindenmayer and Taylor 2018), (4) depleting key soil nutrients and degrading soil structure (Bowd et al. 2019), and (5) reducing water yields from watersheds (Taylor et al. 2019). An additional major environmental problem

associated with logging in Mountain Ash forests is that harvested and then regenerated stands face higher risk of elevated fire severity than old growth stands (Taylor et al. 2014) (Figure 4). That is, young logged forests are at risk of reburning at high severity thereby precluding their maturation to an older (less fire-prone) stage (Lindenmayer et al. 2011).

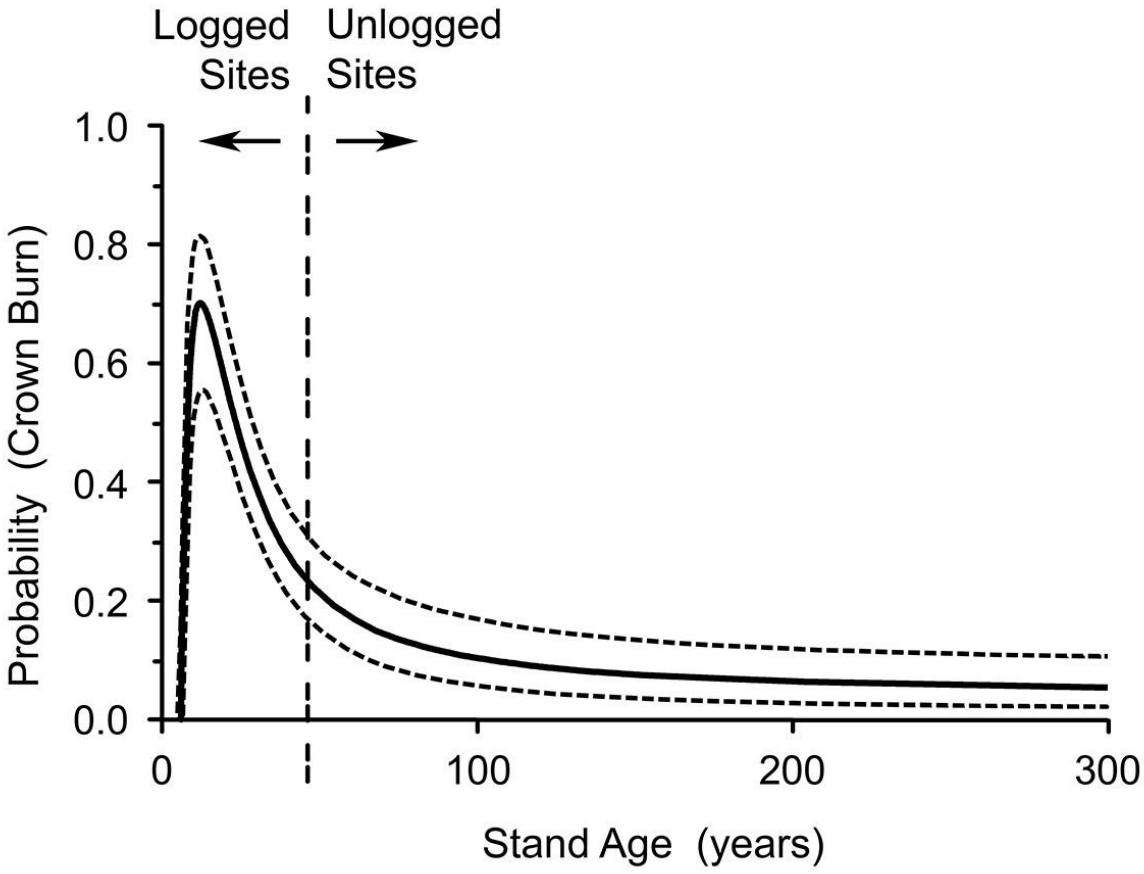

Figure 4. Non-linear relationship between stand age and the probability of canopy fire or crown burn. The probability of crown burn peaks at ~ 40 years before declining as stands approach 80-100 years old. Redrawn from data in (Taylor et al. 2014). The mean response is shown by the solid line and the 95% credible intervals are in dashed lines.

There have been a range of major consequences of extensive logging and repeated wildfires in Mountain Ash forests. These include: (1) a paucity of old growth stands (which now comprise just 1.16% of the Mountain Ash estate (Lindenmayer and Taylor 2020), (2) extensive, highly fire-prone young forest that dominates almost 99% of Mountain Ash landscapes (Lindenmayer et al. 2022), (3) a marked decline in an array of key threatened forest-dependent species over the past 20+ years (Lindenmayer and Sato 2018) (Lindenmayer et al. 2021), (4) rapid declines in the abundance of key elements of stand structural complexity such as the availability of large old trees (Lindenmayer et al. 2018), and (5) a severe shortfall in timber supply, especially high-quality sawlogs (Keith et al. 2017). Indeed, the Mountain Ash ecosystem has been formally classified as Critically Endangered under the Red Listed Ecosystem approach developed by the IUCN (Burns et al. 2015).

Beyond the direct impacts of native forest logging in Mountain Ash forests on fire

regimes, biodiversity and water security, there are signs of major problems in the timber industry, both in Mountain Ash forests and in Victoria more broadly. For example, there have been marked declines in employment in the native forest logging industry over the past decade (Schirmer et al. 2018) and Victorian Government's logging company has suffered significant financial losses in most of its years of operation since 2004 (VicForests 2013) (VicForests 2021). Independent economic analyses, including by the Victorian Parliamentary Budget Office (2020), have indicated that the State of Victoria would be better off financially by between $A110m (Keith et al. 2017) and $A190m per year if it did not log native forests (Parliamentary Budget Office 2020). Moreover, formal environmental and economic accounting analysis has revealed marked disparities between the relative values of different natural assets in Mountain Ash forests (Keith et al. 2017). For example, the value-added value to regional GDP from water is 25.5 times that from timber and woodchips produced by native forest logging. The value of tourism is 20 times that of the native forest logging sector. Notably, the value-added value of plantation sector in the Central Highlands region (where the environmental and economic accounting analysis was focused) was three times that of the native forest logging sector (Keith et al. 2017).

The need to transition wood production out of Mountain Ash forests and to plantations

Factors such as forest economics, biodiversity conservation, fire risk, water security, carbon storage all point to the need for change in the management of mainland Australian Mountain Ash forests. Halting logging in Mountain Ash forests will require finding an alternative source of wood to support forest industries in Victoria. The obvious place to find this timber is from Victoria's existing plantation sector. Such policy and management changes correspond to a large-scale example of land sparing (*sensu* (Betts et al. 2021)) in which the Mountain Ash ecosystem is "spared" from industrial wood production with conservation then being the resulting focus, and the trade-off, in part, being timber and pulpwood being sourced from plantations located in other parts of Victoria. Other studies from around the world have shown that well managed plantations can be important for the sustainable substitution of wood production that provides offsets for enhanced conservation elsewhere (Hunter and Calhoun 1995, Lindenmayer et al. 2015, Ghazoul et al. 2019).

Conclusions

Ecologically sustainable forest management is an important goal for the management of native forests globally (Lindenmayer and Franklin 2003) (Puettmann et al. 2008). However, in some cases, attempts to embrace it fail, and ecological and economic factors indicate a change of forest management is needed, including sourcing timber from alternative places such as plantations (when available). This is clearly illustrated in the case of the Mountain Ash forests of the Central Highlands of Victoria, south-eastern Australia. The case for such a transition is particularly strong given it has multi-faceted ecological and economic support and there is a viable alternative source of timber of wood fibre in plantations located elsewhere in Victoria. These solutions may well be applicable in other timber production jurisdictions. For example, Western Australia will exit native forest logging at the end of 2023 and New Zealand transitioned to plantation-only timber production two decades ago.

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Auroville's Reafforestation Effort in the Larger Context of Bioregional Conservation

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Auroville's environmental restoration work

Auroville was initiated in 1968 in Tamil Nadu, South India, with the support of UNESCO. The plateau that was to be the location of this international township was an eroded, barren landscape devoid of trees, other than some palms (*Borassus flabellifer*) and a few Banyans (*Ficus bengalensis*). The plateau with its a highly eroded red lateritic soil that was as hard as iron; where the summer temperatures reached over 40°c. with a humidity of 90% and with a long dry season that was prone to dust storms, was clearly a very harsh environment (Figure 1).

Figure 1. The Auroville plateau 1968

In the months of the North-East monsoon, rainstorms that could deliver up to 50% of the average annual precipitation of 1250 mm within ten days, transformed the plateau soil into a highly erodible substrate that would wash sediment out along with the precious rain into the Bay of Bengal through a network of canyons.

At that point there was no large environmental wisdom or vision, it was basic human necessity, that of water and shade, that spurred the environmental restoration effort.

Soil and water conservation

The initial work of transforming the environment in those early days was that of soil and water conservation. This would be fundamental in ensuring the seasonal monsoon rains were not lost, but would infiltrate into the subterranean aquifers, ensuring water security for the project. With the intensity of the Northeast monsoon, where rainfalls can reach 300 mm within a 24-hour period, the success of any sapling plantation would be questionable unless the rain water run-off was quelled. To address this, many kilometres of contour bunding were dug by hand on the open land that slopes from 50 metres to sea level over a distance 4.7 km. In the highly eroded system of gullies, ravines and canyons that carried rainfall runoff across the watershed, gully plugs, earth dams and granite check dams were constructed (Figure 2). This effort to maintain "zero run-off" has been a continued effort, as the project developed and impermeable surfaces, paths and roads were developed, refining of the system had to be maintained. To this day, soil and water conservation remains a high priority.

Figure 2. A functioning granite check dam in Ravena, Auroville

The Initial tree planting effort

The early days created a history of rich stories about the collective effort of tree planting. This was a grassroots movement where saplings were planted in a passionate, albeit haphazard way. The absence of any local nurseries and knowledge of the flora of the area, lead to a mix of seeds being collected and germinated from a variety of sources, including the Pondicherry Botanical Garden, roadside plantations, the local government forest department and seeds that community members had collected en route to Auroville, just to mention a few. Plant nurseries were set up and the challenges of seed germination were overcome. Once the saplings were ready, due to the harsh environment they were planted in large pits (between 0.125 and 1 m^3) with as much organic matter added as possible, due to the soil being so compact and devoid of any nutrients (Figure 3). It also became apparent that the plantation season was limited to the period of the North-East monsoon, a narrow, yearly, window of opportunity.

The plantation areas were nurtured, with manual watering and mulched whenever possible. Initially, the plantations were not contiguous but spread out over large areas due to land ownership, this made the aftercare and protection from grazing and browsing by the local livestock very challenging, but as the land was progressively purchased this became more manageable.

Figure 3. An early plantation in 1971

As the decades progressed and the yearly seasonal plantation continued, it could be observed that out of the many species of plants that were experimented with most failed to get established. The species success rate in protected areas such as around dwellings and public spaces, such as schools, was higher due to ease of aftercare. In the larger tracts of land which were designated as green areas or forests, the species survival rate was lower, as it was only those that could adapt to the initial tough pioneer conditions that survived. Certain species like the *Acacia auriculiformis,* an exotic wattle from Australia, outperformed the others. With its nitrogen fixing capacities it not only thrived on the lateritic soils with almost non-existent topsoil, but it also grew rapidly, and in later years provided firewood and timber when it died naturally between 25 and 35 years. Luckily, the tree planting in these areas was prolific, so though the diversity was not as rich as hoped, the areas were covered and by the mid to late 1980's an Auroville forest had emerged. A hybrid forest with an assemblage of exotic and native species, the hardy ones that could survive and prosper in this degraded landscape.

As the forest flourished it was the birds that returned quickly, benefiting from a diverse set of flowers, fruiting plants and an increasing variety of insects (Figure 4). The bird list has reached over 100 species. The butterflies were also attracted to this new environment with current studies estimating over 200 species. The reptile population was seen to increase with over 20 species of snakes recorded, some becoming common, with other species such as the Monitor Lizard (*Varanus bengalensis*) increasing in numbers. The common mammal population soon grew, making this forest a habitat for the Indian Mongoose (*Herpestes edwarsi*), Civet Cat (*Viverricula indica*) and the Jackal (*Canis aureus*). In recent years, even the Porcupine (*Hystrix indica*) and Spotted Deer (*Axis axis*) have made their way back to the area and with occasional sightings of the Jungle Cat (*Felis chaus*) and the Rusty Spotted Cat (*Prionailurus rubiginosus*), the mammal biodiversity indicates a thriving ecosystem.

Figure 4. An emerging forest 1983

The next steps: understanding and introducing the native species

It was clear that this newly grown forest, though it held beauty and offered the services of shade, water and soil security, microclimate creation and biomass production, would not be the final vegetation type aimed for. It could be said that it was a pioneer forest. Though, over the years many foresters in the area were exploring local forests and experimenting with the species they found, it was only in the mid to late 90's, after an in-depth study of the tropical indigenous vegetation type of the area and its dynamics, that the native species of the area were planted in volume (Figure 5). This coincided with the conditions created by the pioneer forest to be optimum for this next stage of development, the shade, the biomass, the soil health and rainwater conservation were all in place.

Figure 5. – Native TDEF species being introduced under the pioneers in 2001

Working from the Pitchandikulam Bio-research Centre and Shakti Herbarium, and with funding from the *Foundation for the Revitalization of Local Health Traditions (FRLHT)* and a *European Commission (EC)* funded project, the work began on researching the native *Tropical Dry Evergreen Forest (TDEF)*. During this research period, with guidance from the French Institute in Pondicherry and Pondicherry University on where to find sites, the team set out to locate potential remnants of the TDEF. Once the remnants were located, visits to 85 sites were arranged for plant identification, phenology, samples were collected for the newly created herbarium, and the practical output was that seeds were collected to be germinated and propagated in the Auroville nurseries.

It was during this period that the work of interplanting the hybrid pioneer forest with the native TDEF species in volume was

initiated. One key advantage of planting these native species, was that they are adapted to the conditions of the geographical location and are drought resistant. This meant there was little or no watering required after planting under the pioneer canopy. With minor aftercare, mulching and management of opportunist species around the sapling pit, a survival rate of 90% was achieved.

This work was executed carefully so as not to disturb the initial canopy but rather to use these species as nurse trees for the TDEF saplings. As the years progressed and these TDEF species got established, the pioneers were managed, sometimes pruning was required, but as they were naturally short lived and were prone to damage from the cyclonic storms during the monsoon, there could be seen a natural transition from the hybrid forest to a more native TDEF prominent ecosystem. As this became the single planting focus of the group involved in coordinating environmental work, it accumulated today in the planting of half a million TDEF saplings of over 200 species. Presently the TDEF has become established, with more than half the species reaching maturity and regenerating. This is a clear indication of the success of the plantation. Climax species such as *Diospyros ebenum (*Indian ebony*), Drypetes sepiaria, Walsura trifoliata, Tricalysia sphaerocarpa, Dimorphocalyx glabellus and Psydrax dicoccos* are now freely regenerating in the Auroville forests, whereas in the mid-nineties it was very difficult to find any of their seed in the TDEF zone due to their rarity and sparse spatial distribution.

It is now apparent that the Auroville project is a host to the largest area of TDEF in the zone and though it is not an old growth but a young forest, it is starting to mature, and to regenerate. This vibrant growing forest, with its rich biodiversity has become a valuable gene bank for the TDEF, securing these rare species for the future.

The Tropical Dry Evergreen Forest

Auroville is situated in the coastal region of south-eastern peninsular India which has a vegetation type defined as Tropical Dry Evergreen Forest – TDEF (Champion and Seth, 1968). It has a narrow range, approximately 500 km long running north to south, and with a width no wider than 50 km (Figure 6). This range experiences both of India's Monsoon systems, the summer South West in the summer and the North East in the winter. The annual rainfall for the zone varies between 1000 to 1500 mm, with the majority experienced at the latter part of the year (Meher-Homji, 1974). This zone is also affected by dew for up to 2 months after the North East monsoon, which all taken into consideration leads to this zone having a limited dry season. The predominant evergreen vegetation of this TDEF zone gives way to more deciduous flora as one moves inland out of the zone

Figure 6. The geographical extent of the TDEF

What is the TDEF?

The TDEF, like most tropical forests, contains large amounts of species and biodiversity, it is estimated that up to 1000 different plant species make this forest type their home with over 300 of these being woody. The forest type has adapted to being in a cyclonic region, with

a relatively low canopy of 8 to 10 m height with the occasional emergent tree. The canopy is rich with inter-linked lianas, and the forest floor is a rich layer of biomass that is effectively recycled by plant feeder roots in the top 1 cm of soil (Figure 7). The TDEF, like classical tropical forests, holds its nutrient wealth in the canopy, thus once cut the soil becomes impoverished and quickly leached by the region's intense monsoon rains.

Figure 7. The Derris ovalifolia liana growing into the canopy of a remnant TDEF grove

A forest type is not only the flora, the plants that are present within the ecosystem, but also the fauna, the mammals, birds, reptiles and insects that survive and thrive in this habitat. In the past leopards and elephant herds would have roamed these regions, perhaps even tigers, but today the TDEF is home to smaller mammals, the mongoose, porcupine, Indian civet cat, jungle cat, and many more including the fruit bat which is an important vector for spreading seeds of the forest. The TDEF is also home to a large population of reptiles and a myriad of bird species that gain protection from the dense habitat the TDEF offers, but it also gives place for the insects, some of which are pollinators, to thrive. These are now proving to be key elements of any environment whether it be natural plant areas or manmade ones such as agriculture.

The status of the TDEF

In 1992 it was estimated that only 5% of the TDEF zone was under forest cover (Meher-Homji, 1992). In 2002 this estimate was revised to only 4% (Wikramanayake et al., 2002), but in both estimations, it was understood that most of this forest cover was disturbed. As a result of extensive field studies made between 1999 and 2004 by the Auroville botanical team, a reliable estimate suggested that from this 4% of forest, 5% could be assessed as a pristine remnant of the TDEF, with the other 95% to be highly disturbed and categorised as degraded scrub. Therefore, it would be fair to state that only 0.2% of this range now exists as a TDEF ecosystem, and consequently making it a very rare forest type in India, if not the rarest due to its anyway limited range. The many factors leading to this fragility of this forest system are mainly due to the high concentration of human population in this coastal belt and the subsequent impacts this has on the environment. There are many other factors like the presence of an active port in Puducherry and in the mid 1800's it was documented that in an area close to Cuddalore, within the TDEF zone, one of India's largest steel mills was active and being fueled by wood and charcoal.

The Sacred Temple Groves

During the study in the early 1990's, the Auroville botanical team located, visited, and assessed 85 sites dispersed within the designated zone, these consisted of reserve forests, hillocks, temple groves, tank bunds, and a few miscellaneous sites (Figure 8).

It was ascertained that governmental reserve forests and hillocks were generally secondary growth vegetation, with species present that could reestablish after the disturbance. Historically these forests had predominately

been managed as woodlots for fuel wood and paper pulp.

Figure 8. An entrance to a Sacred Temple

The last remnants of the TDEF, which indicate a primary forest, existed in the sacred groves that were found around temples, generally of the deity Ayyaner but not exclusively. These shrines were situated outside villages, and the religious cultural belief system that the god enjoyed hunting and being in the forest at night meant that pockets of forest around the temple were kept, protected and held sacred. These groves vary in size, sometimes less than hectare but others up to 10 hectares, during our studies in the late 90's to mid-2000's up to 65 sacred groves were researched and analysed. Each grove was surveyed, recording the species present and their abundance, providing more data about the profile of the original forest. The plant data was recorded at the Auroville Herbarium and cross checked with the French Institute in Pondicherry and the Rapinat Herbarium in Trichy, Tamil Nadu. Phenological information for each plant was recorded to allow for timely further study and seed collection. From the sites studied, a total of 1130 species of angiosperms were recorded.

It was noted that each remnant forest was an island amongst ever increasing cultivated, local dwellings or built-upon land. This highlighted not only the fragility of these existing areas but also their inability to expand.

Figure 9. Measuring the diameter of a rare Diospyros ebenum in a Sacred Temple Grove

Present situation of the Sacred Temple Groves

As India's already vast population increases and with the present trend of modernisation, pressure for land and infrastructural development clearly, like all countries, has an effect on the environment. With this in mind, in 2021, the Auroville botanical team had a project to revisit and assess the present ecological state of the Sacred Groves that were initially visited 22 years previously. The objective was to try to understand the stability of TDEF remnants and hence its ecological trend. This would then give an updated assessment of this rare forest type. The methodology was to revisit each grove, and armed with the original findings implement a rapid assessment. Two members of the original team from 22 years ago were part of the new team, which allowed an accurate comparison assessment to be made. The findings indicate that due to the land ownership status of a temple grove none of the remnants have increased in size. It was observed that 25% of the groves are in a fairly static state, well protected and have maintained a similar canopy cover, whereas, for the remaining 75%, it was observed that there has been a certain level of disturbance that has led to a reduction in their canopy cover. This disturbance was varied in nature, with temple infrastructural development, increase in population visiting

the temple, pressure from outside land on the perimeters, and parts of groves being allocated a different land use being some of the reasons. It was clear that these last pristine remnants of the TDEF are still in decline.

Conclusion

As the forest areas developed by Auroville mature, the security of the TDEF should increase in this area. The 1200 plus acres, with varying stages of TDEF establishment are protected and expanding. The biodiversity contained within the area is increasing, with more than 350 woody species recorded. The climax woody species are now established to the point that they are regenerating, and with the availability of the appropriate vectors are now extending their range. In contrast, it has been observed that the last original remnants of the TDEF that are dispersed within the TDEF zone are in decline, canopy cover is being lost and thus biodiversity is diminishing.

Outlook

With this biodiversity gene bank held in the forests of Auroville, and the nursery infrastructure and knowledge base to propagate TDEF saplings, there is a potential to expand the TDEF bio-regionally in the future.

This, combined with a new impetus within India to improve forest canopy and the increase in potential partners, e.g., industrialists, NGO's and the governmental forest departments willing to invest in environmental rehabilitation, there is a prospect that the decline in TDEF canopy in this rare forest zone can be reversed.

Resource material

Information on the sites and species of the TDEF can be found on the Web resource developed by the Auroville Botanical Gardens on: https://auroville-tdef.info

Information on tropical species and their identification can be found on the Web resource developed by the Auroville Botanical Gardens on: https://www.plantekey.com
The Auroville Virtual Herbarium which contains digital samples of flora of the Coromandel Coast, India can be found on the Web resource developed by the Auroville Botanical Gardens and Pitchandikulam Bio Resource Centre on:
https://www.aurovilleherbarium.org

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Wetland forests and their importance for climate change

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To most people 'Wetland' means 'wasteland' – a bit of empty terrain, a breeding ground for mosquitoes, that should be filled in and used for agriculture, housing or landfill. This lack of awareness and understanding is not only appalling, it is dangerous, for if we continue to destroy and so lose our wetlands, we will destroy something that is crucial for human survival: far from being wastelands, wetlands are vital to people, both as providers and protectors (Figure 1). They produce life in abundance, food for a large number of herbivores and therefore, for a large number of carnivores, including human beings. In fact, wetlands in their natural state are among the most productive ecosystems in the world. Yes, there are a million of mosquitoes, but they, together with thousands of other insects form a most essential food supply for many fish, birds, bats and other wildlife, and an important link in the 'food chain'.

Figure 1. Aerial view of the man-made Pointe-á-Pitre wetland and forest, Trinidad (Source: the author)

Indigenous waterfowl or wildfowl rely on wetlands for feeding and nesting (Figure 2). Temperature species use them as important, migratory stopping-off areas. Many birds, including our national bird, the Scarlet Ibis, depend on them for their survival. Apart from the birds which normally live in the swamp, large communal roosts are formed every evening by several species which feed

elsewhere in the day. The reverse is true and some species which feed in the swamp come from surrounding non-swampy areas. Loss of our swamps will mean loss of all these birds. It will also mean loss of many species of fish, and in turn, our fisheries.

Other forms of wildlife use wetlands for all or part of their life cycles. Otters and raccoons come to fish or find crustaceans. Mangrove snakes feed on birds and frogs. The Galap (fresh water turtle) feed on aquatic plants. Monkeys feed on leaves and fruits. The silky anteater feeds on ants and termites' nests.

Inland Wetlands like the Nariva Wetlands on the East coast of Trinidad are a key source of freshwater (Figure 2). With their capacity to hold, filter and de-toxify water, they are essential for human use. Freshwater also plays a critical role in the production of food. This wetland protects not only the East coast due to its fringing forests as a buffer zone, but it also protects all Central Trinidad from violent storms and hurricanes coming in from the Atlantic. With Climate Change, increasing population, economic growth and lifestyle changes, there will be a greater demand for freshwater.

Figure 2. The interior of the Nariva wetlands in eastern Trinidad (source: Shiv Trinidad Skey, CC BY 2.0 <https://creativecommons.org/licenses/by/2.0>, via Wikimedia Commons

Figures 3 and 4. Bird breeding at Pointe-á-Pitre: (2) Black-Bellied whistling Tree Duck with ducklings at the reserve; (3) Once locally extinct Wild Muscovy ducks bred at the reserve being released.

As the result of intensive advocacy by Molly Gaskin and the PaP Wildfowl Trust, later joined by other NGO's the illicit rice farmers were eventually evicted, after constructing channels allowing some seawater penetration. The 1 1,340 ha Nariva Swamp was designated for the RAMSAR List of Wetlands of International Importance on 21 December 1992.The first RAMSAR site in Trinidad & Tobago.

Figures 5 The Navira-Mayaro River and beach frontage of the wetland (source: the author)

Nariva has the most varied vegetation of all wetlands in Trinidad and Tobago, with distinct zones of swamp forest, forming a critical buffer zone, these forests protect the inland invasion of storms and hurricanes, palm swamp, the Moriche palm is Trinidad's endemic species. It was the home of the Blue and Gold Macaw, (*Ara ararauna*) which was locally extirpated, until re-introduced by flocks bred at the Pointe-a-Pierre Wildfowl Trust (Figures 3 and 4) for this purpose. It was also the habitat of the now extirpated Horned Screemer (*Anhima cornuta*) herbaceous swamp and mangrove woodlands (Figure 5). It is particularly important for the high numbers of waterfowl, and it is the major wetland in Trinidad for anaconda (*Eunectes murinus*) and manatee (*Trichechus manatus*) -the latter under threat because of habitat destruction and because of being trapped in fishing nets and illicit harvesting.

Without wetlands, the diversity and numbers of wildlife, not only within the swamp, but of many land species, as well as fresh water and salt water fish simply could not exist. Unfortunately, to most people, swamps or wetlands also sound just 'wet'. They have forgotten that wetness is necessary for Life. Without wetness we have only dust.

Loss of 'Wetlands' will ultimately mean the loss of many forms of wildlife that people themselves value most. Forests have sustained life on earth from time immemorial. They supply food, medicine, energy, shelter, wood and non-wood products. All species of plant life are used in some way by wildlife and by humans. In addition to representing a source of economic development for individuals and communities, forests and trees provide a way to express human, cultural and spiritual values. Home to many forms of life, they play an essential role environmentally, in particular to maintain biodiversity, conserve soil and water and stabilize our climate. They also sustain and are linked to other ecosystems, from plains and savannahs to wetlands and coral reefs. A working knowledge of some of our important and beautiful forest trees can be both useful and fascinating.

Figure 6. The Gilpin Trace Forest Reserve in Tobago (source: Aivar Ruukel, CC BY-SA 2.0 <https://creativecommons.org/licenses/by-sa/2.0>, via Wikimedia Commons)

Rainforests (Figure 6) play a critical role in climatic conditions – and, in the overall, in man's own survival. When a rainforest is burned and trees are cut and left to decay, vast amounts of carbon dioxide (CO_2) are released into the atmosphere – and carbon dioxide holds heat. Destruction of the world's rainforests and excessive man-made pollution has caused the present alarming rate of change in climatic conditions – 'global warming' 'the greenhouse effect'. Logging too, is a serious problem as it is another form of tree loss. When trees, which remove carbon dioxide from the air and give off oxygen, are no longer alive, the build-up of greenhouse gases accelerates.

Even worse, loggers are often followed by squatters, clear cutting and slash and burn agriculture. This is wasted agriculture. Watersheds, vital to man's own survival are destroyed. Four-fifths of the nutrients in the rainforests are in the vegetation; this means that the soils are nutrient-poor. When the rainforest is cleared, the exposed soil loses its input of nutrients from fallen leaves, and is exposed to the torrential rains. The soils become eroded and unproductive within a few years, and thus vitally productive ecological areas become wastelands.

Planting trees to curb global warming may sound simplistic but it's an idea that's growing not only among environmentalists but also industrial

agencies. It must however, go hand in hand with the prevention of forest fires, with deforestation through indiscriminate logging, with slash and burn agriculture, with better laws and their enforcement regarding squatting to go into immediate effect, with assistance by law enforcement officers and the Judiciary, and with education of the general public.

In the long term, Climate Change and Sea Level Rise, particularly around Small Island States, like Trinidad and Tobago and the Caribbean will cause displacement of people and could trigger regional conflicts. People will be driven from their homes, their land, and their jobs and will need help from larger, richer nations.

Adaptation does not mean passive avoidance or acceptance, Adaptation means knowing and anticipating the effects of Climate Change and taking action, now, to mitigate it. This involves respecting nature and aiming to achieve sustainable social development. “Natural Disasters” are not all natural. Human activities have been the main cause for the past 200 years.

Caring about Climate Change means:

Caring about our Forests
Caring about our Wetlands
Caring about our Biodiversity
Caring about People
ALL LIFE IS LINKED

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The impact of anthropogenic pressures on the forests of the Western Ghats on the livelihoods of a river based tribal community in Kerala, India

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Introduction

The forest is considered to be one of the most resourceful ecosystems of earth and the actual 'birthplace' of human race. The relationship between the forest ecosystem and the modern humans has a long history starting in Africa some two million years ago when people began to depend on forests for food and shelter. Their mere existence was absolutely based on the forests, rivers and the sea for hundreds of generations. The naturally available animals, tubers, grains, fruits, fish and other allied products not only supported humans to sustain their lives but also helped them towards the brain development for further life enhancement and inventions. The efforts taken to gather the aforesaid resources for their daily bread also helped early societies to improvise their skills for hunting, agriculture, fisheries and other ways of food production and utilization. The increasing population and the increased need of food made man to think over expanding agriculture to feed the generations. As the millennia passed by, the forest lands were extensively converted to agricultural fields and the marshy wetlands were altered to aquaculture farms to meet the food requirement. At one point of time the global planners and policy makers encouraged the conversion of the natural ecosystems to productive food production zones under the light of famines and shortage of quality food. Even now, the process is continuing at varying intensities and extents of expansion. The so called "agricultural revolutions" resulting in enhanced food production through the increased use of fertilizers and pesticides, though helped the human race to live better, eventually created irreparable damages to the natural ecosystems. Obviously, the concept of 'utilization' has changed to 'exploitation' during the course of time, even without getting noticed by the planning community.

Forests- the abode of tribes

Returning to the significance of forest ecosystems, the ecosystem services offered by the forests towards the sustenance of the biodiversity of earth need no further emphasis as they encompass the oxygen generation, nutrient supply, freshwater availability, carbon sequestration and absolute nutrient and energy supplies. The harmony of plant and animal life, traversing from micro- to macro-organisms and communities, make the forest system unique and unparalleled. Other than the conventionally discussed points, forests also support the livelihoods of a large section of people who have been unable to cope up with modern industrial and commercial changes and developments: -the "tribes" still generally living away from modern society. They are the known forest dwellers in India who rely almost entirely on the forest for their life and survival. The major occupation of the

tribes is the collection of Minor Forest Products (MFPs).

> *'Tribal people in general, derive either directly or indirectly a substantial amount of their livelihood from the forests. They subsist on edible leaves and roots, honey, gums, animals and fish. They build their homes with timber and bamboo and practice cottage crafts with the help of local raw materials. They use herbs and medicinal plants to cure their diseases and even their religion and folk-lore are woven round the spirits of the forest. Commercial transaction is predominantly by barter, trade being left mostly to the outsiders who control the money economy' (UN).*

The tribal people, the indigenous people of the forests, have a sustainable relationship with the forests as they have their own way of living without harming the ecosystems, they live in. Traditionally, tribes do not commercialise the forest products as they use them for their domestic consumption or sell some to buy other things they need. Apart from collection of MFPs, they practice limited agriculture, cattle rearing and other agriculture-related jobs in and around the forests. Occasionally, they do 'shifting cultivation' in which changing the land for different crops is practised. This means of cultivation is considered as 'organic' as they are not using any chemical fertilizers or pesticides for their cultivation and are giving sufficient time for the land to rejuvenate on its own. According to UN, it is estimated that around 50% of protected areas in the world were traditionally occupied and used by tribes. For over a century, large scale displacement and cultural destruction have been forced upon tribes in the name of 'conservation' and 'development'.

Western Ghats

The term Western Ghats refers to the continuous chain of hills (with the exception of the Palakkad Gap) running roughly in a north-south direction, for about 1600 km parallel to the Arabian sea coast, from the river Tapi (about 21^0 16' N) down to just short of Kanyakumari (about $8^0$19' N) in south India. The Western Ghats (Figure 1) (one of the hot spots of biodiversity regions in the world) are an intricate product of long processes of geological evolution, evolution of life on earth, revolution of human civilizations and historic invasions with long lasting dimensions.

This mountain chain is home to more than 4,000 flowering plants, about 500 bird species and over 300 species of mammals and amphibians. The globally threatened flora and fauna species in this region comprise 229 plants, 31 mammals, 15 birds, 43 amphibians, 5 reptiles and 1 fish. 129 of these 325 globally threatened species in the Western Ghats, are classified as vulnerable, 145 as endangered and 51 as critically endangered. The high human population density and major transformation of the landscape since the mid-18th century emphasize the urgency of conservation of the Ghats and the sustainable use of its resources. Injudicious exploitation of the forests for wood, animal products, plant products, rocks etc. has altered the ecological integrity of the Western Ghats. Construction of dams has been often followed by the construction of roads, connecting remote areas in the Western Ghats to the cities, thereby exposing the virgin forests (Figure 2) to more and more human exploitation. The roads constructed for increasing the communication network and for the 'development of backward areas' intersected the forests and have hastened the process of forest depletion. The extensive deforestation for expanding agriculture and human settlement has made the Ghats a highly vulnerable area, prone to landslides and floods leading to the destruction of biodiversity.

Figure 1 The distribution of tribal languages in the Western Ghats, showing the areas in which tribals groups are found. (By Romaine, S., Gorenflo, L.J - Linguistic diversity of natural UNESCO world heritage sites: bridging the gap between nature and culture. Biodivers Conserv 26, 1973–1988 (2017) https://doi.org/10.1007/s10531-017-1340-x, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=109901423)

Figure 2. Mountain stream in the Western Ghats that provides water for local people

Tribes of Western Ghats

In Kerala, the tribes (known as 'Adivasi' in Malayalam) are mostly found in the forests and mountains of Western Ghats region bordering Karnataka and Tamil Nadu. According to the 2011 census it is estimated that there are nearly 485,000 tribal people in Kerala accounting for 1.5 % of the total population of the State. They have coexisted with nature for centuries in quiet harmony with rich traditional knowledge and cultural life. Wayanad District with 151,443 tribal people has the highest proportion of the State's total. Tribal people in

Kerala have unique physical attributes such as curly hair, stout body, and protruding chin bones (Figures 3 and 4). They have a dark complexion and short stature in height, and also being well built with flat nose. But their social isolation, illiteracy, alcoholism, low income and poor nutrition make this community so weak in health and vulnerable to many diseases. They have unique and hard way of living, varying between districts and communities. In Kerala, each community shows different stages of social, economic and educational development. The latest report shows that the literacy rate among the tribal communities has been increasing trend, reaching 69.4% in 2019. The Government of Kerala promotes a series of developmental programmes for the overall development of the tribes. Most of the tribes are currently working as agricultural or non-agricultural labourers; while some communities like '*Cholanaikkan'* retain a 'hunter-gatherer' life style. It has been observed that the developmental schemes that offered by the Kerala Government and the reservations in government jobs are not shared equally between tribal communities.

Figure 3. Women of the Cholanaikkan *community (Photos courtesy of Mr Vinod Karulayi)*

Figure 4 Men of the Cholanaikkan *community)*

Status of the only existing "cavemen" community of Kerala

Cholanaikkan, the only existing "cavemen" community of Kerala, is one of the primitive hill tribes residing in the *Nilambur Valley* of Western Ghats in the Malappuram District of Kerala. Their settlements are concentrated on the banks of the rivers with limited space and few protective measures. Their settlements are divided into ten territorial groups defined by natural boundaries. This is a tribal community still living under the rock shelters called 'Aale' during day time and climbing to large (5 to 10 m^2 area) and high rocks (8 m and above) during the night hours. These night dwelling rocks protect them from the attack of wild animals including elephants. Occasionally, they also use open campsites made of leaves situated close to the rivers or springs. Generally, each cave has its own names like house name or number.

The total population of *Cholanaikkan* community is 232 according to the census 2011 and the number does not increase much because of the lack of mixing with other similar communities. They dwell in groups named *'Chemmam'* bordered by rivers under the leadership of a *Mooppan* who will be an elderly and most respected person in the group. Generally, they do not cultivate any crops due to the lack of

awareness of, or attitude to, agricultural techniques, disturbance and intrusion by the wild animals and the shortage of suitable land. Due to the poor infrastructure facilities and lack of electricity, they have been without any artificial lightings until recently, and were dependent on daylight. So, their life starts with the sunrise and ends with the sunset. They eat different types of edible plant parts like leaves, fruits, flowers, shoots, seeds, and tubers as well as mushrooms, fish, birds, rabbit and pig available in the premises (Figure 5). Though the cattle rearing has been adopted by a few of the group, they never consume the milk nor meat sourced from the domestic animals. Unlike other tribal communities who worship the Gods/ deities/ natural forces, a *Cholanaikkan* only worships his ancestors as the supreme power. They have their own set of rules and regulations in life.

Figure 5. A typical Cholanaikkan *dwelling (Photo courtesy of Mr Vinod Karulayi)*

Nowadays, with the support of Department of Forests and Wildlife, Government of Kerala this tribal group is involved in the collection and marketing of minor forest products such as Black Dammer (a wild gum used as fumigant), asparagus, medicinal plants, and honey. According to the inhabitants, wild honey is the most valuable product and they can make US$ 6-7 per litre which is considered a good revenue for them. They are following a peculiar social structure that each settlement is considered as one family and all the members of that settlement are equally responsible for food collection and revenue generation. The settlements have around 10 to 15 members each and the oldest member of that settlement will be the *Mooppan* and all the members are supposed to obey his decisions. In general, since time immemorial, only men have been given the privilege of being a *Mooppan,* a practice continuing even now.

Anthropogenic impacts on the tribal life

As indicated above, the anthropogenic interventions have adversely affected the ecosystems of Western Ghats in many ways creating irreversible damages. As a result, coupled with climatic extremes, thousands of microorganisms and macro-organisms are disappearing from this ecosystem on a day-to-day basis, severely affecting the biodiversity. There are alarming reports coming on a regular basis, demonstrating the ill effects of human interventions on the ecological and socio-economic conditions of Western Ghats and its inhabitants by way of displacements, crop failures, floods, droughts, poverty, famines and so on. This kind of adverse effects will be more significant and prominent on the most under privileged and backward communities; that is why *Cholanaikkans* suffer the most under the given backdrop of forest related developments and interventions.

It is widely observed by many social workers that in India, Forest Conservation Act of 1980 was not propitious for the tribes. They were brutally displaced from their ancestral lands and were forced to settle outside the forest which was highly unfamiliar to them. The Government was forced to implement this rule because of the

shrinking forest areas of the country, attributing to tribal settlements as one of the reasons for the deforestation. But, as in the case of much litigation, use of legal loopholes adversely affected the tribes for protecting their land and their rights.

The construction of the Sardar Sarovar Dam, a prestigious reservoir project in Gujarat State, is reported to have displaced many tribes from their livelihood between 1999 to 2006. In 2014, around 450 tribal families were evicted from their land to protect tiger in the Kanha Tiger Reserve in Madhya Pradesh State. Published reports reiterate that in 2017, the number of evicted tribal people from the protected areas has increased to the level of 40,000 in India. In Kerala State, the *Chengara Struggle* saw the tribes of Chengara- a small backward village in Pathanamthitta District protest to re-claim the ownership of their land which was acquired by Harrisons Malayalam Plantations Ltd. The Government has intervened in the matter and new lands were given to the evicted tribes for building houses and developing agriculture. In a similar incident, a reasonable portion of "Aralam" agriculture farm in Kannur District, which had been operated by Kerala Agricultural University for many decades, was allotted to tribes who were displaced in the past for the farm development.

The recently released '*Madhav Gadgil–Report',* published by the Government of India, illustrates that the vivid and exceptional biodiversity of Western Ghats has been under serious threat for the last century. It is reported that the paddy cultivation taking place in the valleys had played a major role in the deforestation of the Western Ghat ecosystem. The shifting cultivation habit of the tribes made them go for *step farming* of rice considering the convenience to plant, irrigate and harvest, followed by the expansion of cash crops such as areca nut, coconut and other seasonal trees like mango, and jackfruit. Cattles had been maintained in great numbers in the natural deciduous forest for many centuries with varying degrees of success. During the course of time, new horticultural tuber crops and plantation crops such as tea, coffee, rubber, cashew, pepper, cardamon, tapioca and pineapple were introduced to Western Ghat region. Cultivation of these crops was expanded by large scale clearing of natural evergreen forests that displaced the tribal populations. The *Cholanaikkan* community are the most affected group, as they still depend forest for their food, fodder and livelihood options.

The large-scale exploitation of Western Ghats for the timber that was initiated by the British during the pre-independence period in the country, is still continuing. Industries like sawmills, brick and tile manufacture, paper, poly fibre, matchwood, plywood and tanning based on wood were started and flourished in the State well before the independence.

Figure 6. Sand Mining in the Western Ghats

Most of the rivers in Western Ghats are facing the consequences of sand mining (Figure 6) as large quantities of sand are being extracted for the construction sector. In many cases, the over exploitation of the rivers for sand has lowered

the water table resulting in the deterioration of water quality. In many coastal stretches of the Ghats, the river beds are lower than sea level which accelerates saline water intrusion. The benthic biota gets disturbed and destroyed in massive volumes and numbers. It is noted that most of the tribal communities, especially *Cholanaikkan* who are deprived of electricity and other amenities in their premises, have to depend on rivers for their drinking water and they face severe water scarcity. Sand mining also disturbs the breeding grounds of fishes and other aquatic species which lead to declined fishery resources making the tribes food deficient. As has been indicated earlier, fish and other aquatic forms contribute significantly to their food, protein and nutritional security. Mining for mineral ores and granite (Figure 7) affects water availability and soil strength which leads to drought in summer and frequent landslides in monsoon seasons. These landslides altered the mountain structure and many of the large rocks and caves shelters of the *Cholanaikkan* have been destroyed over the years.

Figure 7. A typical quarry in the Western Ghats

In South Karnataka and North Kerala, the traditional irrigation system (Tunnel System) in lateritic hills has been disappearing lately, because of extensive laterite mining. Steep slope plantations with soil-eroding monoculture crops like rubber and banana requiring heavy tillage have led to increased surface runoff along with the loss of top soil. The deforestation for plantation crops in higher altitudes resulted in the drying up of hill streams. Land reclamation of valley swamps contributed to water scarcity in the upper catchment areas. This accelerated the water scarcity of the *Cholanaikkan* those depend nearby rivers of their settlements for drinking water.

Conclusion

Most of the land owned by the tribes in Kerala has now been legally transferred to non-tribal groups due to external pressure. Now, the tribes especially the *Cholanaikkan* community who enjoyed much freedom for use and hunt animals freely in the forest areas are deprived of their rights to the land and forest due to several restrictions imposed by the Governments as part of forest conservation and other developmental activities. Deforestation, extensive cash crop plantations, excessive pesticide use, sand mining, rock extraction, damming, urbanization of the forest areas and construction of roads and buildings, along with the climate change are the major reasons for their poor conditions (Figure 8). The depletion of natural vegetation and extermination of wild animals because of all these man-made activities shattered the quality of life of the tribes who used to depend heavily on natural vegetation and hunted meat for their food and fodder requirement.

Alienation of land, due to the development of plantations and mining, displaced them from their natural habitat. Even though, most of the other tribal groups of Kerala have gradually accepted these changes but the *Cholanaikkan* are still finding it difficult to cope with the situation which keeps them away from the main stream.

Figure 8. Forest land cleared for a plantation in Western Ghats
(Photo courtesy Mr. Renjith Rengaraju)

They have not received or accepted any benefit of these 'so called' developments due to the primitiveness and backwardness of their community. So, it is the need of the hour to give special attention to this small group of people to bring them into the mainstream with supportive guidance, projects and programmes.

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Figures 9 and 10. Images of Cholanaikkan *settlements (Photos courtesy of Mr. Vinod Karulayi)*

Managing forests on the west coast of Canada in the context of the United Nations Declaration on the Rights of Indigenous Peoples

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Background

British Columbia, Canada's westernmost province, is rightly known for its natural beauty, clean air and water, and spectacular forests. It is also the home of over 200 First Nations. First Nations have occupied the land 'since time immemorial' with the exact date when humans first arrived being pushed back earlier and earlier. The Indigenous peoples of the west coast of Canada have had a long and complex interaction with the colonists that started arriving in the 19th century (the first European visitors to the Nootka area of west Vancouver Island appear to have been a group of Russian sailors who arrived on 17 July 1741, followed by Captain James Cook on 29 March 1778). Early interactions were related primarily to the trade in sea otter pelts. Once colonists started arriving, with few exceptions they appropriated the lands and territories of the Indigenous peoples, usually with no compensation.

A number of treaties were established by Sir James Douglas, the Governor of Vancouver Island from 1851-1864, and then Governor of British Columbia from 1858-1864. These involved the purchases of 14 blocks of land totalling about 930 km^2 from Indigenous peoples, principally around Fort Victoria, Fort Rupert and

Nanaimo, although this is disputed by the Te'mexw Treaty Association and others who argue that the treaties involved more than land sales. They argue that Sir James committed to the signatories that they would retain their village sites and fields for their continued use, that they would have the liberty to hunt over unoccupied lands and the right to carry on their fisheries as formerly. Many are of the view that these treaties were made in bad faith, especially as the terms of the agreements were left blank at the time they were signed, and (with the exception of the Saalequun Treaty which was left blank) clauses were added later. The wording in these clauses was based on that in the Treaty of Waitangi, signed on 6 February 1840 in New Zealand, and suggested that the signatories had sold their land to the Crown in perpetuity.

Although the Royal Proclamation in 1763 clearly stated that the Crown was required to sign treaties with Indigenous peoples before any land could be ceded to the colony, this largely failed to occur in British Columbia. Treaty 8 was signed

with the Indigenous peoples in the northeast of the Province, to the east of the Rocky Mountains, and there were the Douglas Treaties, but it was not until 2000 that the Nisga'a Final Agreement heralded a new era of treaty-making.

In the interim, the relationship between the Crown and the Indigenous peoples of western Canada was one of oppression, displacement, disenfranchisement and cultural assimilation. It started with massive population losses associated with introduced diseases such as smallpox, followed by major social disruption as cultural activities were banned, traditional territories were appropriated, and children were removed and sent to residential schools – all as part of the assimilation program. A Truth and Reconciliation Commission reporting in June 2015 concluded that Canada was guilty of committing cultural genocide against Indigenous people (Truth and Reconciliation Commission of Canada 2015). The discovery of large numbers of unmarked children's graves near the former residential schools has forced many modern Canadians to consider the legacy of the history of colonization.

Modern treaties

The Nisga'a agreement was the result of a complex negotiation process that had started in 1993 with the British Columbia Treaty Commission. Many First Nations have participated in the treaty process, but others have chosen to assert their rights and title through the courts instead. This has been necessary as although Section 35 of the Canadian Constitution states "The existing Aboriginal and treaty rights of the Aboriginal peoples of Canada are hereby recognized and affirmed", the Constitution neither created nor defined Aboriginal rights.

The development of a modern treaty is a lengthy process, as is the affirmation of rights through the court system. In the meantime, many First Nations have entered into revenue-sharing agreements with the Provincial government in British Columbia. Termed Forest Consultation and Revenue Sharing Agreements, the agreements allow a proportion of the revenue obtained by the Crown from logging operations to be passed to the First Nation on whose traditional (and unceded) territories the logging is taking place. This gives little control to the First Nation and they are essentially a passive partner in the operation.

Huu-ay-aht First Nations

Here, we look at a more interesting development that is enabling First Nations to have a far greater say in the harvesting of timber on their lands. We use the example of the Huu-ay-aht First Nations, a self-governing, modern treaty Nation with lands located in the Barkley Sound region of the southwest coast of Vancouver Island. The traditional lands, termed *ḥahuułi*, have been occupied by the Huu-ay-aht "since time immemorial" (Figure 1). The Nation currently comprises about 850 people, although this is expected to grow to over 2,000 by 2050. It was much larger pre-colonization, but diseases brought by colonizers killed almost 90% of the population in the 1700s and 1800s.

Figure 1. Old growth coastal rainforest in the ***Huu-ay-aht*** ḥahuułi *(Photo: Bryce Bancroft)*

The Nation is a member of the Nuu-chah-nulth (formerly called Nootka) Tribal Council, and was one of the five nations to sign the Maa-nulth Final Agreement, a modern-day treaty. The treaty was implemented on 1 April 2011, and marked when the Maa-nulth First Nations' laws came into effect. The treaty granted the Huu-ay-aht full ownership and jurisdiction over an area of 8,200 ha (the Treaty Settlement Lands), and they continue to hold rights throughout the *ḥahuułi*.

The governance of First Nations in Canada is complicated by the presence of two parallel systems, the traditional system that was in place until the early 1950s, and which with the Huu-ay-aht involved Hereditary Chiefs (*Ḥaẃiiḥ*), and the elected government imposed by the federal government and enforced through the Indian Act. The Huu-ay-aht *Ḥaẃiiḥ* have a traditional role as the caretakers of the lands, waters and resources of their *ḥahuułi*, and today work closely with the Elected Council over any proposed development. The citizens of the Nation play an active role in governance through People's Assemblies, which are held regularly to discuss important issues affecting the Nation.

Three major principles, referred to as the sacred principles, are used in any development: of *ʔiisaak* (utmost respect), *ʔuuʔałuk* (taking care of), and *Hišuk ma c̓awak* (everything is connected). *ʔiisaak* concerns the personal and collective respect for the people and the community, for traditional knowledge, for the natural world and for the metaphysical world. It also extends to other peoples and communities. *ʔuuʔałuk* is all about taking care of present and future generations. It also relates to taking care of the land and the natural world. *Hišuk ma c̓awak* is the recognition of the interconnected, interdependent and reciprocal relationship between the people, the land and the wider world. It is meant in a physical, spiritual and social sense. The Huu-ay-aht First Nations Constitution Act (p. 6-7) goes into more detail about the values held by the Nation, which include:

a. reverence for the Creator (Naas);

b. honour for our ancestors;

c. respect for our elders, our children, our families, our future generations and our kinship system;

d. recognition of an internal order based on our Ha'wiih and Ha-houlthee;

e. a deep pride in our identity;

f. our unique language;

g. appreciation of our unique and vibrant culture, a culture that embraces our myths, stories, ceremonies and traditions;

h. a profound respect for nature, our lands and waters and all living things within our territory;

i. an acceptance and reverence for a spiritual basis to life;

j. a common and mutually supportive economic foundation; and

k. acceptance of our obligation to safeguard our special relationship with the Creator, the spirit world and the earth for future generations

(https://huuayaht.org/wp-content/uploads/2012/07/constitution-act.pdf)

Managing the forests of the *ḥahuułi*

Managing the forests of the *ḥahuułi* is complex, as it is covered by multiple agreements. The Huu-ay-aht First Nations has created the Huu-ay-aht Development Corporation (HDC) which oversees Huu-ay-aht economic development. The Huu-ay-aht have exclusive jurisdiction over the 7,300 ha of Treaty Settlement Lands and 700 ha of private lands. They have shared jurisdiction, including crown tenures and licenses, over a further 12,000 ha. They are part of the Bamfield Community Forest License and Tree Farm License 44 (TFL 44). Two external forestry companies are involved, Western Forest Products Inc. and Mosaic Forest Management. The boundaries of the *ḥahuułi* are mapped and include areas of shared and overlapping territory with neighbouring Nations (Figure 2).

Fig. 2. Sign marking the boundary of the Huu-ay-aht *ḥahuułi*. The Huu-ay-aht First Nations have recently regained a lot of the control over forestry activities on their *ḥahuułi*. Photo: Shannon Janzen.

TFL 44 covers about 137,000 ha of land on west central Vancouver Island (Figure 3) and extends beyond the Huu-ay-aht *ḥahuułi*. The license is operated by C̓awak ʔqin Forestry (Tsawak-qin Forestry Limited Partnership), which is a limited partnership between Huumiis Ventures Limited Partnership (which is beneficially owned by Huu-ay-aht First Nations) and Western Forest Products Inc. It was formerly known as the TFL 44 Limited Partnership. C̓awak ʔqin (meaning "we are one") Forestry was formed in March 2019. As of 3 May 2021, Huumiis Ventures Limited Partnership owns a 35% equity interest in C̓awak ʔqin Forestry, and Western Forest products holds an equity interest of 65%. C̓awak ʔqin Forestry has established strong relations with all of the First Nations on TFL 44 to ensure their decisions and interests are reflected in C̓awak ʔqin operations. The First Nations that are affected by TFL 44 are the Ahousaht First Nation, Cowichan Tribes, Ditidaht First Nation, Halalt First Nation, Hupacasath First Nation, Huu-ay-aht First Nations, Lyackson First Nation, Pacheedaht First Nation, Penelakut Tribe, Stz'uminus First Nation, Tseshaht First Nation, Ts'uubaa-asatx Nation, Uchucklesaht Tribe and Yuułuʔiłʔatḥ First Nation.

Figure 3. Logging activities in Tree Farm License 44. In the past. Large areas were clearcut, but today's forestry adopts a far more ecologically sensitive approach. Photo: Bryce Bancroft.

At the same time, major changes are occurring in the way that the Provincial Government administers forestry and other natural resource development, primarily as a result of the British Columbia *Declaration on the Rights of Indigenous Peoples Act* (Bill 41 – 2019). This requires all laws in British Columbia to be consistent with the UN DECLARATION on the Rights of Indigenous Peoples, and it is worth recalling that Article 26 states:

1. Indigenous peoples have the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired.

2. Indigenous peoples have the right to own, use, develop and control the lands, territories and resources that they possess by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired.

3. States shall give legal recognition and protection to these lands, territories and resources. Such recognition shall be conducted with due respect to the customs, traditions and land tenure systems of the indigenous peoples concerned.

https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf

A variety of other changes are occurring in the way the forest sector is organized and managed, including major revisions to the Forest Act, the Forest and Range Practices Act and other legislation. The Provincial Government has issued an intentions paper *Modernizing Forest Policy in British Columbia. Setting the Intention and Leading the Forest Sector Transition* (available at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/competitive-forest-industry/modernizing_forestry_in_bc_report.pdf) that outlines further changes that are being considered. In addition, a strategic review was undertaken of how British Columbia is managing its old growth forests resulting in *A New Future for Old Forests* (available at https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/old-growth-forests/strategic-review-20200430.pdf), and its 14 recommendations, which include a major paradigm shift for forestry, were accepted by the Provincial Government. Many other significant changes are underway, including a major revision of the Forest Carbon Offset Protocol, which was expected in December 2021, but as of April 2022, had not been released.

Further change is occurring as a result of a major government reorganization. The Ministry of Forests, Lands, Natural Resource Operations and Rural Development was split up in March 2022, with the creation of a new Ministry of Land, Water and Resource Stewardship, reduced responsibilities for the Ministry of Forests and increased responsibilities for the Ministry of Environment and Climate Change Strategy. Several other ministries have an interest in forest-related matters, notably the Ministry of Indigenous Relations & Reconciliation and the Ministry of Jobs, Economic Recovery and Innovation.

The *Hišuk ma ćawak* Integrated Resource Management Plan

The Huu-ay-aht First Nations is now in the process of developing the *Hišuk ma ćawak* Integrated Resource Management Plan (HIRMP). Announced in February 2022, this will be a two-year planning process to develop an all-embracing land-use plan. This goes far beyond existing planning requirements in the Province, and is distinguished by its integrated nature, looking at the land and its relationship with the people as a whole. Elsewhere, the provincial government has a bewildering array of land-use plans, the most recent form being forest landscape plans.

The HIRMP will take into account the Huu-ay-aht Forestry principles. These have been listed as (Huu-ay-aht, undated):

- Managing forest and fishery values to meet present needs without compromising the needs of future Huu-ay-aht generations.
- Managing forests based on Huu-ay-aht values *ʔiisaak* (utmost respect), *ʔuuʔałuk* (taking care of), and *hišuk ma ćawak* (everything is one).
- Balancing forest values to meet economic and cultural needs of peoples within the *ḥahuułi* of the Huu-ay-aht *Ḥaẇiiḥ*, including the Huu-ay-aht First Nations citizens (Figure 4).
- Restoring the damaged ecologies and the most critical 15 watersheds within the *ḥahuułi* of the Huu-ay-aht Ḥaẇiiḥ.
- Conserving biological diversity, soil, water, fish, wildlife, scenic diversity and other forest resources within the ḥahuułi of the Huu-ay-aht Ḥaẇiiḥ.

Giving serious consideration about what needs to be left behind as well as what can sustainably be harvested. And putting back what you take out.

Figure 4. The House of Huu-ay-aht. Traditional buildings such as this require large-diameter cedar. Photo: Huu-ay-aht First Nations.

What is happening within the *ḥahuułi* reflects the return of the stewardship of the lands to First Nations. This is reflected by the Hišuk ma c̓awak Declaration, signed by Huu-ay-aht, Ditidaht and Pacheedaht First Nations, which states:

> ‘For most of the past 150 years we have watched as others decide what is best for our lands, for our waters and for our people. Our three sacred principles are often ignored. We are too often the last to benefit from what is taken out and the last to be asked what must be put back in. That time is over. It is time for our principles, authority and responsibilities to be respected so that we can work for win-win stewardship solutions to heal our lands, our waters and our people for the benefit of our current and future generations – this will take time’ (Figure 5).
>
> ‘From this day forward, in accordance with our traditional laws and our constitutionally protected Aboriginal Title, Aboriginal Rights, and Treaty Rights, we declare that our governance and stewardship responsibilities in our Hahoulthee must be acknowledged and respected. Third parties – whether they be companies, organizations, other governments, or individuals – have no right to speak on our behalf, or on behalf of the lands, waters and resources in our Hahoulthee. Moreover, for third parties to be welcome in our Hahoulthee, they must respect our governance and stewardship, our sacred principles, and our right to economically benefit from our resources.’
>
> (Source: https://huuayaht.org/wp-content/uploads/2021/06/declaration-FINAL-signedpdf.pdf

It is also reflected in some of the statements included in press releases issued by C̓awak ʔqin Forestry. One of the authors of this article, Robert J. Dennis Sr., Chief Councillor of Huu-ay-aht First Nations, was quoted in a press release dated 24 February 2022 as saying:

> ‘It is time for everyone, including expert panels in Victoria and old growth protestors, to show respect for the sovereignty of our nations and to respect our ability to unify and lead all members of society into a brighter future. Governments strike the balance needed in final decisions, not third parties. The land is our culture, and it is our stewardship decisions that count.’

Figure 5. Planting team from the Huu-ay-aht First Nations. Many members of the nation are now working in forestry, one of the few sources of income in the area. Photo: Bryce Bancroft.

To provide context, Victoria is the seat of the Provincial Government, and the government has set up panels to provide recommendations for particular forestry activities, such as the harvesting of old growth. The reference to protestors relates to the activities of environmentalists who oppose logging. The protests concentrated on the nearby Fairy Creek (located in a different Tree Farm License), but have spilled over into the Huu-ay-aht's area of operations, prompting the Nation to set up information check points in May 2021 to inform visitors of the need to observe the three sacred principles while visiting the *ḥahuułi*.

The emergence of Cc̓awak ʔqin Forestry

The development of Cc̓awak ʔqin Forestry illustrates how a small Indigenous Nation can develop a major business. It started in May 2017, when Western Forest Products sold three properties to the Huu-ay-aht First Nations. The sale included a dryland sort located in an area of great importance to the Huu-ay-aht, namely Sarita Bay, and total purchase price for the properties was $3 million. It involved a long-term lease back of the dryland sort to Western. The transaction included an agreement to harvest 200,000 m^3 of timber from Huu-ay-aht Hišuk ma c̓awak Declaration lands, and an employment and training agreement aimed at increasing the number of Huu-ay-aht and other TFL 44 First Nations citizens working in the forest sector. The decision to move forward with the purchase was supported at a People's Assembly. By September 2021, 44 members of the Huu-ay-aht Nations were working in the forest sector.

The relationship between the Huu-ay-aht and Western continued to evolve, and in March 2018, a Reconciliation Protocol Agreement was signed between the two. The agreement covered the exploration of possibilities for economic development in the *ḥahuułi* and more generally in the region, while respecting the three sacred principles described earlier, as well as an exploration of different ownership structures. This led to the acquisition by Huumiis Ventures Limited Partnership (HVLP) of a 7% interest in the newly-formed TFL 44 Limited Partnership, at a cost $7.2 million. The acquisition had to be, and was, approved by the BC Provincial Government and the Huu-ay-aht People's Assembly. The transaction also had the approval of the then Head Hereditary Chief of Huu-ay-aht.

In March 2020, a press release issued by Western and Huu-ay-aht indicated that the two had reached agreement for Huumiis to acquire a majority interest in the TFL 44 Limited Partnership, as well as a 7% ownership interest in the Alberni Pacific Division Sawmill, for a total cost of $36.2 million. More than 80% of Huu-ay-aht citizens voted in favour of the purchase. The agreement proceeds in two stages, an initial purchase of an additional 28% ownership in TFL 44, at a cost of $22.4 million, followed by a further 16% interest that will be acquired in early 2023, subject to approval by the Provincial Government and the Huy-ay-aht People's Assembly. On completion, Huumiis will own 51% of TFL 44 LP, and the transaction allows for further increases in ownership interests by other Nations of up to 26% in TFL 44 LP as well as increases in ownership interests in the sawmill. An important aspect of the transaction was an agreement between Western and TFL 44 LP to enter into a long-term fibre agreement, ensuring that Western's other sawmills would continue to receive logs. TFL 44 LP was renamed Cc̓awak ʔqin Forestry in October 2021, at the same time as the new Witwak Forestry Guardian Pilot Project was announced. The Guardians have

responsibility for the protection, monitoring and enhancement of TFL 44 forestry operations.

Cc̓awak ʔqin Forestry is also involved in restoration efforts, fixing problems that have been created by poor management practices in the past. There is a strong emphasis on the restoration of salmon habitat, and work is underway on the Sarita River, Sugsaw Creek and Pacheena River. Work on other rivers will follow in the future. Western Forest Products has committed $375,000 to Huu-ay-aht for watershed enhancement projects, and Huu-ay-aht allocates $5 from every cubic metre of timber harvested on Treaty Lands toward salmon habitat renewal work (Figure 6).

Figure 6. Huu-ay-aht forestry staff working on the restoration of riparian habitat. Photo: Bryce Bancroft.

Another new venture is equally far-sighted. The *Hišuk ma c̓awak* Manufacturing Initiative (HMI) was announced in March 2022. The goal is to be carbon positive by 2030, and will involve a variety of activities, including the exploration of income streams associated with carbon credits and green energy programs, a reduction in the amount of waste left after logging operations and optimized use of sawmilling residuals. Such a move is entirely consistent with the conclusions released in the Intergovernmental Panel Climate change 6th Assessment Report:

'**SPM.C.2.3** Adaptation for natural forests includes conservation, protection and restoration measures. In managed forests, adaptation options include sustainable forest management, diversifying and adjusting tree species compositions to build resilience, and managing increased risks from pests and diseases and wildfires. Restoring natural forests and drained peatlands and improving sustainability of managed forests, generally enhances the resilience of carbon stocks and sinks. Cooperation, and inclusive decision making, with local communities and Indigenous Peoples, as well as recognition of inherent rights of Indigenous Peoples, is integral to successful forest adaptation in many areas. (*high confidence*)'

(Source; IPCC WGII Sixth Assessment Report. 2022. Summary for Policymakers. p. 11.)

Fig. 7. Retention of riparian forest along rivers is an important part of maintaining the ecosystem functions. Photo: Huu-ay-aht First Nations.

Conclusions

Given the past 200 years of colonization, the efforts of Huu-ay-aht First Nations to regain the stewardship of the forest in the *ḥahuułi* are remarkable. They have developed a forestry operation that is consistent with their sacred values of *ʔiisaak*, *ʔuuʔałuk* and *Hišuk ma ćawak*. The work has not been done alone, and due recognition needs to be given to Western Forest Products, the major forestry licensee in the area. The company's CEO, Don Demens, and Chief Forester, Shannon Janzen, have followed the principles of reconciliation laid out by the Truth and Reconciliation Commission, and have treated Huu-ay-aht with the respect that is missing or in short supply in many of the relationships between forest licensees and First Nations. Despite the chaos caused by a major government reorganization, conducted simultaneously with major changes to existing legislation, Ćawak ʔqin Forestry has embarked on an ambitious program associated with the development of the *Hišuk ma ćawak* Integrated Resource Management Plan and the *Hišuk ma ćawak* Manufacturing Initiative. As such, it is providing the leadership and role model for other First Nations' companies in British Columbia and Canada, as well as in other parts of the world.

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The future of forests in Aotearoa

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In a policy environment that focuses on carbon emissions reductions, it is encouraging to see the potential for nature-based solutions attracting more attention and building an evidence base. Some proponents of nature-based solutions highlight the role of vegetation in cooling the locale through shading, the heat fluxes caused by transpiration, and as drivers of the hydrological cycle (Schwarzer, 2021). Our emerging understanding of the biotic pump (Makarieva & Gorshkov, 2010), atmospheric rivers, and the nucleation of rain from plant aerosols (Jardine et al., 2015) reveals that carbon sequestration is only one of several benefits gained by regenerating vegetation.

Viewed in this light, climate change is not just an industrial age phenomenon, but reaches back to the dawn of the agricultural age. Our collective development as farmers paralleled our development as unintentional desert makers (Rose, 2021). Further back in time, as our ancestors migrated to the farthest ends of the globe, we drove important species of megafauna into extinction with climate-engineering consequences (Macias-Fauria et al., 2020).

In this context Aotearoa [New Zealand] offers a compressed history of human impact, given that humans have inhabited these islands for less than 1,000 years. A landscape shaped by environmental forces has been radically modified first by Māori, then colonising Europeans whose arrival here coincided with the industrial revolution. The colonisers soon adopted industrial technology to accelerate the destruction of forests and went on to develop the current *Pinus radiata* monocultures. For some, increasing pine plantations offers an easy pathway to meet Paris Accord obligations, while for others the value proposition is not so clear. After a brief review of changes in forest cover in Aotearoa over time, this paper explores how forests can best contribute to climate mitigation, while supporting our social, cultural and economic aspirations.

The forests of pre-human Aotearoa

Aotearoa has been blessed with ample rainfall and a benign climate that fostered the development of temperate and sub-tropical evergreen forest. The warmer northern North Island is the southern boundary for mangroves while the extensive cooler mountain ranges confine forests to below the snow line. The natural forces of volcanism and sea-level fluctuations have occasionally disrupted the forest species mix. Unlike most other land masses, our vegetation developed in the absence of land mammals. Consequently, some our bird species, such as the kiwi abandoned flight as there were no significant land-based predators.

Beech (*Nothofagus spp.*) forests share their ancestry with relatives from Australia, Antarctic and South America as survivors of the Gondwana supercontinent. *Podocarpus* are another genus from Gondwana that populated much of the Southern, and parts of the Northern hemisphere. Another forest species of note is the kauri, *Agathis australis*, prized for timber by both Māori and Pākehā (New Zealanders of European descent).

Pre-European Māori

The historian Michael King (2012) called Māori who settled New Zealand colonising Polynesians. Like other colonisers, they revelled in the abundance encountered in a land much larger than the islands they migrated from. Fire, used as a hunting tool, destroyed significant areas of forest and endemic species such as the giant flightless Moa were driven to extinction. Māori rediscovered their innate indigenous reverence for the natural world and developed customs to sustain it. In forests, species such as tōtara (*Podocarpus totara*) were, and remain, taonga [treasured items]. Tōtara is valued for waka [canoe] building and carving.

European colonisation

Early European colonisers encountered a forested arcadia. Between 1831 and 1832, Samuel Polack travelled through western Northland. His description of the forests flanking the Northern Wairoa River and its biodiversity contrast with present day farmland with forest remnants.

> 'We sped gaily [down the winding river], the rays of the burning sun caused the heat to be intense. The river was literally crowded with wild duck, whose tameness enabled us to catch several, principally killing them with our paddles. Wild pigeons flew about in great numbers, as did also several parrots, paroquets, hawks and singing birds. The banks of the river were covered by forests filled with splendid timber of magnificent height and foliage; where the forest ended, flax [abounded] on the plains' (Byrne, 2002).

Colonisation is essentially extractive, and colonisers and settlers quickly harvested ancient trees, including kauri, valued as spars by the British Navy. In a second assault, settlers dug through once-forested land for kauri gum, used for varnish.

Industrial plantation forests

During the 20th Century *Pinus radiata* became the dominant plantation forest species as the remaining native trees species were conserved. By the end of the Century harvesting was highly industrialised with machine harvesting and debarking of trees, with large yarders used to transport logs from hills to assembly points. Economic gain remains the predominant factor in determining rural land use and remains privileged over social and environmental considerations.

Focusing on the Northland region (Figure 1), considering GDP, employment and ownership, the value proposition for plantation forestry is not strong. The data in Figure 2 is eleven years old, but the underlying trends will not have changed significantly.

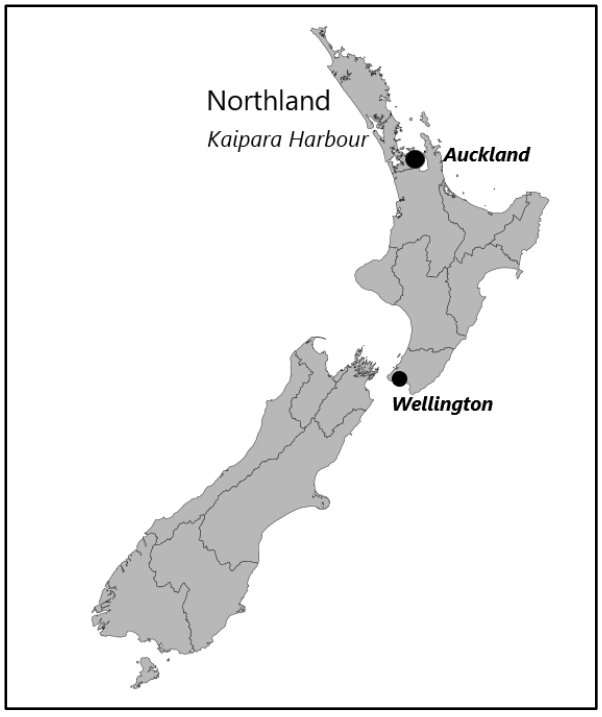

Figure 1. Map of New Zealand showing Northland and the Kaipara area. (Source: Creative Commons Attribution-Share Alike 4.0 International)

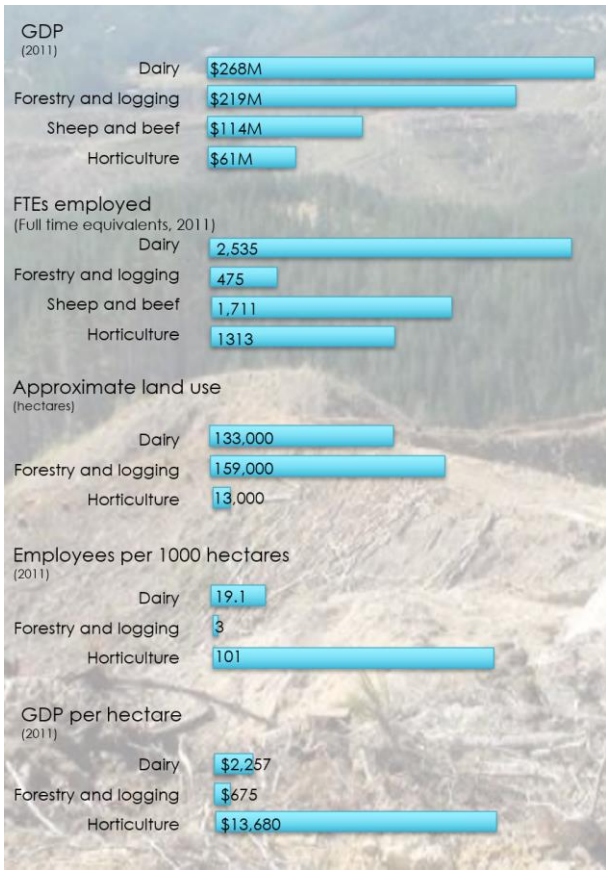

Figure 2: Forestry GDP, employment and land use. (Data from Infometrics (2022) and industry sources)

This data (Figure 2) reveals how plantation pines in Northland contribute to an ongoing extraction of value. The employees per 1,000 hectares reveals the paucity of employment opportunities for commodity logging. Forestry GDP per hectare is five percent of that of horticulture. A further value extraction is in land ownership. The hundred largest private landowners own 1.42 million hectares, approximately 5% of total land area. The four biggest private owners are internationally owned forestry companies (Newton & Espiner, 2019).

Pine plantations are the cheapest way to achieve the Government's Billion Trees policy. With incentives to plant trees and the prospect of increasing carbon offset prices, some forest-owners are now planting pines as carbon farms, rather than timber plantations, effectively locking that land out of the productive economy, reducing biodiversity and increasing fire-risk (Salmond, 2021). The impact of pine on soil, water quality and aquifer volumes is contested, but there is an growing discursive shift favouring indigenous forests over plantation forests (Pure Advantage, 2021). The New Zealand Government is responding by releasing a discussion document considering a ban of exotic forests as permanent carbon forests (Nash & Shaw, 2022).

How can forests deliver social, cultural, environmental and economic justice?

Plantation forests occupy 2.1 million hectares, 20% of total forest cover, and 7% of the land in Aotearoa (Ministry for Primary Industries, 2020). This generates 1.6% of GDP and produces sustainable construction materials. To replace the economic imperative underpinning land use decisions with a more sustainable mix of social, cultural, environmental and economic imperatives, the availability of timber for construction requires consideration. The economic and employment benefits of plantation forests can be more readily remedied with increasing diversity of land use targeting high value exports.

What might our forests of the future look like? Visualising future forests can be made more tangible by identifying innovations in place now. Four examples of land use follow that can help build our vision of future forests.

The Northland Tōtara Working Group (NTWG) identifies *Podocapus totara* as an ideal species for a more diversified forestry industry. Tōtara's prickly leaves are avoided by farm animals, so they are one of the few native trees to survive in farmland. In open land, tōtara develop a squat growth habit, but in even small forest remnants or regenerations will grow to a 20 to 30 metre tree. Paul Quinlan has led efforts to learn about how these remnant trees

can be optimised for regenerative forestry. When some are thinned out and the remaining trees pruned, tōtara grow faster and develop as high-quality timber trees. Farmers can then develop forest remnants in riparian plantings and marginal country for continuous canopy cover sustainable forestry. While in the same classification order as pines, totara have fruit that birds eat (Landscape Architecture Aotearoa, n.d.).

The Tahi Honey site was an almost treeless farm on the east coast of Northland. Since the Craig family purchased the land, 349,000 native trees have been planted with their nursery producing 250,000 seedlings, The trees and the 34.3 hectares of wetlands that have been re-established are foundational to an ecosystem that supports 71 bird species and nine fish species. Tahi's regeneration work is partly funded by sales of manuka and other honeys, family investment, luxury accommodation, and carbon credits. Manuka honey commands a premium price in global markets. Tahi is one of ten Centres of Excellence of Sustainability certified by the Long Run as a Global Ecosphere Retreat (Tahi Honey, 2020).

Professor John Craig developed a biosphere value for native trees and shrubs. The biosphere value includes five factors: bird attraction, invertebrate value, longevity, carbon storage capacity, and longevity of carbon storage. The puriri, *Vitex lucens*, tops the table with a score of 100. Puriri flowers and berries feed birds, sometimes when other sources are rare, and the tree is the favoured habitat for the puriri moth. Especially impressive is the restoration of wetlands, recharging aquifers and providing habitat for water birds including the pāteke, Aotearoa's rarest duck (Craig, 2020). The new and re-established wetlands are recharging aquifers and improving fire resilience. Notably, Tahi Honey employs about 14 people, while the former farm employed 1.5.

Agroforestry has potential to soften the sharp edges between plantation forests and farmland. As climate disruption increases farm animals will benefit from the provision of shelter and shade that trees provide. Farmers have favoured monocultural pastures of ryegrass tolerating other species but have often been averse to the presence of trees. The commonly held conception that trees compete for sunlight and water are slowly giving way to a more nuanced appreciation of trees on farms. Wayne Douglas in the Kaipara region (Figure 1) values his trees. He planted them on the side of a drain and also the side of a farm road running alongside the drain. Now that the trees are mature, the drain has become a small stream, more than trebling its capacity. The shade from the trees cools the water increasing aquatic life and biodiversity. Farm animals enjoy the shade, shelter and the diversity of diet from leaves and buds. Wayne also has developed low-cost protective structures to help establish trees in pasture. He advocates a 20% canopy coverage for agroforestry.

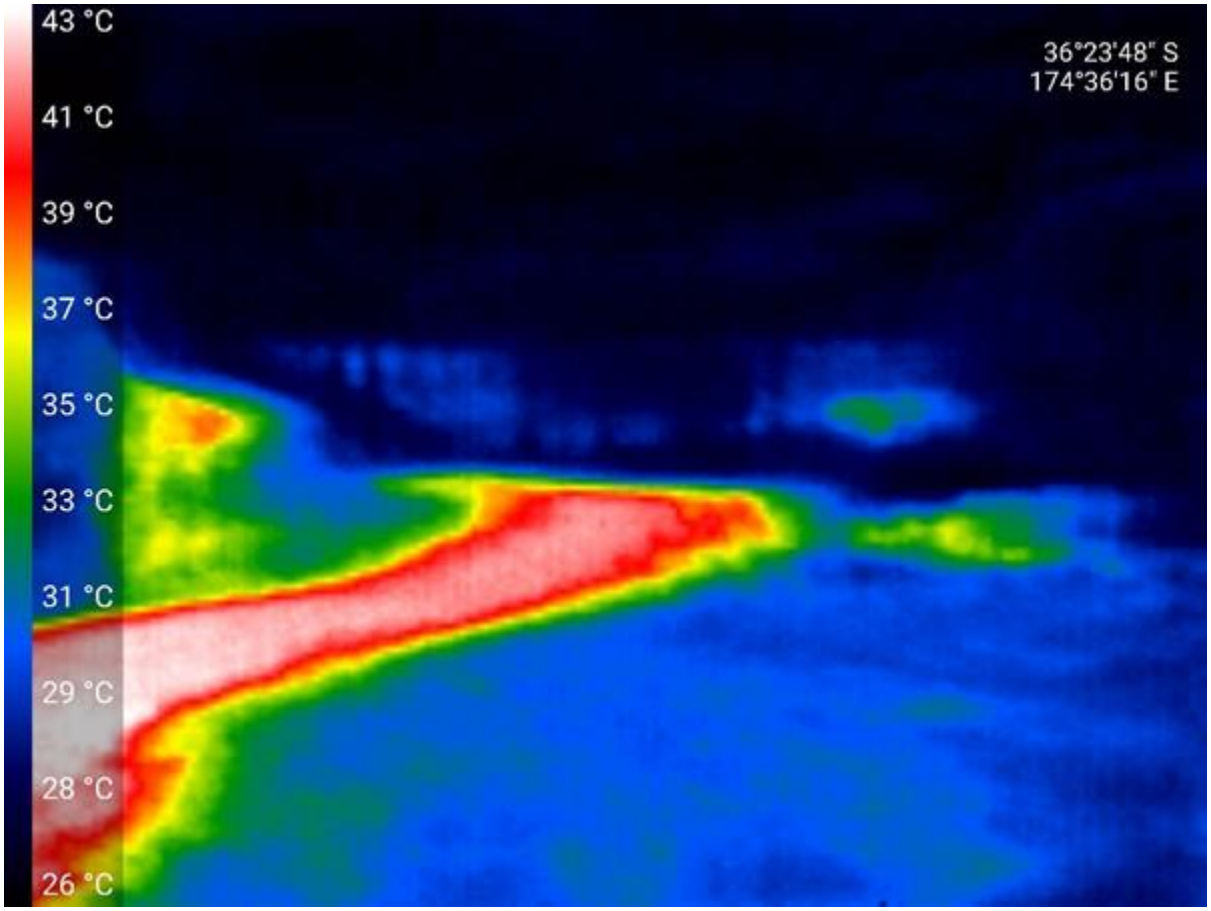

Figure 3: Thermal image of the Douglas farm

This thermal image of the Douglas farm (Figure 3) reveals the cooling impact of trees. The dark blue in the background of the image is as cool as 26°C., while the limestone race (farm road) is as high as 43°C.

In Aotearoa farming is often large scale and monocultural, contrasting with small scale biodiverse permaculture. With the inclusion of trees and honey production the Douglas farm softens that dichotomy. The long-running *Country Calendar* weekly documentaries on New Zealand television highlight varied approaches to diversifying production, including farm forestry. Public pressure on farms to improve water quality has led to a large increase in riparian plantings.

Looking further afield, Permaculture, originating in Australia, has informed large-scale dramatic landscape transformations in arid areas of India and Africa. While Aotearoa has a more benign climate, the application of permaculture principles has potential to support diversification of pastoral farming, including trees.

Aotearoa's benign climate can easily support a mosaic approach to land use where boundaries between commercial production and indigenous forest soften. Rather than land-use decisions based on economic considerations, a much more nuanced approach bases land use decisions on the capability of land, ideally led by the people living on that land informed by the urgent need to heal the climate and deliver social, cultural, environmental and economic value for the people living there.

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Communicating biodiversity – using virtual reality and gamification to sensitize the world to the importance of the Iwokrama Rainforest

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The riches of the Iwokrama Forest

Though they cover only ~10% of Earth's land surface (Lewis, 2006), tropical rainforests constitute the largest source of terrestrial biodiversity (Ghazoul and Sheil, 2010); and are predicted to host over half of all known species (Groombridge et al., 2002; Scheffers et al., 2012). They also represent a major component of the global carbon cycle, accounting for nearly 40% of terrestrial net primary production (Townsend et al., 2011) and comprising ~17–25% of all carbon in the terrestrial biosphere (Bonan, 2008). Moreover, tropical rainforests such as those of the Guiana shield can interact with atmospheric circulation to influence continental-scale patterns in precipitation and temperature (Bovolo et al., 2018). Through their various natural resources and ecosystem services (including medicinal discoveries, timber, ecotourism, and food), up to 1.5 billion people are estimated to rely directly on tropical rainforests (Vira et al. 2015); for people indigenous to such places, rainforests also hold immense cultural importance, further to this material value. Despite their importance, however, many of the world's rainforests are threatened, driven by practices such as unsustainable logging, clearing land for agriculture, fires, and mining (Lewis et al., 2015).

Figure 1. The Iwokrama Forest.

One such area of rainforest is the Iwokrama Forest, Guyana, which is located ~300 km south of the nation's capital, Georgetown (Figure 1). Iwokrama's 371,000 hectares of lowland tropical forest host a wide range of intact habitats, contributing to its remarkable biodiversity. Indeed, though it comprises only 2% of Guyana's total forest area, it is home to over 1250 of the nation's 8000 recorded species (Thomas, 2019), including 471 bird, 134 fish, 81 reptile, 56 amphibian, and 142 mammal species (Engstrom et al., 2017). The Iwokrama Forest is extremely important for Guyana's floral biodiversity; it contains over 1250 recorded plant species of economic and cultural significance to Guyana. For example, the Greenheart Tree (*Chlorocardium rodiei*), which is endemic to Guyana, is a prized export due to its high quality, fire resistance, and suitability for marine timber (Thomas, 2019). The seeds of the Crabwood Tree (*Carapa spp.*), meanwhile, produce oil that is widely used by the Guyanese as an insect repellent, among many other cosmetic and medicinal uses (Forte, 2002), while the Kapadulla vine (*Tetracera asperula*) is considered an aphrodisiac (Tomei, 2008). Given the multifaceted importance of the Iwokrama Forest, and its intact nature, it is vital to establish best practices for its successful conservation, in such a way that it can be managed sustainably.

The Iwokrama International Centre for Rain Forest Conservation and Development (IIC)

In formal recognition of the importance of the Iwokrama Forest, in 1996 the Guyanese Government established the IIC as a major environmental programme, through an Act of Parliament. IIC seeks to develop and promote the sustainable management of the Iwokrama Forest, with the aim of establishing best practices that can be applied across the world (Figure 2).

For the conservation of rainforests such as Iwokrama to be successful, it is vital that both local stakeholders and national governments can benefit financially through the sustainable use of multiple rainforest resources. Without this sustainability and profitability, the current trend of tropical rainforest loss will surely continue.

Figure 2. IIC's river lodge and research centre, on the bank of the Essequibo River, Iwokrama Forest.

To this end, IIC's mission is as follows:

> 'To promote the conservation and the sustainable and equitable use of tropical rain forests in a manner that will lead to lasting ecological, economic and social benefits to the people of Guyana and to the world in general, by undertaking research, training, and the development and dissemination of technologies.'

IIC approaches this mission by pursuing multiple conservation goals: sustainable forest management (e.g., through high value, low volume timber extractions and forest certification), research, community engagement with indigenous partners, and ecotourism. Through its educational and ecotourism ventures, IIC seeks to promote ecoliteracy:

> 'an understanding of the principles of the organization of ecosystems and the application of those principles for creating sustainable human communities and societies' (McBride et al., 2013).

We can also think of IIC's multifaceted, sustainable rainforest management through a 'systems thinking' approach, which considers the multiple interlinked aspects involved in rainforest conservation. Systems thinking recognizes that challenges such as rainforest conservation cannot be addressed by focusing on each aspect in isolation, instead they must be tackled holistically, considering all aspects and their relationships (Capra and Luisi, 2014). Visitors to IIC develop ecoliteracy and learn about the importance of safeguarding rainforests from different viewpoints, while immersed in Iwokrama's rich flora and fauna. They also learn about the interconnectedness of different parts of the ecosystem. For most people, however, visiting Iwokrama in person currently represents a huge logistical, temporal, and monetary commitment. Thus, we need to bring this experience to those who cannot make the journey or are not yet ready to make the commitment.

It is possible to communicate IIC's methods remotely. However, the current modes of remote communication are unengaging, consisting of largely passive techniques that

lack the immersivity or multi-sensory nature of the real world and struggle to support constructivist (learning from experience) approaches to education (Christou, 2010; Sterman 2016). Given the importance of biodiverse ecosystems such as the Iwokrama Forest, we must develop more engaging and immersive ways to remotely communicate the need for their sustainable management, thereby increasing ecoliteracy and allowing for the challenge to be understood from a systems thinking perspective (Capra and Luisi, 2014; McBride et al., 2013).

Virtual Reality and Gamification

Virtual reality (VR) entails 'placing' a user within a computer-generated, three-dimensional (3D) environment (Christou, 2010). As an educational and communicative tool, VR could become a key building block for society; it could help us to engender ecoliteracy and embrace systems thinking approaches to issues such as biodiversity loss. VR headsets create a virtual environment that immerses the user, allowing messages to be communicated in an engaging, immersive, and multi-sensory manner. Indeed, as they let us view problems through someone else's eyes, VR headsets are often referred to as 'empathy machines' (Barbot and Kaufman, 2020). Therefore, from a holistic viewpoint, VR can communicate the importance of the biodiverse flora of Iwokrama, while showcasing IIC's best practice approaches to ensuring their survival through conservation, sustainable management, ecotourism, and other forest-based businesses. By highlighting the indigenous uses and cultural importance of Iwokrama's flora, VR can help often overlooked viewpoints to be experienced first-hand by the user. VR can also enable access for people unable to visit Iwokrama due to financial, physical, and societal barriers. Immersive VR experiences can also convey a lasting sense of connectedness; in the current setting they could support IIC's mission to transfer knowledge and kindle motivation (Loureiro et al., 2020).

At its best, VR can be interactive, not passive. To this end, the process of gamification, in which a user controls how they move and interact with a virtual environment, is incredibly powerful in delivering key messages (Werbach and Hunter, 2020). Gamification applies game-design elements and game principles in non-game contexts. It can also be defined as a set of activities and processes to solve problems by using or applying the characteristics of game elements.

By gamifying an experience, we can let users interact with it and drive it forward on their own terms. This is much more engaging than passive communication, and aids a constructivist approach to science communication (Christou, 2010). When focusing on designing human-centric gamification, Chou (2019) identified eight core drives for human motivation, thus creating the 'Octalysis framework' (epic meaning, accomplishment, empowerment, social influence, unpredictability, avoidance, scarcity, and ownership). This approach has been widely used to create fulfilling and rewarding interactive educational experiences. A further framework that has been applied extensively in the field of gamification is self-determination theory (SDT). SDT focuses on the inherent strength of intrinsic motivation (when one is inherently motivated to complete a given activity because it is enjoyable or rewarding in-and-of itself), as opposed to extrinsic motivation (driven by external factors). STD holds that three basic psychological needs motivate one's drive to self-initiate an action - autonomy, relatedness, and competence (Ryan and Deci, 2000).

Creating the Georgetown Botanical Gardens

To leverage VR to communicate the importance of Iwokrama's biodiversity, we worked with IIC to develop a short demonstrative, standalone VR experience that introduces the user to key species within the Iwokrama Forest and Guyana as a whole. This

experience takes place in a virtually modelled 3D environment based upon the Botanical Gardens in Guyana's capital, Georgetown. We chose this setting for several reasons: first, botanical gardens can feasibly showcase a wide range of flora and habitats in a small, concentrated area. Second, part of IIC's mission involves overcoming the challenge in that the Iwokrama Forest is over 250 km from the coastal regions where most of Guyana's people live. The Georgetown Botanical Gardens represent a cultural linkage between these coastal residents and the rainforests of the nation's interior, hosting both diverse flora and historical and culturally important monuments. Third, designing the VR experience in this way allows for further expansion through the incorporation of more environments and experiences based in the Iwokrama Forest. In this scenario, the current experience could become a tutorial to introduce users to the format, as well as to Iwokrama's flora.

Prior to constructing this virtual environment, we first drafted an initial 'floor plan', using a combination of satellite images and photographs captured in-person. The area to be modelled was selected so that it contained a range of different habitats in which to host the target species. This area also included the Seven Ponds monument, which commemorates several influential figures from the early years of Guyana's development as an independent country (Figure 3). Following the completion of this plan, we developed the virtual environment using Unity, a free-to-use real-time development platform.

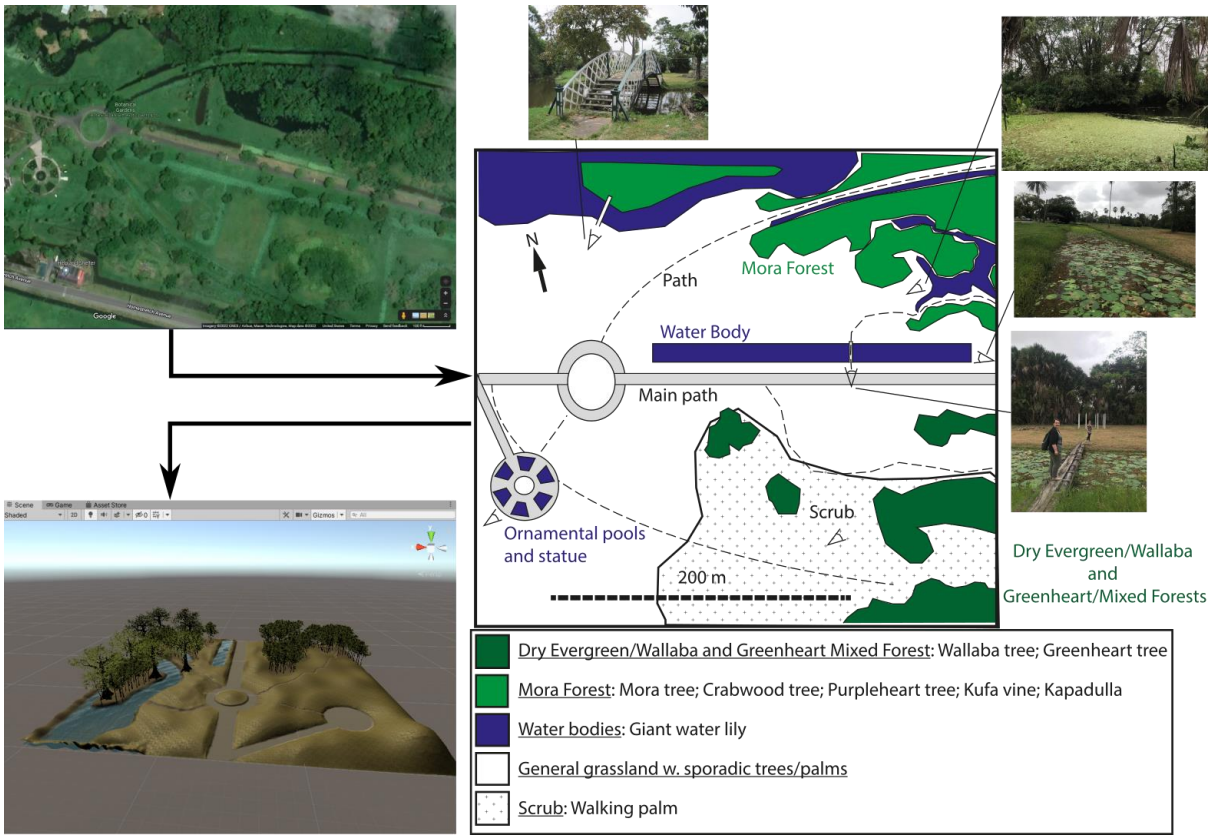

Figure 3. Creation of in-game environment: original media (top left; Google Maps, 2022), two-dimensional mapping (right), and creation of virtual environment in Unity 3D (bottom left).

Our next step was to populate this virtual environment with target flora species (including separate models of their leaves and seeds, where appropriate), accompanied with other flora and features (such as paths, bridges, and the Seven Ponds monument). For this purpose, we employed Blender 3D, a free-to-use, open-source computer graphics software toolset. Blender 3D can create and modify 3D models that can then be imported into a Unity environment to increase its realism (and thus its immersivity); three examples of this design process are shown in Figure 4, while a view of the final environment is shown in Figure 5. Moreover, through Unity, we can include opportunities for the user to transition between the modelled environment and real-life, 360° videos and photographs captured in the field.

We further built upon this immersivity by composing a bespoke musical score. We developed soundtracks using the software package Cakewalk by BandLab, a digital audio workstation for music production. We also employed the Native Instruments free VST plug-ins to craft and combine sounds and effects, and to format melodies. Drawing inspiration from local folk music, these sounds and melodies aim to immerse the user in Guyana's fascinating botanical environment. The album 'The songs of the Guiana Jungle' by Ramjohn Holda and the Potaro Porknockers provided a further, more contemporary source of inspiration. The resulting melodies have a soft, uplifting tune that keeps the user engaged, making exploration pleasant and rewarding. The percussive loops give the feeling of adventure and maintain the user's motivation and interest for exploration by providing a continuous pace.

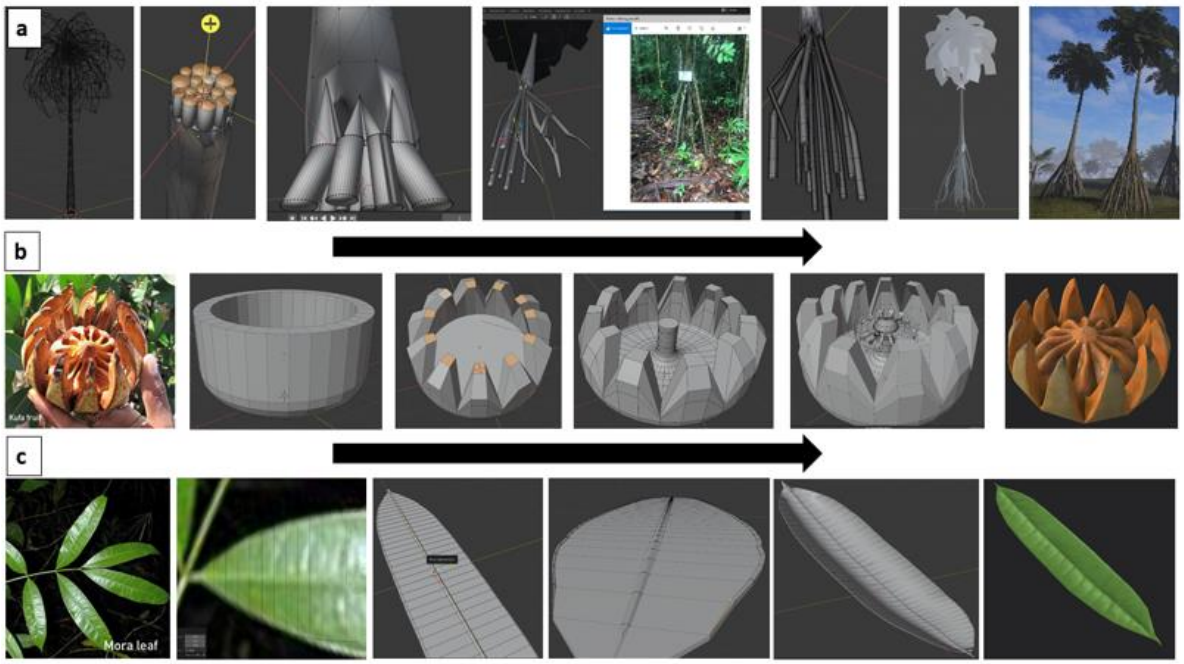

Figure 4. Creation of flora using Blender 3D: a) walking palm tree, b) kufi fruit, and c) mora leaf.

Figure 5. In-experience screenshot showing modelled 3D environment.

The next step involved developing the gamification for this virtual experience, in which we aimed to invoke the three aspects of intrinsic motivation outlined in SDT (autonomy, relatedness, and competence), while also reflecting upon game techniques aligned to the core drives outlined in the Octalysis framework (Chou, 2019; Ryan and Deci, 2000). We created a narrative in which the user is tasked with finding eight different species native to Guyana (this aligns to the 'narrative' technique in the 'meaning' Octalysis core drive). Their challenge is to locate each of these species using clues provided in a 'journal' (Figure 6), which outlines their habitat, gives descriptive clues, and provides sketches of seeds/fruit and/or leaves; breadcrumb-style trails of these leaves, fruits, or seeds lead to the species in question. The user is free to explore the immersive environment at their own pace, in any order, and in an 'open world' setting. This helps to engender a sense of autonomy, playing on the user's intrinsic motivation to complete the experience. This sense of exploration has also been identified as a key tool in effective gamification (Werbach and Hunter, 2020).

Figure 6: In-game journal, showing botanical information and highlighting cultural importance. The 'photograph' in the top right corner has been captured by the user and added to their journal.

The user can also physically pick up the leaves, seeds, and fruits to inspect them from all angles, or even to hold them up to the pages of their journal to compare their distinguishing features. Figure 7 shows an example storyline plotted for each target species.

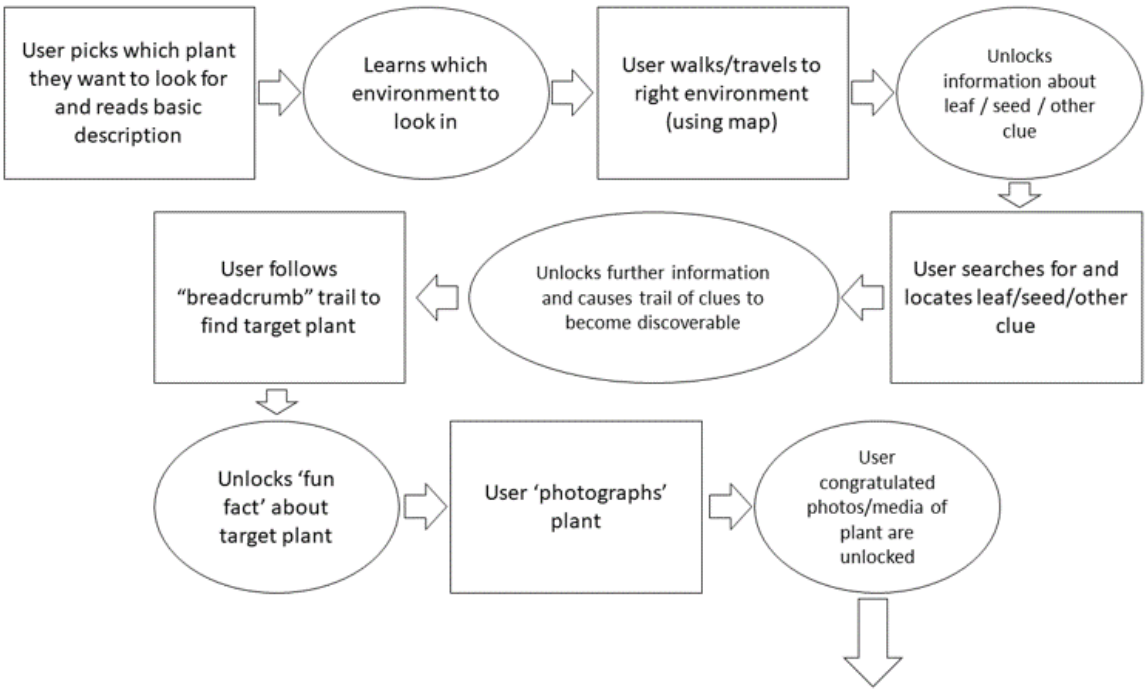

Figure 7: Generalized story flow showing user's progress when finding one of the target species.

Upon finding each species, the user can celebrate their achievement by taking a 'photograph', which is then added to their journal as a permanent record of their progress (Figure 6; aligned with the 'progress bars' technique in the 'accomplishment' Octalysis core drive). Finding each species also unlocks information about its importance to Iwokrama's indigenous peoples or Guyana as a whole (aligned with the 'milestone unlock' technique in the 'empowerment' Octalysis core drive). These 'rewards' for the user's actions also help to strengthen the user's intrinsic self-motivation by conveying a sense of competence. Overall, the game experience reinforces the necessity of preserving biodiversity, giving meaning to the player's actions and so appealing to the 'higher meaning' technique of the 'Meaning' Octalysis core drive. Moreover, the overall effect of the experience actively, visually, and aurally immerses the user in Guyana's diverse flora, while emphasizing its importance in terms of its cultural and economic value. In this way, the experience aims to draw on the final aspect of intrinsic motivation as outlined in SDT – relatedness.

Future considerations and developments

This virtual experience functions as a standalone tool for communicating ecoliteracy regarding tropical rainforest biodiversity. However, it could easily be incorporated or scaled into larger virtual experiences featuring multiple environments. For example, we are currently developing a similar project based on developing ecoliteracy regarding the role of rainforests in global carbon cycling, with plans to incorporate the botanical gardens experience into the overall story (Cole et al., 2021). Bringing together multiple environments in the same virtual experience, representing both Iwokrama and research facilities such as the Lyell Centre, UK, could advance knowledge exchange and take-home value for audiences both in Guyana and in the UK. Moreover, from the perspective of IIC, this experience could represent a tutorial for a much larger experience to showcase their ecotourism and education efforts.

Another promising development direction is the incorporation of multiple users into the same environment. Adding a multiplayer element to virtual experiences can foster cooperation and knowledge exchange, while also allowing for expanded possibilities regarding gamification (Chou, 2019). Building upon this, a further approach could entail developing multiple different roles that contribute to an overarching storyline (e.g., a Makushi forest ranger from IIC working with a researcher to conduct fieldwork). Inhabiting different roles in VR in this way, while collaborating, may offer a useful tool to reinforce the systems thinking approach, which can address global challenges such as biodiversity loss, where different perspectives are undoubtedly necessary for any sustainability agenda to be successful.

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Introductory remarks to the articles on forests and communities in the UK

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The three papers that follow deal with what might be called 'Urban Forestry' in England, the largest of the UK's four nations. Laws and entities dealing with woodlands and forests differ between England and the devolved governments of the three smaller nations. The word 'Forest' has different uses in England and thus some explanation may be helpful. In addition, the people and organisations dealing with trees, woodlands and forests are varied and complex, ranging from national to local, commercial enterprises to charities, and the land owners themselves. The following paragraphs may help clarify some of the complexity.

Use of the term 'forest' in England

In Britain it is necessary to distinguish between 'forest' and 'woodland'. The Norman colonists introduced the concept of 'Forest' as a legal land ownership term in the 11th century when the invader King took possession of common, ownerless, land to establish Royal Forests or to distribute property to his lieutenants and supporters (the founding of the English 'landed gentry'). These Forests were mainly large commons, some having much woodland (like Epping Forest). Others had extensive areas of moorland (Dartmoor), or heathland (New Forest and Sherwood Forest). Usually, the legal Forest was considerably larger than the physical forest (the area with trees) (Rackham, 2006). This legacy leads to customary expectations that areas designated as forests will not have a continuous tree cover. For example, the New Forest, a National Park, has only 14% of its area under natural woodland, 30% is covered by pine or hardwood plantations and 56% under heathland and other uses (Tubbs, 1986).

Woodland in England

Only 10% of England is covered with woodland. 342,000 ha are conifer woodland of which 56% is in the private sector, 970,000 ha are broadleaved forest, of which 96% is in the private sector. Thus, most of England's forest is still in private hands, a long-term consequence of the distribution of land to supporters by the Norman conqueror over 1000 years ago. However, a proportion of the private land is in the hands of charities, such as the National Trust, much of whose property is in the National Parks (which in the UK are areas that also contain farms, villages and towns whose planning is regulated by the relevant National Park Authority).

Today, many National Parks in England are seeing an expansion of wooded areas, Forestry Commission England and National Parks England have stated: 'we recognise the wide range of benefits that well-planned, well-designed and well-located woodlands can provide, and we will coordinate our efforts to create more of these woodlands in National Parks'. 2,180 ha of new forest planting occurred in England in 2020-21, all but 10 ha in the private sector. 2,070 ha were broadleaved forest. Thus, the future of England's woodlands is in the hands of the multiple private sector organisations. Table 1 shows a small sample of them, particularly the water utility companies, many of which own large forest estates around their water supply areas.

The urban forest

Urban woodlands in the form of communal, city or town woodlands are a very European phenomenon, with a long history of woodland conservation and management (Konijnendijk, 2003).

Table 1. Statements of activity and responsibilities relating to forests and woodland in England from varied organisations

Organisation	Statement
Defra (Department for Environment, Food & Rural Affairs)	Defra has five strategic priorities: climate change and energy; sustainable consumption and production; protecting the countryside and natural resource protection; sustainable rural communities; and a sustainable farming and food sector including animal health and welfare.
Forestry Commission	A non-ministerial department, reporting to the Secretary-of-State for Defra, responsible for protecting, expanding and promoting the sustainable management of woodlands, while increasing their value to society and the environment.
Forestry England	Forestry England (an executive agency, sponsored by the Forestry Commission) manages 1,500 woodland and forest areas covering around **250,000 ha** spread from Northumberland to Cornwall, Shropshire to Norfolk, making them England's largest land manager.
Natural England	An executive non-departmental public body, sponsored by Defra, it is responsible for Sites of special scientific interest on or near woodland aims to **ensure that more protected sites are in favourable condition for their geodiversity and biodiversity and enhance support for nature recovery.**
City region authorities	Create initiatives such as Greater Manchester's City of Trees, declare a biodiversity emergency and sponsor planting schemes
Local Governments	Biodiversity plans and identification of areas of conservation interest, control of tree felling through planning system. UK Government to publish guidance for local authorities to develop their own local tree and woodland strategies.
United Utilities (the water supply company in NW England)	By 2030 the company has pledged to improve its land holdings by planting more than one million new trees (creating 550 ha of woodland) and restoring 1,000 hectares of internationally important peat bog. In 2021 it planted 10,000 trees around its treatment works in Kinder, Derbyshire.
Community Forests	Working to ensure that trees and woodlands are at the very heart of what it is to be an urban landscape today**.**
Groundwork	Passionate about creating an environment where every community is vibrant and green, e.g., planting 1,500 native trees on farms in peri-urban Greater Manchester in 2021, and 2.5km of hedgerow (13,000 plants) in 2022.
National Parks England	Forests and woodlands cover a significant land area, with one third of the public forest estate found within National Parks.
National Trust	As part of our work to conserve and protect the 25,000 ha of woodland in England, Wales and Northern Ireland under our care, we have joined campaigns such as Charter for Trees, alongside 48 other organisations, and have partnered with separate organisations to purchase important land,
Royal Horticultural Society	Has woodland areas at many of its gardens (e.g., Bridgewater in Greater Manchester); encourages woodland planting and supplies plants suitable for woodland gardens; carries out research on out in-depth studies of garden plants in order to maximise their benefits and improve the environment, human health and well-being.
Wildlife Trusts	The Wildlife Trusts care for hundreds of woodland nature reserves, managing them sympathetically for wildlife, and encourage others to do so, too.
Woodland Trust	We've planted 55 million trees since 1972 and are aiming to get 50 million more in the ground over the next five years.

'Forest' within 'urban forests' has been given a different meaning than the traditional forest concept encompasses. By including small woods, parks and gardens with area, size and or canopy cover below thresholds for 'forest', as well as individual trees, the traditional forest concept has been broadened considerably.

Great attention is now being paid to the 'urban forest', the combined effect of the trees in the streets, gardens, parks and woodland patches that produces what is now called the 'urban green infrastructure' – the network of natural environmental components and greenspaces and bluespaces that lie within and between cities and towns (Douglas and James, 2015). Many organisations now promote trees and woodlands in urban areas. The UK National Urban Forestry Unit (NUFU) was set up in 1995 as an independent organisation championing the need for integration of tree planting, conservation and management with different agendas, such as health, land reclamation, built development, heritage and education. Natural England has a strong emphasis on the role of the urban forest in bringing nature close to where people live. Thus, a multitude of urban tree planting and woodland generation schemes are now operating across the country, all emphasising community involvement (Table 1).

Most of the projects now involving community action are specifically created in response to funding opportunities, whether directly from government of from sources such as the Heritage Lottery or major charities. Projects are often drive by the enthusiasm, drive and initiative of key individuals who make the contacts and build the partnership to meet the needs of the particular programme. The Wildlife Trusts and Community forests have been particularly effective in so doing. The examples below show the size of some of the partnerships helping to extend the urban forest in north-west England,

Two examples of complex projects for nature-based solutions that include enhancing the urban forest in Greater Manchester

The IGNITION project is a ground-breaking initiative that aims to develop innovative financing solutions for investment in Greater Manchester's natural environment. This investment will help to build the city region's ability to adapt to the increasingly extreme impacts of climate change. Working with nature, solutions such as rain gardens, street trees, green roofs and walls and development of green spaces can help to tackle socio-environmental challenges including an increase in flooding events, water security, air quality, biodiversity and human health and wellbeing (https://www.greatermanchester-ca.gov.uk/what-we-do/environment/natural-environment/ignition/). The project partners are: Business in the Community; City of Trees; Environment Agency; Groundwork; Manchester City Council; Royal Horticultural Society; Salford City Council; UK Green Building Council; United Utilities; University of Manchester; and University of Salford. Major funding came from the European Union.

The Carbon Landscape project transforms an area affected by past coal mining between Manchester and Liverpool. Once full of industrial dereliction, mine water tips and water-filled hollows due the mine subsidence, the Carbon Landscape now boasts a huge variety of habitats, from lowland raised bogs, wet meadows, mire and fen to semi-natural broad-leaved woodland. Many individual activities have restored wetlands and woodlands and improved access for local people. Community involvement is at the heart of the project. The partners are: The Wildlife Trust for Lancashire, Manchester and North Merseyside; Wigan Borough Council; Salford City Council; Greater Manchester Ecology Unit; Warrington Borough Council; Manchester City of Trees; University of Manchester; Woolston Eyes Conservation Group; Woodland Trust; Environment Agency; Mersey Rivers Trust; and Natural England. Major funding came from the UK Heritage Lottery.

Figure 1. Urban woodland planted on the former Barlow Hall landfill site, Manchester, about 1990. (photo Ian Douglas)

The three articles that follow illustrate differing aspects of working with communities. Judy Ling Wong deals with connecting people of diverse backgrounds to nature, whether in the city or beyond. Not everyone sees urban nature of woodland in the same way; the opportunities green infrastructure offers to them vary and choice of how to use nature in and around the city should not be constrained.

Sue James works with professional bodies and local governments to improve the 'urban forest' by enhancing urban design through incorporating trees in an effective manner. Mitigating climate change and counteracting urban air pollution are benefits that can be enhanced by careful use of green infrastructure.

Paul Nolan and his colleagues have long experience of obtaining funding and building partnerships in north-west England. Their schemes involve close working with local governments and with communities, including restoration of woodland on former industrial sites. They provide excellent examples of recent projects linked to the Queen's Green Canopy.

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Unlocking environmental action

through attention to personal and cultural relationships

Judy Ling Wong CBE

The process of engaging people with nature, leading to their contribution to its care and protection can be encapsulated in two short phrases: we love what we enjoy, and we protect what we love. This process cannot be taken for granted. We now live in an urbanising world, where the starting point, contact with nature continues to diminish. We are also living in a world dominated by economic concerns, with a tendency to present the natural world as a machine. At times, I listen with dismay to the description of a tree only in terms of it being a machine for carbon sequestration. The relational qualities that are intrinsic to this most iconic feature of our beautiful natural environment are bleached out. What is left is a skeletal identity of a tree set within a utilitarian interpretation of nature as resource, so that sustainable development descends to being the art of how much we can get away with in damaging the earth while continuing to exploit it. It is time we purposefully took action to build heart-based connections that ensure we will have the future eco-warriors that we need for a sustainable green future.

Building commitment through the power of personal stories - The Tree Charter

Personal stories inform, nourish and reaffirm our understanding of the significance of our relationship to nature. In 2010, the UK government announced its intention to sell off the public forest estate[1]. Within days, it took a U-turn, confronted by the unexpected indignation of the general UK public. The Woodland Trust UK[2], an organisation solely devoted to the future of trees, remained anxious. It recognised the significance of people power in the protection of the future of trees. Over time, it sought to find a way of building and amplifying the relationship of people to trees. It homed in on the power of personal stories through the Tree Charter[3] campaign (Figure 1). The analysis was that we all already love trees, but it remains in the back of our minds. The exercise was to find a focus to bring it to the front of our minds. The organisation carefully designed a process to raise public consciousness of the value of trees around two elements. The first element was the power of personal stories. The second was the creation of a contemporary Tree Charter as a prominent historical marker, on the 800th anniversary of the 1217 Charter of the Forest. The campaign collected over 60,000 stories from people of all backgrounds. It used digital keyword identification programmes to root the content of the new charter in these personal stories of treasured and meaningful life experiences (Figure 2). The Charter for Trees Woods and People was crafted using people friendly language, with beautifully simple symbolic graphics. Over 100,000 people signed the Charter. A tree was planted for every signature.

Figure 1. The Tree Charter

Figure 2. Telling stories about trees.

The Woodland Trust also strategically put into place a supported network of over 600 Tree Charter Branches[4], where groups of local people come together to celebrate, tell stories, plant, campaign, care for and protect trees. They embedded the Charter's 10 principles and work to ensure that the relationship between people and trees would be recognised in decision making across homes, neighbourhoods, communities and government. Each Charter Branch was able to apply for a Legacy Tree, with 800 of these being planted around the UK, each with a commemorative plaque, as a living reminder of the 800 years between the original 1217 Charter of the Forest and the 2017 Tree Charter. There is a Tree Charter Art and Heritage Trail, and festivals are organised to continue to grow the relationship between people and trees to consolidate the protection and care of trees into the future by committed people.

Enabling contact with nature where people live and work

The first phrase above points to the provision of access to nature to kickstart the process. At a policy level, for new developments, it means the incorporation of green elements into the planning of the built environment. More challenging are the existing impoverished areas of bleak concrete jungles. Natural England's "People and Nature Survey[5]" indicates clear inequalities in opportunity for engagement with nature. Recent research linking mental and spiritual health to the natural environment has encouraged more action to strategically provide parks, gardens and other green and blue spaces near where people live and work. Defra (the UK Department of Environment, Food & Rural Affairs) responded to the rising wave of research in this area with a review of evidence by the European Centre for Environment and Human Health[6]. Reports pointing to the cost of mental health to society and business have prompted further incentives for action. The report "London Mental Health: The invisible costs of mental ill health[7]" gave a figure of around £26 billion each year to the wider total economic and social costs to London, beyond those for health and social care, naming aspects such as lost days of work, and impacts on family and community.

Linking urban people to nature at large through tree planting

In terms of access to nature, the tree stands out as an iconic symbol of nature. Some cities are fortunate enough to have a web of green spaces with huge mature trees, and substantial stands of trees making up woodlands or forests within their boundaries. Looking for places where single large trees can grow to their full size provide a very specific emotional encounter. The purposeful planting of single and small groups of trees in very built-up areas can provide a continuity of experience, when combined with programmes of activities designed to enable people to experience the drama of nature at large in the countryside. I will always remember the impact of such a trip for small group of young people living in Birmingham. They were typical of many people trapped within the barren environments of inner cities. They had never seen wide open spaces, mountains or waterfalls, or walked within woodlands or forests. The youth worker told us how, after coming home, they just went on and on about how they longed for more green where they lived. The youth organisation did various projects, including planting trees in small areas of land identified with the help of supportive local environmental organisations. This was the story that struck me. "Before I went into the countryside, the tree in the

pavement was just a tree in the pavement, but after we came back, every time I see a tree in the pavement, it brings me the feel and smell of the forest walk and the endless green of the countryside."

The Arts

Arts-related activities at natural sites always extend heart-based connections to nature. The provision of art activities related to natural elements such as trees in schools or other venues such as community centres can bridge the gap between visits to natural sites for groups living in areas with very little green. Writing fantasised stories about trees can be really fun. The telling of stories under the trees that relate to feels extra special (Figure 3). We can use parts of trees to create art.

Figure 3. Making a story and an image about a tree

Drawing and painting stimulate people to look at detail in a way that they may not have before and enable them to creatively express and share feelings with each other. Art products stimulate conversation, and of course there is something to take home.

Re-imagining spaces allied to the flexibility of local authorities

Policy to provide green spaces is crucial in our cities. The Green Infrastructure Framework[8] UK is a commitment in the Government's 25 Year Environment Plan. It says, "Early high-level analysis using Natural England's Beta Green Infrastructure Mapping tool shows that around a third of us don't live within 15 minutes' walk of a natural green space. It also tells us that in some of the most disadvantaged areas there is little or no access to green space within walking distance from home". Where there is little space to create substantial green spaces, the re-imagining of available space of any kind plays an important role. Not all people are vulnerable. People have agency. In one particular area of London, where the local authority has a flexible attitude, people in poor communities have transformed their neighbourhood through planting in tree pits, allowing front gardens to spill onto the pavement, and lifting up paving stones to plant bushes and other plants (Figure 4). No project money. They used huge garbage bins as cheap plant pots on the pavement. In residential areas, the only cars in the street belong to those that live in the street. The only pedestrians are family and friends. The space can be claimed to extend life into the outdoors. They even set benches and chairs outside to expand the use of the space. As one walks into this area, one is held by the lushness of the greenery. Creepers cover the walls of the old buildings. There is birdsong. One is distracted enough not to notice the parked cars. It is a green urban oasis created by ordinary people without funding. As long as there is enough space for a wheelchair or buggy to get through there is really no problem. It takes time, but let's make a start and envision that every residential area can be like this.

Figure 4. An urban green oasis in London created by the residents of the street.

Besides using pavements to transform streetscapes, there are also hard grey spaces everywhere if one looks carefully. One does not have to break up grey surfaces. Having pots on grey spaces is the same principle of having a green roof or a roof garden – nature lifted off the ground. The Eden Project, reminds us that one can grow selected trees in only 9 inches of soil, set on top of hard surfaces, as long as there is consistent watering. To put a big idea into your minds, beyond the attention to the canopy of urban forests, lets start paying attention to the rich potential of grey, green and blue spaces deliberately created as the urban forest floor. Partnership with strong trusted grassroots organisations that embed creativity and value ideas in their work, and that have inroads into local government, such as London National Park City[16], can unlock valuable community-based actions.

The Sacred Land Project

The cultural and spiritual framing of nature is another avenue that enables the care and protection of nature. The presence of multicultural communities and individuals in our cities opens us to the inspiration of multi-faceted ways of working with cultural and spiritual contexts. The value of the consistent declaration of aspects of nature as sacred is well recognised. There are well-known examples in our cultural histories. The stewardship of land by indigenous peoples[9] is rising up the agenda around the critical theme of climate change. The recent return of lands to native tribes[10] in California is encouraging. Woodlands and forests are strong features of these places. Sacred groves of trees have traditionally satisfied deep spiritual needs, protected fundamental resources for day-to-day life and served the conservation of nature. As an example, in Kerala, India, there are some 2000 sacred groves, common examples being the Peepal tree and the Banyan tree, but rare, endangered and endemic species are also protected. Often these sites also protected other important features of nature, such as water sources. It is good to see the introduction of the protected area category community reserves in India under the Wild Life (Protection) Amendment Act 2002[11] has introduced legislation for providing government protection to community held lands, which could include sacred groves.

The realisation of the power of declaring aspects of nature sacred led ARC (Alliance of Religions and Conservation) and WWF (Worldwide Fund for Nature) to set up the Sacred Land Project[12] to stimulate faith communities to look again at their traditional relationships to nature and people. The aim was to revive and increase the impulse to care for and protect nature. The Sacred Land Project was followed by the initiative Community Action for Sacred Lands[13], which went beyond the stimulation of faith communities to look at their traditional relationships to nature and people, and embarked on the imaginative exploration of the engagement of people to declare a natural feature or space as sacred on their own terms,

facilitating the impulse to continue to provide care and protection. It encouraged environmental groups to look at the role of faith, spirituality and contemporary personal meaning making within their own portfolios of work.

Creating contemporary cultural and societal associations

The act of planting trees can be a vehicle for cementing enduring meaningful cultural or social associations. This work aligns with building social cohesion and a sense of belonging. Decades ago, in Nottingham, a Sikh group asked us to find them somewhere to plant 300 trees to commemorate the 300th anniversary of the birth of Khalsa[14], their holy scriptures (Figure 5).

Figure 5. The Nottingham Khalsa Woods group

If you visit the small wood now, in the grounds of the Bestwood Country Park, you will see nothing but trees, with its small sign in 2 languages, saying Khalsa wood and a carved archway. The Sikhs, having worked with BEN (the Black Environment Network) over some years, had absorbed the principles of nature conservation. They also planted the wood as an action responding to climate change. They stated that they wanted to plant native trees and that it was to be a woodland for all to enjoy. The colour and ceremony of the planting is in the past, but whenever members of the Sikh community visit the woodland, there is the deep echo of spiritual meaning.

An example of using a tree as a societal marker is the planting of a single trees in Embankment Gardens[15], a much-loved small green space not far from the Houses of Parliament in London to remember those that were killed or injured at the 7/7 bomb attack on London in 2005.

In Scotland's Cashel Forest for a 1000 Years, refugees and asylum seekers have created their own personal and religious ceremonies as part of the process of dedicating trees they were planting to remember those they had lost or those they had to leave behind, marking the realities of contemporary unrest all over the world.

Towards a rich sustainable future

The role of personal and societal associations, faith, cultural and spiritual contexts, and secular interpretations of sacredness can be given a much greater place in our consideration of building relationships with nature to nourish our well-being and consolidate our commitment to actions for a sustainable future. Beyond the significance of science in our 21st century lives, there is still much power within our deeper selves to mine if we care to look at the diverse cultural dimensions of Black, white or other communities. The different moving parts allow

us to reach for creative ways of thinking, feeling and being that can be valuable to us now. I look forward to an expanding inspired portfolio of heart-based actions purposefully consolidating our relationship to nature.

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Why we must take our urban forests seriously

Sue James *AA Dipl RIBA FICFor (Hon) for the* ***Trees and Design Action Group***

In late 2006 an architect and a landscape architect were having a discussion about the future of trees in London[i] The issue of concern was the reliance on the London Plane tree and what would happen if they were struck down by the disease[ii] which was just starting to threaten the plane trees along the Midi canal in France?[iii] What should be the succession plan?

This concern was shared with a few others and it was decided to hold a round table to air the problem. This took place in January 2007 and over 25 people joined this discussion from a wide range of organisations including the Royal Parks, Transport for London, the City of London, the Forestry Commission, the Greater London Authority and several built environment professionals. At the end of the discussion, it was concluded that there were many issues involving urban trees that needed to be resolved and the conversation must continue…and so the Trees and Design Action Group was formed with terms of reference and a 10 Point Action Plan.[iv]

Where have we been?

This was not the first time that urban trees were on the agenda. *Trees in Towns: A survey of 66 towns and villages (research for amenity trees)* prepared by Land Use Consultants for the Department of the Environment was published in 1993. This was followed up just over ten years later by *Trees in Towns II: a new survey of urban trees in England and their condition and management*, edited by Chris Britt and Mark Johnston for the Department of Communities and Local Government (DCLG). This looked particularly at local authority resources and policies for the planning and management of trees with case studies of good and innovative practice and recommendations going forward.

There was also the National Urban Forestry Unit (NUFU), a charity established in 1996, which raised awareness of the positive contribution that trees make to quality of urban life supporting improvements in public health, leisure and recreation as well as education and heritage. Sadly, the NUFU was wound up in 2005.

We also had the Commission for Architecture and the Built Environment (CABE) along with CABE Space, the government's adviser on architecture, urban design and public space which offered a brilliant service of 'enabling' to advise and guide development and raised the profile of green infrastructure. CABE was disbanded in 2012 with elements of its working taken over by the Design Council.

On a more positive note, the Community Forests in England[v] have gone from strength to strength, working in and around towns and cities where most people live.[vi]

Another positive note is the development of the *Trees, People and the Built Environment (TPBE) Urban Tree Research* conferences. These were born out of another conversation with Dr Mark Johnston, then of Myerscough College. The first conference, hosted by the Institute of Chartered Foresters on behalf of the wide range of partners, was held in 2011 and has been repeated every three years since.[vii] These conferences enable the presentation of the latest urban tree research and also create a platform where research and practice can come together.

So, what did the Trees and Design Action Group decide to do?

There are two words in the group's name which are important to focus on, apart from 'trees' of course!

'Design' – with a sufficiently broad understanding amongst all decision makers – developers, designers and planners – about the value of trees and the many benefits that they deliver, more investment would be made in 'design' and master planning to ensure the retention of existing trees as well as the planting of new ones and this would translate right through the project to completion.

'Action' – there is a great deal of research about trees, from tree biology to social, economic and health benefits. What we need to do is to translate this knowledge into effective 'action' on the ground and this requirement has guided TDAG's subsequent work. We aim to provide the evidence and practical guidance to protect and enhance the urban forest.

In 2008, and updated in 2010, TDAG published *No Trees, No Future*, perhaps a dramatic title, but an attempt to highlight the seriousness with which we were tackling the issue. It offered a balanced assessment of the problems that trees could cause…and the solutions needed to avoid them.

However, it became clear that it was essential that decision makers – all those engaged with the planning, design and management of urban trees – should be as well informed as possible and so we embarked on *Trees in the Townscape: A Guide for Decision Makers* (2012). "This offers 12 action-oriented principles spanning the range of planning, design, works and management issues that must be addressed for maximum economic, social and environmental returns. Each principle is supported by explanations of benefits and delivery mechanisms, as well as references for further reading."

Figure 1, Principles for Urban trees (from Trees in the Townscape*)*

Trees in the Townscape was endorsed by several local authorities and other influential organisations.

But, there still remained a major problem when it came to long term success for urban trees and especially those in heavily urbanised areas. We had noticed that other countries were being more successful than most UK towns and cities in their attitude and success with trees, mostly notably, Lyon in France where the head arboriculturist was working closely with the highways department to move the city from a traffic-oriented environment to one that encouraged walking and cycling along with the integration of sustainable urban drainage, trees and additional green infrastructure.[viii]

Figure 2. Street trees in Lyon, France

TDAG's next step was therefore to provide a guidance document that would cover the critical issues in delivering trees successfully in hard landscapes and we published *Trees in Hard Landscapes: A Guide for Delivery* in 2014. This was an important step forward as the guide was supported by four relevant professional institutions: the Institution of Civil Engineers, the Chartered Institution of Highways and Transportation, the Chartered Institution of Building Services Engineers and the Institute of Chartered Foresters.

With all this information, why are there so many barriers to overcome? Why are highway engineers reluctant to adopt street trees? Why do developers often clear sites of existing trees before applying for planning permission? Why are trees not sufficiently valued for the many environmental, social and financial benefits that they actually provide? What would change this situation? We decided that the gap in our knowledge and guidance related to planning as effective planning should be the key to effective design and delivery.

We set to again and embarked on producing *Trees, Planning and Development: A Guide for Delivery* as the companion document to *Hard Landscapes* and under the umbrella of *Trees in the Townscapes*. This has been a lengthy and arduous task because planning does not stand still. We decided that the document should have three key sections:

- *Section One: Creating financial, environmental and social value into the future*

This section shows how developers, local users and wider communities all benefit from the presence of trees in new developments. It outlines key legislation, polices and standards for development management and delivery and it explains urban tree metrics that can be used to inform decision making.

- *Section Two: Project considerations*

This section will detail the mindset, skillsets, information and key steps needed at each stage of a building project to maximise the value that trees can add. It will provide clear guidance on how to set a project on the right track from the outset, to make the most of trees to gain planning consent and achieve good design. It will also address how to ensure implementation is successful and secure quality delivery – providing strong returns well into the future.

- *Section Three: The role of the local planning authority*

From plan-making to development management, this section will present the simple steps LPAs can take to ensure development projects fulfil their potential to make the most of trees. It will present policy examples, identify tree-friendly good practices for each step of the development management journey, and offer tips on how to create greater capacity to adopt such practices with limited budgets and staff resources.

There is also a fourth section on *How to develop a tree and woodland strategy that delivers* as TDAG would like to see every local authority have an adopted, comprehensive tree strategy as recommended in *Trees in Towns II* in 2004!

What is important here is that the document is endorsed by several professional institutions whose members can effect the changes needed: the Royal Institute of British Architects (RIBA), the Royal Town Planning Institute (RTPI), the Town & Country Planning Association (TCPA), the Landscape Institute (LI), the Institute of Chartered Foresters (ICF) and the Arboricultural Association.

Trees Planning and Development will be on line only reflecting the changing nature of planning.

Figure 3. The value of trees to promote health for people and place in towns and cities (from

Trees, Planning and Development: A Guide for Delivery*)*

The final element in the urban tree information mosaic is tree species selection. This is becoming an ever-challenging issue with the impacts of climate change and the increase in tree pests and diseases caused partly by the changing climate and partly by the limitations of the UK's approach to biosecurity. Working with Dr Andrew Hirons at University Centre Myerscough and Henrik Sjöman, Senior Researcher at the Swedish University of Agricultural Sciences and Scientific Curator at Gothenburg Botanical Garden with a NERC research grant we have produced an interactive guidance document: *Tree Species Selection for Green Infrastructure: A Guide for Specifiers*

Figure 4. The tree species guide for speicfiers

While these are our 'big four' guidance documents we have also worked with Dr Emma Ferranti and colleagues on a series of 'First Steps' guides on air quality, urban heat and valuing green infrastructure.[ix]

*Figure 5. The "*First Steps*" guides*

How seriously are we taking the urban forest today?

Events have demonstrated how vital the urban forest is in making our urban areas both resilient and liveable. In the 15 years since TDAG was first convened we have seen increasing impacts of climate change in terms of both increased heat and increased heavy rainfall events and flooding. We also have the Covid pandemic, still with us at the time of writing, which has shown how important access to nature is for urban dwellers for both physical and mental health and wellbeing. We also know that the UK is one of the most nature deprived countries in the world and that every effort must be made to restore nature including nature in towns and cities.

What is our progress report to date?

- Changes to planning policy in England such as Clause 131 in the revised NPPF require street trees in all new developments.

- The Environment Act requires a 10% biodiversity net gain in new developments and more can be achieved in our towns and cities than might be thought possible. Cities such as Barcelona are showing how this can be done.[x]

- Defra (the UK Department of Environment, Food & Rural Affairs) has published the England Trees Action Plan and this includes a section on urban trees as well as a recognition of the need for local tree and woodland strategies.

- Cities such as Birmingham are leading the way with its Urban Forest Masterplan, a partnership between Birmingham Tree People and the city council[xi]. Birmingham was also the UK's first Biophilic City (2011).

- Homes England has produced *Streets for a Healthy Life* as a companion document to *Building for a Healthy Life*, showing what 'good' can look like including the role of both tree retention and tree planting.[xii]

- i-Tree Eco, developed by US Forest Services, was brought to the public's attention in about 2009/10 with the startling headline "*Invest $1 in urban trees and get $5 returned in ecosystem services*." This was a game changer because, suddenly, we had the means to put a quantifiable value on the many ecosystem services that urban trees provide. Treeconomics and Forest Research have now undertaken several i-tree surveys across the UK to provide the evidence base for the development of tree strategies.[xiii]

- Further work is needed to try to quantify the health and wellbeing values that trees and green infrastructure can provide. A useful introduction is a scoping review on urban trees and human health by Dr Kathleen Wolf, University of Washington et al.[xiv]

- The community forests continue to grow and protect and promote trees around our towns and cities.

- It is recognised that 'tree equity' is an issue that must be addressed so that those areas which tend to be the most socially and economically deprived are also not those that are most deprived in terms of canopy cover and greenspace. If nothing else, 'Covid' has taught us this important lesson.

- Education and encouraging engagement with trees and nature is developing with the increase in forest schools, with work by groups such as Trees for Cities and the Tree Council encouraging tree planting and general interest in trees with schools across the UK.

What would we hope for?

We know that time is not on our side in responding to the twin emergencies of climate breakdown and biodiversity decline. We also know that most people live, and are likely to live, in towns and cities and so what happens in this environment is paramount.

As TDAG we would like to see citizens of all ages have an understanding of and enthusiasm for trees and the natural world so that they value trees and nature as a top priority and welcomed the changes that this would bring to our urban environments: creating more space for nature, for people to engage with nature, for walking and cycling and so taking back road space from cars and motorised transport and thus improving air quality; reducing the urban heat island effect; slowing down the run-off from heavy rain events to help reduce flooding; and providing a healthy and life promoting environment for all.

Pipe dream or real possibility? Our choice!

Endnotes

[1] Sue James and Jessica Beattie, then a director at Lovejoy London.

[1] *Ceratocystis platani* – an untreatable fungus.

[1] Jacques Noisette of the VNF noticed in spring 2006 that some of the plane trees were dying https://www.bbc.co.uk/news/magazine-15305048

[1] The Trees and Design Action Group (TDAG) remained a loose association until it was established as a charity in 2013. All details and the Action Plan can be found at https://www.tdag.org.uk/about-us.html

[1] While TDAG operates UK wide, this article tends to refer to 'England' because planning and the environment is a devolved responsibility with differences in Wales, Scotland and Northern Ireland.

[1] Community Forests https://englandscommunityforests.org.uk/

[1] TPBE conferences https://www.forestryjournal.co.uk/news/19019095.trees-people-built-environment-4/

[1] See the Lyon Tree Charter https://blogs.grandlyon.com/developpementdurable/files/downloads/2015/06/Charte-v-british-complete-2.pdf

[1] All TDAG guides are available without charge at https://www.tdag.org.uk/our-guides.html

[1] Barcelona Green Infrastructure and Biodiversity Plan 2020 https://ajuntament.barcelona.cat/ecologiaurbana/sites/default/files/Barcelona%20green%20infrastructure%20and%20biodiversity%20plan%202020.pdf

[1] Birmingham Urban Forest Masterplan http://birminghamtreepeople.org.uk/birminghams-urban-forest-master-plan/

[1] *Streets for a Healthy Life* Homes England 2021 https://www.tdag.org.uk/uploads/4/2/8/0/4280686/04791-sfhl_issue-01.pdf

[1] Treeconomics for information on i-Tree https://www.treeconomics.co.uk/

[1] Urban trees and human health: a scoping review https://www.tdag.org.uk/uploads/4/2/8/0/4280686/04791-sfhl_issue-01.pdf

The evolution of community forests in England and their role in delivering the Queen's Green Canopy

Paul Nolan, Michelle Whalley and Rhianna Weston

Mersey Forest Team

Introduction

Across towns and cities in England, the 1970s and 80s saw dramatic social, economic and landscape changes. De-industrialisation of many areas, as heavy industry closed, left large areas of derelict and neglected land and communities facing rapidly changing economic and social situations. At the same time, there were concerns about the falling quality of landscapes on the urban fringe, leading to actual or perceived changes to the greenbelt.

Two Dutch Elm Disease epidemics at this time (Potter et al., 2011) killed around 50 million trees in England, greatly altering the landscape, not merely in rural areas, but also in and around many of England's towns and cities. Prominent large trees, often of historic and cultural significance, disappeared from hedgerows and woodlands.

Originally set up in 1949 to guide the development of National parks, the Countryside Commission for England and Wales was redefined in 1968 with a three- fold remit covers conservation, public understanding of countryside issues and recreation. (With devolution in 1991, Wales took responsibility for its own countryside and the Commission 's activities subsequently have been confined to England). The Commission began to explore better use and management of countryside around towns and cities to counter threats to designated urban greenbelts and peri-urban farmland that reduce local landscape quality and biodiversity. (In 1999, the Commission merged with the Rural Development Commission to form the Countryside Agency and later joined English Nature to form Natural England).

The 1968 Countryside Act permitted experimentation in landscape access and conservation:

> 'The Commission, after consultation with such local authorities and other bodies as appear to the Commission to have an interest, may from time to time prepare and submit to the Minister for his approval proposals with respect to any area for an experimental project or scheme designed to facilitate the enjoyment of the countryside, or to conserve or enhance its natural beauty or amenity' *(Section 4, Countryside Act, 1968).*

The original Community Forests (Figure 1) can be seen as one of these experiments, initially testing how new tree cover in general, and community forestry in particular, could be effective and relatively low-cost mechanisms to improve environmental quality, tackle vacant and derelict land and actively engage local communities in landscape renewal.

The case for Community Forests can also be traced to Professor Laurence Roche's presentation to the British Association for the Advancement of Science in 1977 (Roche, 1977). urging national and local government to bring forests to the people.

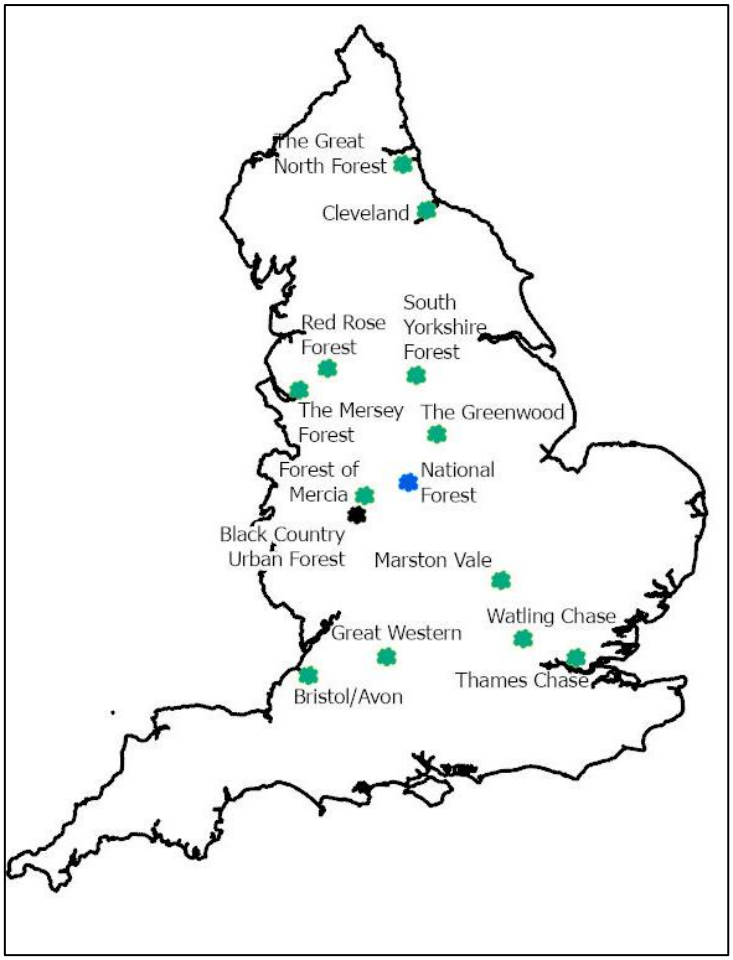

Figure 1. Map showing the location of the original Community Forests, plus National Forest and the Black Country Urban Forest - the latter two were also products of the Countryside Commission's forest policy

It was not until 1987 that these strands of thinking and experiment came together in the Countryside Commission's document CCP 224 (Countryside Commission, 1987) that set the scene for both the National Forest (Figure 1) (a new forested landscape in a former coalmining area of the English Midlands planned to bring the benefits of trees and woodlands near to where people lived and worked) and the Community Forests.

The Community Forests were to be created in and around 12 towns and cities in England (Figure 1). The Countryside Commission would work closely with local authority partnerships with the Commission providing 50% funding to develop government approved Forest Plans, engage of communities and provide recreation infrastructure. The Forestry Commission would provide grants for tree planting, normally with a dedicated Forestry Commission woodland advisor attached to the Community Forest team.

The 12 Community Forests' plans all aimed at landscape enhancement, community engagement, job opportunities, skills, education, training and also possible timber production. Even in the early 1990's forest development was linked to mitigating climate change. The multiple objectives also included improving visual amenity, creating wildlife habitat, providing for recreation and enabling tourism. These were, in fact, multifunctional forestry plans. A wider goal for the Community Forests was to:

'Create Community Forests that are cherished by local communities' (Lawrence et al., 2009).

Started in 1990 and 1991, all 12 Forest Plans were approved by 1994, with work already underway to deliver these ambitious programmes. Despite initial plans for 50% forest cover within Community Forest areas, the target was reduced to 30% of the plantable areas in the Community Forests, because of expected urban pressures on land for food production and development. In addition to recognising the multi-functionality of trees and woodlands, the Forest area provided an early test of environmental economics, a cost benefit analysis of some of them being published (Whiteman and Sinclair 1994).

Early Progress

With significant funding, strong local partnerships and the stimulus of novelty, the strong start to this new strand of forestry in England successfully tackled some of the derelict land resulting from the closure of heavy industries in and around the Community Forests. In the Mersey Forest area (Figure 1), the innovative programme of the Groundwork Trust St Helens, had already carried out significant work creating well wooded landscapes. The Mersey Forest extended the work in areas such as former chemical industry land, around Northwich in Cheshire. Today, both areas are identified as Forest Parks, with about 35% woodland cover.

Changing governance

Political reorganisations of Countryside Commission (Table 1) led to changes in funding policies over the decades, with, at times, the Forestry Commission playing a bigger role. Particular funding opportunities came through European initiatives funding for forestry and woodland creation in and around urban areas. funding through the Forestry Commission expected to support the Community Forests.

Date	Event
1968	Countryside Commission for England and Wales established
1989-91	Original community forests established
1999	Countryside Agency formed by merger of Countryside Commission and Rural Development Commission
1999	Forestry Commission's English Forestry Strategy includes urban forestry
2006	Natural England formed by merger of Countryside Agency, English Nature and the Rural Development Service

Table 1: Summary of key changes in Government Agencies influencing the Community Forests

The resulting uncertainty caused anxieties and strains on individual Community Forests. Much depended on local leadership and enthusiasm, support. However, the Countryside Agency local teams, continued to provide significant support to the Community Forests, seeing them as natural partnerships to help deliver a series of new area-based initiatives, including the new Countryside Around Towns Programme.

Community Forests in Policy

Many of the objectives of the Community Forests were contained in the 1999 Forest Strategy for England (Table 1). The inclusion of the Community Forest Plans in planning guidance in the mid-2000s, highlighted that Community Forest Plans were, and remain, a key part of urban environmental strategic planning.

The 2018 25-year Plan for the Environment, 'Our Greener Future' provides significant support for the Community Forests, setting out plans for the Northern Forest (Figure 2). This initiative brings the Community Forests in the north of England

together with the Woodland Trust to deliver 50 million new trees and also recognizes that the Community Forests play a key role in delivering health and education benefits for the more disadvantaged areas of the country.

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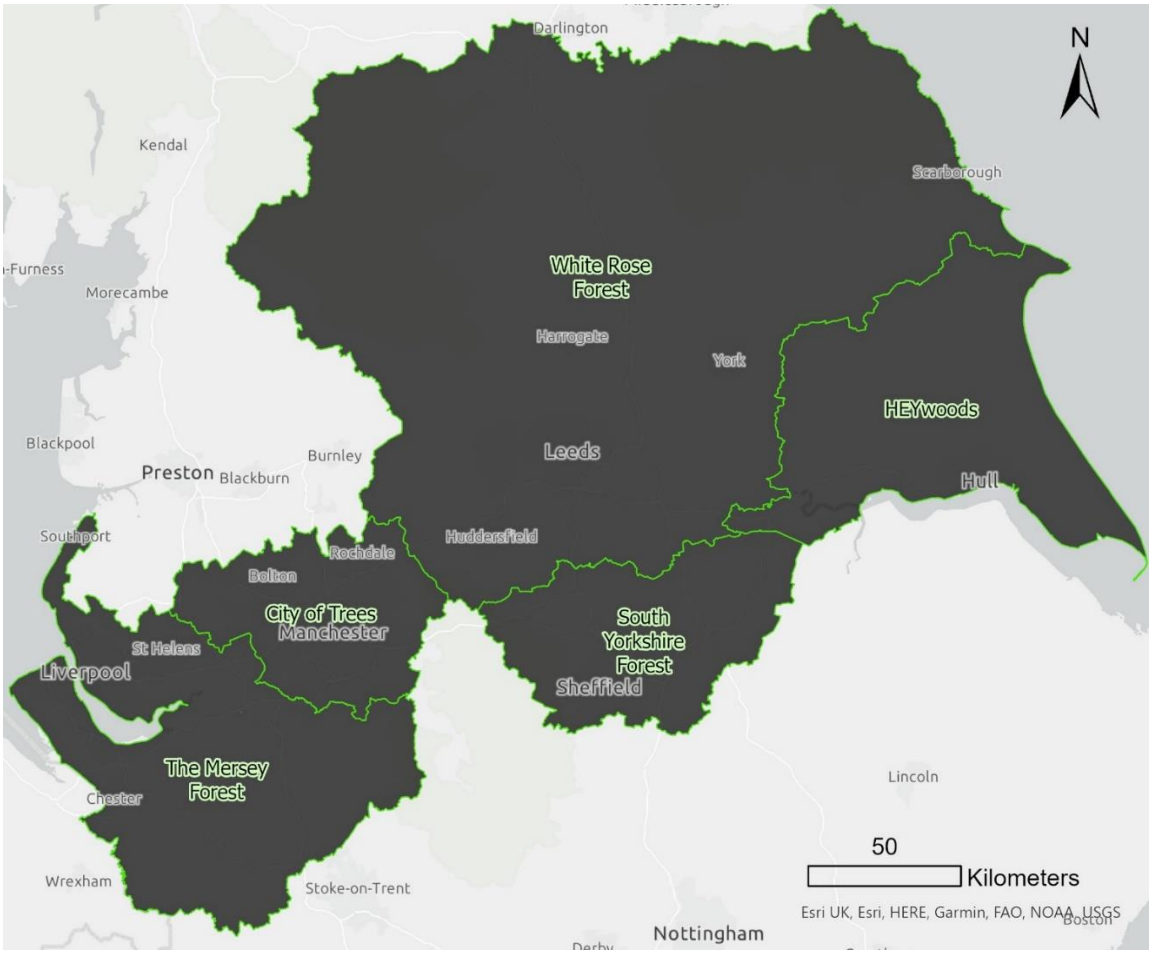

Figure 2. The Northern Forest: Bringing the Woodland Trust and four Community Forests together to create a countrywide forest programme (details of the individual forests are available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1041741/Woodland_Creation_Partnership_-_England_s_Community_Forests_Gov.uk_page.pdf)

The central government has required new developments to promote the conservation, management and enhancement of woodlands and other valued landscapes in the National Planning Policy Framework 2021. The goals of another measure, the Environmental Act 2021 include improvement of water and air quality, 10% biodiversity net gain, responsible improvements their area, including tree planting projects and contributing to making the Forest Plans for Community Forest areas. England's Tree Action Programme continues to support the Community Forests, setting out how they help deliver the government's woodland establishment plans for the Northern Forest and the £140 million Trees for Climate programme.

Local plans, in particular, encourage communities to get involved in ecological resource management, including for forestry felling and planting.

Evolving and adapting Community Forests

Following some of the largest plantings in the early 2000s, Community Forests intensified attention to the wider health, education and skills development benefits they were delivering, with contributions to place-making becoming as important as the establishment and management of woodland.

Marston Vale was perhaps the first Forest to engage with Department of Communities and Local Government on strategic housing growth, focusing on multi-functionality with the concept of green infrastructure linking the Forest to housing and the wider landscape (Figure 3). This work in Marston Vale was quickly picked up by other Community Forests. In the north west of England, Green Infrastructure planning and delivery funding became an essential way of working with the newly set up North West Development Agency. This was partly because its ability to link in with and speak to the strong focus on economic growth, partly because it could be seen as new, not an inherited national programme. This led to a series of Green Infrastructure plans and strategies and significant funding from consultancy advice to others and from European Union projects.

Marston Vale's experience and the adoption of the idea by other Community Forests

Financial crises, policy changes by both governments and national agencies, such as the Forestry Commission affected the stability of the Community Forests. Several Community Forests lost their core support from Local Authorities and moved wholly into charity-based structures. The Watling Chase and Cleveland Forests closed.

The National Urban Forestry Unit, a charity working in partnership with central and local government, the corporate sector and other environmental charities to help create a more tree-rich environment, developed the Community Forest Initiatives (CFis). Two new CFis involving collaborations between councils and local, regional and national organisations, were the White Rose Forest and Heywoods in Yorkshire (Figure 4). These forests add to the areas already within Community Forests.

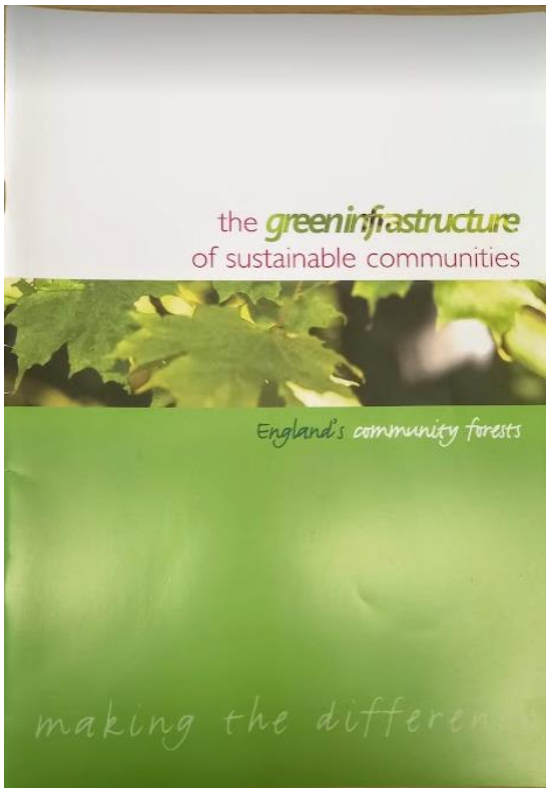

Figure 3. Community Forests and Green Infrastructure - based mainly on the Marston Vale experience (after https://www.theccc.org.uk/publication/sixth-carbon-budget/)

Figure 4. Cover of the Northern Way Prospectus – Early joint work between the Community Forests and community forestry initiatives.

A re-evaluation of the outcomes of Community Forest programmes

A health check carried out in 2015 showed that there was a significant chance that by 2020 there might have been only three Community Forests operating. A follow up report carried out by Regeneris in 2018, funded by the Community Forests and Defra (the Department of Environment, Food & Rural Affairs), once again made the case for national support for a programme that had policy support, effective local partnerships that enabled delivery, with a short chain from policy to delivery enabling rapid response to opportunities. A second report, by Nicol Economics, assessed the economic impacts up to 2018 and what the likely economic and social benefits of the Community Forests were likely to be (Figure 5). Their effects on carbon storage and biodiversity warranted the place of Community Forests in planning policies.

The Regeneris report set out the scale of the outputs achieved up to 2018:

- 11,300 hectares of new trees planted
- 14,800 hectares of woodland brought into management
- 25,250 hectares of non-woodland area created or managed
- 51,000 hectares of area planted or brought into management (accounting for 0.4% of England's total land area)
- 5,436 km of access routes created
- 2,950 km of hedgerows created
- 138,200 community events held
- £235 million of resources levered

A new policy framework - the path to net zero

The Community Forest health check gained significant attention and interest at a time when a new approach to the natural environment was gaining momentum. The Government's 25 Year Plan for the Environment, provided an opportunity for Community Forests to put forward the case for support, at least in policy terms.

The re-evaluation of the benefits stemming from Community Forests assured that they had a place in the 2018 25-year plan. The Northern Forest was cited as a flagship project in the 25 Year Plan. Funding and interest in the Community Forests increased, with the Trees for Learning Programme, the first Community Forest targeted for about 15 years. This not only led to 164,000 trees being planted with the involvement of primary schools, but also allowed Forests to plan ahead more effectively and galvanized national working.

At the start of the Trees for Learning project a Social Return on Investment (SROI) model was produced for the Community Forests by Arup, with advice from Natural England and Forestry Commission economists.
The work showed that by engaging children in nature an estimated benefit of over £10m might be achieved, a 9:1 return on the Defra investment. Along with the earlier economic appraisals, this SROI model shows that shows how another of the building blocks to justify the case for the Community Forests have, like a golden thread, found themselves woven into the work of the Community Forests over decades

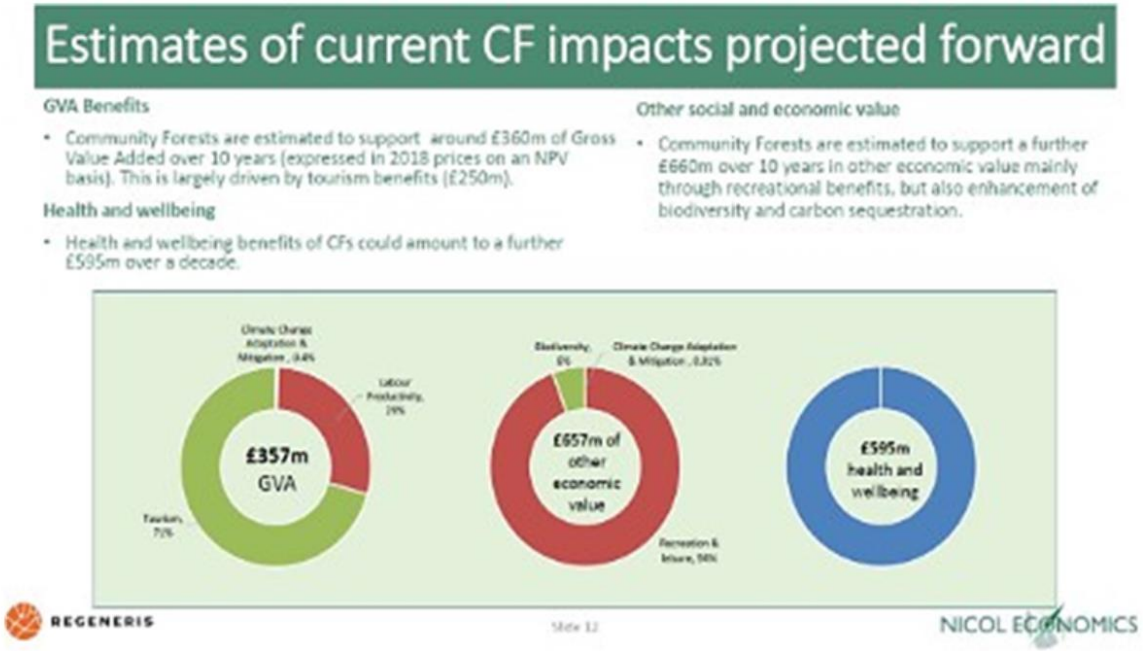

Figure 5. Summary of potential future economic benefits from Community Forests (after: http://uknea.unep-wcmc.org/Home/tabid/38/Default.apsx

Trees for Climate

The Committee on Climate Change report on how government could reach net zero by 2050, indicated that woodland establishment had to be a key strand of activity. As a net negative intervention, it complimented other work to reduce reliance on fossil fuels and had the added benefit of providing adaptation benefits too. A 2017 speculative proposal for a £100m programme of support for Community Forests

to follow on from Trees for Learning was picked up and developed into a now £140m programme of activity to create 7000 ha of new woodland by 2025. (mindful that the Regeneris document of 2018 (see above) had put planting to date at 12,000 ha, a an ambitious five-year programme to deliver the equivalent of nearly 60% of what had been achieved in the previous 25 years.

Despite financial resource constraints, the Forests identified that, potentially, 10,000 ha of land might be available for planting. This indicated to all parties involved, including Defra, that, in principle, and assuming support to tackle the known issues and risks in all woodland creation programmes, the 7000 ha target could be attainable.

For the first time in 30 years, new Community Forests were to be created as part of the Trees for Climate programme, giving further momentum toward the 7000 ha target, and England's Community Forests have been joined by

- Plymouth and South Devon Community Forest
- North East Community Forest
- Cumbria Coastal Community Forest (Figure 6)

In one and a half planting seasons of the programme, the Forests have created 1050 ha of new woodland, accelerated woodland establishment, developed teams and partnerships and worked with communities

For 30 years, the Community Forests have enabled millions of people to watch trees in their school grounds grow tall; see street trees become havens for wildlife, and go for walks in local woodlands only minutes from their front doors.

Tree planting with communities and for communities, raises people's connections with nature. This promotion and delivery of "Nature Equality" enables the Forests to engage with urban communities to lead and advance national initiatives such as the Queen's Commonwealth Canopy and the UK Queen's Green Canopy programmes.

Community Forest Teams and their partners have worked with the UK Queen's Green Canopy Team, local partners and communities to plant trees and woodland as part of the Platinum Jubilee celebrations. The Trees for Climate programme, plus Northern Forest funding, together with complementary funding from other sources has made further significant planting for the Queens Green Canopy in today's 13 Community Forests (Figure 6) possible.

England's Community Forests working together

The Community Forests have always come together to share ideas, develop projects and attempt to influence policy. In the early years of the Forests these were coordinated by Countryside Commission's Community Forest Unit, with formal quarterly meetings and frequent input from ministers.

As the forests moved to the regions, first Forestry Commission took on the role of coordinating the national meetings which subsequently was passed to the Community Forests to coordinate themselves. Meetings moved to teleconferences and in recent years and through COVID to virtual on-line meetings. After years of teleconferencing, virtual meetings seemed like a step forward and the Partnership worked flourished on line.

Queen's Commonwealth and Green Canopy Initiatives

The Community Forest Teams and their partners have been working with the national Queens Green Canopy Team, local partners and communities to plant trees and woodland as part of the Platinum Jubilee celebrations. The Trees for Climate programme, plus Northern Forest funding, alongside

complementary funding from a range of sources has provided an opportunity for significant planting for the Queens Green Canopy in the now 13 Community Forests (Figure 6)

Figure 6. *England's Community Forests in 2022 (from: England's Community Forests Map — England's Community Forests (englandscommunityforests.org.uk)*

The Queen's Commonwealth Canopy and the UK Queen's Green Canopy Initiatives

In the 2021/22 tree planting season, over 135,000 trees were planted across Community Forest areas, a total of 106 ha, as part of the Queen's Green Canopy. More projects are planned for autumn 2022. Here are some examples of projects by one of the Forests, the Mersey Forest, that have contributed to the Queens Green Canopy.

Supporting Chester to become Champion City

The Mersey Forest team, worked with Cheshire West and Chester Council to successfully apply for Chester to become a Queen's Green Canopy Champion City. This prestigious award was received at a special public planting event (Figure 7) held in January 2022 where a ceremonial plaque was handed to the Sheriff of Chester by Lord Lieutenant Lady Redmond, MBE. 40 members of the public attended alongside council leaders to help plant over 300 hundred trees including two ceremonial Oak Trees.

Figure 7. Celebrating Chester as Champion City

Dee Point primary school was selected to receive a special celebratory tree from the Queen's Green Canopy Foundation.

Mersey Forest worked with Dee Point Primary School in Blacon to apply for one of the Queen's Green Canopy Platinum Jubilee celebration trees that were given to selected primary schools in cities across the UK to highlight the educational aspects of trees and the significance of giving young people access to nature. The Lord-Lieutenant, joined head teacher Dave Williams on Tuesday for the planting ceremony along with many other local dignitaries and Mersey Forest representatives. The school choir and musical theatre group 'Rewind' launched the event before the planting ceremony by the children.

Figure 8. Dee Point School celebrates the Queen's Green Canopy Planting

Grosvenor roundabout planting.

Grosvenor Roundabout- a prominent entry point for Chester, was selected as a perfect location for the planting of a dedicated ceremonial tree marking the Queen's Green Canopy Champion City Status. Mersey Forest worked with the local authority and VINCI Construction UK to carry out the planting. The Jubilee Tree species is an *Amelanchier Arborea Robin Hill* (known as downy serviceberry, a deciduous tree in the Rosaceae (rose) family, native to eastern North America) which will provide spring flowers and rich autumnal colour.

Liverpool John Moores University Queen's Green Canopy.

The Mersey Forest team have worked alongside Liverpool John Moores University to plant over a hundred native Broadleaf trees in the new outdoor learning zone within the grounds of the John Lennon Building (Figure 9). This inner-city planting will provide a wonderful canopy which will be used as a green corridor for wildlife whilst providing trainee teachers and local school children, the opportunity to teach and learn in Nature. The site will be officially opened by the High Sheriff of Liverpool in June 2022.

3000 Free Trees handed out at Liverpool One

Over two weekends in December, the Mersey Forest team worked alongside staff from Liverpool ONE (the largest shopping, residential, and leisure complex in the city) to hand out over 3000 free trees to shoppers as part of encouraging local people to plant a tree in their garden as part of the Queen's Green Canopy Initiative. Those taking trees home were given tips and advice on how to care for them and help them to flourish, and encourage them to register their trees on the Queen's Green Canopy website.

Alongside the more formal planting, Mersey Forest has supported local Community Groups in planting thousands of trees as part of the Queen's Green Canopy. Examples include the planting at Hoole tennis Club where volunteers came together to plant over 300 native broad leaf trees (Figure 10)

Figure 9. Tree planting at Liverpool John Moores University

Figure 10. Hoole Tennis Club contribute to Queens Green Canopy

Next Steps

Community Forests in England have come a long way over the past 32 years. Emerging from several strands of policy they have collectively managed to navigate a way through changing political, economic and social cycles, finding new ways of working and evolving their work. The Forest Plans have been a constant guide for most of the Forests throughout this time, providing the strategic direction for local organisations, teams and Partnerships.

The Queen's Green Canopy provides an opportunity for the Community Forests to again support a national initiative, using resources made available through Northern Forest and Trees for Climate to create new woodlands in and around towns and cities in England

The Mersey Forest is now developing further Queen's Green Canopy schemes for the next planting season that begins in November 2022.

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