Sustainable Forest Management

Teaching Tool

# Overview

This teaching tool educates through an interactive session, about forest management principles and challenges related to using forests as carbon sinks.

Users shall take on the role of a private forest owner who can make management decisions that influence the resources they can supply from the forest and the amount of carbon it is able to sequester.

The goal of the game is to encourage realization of the following.

1. Retaining old growth forests is the best way to sequester carbon. The best management policy is no management for the most part with limited human interference except in the form of disaster mitigation in case of severe calamities.
2. Funding ecosystem restoration whilst ensuring minimum carbon footprint is challenging. The best way to do this, though seemingly counterintuitive, would be to use a small portion of the forest for exclusive timber production and income so generated to fund restoration and management activities.
3. Despite best efforts, the only way to sustainably increase carbon sequestration is to minimize resource consumption in addition to forest conservation and restoration efforts.

# Gameplay

This section documents how a user progresses through the game and what decisions they may make.

Initially, the user is presented with a mixed forests scenario where 1 big plot of land is divided into 4 quarters (2 understocked subplots, 1 plantation and 1 ecosystem). This tries to capture how the world today is a mix of intact and non-intact forests with a small percent of the forest being a thriving ecosystem.

The world has a set starting atmospheric carbon level, trees on the plot, and monetary capital. Carbon levels (atmospheric and sequestered) shall be kept track of, along with biodiversity and tree count and properties throughout the game.

Following are a list of key props that comprise this world .

* **Tree:** Trees maybe coniferous or deciduous. These are the 2 kinds of trees that users work with in this world. Both share many parameters but also have unique features as shall be discussed in following sections.
* **Demand:** Demand refers to demand for resources measured in m3.
* **Barcon:** Barcon is the currency of this world.
* **Policy:** Users may draft policies that can be set up to repeat after a set interval of time (called a rotation). These policies are how users define their management strategies that they can then see playing out across time.
* **Timeline and related controls:** The timeframe within which users explore their various options is set to be 1000 years. The interface shall feature a timeline that can be scrubbed to explore specific points in time and play/pause buttons enable users to view consequences of their decisions unfold before them in a video like fashion.
* **Land:** As previously mentions, the land is divided into subplots and then further into positions on a grid. Each grid spot can support a single tree. Users may select 1 or more grid spots and chose to perform an action at that position.

The game progresses in **3 levels**.

**Level 1:** The objective for this level is to make as much profit as possible at the end of 1000 years without getting broke in between. Learning outcomes include discovering that such an approach with no regard for carbon footprint can result in catastrophic carbon levels in the atmosphere. Also, this level serves as a way for users to get comfortable with the interface and play the bad guy and realize how easy this is.

**Level 2:** The objective for this level is to draft a policy that, at the end of 1000 years, reduces as much carbon from the atmosphere as possible without getting broke. This is tricky. The learning objective for this task is to realise how this may not be as straight forward as it initially seems (just planting as many trees as possible will not work as this is not economically practical) and stumbling upon various existing forest management strategies like reforestation, afforestation, proforestation, young forest initiative and others like intermitted plantations to fund ecosystem restoration (a most practical and likely the optimal strategy).

**Level 3:** So far, the user has never been able to control demand. Now, they can increase or more logically, decrease demand for resources in addition to creating policies to improve sustainable carbon capture. The learning outcome here is for users to realize that even with the best forest management strategy to combat climate change, significant change is only possible when we reduce our resource consumption to meet nature in the middle and ensure the survival of our species and the planet as we know it.

# Game Mechanics

This section of the document describes the various components that comprise the game and rules that govern their parameter values and states.

## Start State

Variables associated with the land may me as follows.

* Slope.
* Soil properties.
* Climate.
* Health.
* Biodiversity

## Living Assets

Living assets refer to the flora and fauna in the forest.

The simulated trees may contain the following species.

* Trees[Sitka Spruce (60%), Lodgepole Pine (20%), Birch (10%), Ash (10%)] (Department of Agriculture, Food and the Marine, 2022).
* Other plants [**Bilberry** (edible), Bramble (edible), **Heather** (flowering), Rhododendron Ponticum (weed)].
* Mammals [grey squirrel, red fox] (askaboutireland, n.d.).
* Birds [treecreeper, crossbill] (Planforbio, n.d.).
* Insects [Honeybee (pollinator), large pine weevil (pest)] (Forestry Focus, n.d.) (www.pollinators.ie, 2018).
* Amphibians [Common Frog] (J.L., et al., 2011).
* Reptiles [Common Lizard] (J.L., et al., 2011).
* Fish [Atlantic salmon] (J.L., et al., 2011).
* Fungi [Shiitake Mushrooms, Root Rot Fungus] (Somers, n.d.) (Forestry Focus, n.d.).

## Non-living Assets

Non-living assets include man-made infrastructure (accommodation, road) and natural formations (waterbody, deadwood).

## Demand

Following are resources for which there are demands within the simulated world.

* Wood (W%) from trees.
* Honey (H%) from honeybee hive.
* Berries (B%) from berry shrubs.
* Flowers (F%) from flowering shrubs.
* Mushrooms (M%).
* Conservation grands (CV%).
* Carbon offsets (CO%).
* Tourism (T%)

## Health

Following is a simplified tree health classification system.

1. **Excellent Health:**

*Characteristics:* The tree exhibits vigorous growth, has a full and well-formed canopy, and shows no signs of stress, disease, or damage.

*Indicators:* Lush green foliage, balanced crown structure, and strong growth patterns.

1. **Good Health:**

*Characteristics:* The tree is healthy overall but may show minor signs of stress or slight damage.

*Indicators:* Some discoloration or minor leaf damage, but the majority of the canopy is healthy and intact.

1. **Fair Health:**

*Characteristics:* The tree shows noticeable signs of stress, disease, or damage, impacting its overall vitality.

*Indicators:* Reduced growth, yellowing or browning leaves, dieback in specific branches, or visible signs of pests.

1. **Poor Health:**

*Characteristics:* The tree is in a weakened state with significant stress, disease, or damage.

*Indicators:* Severe dieback, extensive leaf loss, discoloured foliage, and visible signs of pests or diseases.

1. **Critical Health:**

*Characteristics:* The tree is in a critical condition, with severe stress or disease that threatens its survival.

*Indicators:* Extensive dieback, nearly bare branches, and clear signs of severe pest infestation or disease.

1. **Dead:**

*Characteristics:* The tree is no longer alive and has no foliage or signs of life.

*Indicators:* Bare branches, no leaves, and visible decay or deterioration.

# Step 1: Set Management Objectives

Following are available objectives that users can choose from to optimise their policies for.

1. Carbon sequestration.

* {Tíscar, 2016 #13}involved = trees.

1. Profit.

* Entities involved = Trees, berry shrubs, flowering shrubs, edible mushrooms, honeybee hive, hunted animals.

1. Conservation.
2. Forest health.
3. Disaster management (fire, flood, frost).
4. None.