# ECOSYSTEM SERVICES GAME

## Game Design Document

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playerthree

# Contents

# Introduction

This is a serious game about ecosystem services. The intention is to raise awareness and teach players about integrated landscape management and ecosystem services in a fun and interactive way. By making choices, observing outcomes and adjusting strategy, players will learn how to maximize benefits from specific ecosystem services using different management tactics.

The game is intended to be part of an educational pack that includes learning modules, case studies or other useful teaching resources.

## Target audience

- The game is expected to receive an ESRB rating of Everyone.
- Secondary and Tertiary-education students (13+) interested in agriculture and environmental issues, in developed and developing countries.
- Teachers who could use the game as part of their lesson plan on ecosystem services and integrated landscape management.
- Those who own or have access to a computer, smartphone (for app version) and enough internet connectivity to download and receive occasional updates.
- The game should be engaging enough to be intrinsically fun for casual players.
- The game will be in English, but this should not limit non-English speaking players.
- The game will not include any graphic violence.

## Learning Goals (in order of priority)

- Players will understand that ecosystems provide services that people benefit from.
- Players will learn that management options impact the delivery of those services.
- Players will recognize that different ecosystem services are produced and consumed at different spatial scales.
- Players will understand that land management choices are often plagued with trade-offs, but also synergies, e.g. pesticide use can reduce crop loss but also reduces water quality.

## Limitations of the game

A game can only do so much. For a serious game to be able to teach something while retaining its entertainment factor, the player needs to have clear goals and instructions. While it is tempting to include all the complexities of ecosystem services and integrated landscape management, this would simply overwhelm the player.

To overcome this dilemma, the proposal is for the game to be an introduction to the topic, a snapshot to get some basics across. The game should supported by other resources that can provide the more complex aspects of the topic, hence the idea of an educational pack that can be used by teachers and students, or others interested in learning more (see ‘Beyond the Game).

## Game Platform

The game will most likely be developed in HTML5. It will be available for download to play offline, or played online on a web browser. A simplified app version for mobile (Android and iOS) could also be developed as part of the development package. Social media will be limited to promotional and feedback purposes, not a facebook app.

## Further Development Time

6 months to 1 year depending on funds acquired

## Publishing Plan

The game and accompanying educational pack is expected to be launched and hosted on the CGIAR Research Program on Water, Land and Ecosystems website, or a sister site. Several other channels have been identified as potential outlets and promoters of the game including:

- WorldReader
- Cornell University's Conservation Bridge
- FAO's Youth and United Nations Global Alliance (YUNGA) (>40 million subscribers)
- Landscapes for People, Food and Nature Initiative (Ecoagriculture Partners)
- Ecosystem Services Partnership (>50 organizations and >400 members)
- Edmodo learning portal (>25 million users)
- Gooru learning search engine
- Games for Change
- Project Noah
- CK-12 Foundation
- EverFi
- Connect4Climate
- National Science Teachers' Association (US - Ilse Pukinskis contact)
- landscapes.org
- CPWF Mekong (esp. those involved in Basin Challenge Game)
- other CGIAR Resarch Programs and centers (e.g. Mirelle from IWMI Business Dev. Unit)
- youth networks in developing countries

as well as **current partners**:

- Bioversity International
- University of Idaho - McCall Outdoor Science School (MOSS)
- Ecological Society of America

Presentation opportunities:

- Resilience 2014, Montpellier
- Ecosystem Services Partnership 2014, Costa Rica

Social media outlets will also be developed for the game: Facebook, Twitter, game scoreboard/ show-off panel, etc.

## Funding

A teaser website has been created to help approach funders who might be interested in providing resources for the game. A customizable presentation with more information can easily be created for a more informative pitch.

**Estimated costs:**

So far the concept development has included the assistance from a web/HTML 5 consultant and services from UK creative production studio Playerthree, as well as student contribution from University of Idaho. This document and supporting documentation is sufficient for proceeding to game development and ironing out details of game play.

| Item | Costs |
|---|---|
| Concept development<br>(Game play, concept, website, research) | 5600 USD used (19% overheads from 7000 USD) |
| Complete game development | 100-250,000 USD (variability based on features) |
| Prototype development (one playable level) | 25-30% of total game costs (>50,000 USD) |

**Potential funders** that Bioversity can approach include:

- Omidyar Network
- i.am.angel.foundation
- Zynga
- Amplify Partners
- Rockefeller Foundation
- National Science Foundation
- Tinker Foundation Incorporated
- The Ludus project (small grants)
- Kickstarter and other crowdfunding channels?

## Measuring Success

The game would be considered successful when:

- The number of players/visitors exceeds 500,000
- It is used in multiple contexts, including the adoption by teachers or other educational outlets
- Players come back to play again and again
- It is played by those beyond our primary target audience
- It is promoted without request by partners, scientific community and target audience
- Social media and other channels provide good feedback
- Constructive feedback is provided by those that using the game for educational purposes or scientific community

## Beyond the Game

For the game to be truly a worthwhile investment, the idea is to aim for deeper rather than wider impact. The game could be used as an introduction or teaser application that draws players in to further resources. The game could:

- Lead to a webpage or theme-based pages packed with additional resources such as factsheets, case studies, learning modules for teachers, and good quality scientific publications
- Drive traffic to the CGIAR Research Program on Water, Land and Ecosystems website, and inform players about research on this topic
- Link to other relevant resources and websites available
- Create or enhance an online community on ecosystem services and landscape management

# Game Concept & Science

The Ecosystem Services Game is a single-player land use managament simulation game. The game is divided into 6 levels (a.k.a mini games), with each level focusing on specific ecosystem services, such as pollination or water quality. Thus, the player learns something different as they conquer the goals set at each level.

The player begins as a farmer and is given a plot of land to manage. With every new level, the player is given more land to manage until they are challenged to manage at the watershed scale. As their perspective changes with increasing land area, the challenges set for the player also changes: from managing crops on their own farm, to organizing irrigation in their community, to setting up protected areas and environmental policies. Throughout the game, the player is challenged to find synergies between agricultural production and the provision of the ecosystem services that allow that production to thrive.

The key message of the game is that everything we use comes from the environment. How we manage our resources and services will ultimately define our health, happiness and wealth.

## Synthesis of levels

### Level One

The player manages the crops to plant on their farm in order to improve pollination, natural pest control and yield

### Level Two

The player manages crop rotation in a farming co-op and other techniques to maintain soil health and encourage nutrient cycling

### Level Three

The player is challenged to set up an irrigation system and other water saving techniques to ensure water availability for the whole community

### Level Four

The player manages vegetation in and around farms, as well as some wild areas to provide an array of ecosystem services

### Level Five

The player makes policy decisions and other large-scale management plans to ensure water quality is maintained after the construction of a hydropower dam

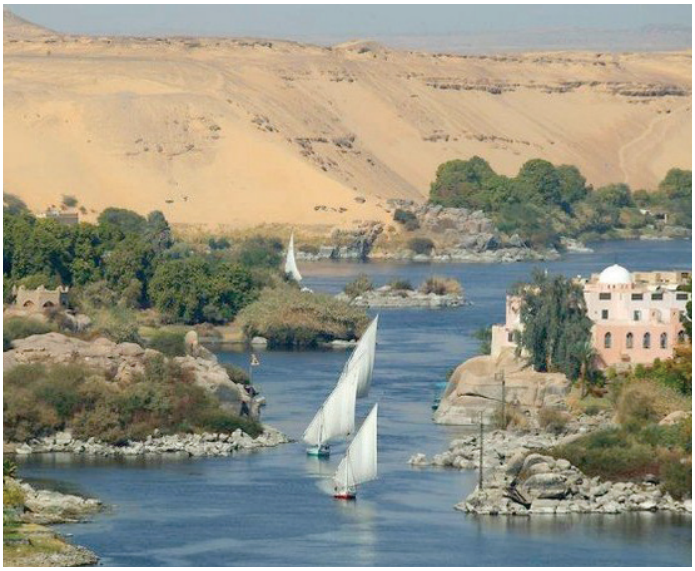
### Level Six

The player is given an overview and re-cap of their actions throughout the game

## Location

Primary areas of interest to the CGIAR Research Program include the Indo-Ganges, Mekong, Nile and Volta basins. Though not a specific location, the first edition of the game will be set in an equatorial, two-seasonal location with a wet season and a dry season. The climate however, will not be too extreme (extreme wet or extreme dry), so that the player can focus on the ecosystem service challenges at each level.






Real-life landscapes to inspire game – the Indo-Ganges, Mekong, Nile and Volta Basins

# Ecosystem Services in focus

Ecosystem services are the functions and benefits provided by biological systems to people. A wide-range of ecosystem services exist, some yet to be discovered and understood properly. The game focuses on a selection that are particularly relevant to agriculture and rural landscapes. They were also chosen because they had the most potential for game play and many techniques used to manage these services are synergistic.

### Carbon sequestration

The absorption of carbon dioxide from the atmosphere, well-known in relation to carbon emissions and carbon credit schemes. Ecosystems most valued for carbon sequestration include, forests, peatlands, soil and oceans.

### Erosion Control

The retention of soil is key to both retaining nutrients and fertility, as well as protecting communities from natural disasters (landslides). Controlling erosion is also directly related to water quality.

### Nutrient Cycling

Approximately 20 nutrients are essential for life. Different ecosystems and soils contain and recyle nutrients differently. Many agroecological methods exist to improve soil fertility and nutrient content.

### Pest and Disease Control

Pests and diseases are a natural part of any ecosystem, but outbreaks can be detrimental for farmers. Changes in land use, vegetation, water and crop diversity can have a great impact on the the prevalence of pests and diseases.

### Pollination

Over 100,000 species such as bees, bats, flies and birds provide pollination services to improve the fertility and yield of trees and crops.

### Provisioning services

The natural resources provided by ecosystems such as food, fibre, fuel, biodiversity and water.

### Water quality and availability

Ecosystems can help filter impurities in water, and are healthy vegetation and tree cover are key to good water quality and groundwater storage. Vegetation along rivers for example are a good buffer for runoff.

| Ecosystem Service | Game level |
|---|---|
| Pollination | 1, 2, 4 |
| Pest and Disease Control | 1, 2, 4 |
| Nutrient Cycling | 2 |
| Erosion control | 2, 4, 5 |
| Water quality and quantity | 3, 4, 5 |
| Carbon sequestration | 5 |

# Space and Time

Much of the game concept is based on the theory developed by Fremier et al (2013) in their paper on ‘Understanding Spatiotemporal Lags in Ecosystem Services to Improve Incentives’. The delivery and use of ecosystem services vary across space and time. Some services, such as pollination,

have a more local and short time span between their provision and their consumption, others have time spans that can last centuries, such as the conversion of biomass to oil and coal.

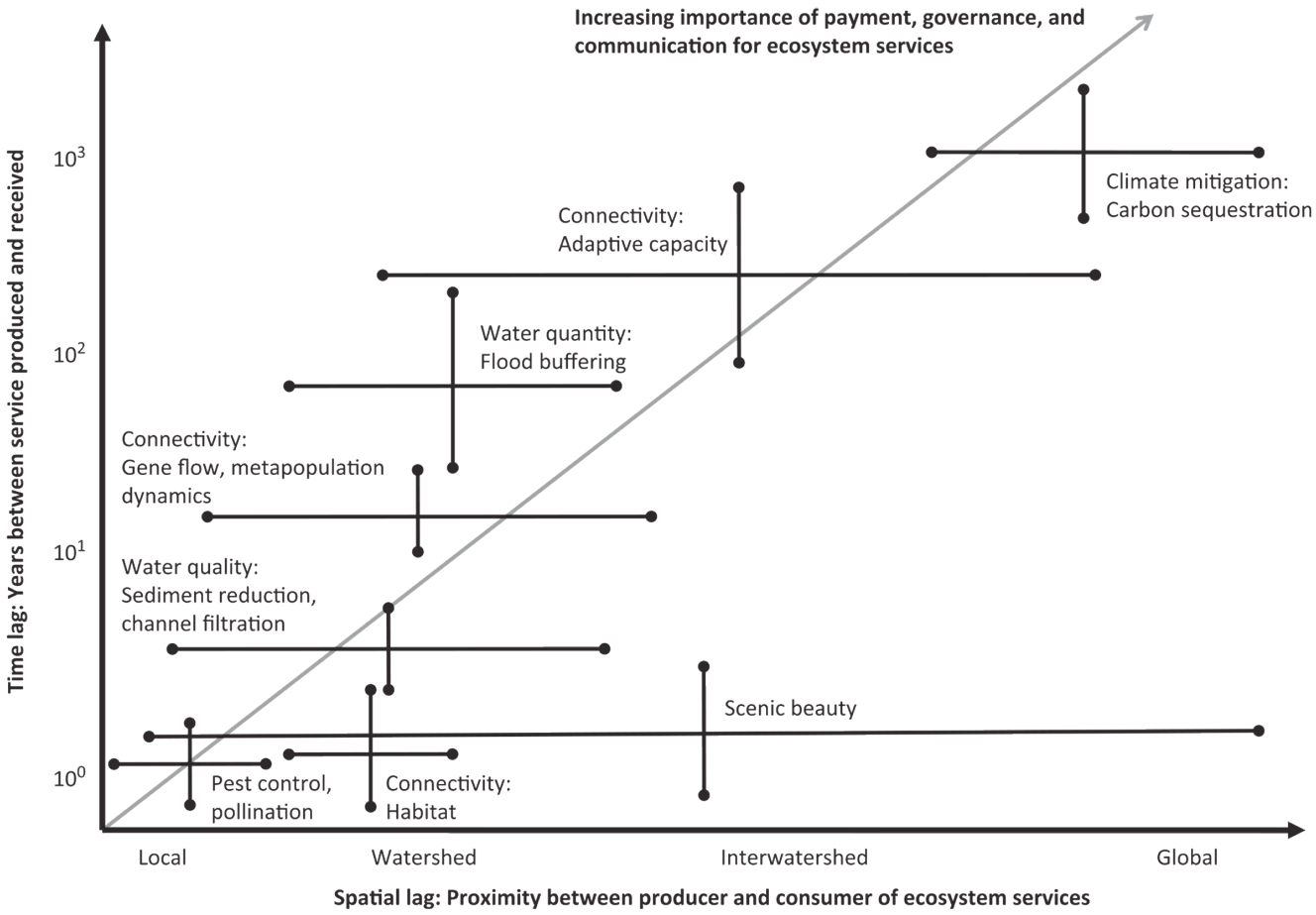



*Fig. 1 from Fremier et al (2013) shows the spatial and temporal lags between the production and consumption of different ecosystem services*

To give an example, leaving some 'wild' areas near a farm can increase habitat for bees and other pollinators. This is a local action that receives local results (better productivity) within a relatively short period of time (weeks and months). Carbon sequestration on the other hand, is quite different: local actions can have a global impact, but the time span before getting any results is very long (decades or centuries).

Taking these lags into consideration is important when making landscape management decisions because the perspective of different players will differ across a landscape. A farmer will have very different priorities than a policymaker. We try to bring this out in the game through the various levels:

| Level | Land area |
|---|---|
| 1 | Farm |
| 2 | Farming Cooperative |
| 3 | Village Community |
| 4 | District |
| 5 | Upper Watershed management |
| 6 | Basin |

## Synergies and Trade-offs

When it comes to landscape management and ecosystem services, synergies and trade-offs between different decisions are always present. This is something we hope to bring out in the game by giving the player the dual challenge of satisfying agricultural production needs, while maintaining ecosystem service health.

While some actions may benefit multiple services and interests, others might benefit one at the cost of the other. To give an example, planting crop diversity synergistically helps pollination, natural pest control and gives a farmer more options in case of market fluctuations and extreme weather events. But too much diversity can also become unmanageable.

Trade-offs on the other hand are often difficult decisions plagued by strong political interests. Building a dam for example, can provide hydropower and regulate water availability, but it also disrupts fish migration and sediment patterns. It can also increase pollution and decrease oxygen levels in the water, further damaging the ecosystem services and natural resources many benefit from. In Level 5, the player is challenged to maintain good water quality and quantity in light of dam construction.

Throughout the game, the challenge for the player is to try to create synergistic management decisions wherever possible.

# Game Design

This section includes the base of the game play and game logic. Further details would need to be developed during the production phase, after funding conditions are more defined.

## Overview

| Features | |
|---|---|
| Genre | • Serious game<br>• Role-playing game (RPG)<br>• Strategy<br>• Simulation<br>• Construction & Management |
| Player | • Single-player |
| Platform | • Online browser game (HTML5)<br>• Mobile game (Android, iOS app) |
| Gameplay | • Alignment (ethics)<br>• Cooperation<br>• Obstacles<br>• Resource Management<br>• Time |
| Victory Conditions | • Goals<br>• Risk and reward |
| Setting | • Fictional location<br>• Realism<br>• Pure Play |
| Graphic Style (see Mood Board) | • Cartoon<br>• Fantasy<br>• 2D<br>• 3/4 angle view |
| Game Sequence | • Linear - Scenarios, challenges<br>• Simulation |

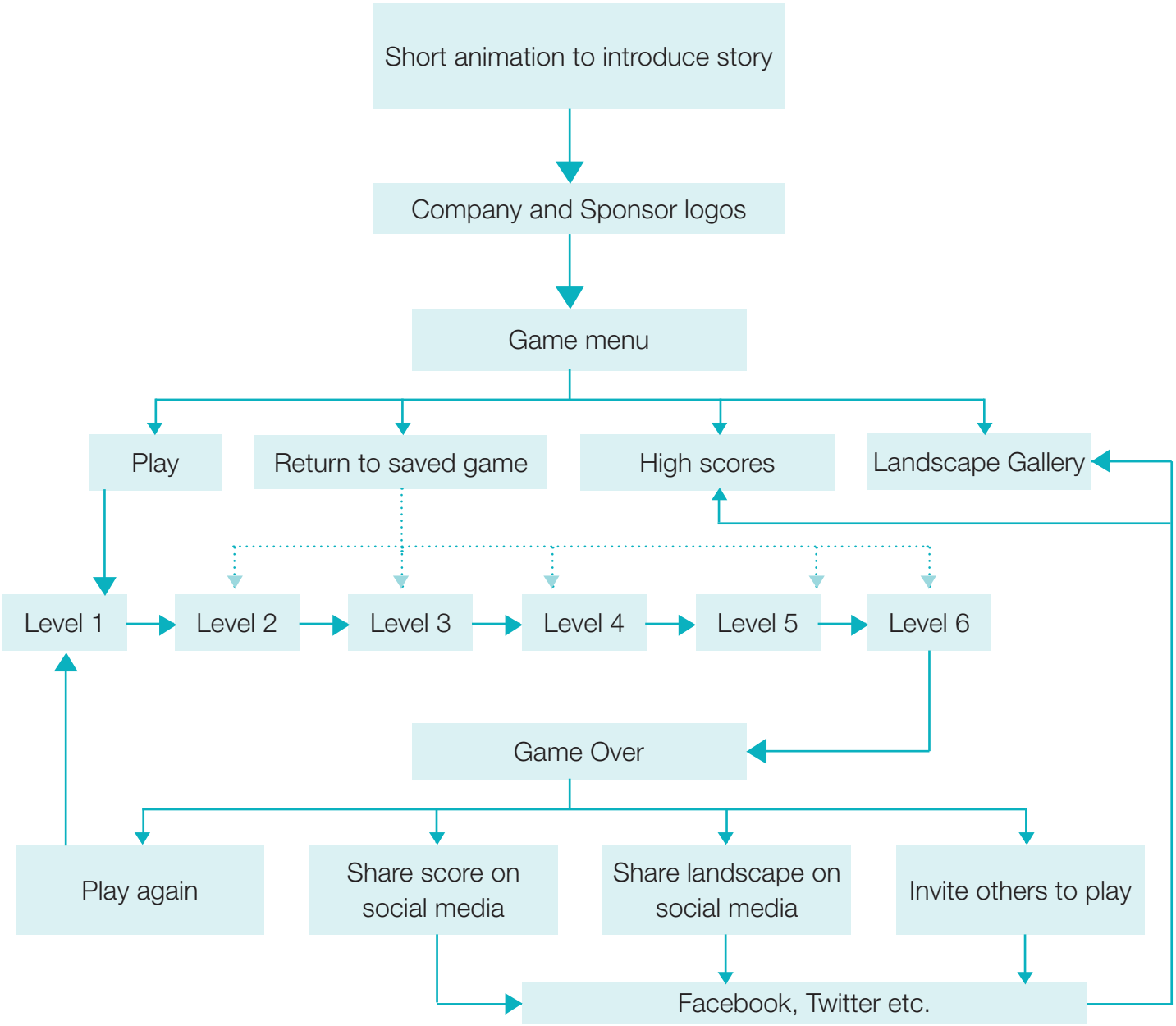
## Potential Names

The name of the game is still very much at brainstorming stage but here are some ideas:

| Ag+Eco+Landscapes | Economics Twist | Growth (Crop growth, land size, Economic growth, Population growth) |
|---|---|---|
| Farmscape | EFFEciency (Ecologically Functioning Farmscape Economics) | Grow+h (h represents human, + is the t) |
| Agriscape | EcoEconomics Farmscape | EcoGrow+h |
| Farmicology | Eco²nomics Farm | Eco²Grow+h |
| Agroecology | Eco²Ag | Grow on |

Other words to play with:
flow, system, being, ecosystem (eco²system), services

## Game Flow



# Level 1

### Scenario: Birds and bees

You're taking over a small farm. Its current yield is $x. With improved crops you can do better.

Choose crops and their best companions improve the yield of the crops over 5 years.

### Visual

Farmville style layout, single field with 12 spaces in 3x4 grid. Start with visual of mono crop – previously harvested.

### User given

- limited land (spaces/pixels)
- limited years (seasons) to play (5 years)
- choice of crops to plant
- option of fertiliser
- option of pesticides

### Each crop has

- Water cost
- Financial Cost
- Yield
- Extra info such as 'grows well next to', or 'nitrogen-fixing'

### Gameplay

You click on a crop to get information on it.
----> Choose your crop, click to place it.
------> When all spaces are full, 'go' button lights up – press it to advance.
--------> Animation runs through seasons to harvest, results are displayed.
----------> Financial cost of crop + yield = financial profit for the year.
----------> Displayed in relation to previous yield, with some explanation and learning point.

### Game Logic

- Pollination:
  - » Diversity of crops increases pollination, increases yield
  - » Too much diversity of companion planting is not financially viable (to harvest), reduces yield (% on financial cost of harvest)
- Pests:
  - » Pests damage crop yield (should have an invasion in year 3/4/5?)
  - » Diversity of crops reduces impact from pests as less concentration of crops they like (crops they don't like can act as physical barrier)
  - » Pesticide reduces pests, increases yield
  - » Too much pesticide reduces pollination, decreases yield
  - » Too much pesticide ruins the soil, decreases yield (although pesticide is always used to some extent)
- Fertiliser:
  - » Fertiliser increases yield, but only in the short term (have to apply every year)
  - » Too much fertiliser ruins crops and soil (exploding melons in China!)
  - » Fertiliser maxes out yield at some point (no benefit from continued fertilisation)
  - » Fertiliser costs would increase year on year for same yield

» Too much fertiliser ruins the water supply (eutrophication – lose points?)

- Nutrients:
  » Some plants (legumes) return nitrogen to soil. Bonus yield for using them during that year. (bonus shown on end panel)

### Content needed (research + decision)

- Range of crops to plant
- Combination of crops that will provide better yield (pest control, pollinators)
- Features of crops (water use, cost, profit from yield, companion plant, nitrogen benefit)
- Values for impact of continued pesticide
- Values for impact of continued fertiliser (maxing out and external values for future levels)

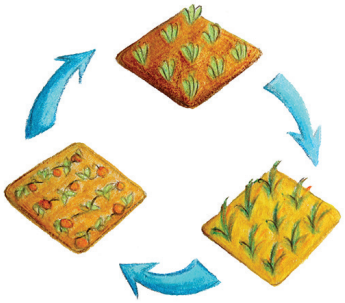
### Key education message

Companion planting and use of crop diversity is better than monocropping (for pollination, pest control and nitrogen-fixing/nutrient use)

### Ecosystem Services learnt

- Pollination
- Pest and disease control

## Level 2



### Scenario: Nutrient boost

You're overseeing a farm which is much bigger than your original plot. The farm is a co-op, but you are all working together and have the same interests (no conflict). The focus of this level is still on improving yield, but you are concerned with nutrient cycling and the allocation of land use (crop rotation).

The fields are divided into 4 pre-defined areas. In the first year, they are pre-filled with crops, some of which are fallow. Each field has a pre-determined history which includes fallow years. You see the yield from each field, and are invited to choose what crops you want to plant this year. You can choose up to 4 crops each year (this includes option to leave one area fallow).

Rotate the crops to give your co-op the best soil health and nutrients year after year.

### User given

- limited land (spaces/grouping of multiple pixels)
- limited years (seasons) to play (5 years)
- choice of crop patches to plant
- option to leave areas fallow (automatically covered in legumes)
- Information of previous crops year by year (stacked tiles?)
- Yield +/- with every harvest

### Each crop patch has

- Water cost
- Financial Cost
- Yield
- Nutrient restoration/contribution (e.g. nitrogen, 'grows well after...X', legumes indicated)

### Gameplay

You click on a patch of land to get information on it (what has been grown before)
----> Choose your crop patch or fallow area, click to place it.
------> Choose if want irrigation or vegetation border, click to place it.
--------> When all spaces are full, 'go' button lights up – press it to advance.
----------> Animation runs through seasons to harvest, results are displayed.
----------> Financial cost of crop + yield = co-op financial profit for the year.
----------> Displayed in relation to previous yield, with some explanation and learning point.

### Game Logic

- Nutrients:
  - » Crop rotation improves soil nutrients (A -> B -> C -> D -> A)
  - » Fallow areas let your land rest, recharges nutrients, improve yield in later years (3,4,5, i.e. long-term planning)
  - » Legumes put nitrogen back into the soil
  - » Any rotation is better than no rotation
- Harvest and yield:
  - » As harvest occurs, a value appears over each field +10%! -5%! based on nutrient availability
  - » Harvest panel shows reduction of yield if crops lack diversity
  - » Harvest panel shows reduction of yield if crops are not rotated
  - » Yield % increase is more when patches are not the same (to avoid player monocropping all 4 areas and switch all 4 patches every year)
- Water*:
  - » Yield % increase is more when water is not overused (e.g. choose plants with low water cost after plant with high water cost)
  - » Setting up an irrigation system improves yield. Bonus yield for installing at financial cost (bonus shown on end panel)
- Soil erosion options:
  - » Yield % increase when vegetation planted to reduce runoff (also harvestable crops)
    - – Perennial crop – $ - yield every year, crop yield +5%
    - – Shrubs – $$ - yield after first year, crop yield +10%
    - – Trees – $$$ - first yield after 3 years, crop yield +15%, more valuable produce

*Water efficiency at this stage only in terms of crop decisions and runoff control, and yes/no option for irrigation system.

*Include basic supply & demand? e.g. if player plant too much of one crop, reduce price or just yield % increase? (Just flag as score on end panel?)*

### Content needed (research+decision)

- Range of crops to plant, including nitrogen-fixing
- List of crops that grow well after each other
- Features of crops (water use, cost, profit from yield, nitrogen benefit)
- Values for impact of vegetation borders per type of crop (perennial, shrub, tree)

### Key education message

- Crop rotation helps recharge nutrients in soil and improves yield over time
- Vegetation can help reduce water and soil runoff and nutrient loss

### Ecosystem Services learnt

- Nutrient cycling
- Erosion control (soil/water)

# Level 3

### Scenario: Every drop counts

You see more of the external environment – including the river. This level is about water availability. You are sharing this resource with other farmers in your community. Figure out the best win-win irrigation system so that everyone gets enough crop per drop.

Choose options to help store water and control runoff.



#### User given

- limited land (spaces shared with others)
- limited years (seasons) to play (5 years)
- a variety of farm sizes to layout and map irrigation (suggest non-square grid system so more options for different shapes and lengths of canals/pipes, see mixed irrigation in US)
- choice between a set of irrigation methods:
  - » divert water from river/dam vs. pump groundwater
  - » open canal vs. pressurized pipeline (can turn on or off)
  - » sprinkle/time of day-based vs. trickle/drip
- choice of water storage and control methods (bunds to slow down water, catchment ponds, storage tanks)

#### Each water storage or control method has

- Water efficiency measure (how much water it saves or provides)
- Financial Cost

#### Each irrigation method has

- Water efficiency measure
- Financial Cost

#### Gameplay

You click on a patch of land and get irrigation method
----> Choose irrigation method, click to place it.
------> Link parts of pipe/canal to create map of irrigation system.
--------> Click on part of farm that want to add storage or control method.
----------> When irrigation ready and storage placed, 'go' button lights up – press to advance.
----------> Animation runs through wet and dry season to see if all farms watered.
---------->Results display succes or failure.
----------> Financial cost of method + water sufficiency for all farms = community profit for year.
----------> Some explanation and learning point (incl. social impact?)

#### Game Logic

- Irrigation system map:
  - » All fields need equal amount of irrigation (crops not obvious factor in this level, automatic).
  - » Well-connected irrigation leads to better water availability and hence better yield for all.
- Irrigation method (see table):
  - » Optimize irrigation system using minimum materials/costs.
  - » Groundwater more expensive but more reliable in dry season.
  - » Divert from river/dam cheaper but less reliable in dry season.
  - » Open canal is cheaper but more evaporation so less water availability.

  - » Pipeline more expensive but more control of water use and availability.
- Storage method:
  - » Use of water storage and control methods will improve water availability.
  - » Bunds reduce runoff which retains nutrients and maximizes water storage, yield increase x%.
  - » Catchment ponds and storage tanks provide reliable water supply all year, yield increase x%.

| Irrigation method | Water availability/efficiency | Financial and Labour Costs |
|---|---|---|
| Groundwater pump | √√√√ | $$$ |
| Diversion from river/dam | √√√ | $$ |
| Open canal | √√ | $$ |
| Pipeline | √√√ | $$$ |
| Time-based release/sprinkler | √√ | $$ (probably more politics) |
| Drip system | √√√ | $ |

### Content needed (research+decision)

- Range of irrigation methods
- Range of water storage or control methods
- Features of above methods (water efficiency, cost, difficulty to set up)

### Key education message

- Different irrigation systems exist and have different costs and efficiency.
- Water is a shared resource and requires management beyond the farm scale.
- Seasons affect water availability.

### Ecosystem Services learnt

Water quantity and availability

## Level 4

### Scenario: The Power of Vegetation

You can now also see wild areas, including forest resources that are near and around agricultural land. This level is about the ecosystem services provided by vegetation and wild areas. Your concerns are services that contribute to agriculture, including water quality and some others you have already learnt about (water availability, pollination, pest control). The key word here is ‘buffer’.

Allocate vegetation in areas to maximize the provision of these services while still keeping a minimum about of land for agricultural production.

### User given

- Minimum agricultural land requirement (unit)
- limited agricultural area (set as below minimum required, so that player must increase)
- limited years to play - cycle shifted to over 25 years (5 cycles of 5) or 50 years (5 cycles of 10)
- forested area (set in small and big patches, player can deforest to reach min. agricultural land)
- choice of vegetation to plant or maintain (virgin forest, agroforestry system, native trees, native shrubs, native grasses)
- placement of vegetation (along farms/corridors, on hill, along riverbanks: see page 41)

### Each vegetation type has

- Ecosystem service indicator (pollination, pest control, water quality etc., based on placement)
- Financial Cost
- Deforestation/land conversion to agriculture is one vegetation option

### Gameplay

You click on a patch of land and get vegetation/deforestation option.
----> Choose option, click to place it.
------> Repeat as desired. (suggestions when hovering over areas?)
-------->Design vegetation system along farm areas and pixels
----------> When vegetation ready, 'go' button lights up – press to advance.
------------> Animation runs seasons to see how vegetation contributes to ecosystem services.
--------------> Results display where on map well done or could improve.
----------------> Financial cost of veg + ecosystem service points + yield = district wealth for decade.
------------------> Some explanation, suggestions and learning point.

### Game Logic:

- General vegetation:
  - » Vegetation and wild areas contribute ecosystem services (points!) to agriculture
  - » Vegetation along river banks provide erosion control and improve water quality
  - » Vegetation along farms provide habitat for pollinators
  - » Vegetation along farms act as barriers to pests, and wind breaks (reduce crop breakage)
- Trees:
  - » Trees placed on slopes store water and control erosion
  - » Trees placed high on hill act as good water catchment
  - » Virgin forests retain more water and provide more habitat for biodiversity than planted trees
  - » Native trees retain more water and provide more habitat for biodiversity than non-native trees/agroforestry systems
  - » Trees near river banks increase water availability/seepage into rivers and groundwater
- Other vegetation:
  - » Grasses are best buffer for fertilizers and pesticides next to farms
  - » Multispecies buffer (diversity! - combination of trees, shrubs, grasses) provide most effective method for erosion control and pollution control/water quality (again see page 41)
  - » Agroforestry system is agriculture + vegetation (bonus shown on end panel)
- Deforestation:
  - » Deforestation creates more land for agricultural production, but reduces provision of ecosystem services (pollination, water quality, water quantity, erosion control)
  - » Player can compensate for deforestation by planting vegetation in strategic locations

### Content needed (research + decision)

- Range of vegetation types available for planting (agroforestry system, native trees, etc.)
- Estimated costs of vegetation types (based on labour, difficulty to set up)
- Value for impact of vegetation on water quantity and availability
- Value for impact of vegetation on water quality
- Value for impact of vegetation on pollination
- Value for impact of vegetation on pest and disease control
- Value for impact of vegetation on erosion control

### Key education message

- Vegetation and wild areas contribute ecosystem services to agriculture

- Ecosystem services provision depends on type of vegetation and where it is placed

### Ecosystem Services learnt:

- Erosion control
- Pest and disease control
- Pollination
- Water quantity and availability
- Water quality

## Level 5

### Scenario: The Dam

Water always flows downhill. But wait, the national government has decided to build a dam to provide hydropower and regulate water! This has created many benefits such as electricity, irrigation and drinking water. But the dam has also caused problems:

- A decrease in fish populations (migration patterns disrupted, temperature changes)
- Oxygen loss due to flooded vegetation (decomposing) and an explosion of water hyacinth
- Siltation and pollution will increase over time

While you cannot change the fact that the dam has been built, the pressure to ensure water quality is ever more pressing! You are in charge of managing the upstream area of the dam.

Alter the landscape and introduce policies to reduce erosion, pollutants and carbon emissions.

### User given

- limited land area (upstream of dam)
- limited years to play - over 25 years (5 cycles of 5) or 50 years (5 cycles of 10)
- some forested area (set in different areas and sizes, player can deforest or plant more)
- placement of vegetation (along farms/corridors, on hill, along riverbanks: see page 41)
- policy schemes to choose from (REDD+, PES, a mix of guidelines)
- limited policy schemes allowed (max. 2?)
- a few pre-placed factory widgets (causing pollution into river)
- limited deforestation rate as years pass

### Each policy or landscape alteration has:

- Ecosystem service indicator (water given more points, some options have multiple benefits)
- Financial Cost
- Stakeholder Negotiation difficulty

Examples of policy or landscape alteration (see table): PES scheme with land use guidelines (erosion control), carbon credit scheme (REDD+, FSC), terracing scheme, vegetation strips, pollution tax.

### Gameplay

You click on landscape and get policy or landscape alteration options.
----> If choose landscape alteration option, click to place it.
------> If choose policy option, auto-applied to entire upper watershed area (max. 2)
----------> When player several options chosen, ‘go’ button lights up – press to advance.
------------> Animation runs years to see how policies and alterations contributes to dam quality.

----------> Results display where on map successes and failures.
----------> Financial costs + negotiation difficulty + ecosystem service points = watershed wealth for 25 years.
----------> Some explanation, suggestions and learning point.

### Game Logic:

- Landscape alterations:
  - » Player can make landscape and resource management decisions to reduce pollution and maintain water quality
  - » Vegetation along river banks provide erosion control and improve water quality (buffers pollutive effluents)
  - » Trees near river banks increase water availability/seepage into rivers and groundwater
  - » Trees placed on slopes store water and control erosion
  - » Player can compensate for deforestation by planting vegetation in strategic locations
  - » Terracing reduces soil erosion and increase water storage (and increase farmland area)
- Policies:
  - » Carbon credit scheme gives financial compensation for keeping forest intact
  - » FSC gives niche market for sustainable forest use (paper, wood)
  - » PES scheme gives financial compensation for erosion control and eco-friendly methods (no till, organic agriculture etc.)

| Policy/Tax/Alteration | Ecosystem Service | Financial Cost | Negotiation Difficulty |
|---|---|---|---|
| Carbon Credit Scheme (REDD+) | Carbon sequestration, water quality, biodiversity habitat, erosion control, carbon offset for factory | $$$ | √√√ |
| Hydrological PES Scheme | Water quality, Erosion control | $$$ | √√√√ |
| Forest Stewardship Council Certification (or other certification) | Carbon sequestration, biodiversity habitat, water quality and quantity, erosion control | $$ | √√ |
| Terracing | Erosion control, water quality and quantity | $$$$ | √√√ |
| Vegetation strip | Erosion control, water quality and quantity, biodiversity habitat | $$ | √ |
| Pollution tax | Water quality, biodiversity habitat | $$ (depends for who) | √√ |
| Eco-standards (regulation) | biodiversity habitat, water quality and quantity, erosion control, reduce $CO^2$ emissions | $$ | √√√ |

### Content needed (research + decision)

- Range of policy and land alteration options
- Estimated costs and negotiation difficulty for above
- Value for impact of policy or land alteration on water quantity and availability
- Value for impact of policy or land alteration on water quality
- Value for impact of policy or land alteration on erosion control

- Value for impact of policy or land alteration on carbon sequestration

### Key education message

- Dams require active management upstream to ensure usability
- Industry has negative externalities that affect the provision of ecosystem services
- Management decisions can minimize negative externalities of industry and dam
- Policy schemes exist to help manage land areas at a greater scale

### Ecosystem Services learnt

- Carbon sequestration (via emissions, REDD+ policy)
- Water quality and quantity (via pollution control)
- Erosion control (via vegetation and land shaping)
- Biodiversity?

## Level 6

We discussed the idea of reversing the player's view from supply to demand. The player will see the management of the entire watershed from the view of downstream users, e.g. a nearby city.
This could either be done as game play, but could also simply be a played out as a film to re-cap entire game's actions.

To discuss.

# Graphics & Sound

Many similar landscape simulation games exist, although not directly catered to the theme of ecosystem services. Graphic styles have an important role in maintaining the interest and attracting players. Here is a mood board of screenshots and sketches of potential styles, look and feel.


Imaginary octopus landscape by game company 1octop


Natural resource problems can be drawn in a fantasy-like way like the Scarygirl game


Hand-like illustration from Don't Starve simulation game


Managing water along a watershed in Catchment Detox game


Example from Farmville of farm area and important info on top of heads-up display


Caribbean coastline from Stop Disasters Game


Earth's crust landscape from REUS game

Sketches of pristine to degraded watershed by B.Miller


Aerial view can come in handy to show player the bigger picture like Civilization game

## Music and Sounds

Background music and sounds are as important as visuals. The music for the ecosystem services should be light and not too distracting. Sound effects need to be timely and help set the mood of the player's actions. Poor or successul decision-making can be communicated through sounds.

So far we have insufficient research on music and sound, which will have to be tested through trial and error during the development phase.

# Resources

Here are some other useful links and points of information for reference. Also see the Game Design Document section and related pages in the Ecosystem Services and Resilience section of the WLE wiki. Some documents that do not have public links have been directly uploaded there.

http://waterlandandecosystems.wikispaces.com/Game+Design+Document

## Similar games

These games have all been studied, see WLE wiki for analysis of several:

- **Stop Disasters** http://stopdisastersgame.org
- **Catchment Detox** http://www.catchmentdetox.net.au/play-game/
- **Farmville 2** https://www.facebook.com/appcenter/farmville-two
- **Don't Starve** www.dontstarvegame.com/
- **Portal** http://www.valvesoftware.com/games/portal.html
- **Game Dev Story** https://itunes.apple.com/app/id396085661
- **Reus** http://www.reusgame.com/
- **Towns** http://www.townsgame.com/
- **Imagine Earth** http://www.imagineearth.info/
- **Electrocity** http://www.electrocity.co.nz/Game/
- **Half the Sky** https://www.facebook.com/HalftheGame
- **Rotate2** http://www.gamesforthebrain.com/game/rotate2/
- **Pipe Dream game** http://www.playitontheweb.com/games/Pipe-Dream-game.htm

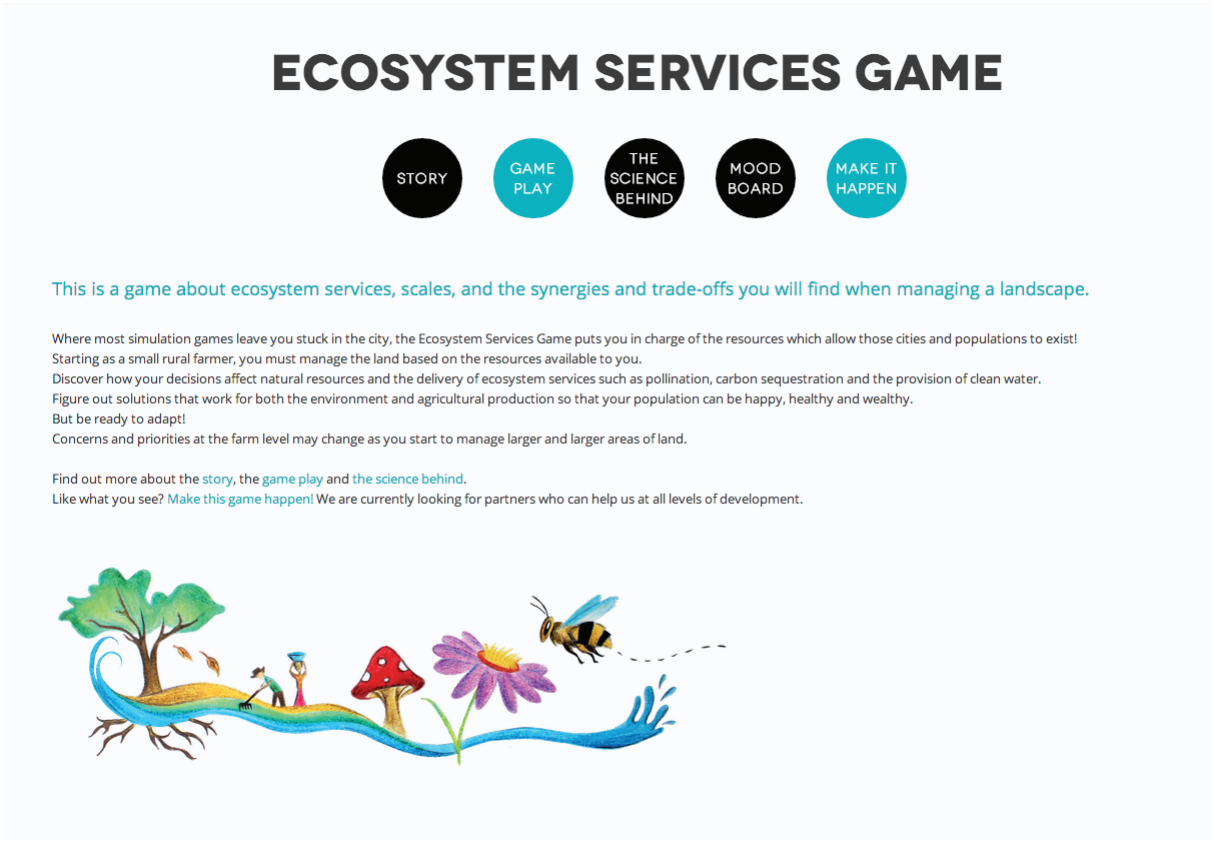
## Research papers and useful documents

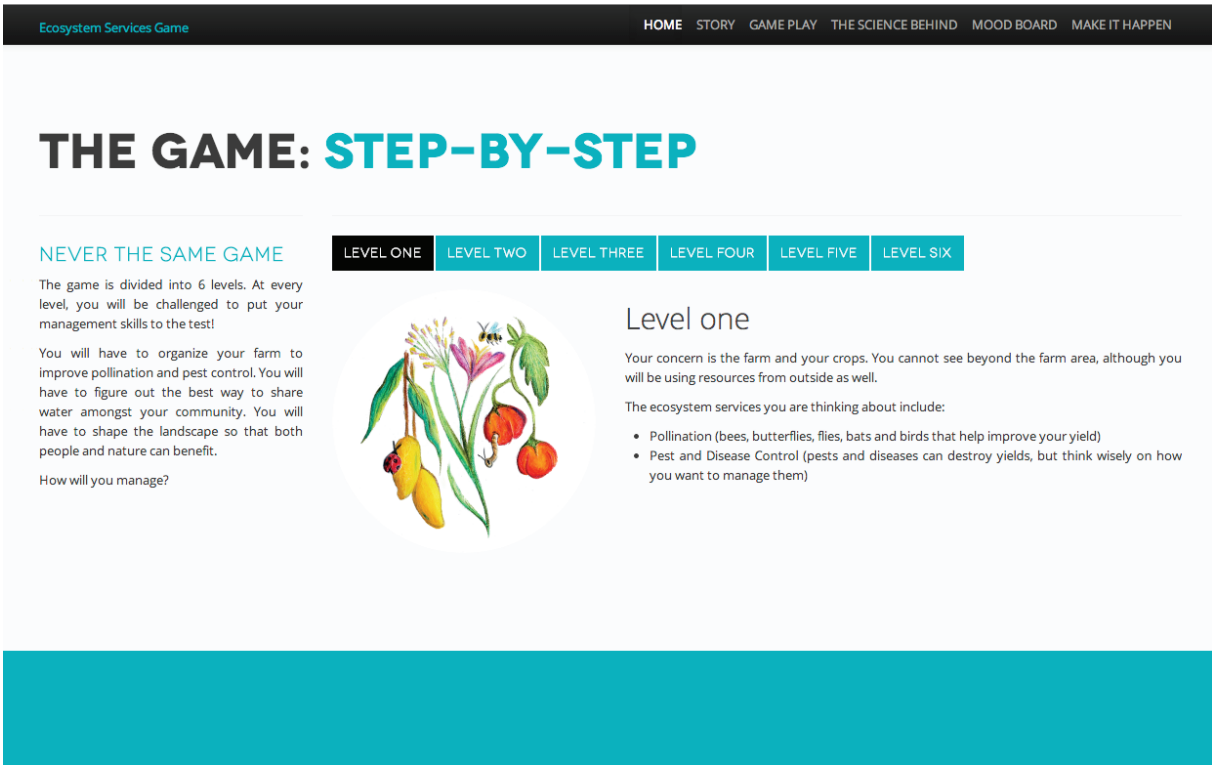
- **Microcredit schemes for nature conservation**
  http://www.wetlands.org/Aboutus/Howwework/Biorights/tabid/2732/Default.aspx
- **Rapid Hydrological Appraisal - how much to pay for services**
  http://www.worldagroforestry.org/downloads/publications/PDFs/B14765.PDF
- **Riparian forest buffers in agroecosystems**
  http://www.nrem.iastate.edu/class/assets/NREM471_571/Agroforestry%20readings_2009/Week%202/Schultz%20et%20al_2004_Riparian_forest_buffers.pdf
- **Pollinator-Friendly Practice Handbook**
  http://www.internationalpollinatorsinitiative.org/uploads/SocioEconomicEvalPollinatorFriendlyPractices.pdf
- **Landscape Water Management**
  http://www.irrisoft.net/downloads/manuals/Landscape%20Water%20Management%20Training%20Manual.pdf
- **Pest and Disease Management in an Organic Ecosystem**
  http://agritech.tnau.ac.in/org_farm/IPM%20Booklet%20for%20OF-Dr.P.D.pdf
- **Natural Pest and Disease Control**
  http://www.gardenorganic.org.uk/pdfs/international_programme/PestDisease.pdf
- **Wildlife Corridors** http://www.in.gov/dnr/fishwild/files/HMFSCorridors.pdf

# Website

As mentioned previously, a website has been created for potential donors and partners who are interested in the game. Here are some screenshots for reference.

Currently: http://biogame.antoninocarella.com/
but the name will change soon to ecosystemservicesgame.com



# MOOD BOARD

Ecosystem Services Game
HOME STORY GAME PLAY THE SCIENCE BEHIND MOOD BOARD MAKE IT HAPPEN

# MAKE IT HAPPEN

The goal of the game is to increase awareness on ecosystem services and landscape management in a fun and interactive way. While the game should eventually be attractive to a wide range of players, our primary target audience is secondary and tertiary education students in developed and developing countries, particularly those with an interest in agriculture, environmental issues and sustainable development. Although technically a serious game, the game can be played beyond the classroom on mobile devices.

Led by Bioversity International*, this game is an initiative of the CGIAR Research Program on Water, Land and Ecosystems and partners.

*Developing the game*
Are you a video game artist, designer, scientist or game developer interested in being part of this exciting project? Help build your portfolio or provide professional expertise by joining forces with us.

*Sharing the game*
We are currently working on potential channels to release the game through schools, youth networks, education portals and NGOs, with a potential reach of millions of students and extension agents. Let us know if you would be interested in partnering with us to distribute this game when it is ready. Or give feedback throughout the prototype phase.

*Investing in the game*
Based on an initial start-up fund, we are currently in the concept development and design phase of the game. If you are interested in funding the prototype, partial or full development of the game, please get in touch with us, and we can share our projected budgeting and costing details.

*What's in it for me?*
If you are enthusiastic about science education through the use of engaging and innovative media, this could be a good opportunity for your or your organization. We believe that if done well, our game would be an intrinsic motivator to learn more about how we benefit from the environment and what we can do to continue earning those benefits.

The best teachers engage students by challenging them to find solutions in an environment where failure is tolerated (Bain, 2004). We want a game that is easy to play but difficult to master. The learning aspect is a subconscious process that happens as the player makes decisions, finds synergies or fails miserably.

*Contact Us*
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