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Exploring the Social and Ecological Trade-offs in Tropical Reforestation: A Role-Playing Exercise

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ABSTRACT

This exercise introduces students to the complexities of conservation in rural tropical landscapes. It introduces the concepts of payments for environmental services (PES), trade-offs and synergies between agricultural land-uses and society's needs, and introduces students to tropical land-uses and common rural stakeholders in the tropics. The exercise has two main parts. In Part 1, students learn about a new reforestation program in the fictional country of Nueva Puerta and must debate how to direct the reforestation program: towards poverty alleviation, export production, water protection, or habitat connectivity. In Part 2, students break into small groups to negotiate the placement of PES in a tropical land-use simulation game. The land-use simulation is designed to show students some of the realities and limits of tropical conservation. In the final phase of the exercise, students reflect on their experiences through discussion questions. Optionally, they can write a reflective essay and/or vote which real-world reforestation project they are interested in supporting as a class.

LEARNING OBJECTIVES

After this debate and land-use simulation game, students will be able to:

1. Understand how the impact of policies to promote ecological services will differ in areas with distinct social and ecological contexts.
2. Describe the ecological services associated with reforestation.
3. Make a persuasive and evidence-based argument (written or oral) about the relative importance of ecological services and other social values.
4. Appreciate the distinct perspectives of stakeholders in rural tropical landscapes.
5. Evaluate the impact of real world reforestation projects (optional).
6. Identify/infer trade-offs associated with different kinds of reforestation.
7. Negotiate cooperatively to find compromises to resolve stakeholder conflicts.
8. Identify and appreciate the limitations facing conservation programs.

INTRODUCTION

The Promise of Tropical Reforestation

People increasingly recognize the benefits of forests, especially tropical forests, in providing environmental services (also known as ecological or ecosystem services). Environmental services are benefits that humans receive, typically for free, from ecosystems. Some examples of environmental services are crop pollination by native insects (e.g., bees), water purification and denitrification in wetlands, food provision from fisheries, and recreation opportunities, such as in parks. Forests provide many environmental services: they store carbon, prevent erosion, provide wood and other products for people, improve hydrological cycling, provide habitat for threatened or endangered species and more.

Historically, we have received environmental services for free and taken for granted that ecosystems would provide them. However, environmental change means that some of these services are becoming scarce. For example, due to deforestation, the amount of carbon being stored by tropical forests is declining. Now, conservationists and natural resource managers are looking for strategies to protect these ecosystems and ensure that nature continues to provide these services. One such strategy is payments for environmental services (PES) programs, systems in which "beneficiaries of nature's goods and services pay owners or stewards of ecosystems that produce those services, with payments contingent on service provision" (Naeem et al. 2015). Some examples of PES programs are: biodiversity protection (e.g., conservation donors paying to set aside land to create a biological corridor), watershed protection (e.g., downstream water users paying to

promote upstream land use that prevents erosion and improves water quality; Wunder 2005), and carbon sequestration and storage (e.g., an electricity provider paying for tree planting to pull carbon dioxide (CO2) out of the atmosphere). While some conservationists object to putting a monetary price on nature, or worry about the impacts or risk involved (e.g., Silvertown 2015), supporters of PES programs argue that they can be effective in changing drivers of biodiversity loss, and provide valuable additional funding for conservation (e.g., Ferraro and Kiss 2002).

Tropical forests are important providers of environmental services. Tropical forests account for 50 percent of the world's existing forests (Pan et al. 2013), and they store large amounts of carbon: more than double the amount of carbon per hectare than temperate and boreal forests (not including soil carbon; Malhi et al. 1999). Tropical forests harbor most of the world's tree species (Fine et al. 2008), and are also the forests most threatened by deforestation and land-use change (FAO 2010). Reforestation in tropical forests thus has the potential to provide multiple benefits in tropical landscapes (Locatelli et al. 2015). It contributes to climate change mitigation and biodiversity conservation. In highly deforested landscapes, reforestation can improve connectivity and create biological corridors, enhancing some species' abilities to move across landscapes. In addition, tropical reforestation has the potential to provide economic benefits to landowners in the form of timber production, and other local benefits such as erosion prevention and water regulation.

Tropical reforestation can take many different forms, and the benefits stemming from these also vary. If reforestation can occur naturally, or with some assistance (ecological restoration), the resulting natural ecosystems are called secondary forests. Alternatively, landowners can establish tree plantations, which can be monocultures or polycultures (depending on how many species are planted) and can be composed of native species or non-native (exotic) species. Monocultures are the simplest plantations to manage, with uniform production and uniform species characteristics, such as harvest time. In the tropics, non-native timber plantation species are often the best understood by foresters, easy to grow and with large markets for their wood. But neither monocultures nor non-native plantation species have many benefits for local biodiversity (Brockerhoff et al. 2008). By contrast, highly complex native-species polycultures have high biodiversity (Nájera and Simonetti 2010). With moderate amounts of biodiversity, agroforestry is a type of polyculture where trees are grown alongside agricultural crops or animals. For example, coffee agroforestry with a shade overstory has more species of birds than sun-grown coffee monocultures without trees, but fewer species than complex native tree polycultures (Nájera and Simonetti 2010). Thus, the benefits associated with reforestation vary based on the type of reforestation. The location of reforested land can also play a key role in the types and quantity of benefits accrued. For example, reforestation on steep slopes may best help prevent erosion, while reforestation near existing forests may best help promote connectivity.

Perils, Pitfalls, and Problems in Tropical Reforestation

Due to its potential to remove CO_2 from the atmosphere and provide other benefits, many conservation organizations and local governments have been promoting tropical reforestation. By attaching payments to this type of land-use, PES programs can provide the necessary incentive so that landowners choose reforestation over other land uses. However, developing a PES program for reforestation is complicated by the many different, and sometimes conflicting, interests of stakeholders in tropical landscapes. A persistent question is where to conduct these programs in order to both maximize benefits for local communities and issues of global conservation importance. A local farmer may be more interested in growing grain for their family than in sequestering carbon for foreigners.

Planting a tree has myriad environmental benefits, no question. But it also has economic opportunity costs. You have committed that space, and the shadow it casts, to growing a tree for the next several years to decades to centuries. If that is a farm field that you planted your tree in, you can no longer grow dense, productive crops that need full sunlight. If you have the money and live in one of the few suitable areas where they grow, you may be able to switch to lower-density, shade-loving

crops like coffee or cacao (chocolate). But for most of the world's "poor" (i.e., low-income) tropical farmers, switching crops isn't an option because it would cost too much money. Neither is waiting twenty years to harvest wood they planted—they might go hungry in the meantime, with nothing to sell or eat. Wealthy farmers with money saved up are better able to wait for slow-growing trees to yield timber and fruit—they can bear the opportunity costs. Even when farmers can afford to plant trees, having all of your wealth standing in trees is a risk—a single fire could wipe them out.

Depending on which species you plant, and where you plant it, reforestation may also come with environmental costs or ecological costs. In dry areas, planting non-native trees can lower the water table and dry up wells (Le Maitre et al. 2002), or, in the case of *Eucalyptus*, cause an increase in forest fires with their flammable dry leaves. Certain non-native species are invasive, and will spread out rapidly from a plantation—for example, the invasive tree *Casuarina equisetifolia* was once widely planted for erosion control and is now responsible for choking the habitat of endangered species on nearby beaches (Global Invasive Species Database 2017). Plantation species grown in orchard monocultures, like oil palm in southeast Asia, often have little to no value for biodiversity (Nájera and Simonetti 2010)—and when they replace diverse rainforests, secondary forests, and polyculture house gardens, populations of orangutans and rhinos go locally extinct (Fitzherbert et al. 2008). Once oil palm has expanded to cover most of the landscape, as it is doing in many parts of southeast Asia, South America, and Africa, whole species will go extinct (Vijay et al. 2016).

THE ASSIGNMENT

To help you better understand the trade-offs implicit in choices about reforestation, you are going to learn about and role-play two related scenarios. In Part 1, you will make an informed argument based on the assigned reading, recommending which region of a country should receive PES payments from the national government. Your instructor will think critically about the recommendations from the class and use them to determine which region will receive the PES money. In Part 2, you will break into four stakeholder teams: reforestation program representatives, local town council, small farmers (i.e., small farm landholders), and large farmers (i.e., large farm landholders). The different stakeholder teams will need to work together to decide the fate of the reforestation program in your region: where incentives will be offered, to whom, and for what kinds of reforestation.

PART 1. TRADE-OFFS IN CONSERVATION AND DEVELOPMENT: A DECISION-MAKING AND DEBATE EXERCISE

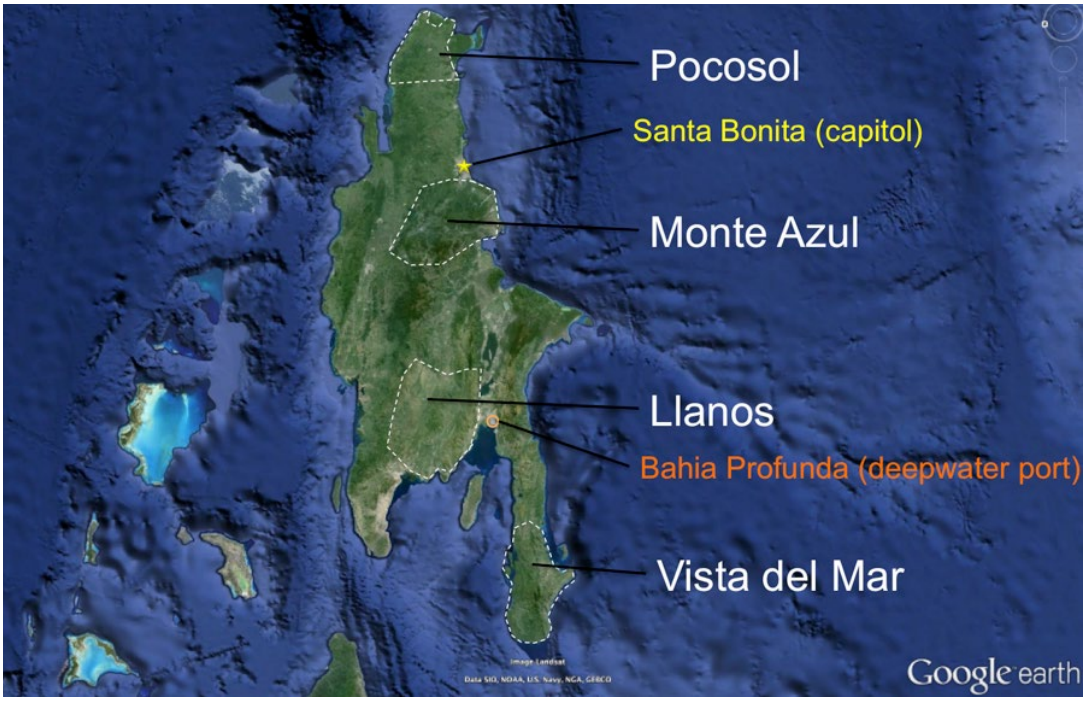
You are a young, ambitious official (representative) in a national government program that administers payments for environmental services (PES) to fund reforestation on private farms. Farmers that sign up for this program receive $5,000 to plant trees or allow natural reforestation on their land, and may harvest and sell the wood twenty years later. The program has increased forest cover in many regions of your country, Nueva Puerta, but critics of the program say it is a waste of money because the forest cover increase has not been targeted to achieve real benefits in terms of habitat connectivity, wood production, environmental services, or poverty reduction. Your job is to improve the targeting of reforestation by selecting which *one* region in Nueva Puerta will receive a PES program in the next year.

Your supervisors have requested a short report that outlines and supports your choice with logical arguments. Depending on your supervisor, this may be a verbal or written report—ask them for the format and length. Because this is a political matter, you must be ready to debate and support your choice with arguments in favor of your chosen region, but also directly address why your choice is better than another region.

You have four regions of Nueva Puerta to choose from (Figure 1). Read about each region before making your decision and starting your report.

The first region, Monte Azul, is high in the central mountains, near the capital city. Most of the landowners in this region live in the big city and run large cattle ranches or coffee farms ("large farmers"). A few small farm landowners ("smallholders" or "small farmers") run low-income coffee farms on the least fertile hill soils. Forest

Figure 1. Map of Nueva Puerta



is abundant on the high steep slopes, but overgrazed cattle pastures and coffee predominate everywhere else. Regional forest cover is 40 percent. The high mountains here are a main source of water for the city reservoir, and in recent years there has been concern about soil erosion and water quality in the reservoir. Possible reforestation options in this region include:

- Agroforestry: planting trees in coffee farms (shade coffee),
- Timber: planting monocultures of cypress (a non-native conifer with low invasive potential and valuable wood), and
- Conservation: planting native trees to accelerate natural regeneration in pastures.

The second region, Vista del Mar, is the poorest region of the country and has the lowest forest cover (<10%). It is far from the main cities and is mainly accessed via coastal ports and poor-quality roads through the hilly terrain. The landowners in this region are almost entirely low-income small farm holders on the edge of extreme poverty, running small subsistence farms or cattle ranches. There are a few larger-land owners along the coasts growing bananas for export. Tropical dry forest used to cover the region, but now forest is quite rare, with most trees along rivers and scattered through fields. Even the steepest slopes are mostly grassy pastures kept open by skinny cattle and escaped fires. High soil erosion degrades water quality and farm fertility during the brief rainy season. The soil is of decent quality, but the low annual rainfall slows the forest regrowth and the recovery of land after overgrazing. Possible reforestation options in this region include:

- Agroforestry: planting economically valuable trees in pastures (a silvopastoral system),
- Timber: planting monocultures of *Leucaena leucocephala* (a non-native, nitrogen-fixing tree with high invasive potential, good fire resistance, and valuable firewood), and
- Conservation: fencing riparian areas to encourage forest regeneration along rivers.

The third region, Pocosol, is located in the flat rainy lowlands between two large rainforest parks, relatively far from the capital. The two parks protect the last two large populations of the endangered Puertanuevan Ant-thrush, a forest-dependent, highly mobile bird that is disappearing from isolated forest fragments around the region. The Ant-thrush is incredibly popular among bird-watchers, with a scarlet body and striking green wings. Remaining forest cover is at 30 percent, but the forest outside the parks is highly fragmented and restricted to swamps, hill slopes, and riversides. In this region, the large landowners are primarily focused on planting sugarcane, raising cattle, or conducting bird-watching eco-tourism, while the smallholders are focused on

cattle and logging. Possible reforestation options in this region include:

- Agroforestry: planting wood rows of valuable native trees along the edges of cattle fields ("green fences"),
- Timber: planting monocultures of teak (a non-native tree with highly valuable wood and low invasive potential), and
- Conservation: planting polycultures of trees (a diverse mixture of twenty native tree species with low economic return but good habitat value).

The fourth region, Llanos, is a flat cattle-ranching region with poor-quality soils and good road access to Nueva Puerta's deep-water port. The country has been trying to establish a fruit or timber industry there for years, and has discovered through trial and error that there are a few varieties of trees that grow well in the acidic soils of the region. There is great interest in establishing plantations for export among the large cattle ranches in the region, to increase the national income and reduce international debt. The eastern rolling hills are where the remaining forest cover is concentrated (15%) and are dominated by smallholders raising cattle, with 5–50 cows per ranch. Possible reforestation options in this region include:

- Agroforestry: planting oil palm in open orchards,
- Timber: planting monocultures of *Gmelina arborea* (an incredibly fast-growing non-native tree with good wood for shipping pallets), and
- Conservation: planting monocultures of mountain ash (a native, slow-growing species with valuable wood that is the chief nesting tree of the migrating Montezuma Parrot).

Use the remaining space on this page to outline your report.

PART 2. STAKEHOLDER NEGOTIATION EXERCISE: BASIC INSTRUCTIONS

Congratulations! Your region has been selected to receive payments for environmental services (PES) to fund reforestation on private farms. What's more, your town has been selected as the test pilot case for the first year of the PES program. Posters have gone up around the village, pointing out that farmers who sign up for this program receive a cash payment per hectare. Participation will entail either A) planting timber trees to harvest in 20 years, B) practicing agroforestry for 20 years, or C) putting your land into conservation for 20 years. A town meeting has been called to discuss and negotiate the new program.

Pick a Stakeholder Team

Decide which stakeholder team you want to represent in this town meeting: one of the reforestation program representatives, the local town council, a small farmer, or a large farmer. There must be at least one person for each team, so a group of four people will have one person for each stakeholder role.

Examine the Regional Map

Take a moment and think about the viewpoint you would have, growing up in the area described in Part 1. Then take a look at the map of your region (provided by your instructor; Appendix I), which includes towns and the surrounding agricultural land. Towns (in red) and properties belonging to the large farmers (dark yellow, four square clusters) and small farmers (light yellow) are pictured on the map, along with forested areas (green) and rivers (blue)[i]. Areas in light green are farmers and ranchers who didn't make it to the town meeting, and are thus not eligible for PES. Red roads connect the towns.

The Negotiation

You are about to enter a negotiation with the other stakeholders living in your region, and how your team performs may affect your grade. Each of you will negotiate the placement of PES contracts in your township. You will have the opportunity to decide if each eligible square of property in the township will either stay in agriculture or be converted to one of the three options for reforestation: agroforestry, timber, or conservation. Your score will depend on how you negotiate to locate reforestation and agriculture in your township. Understand your own incentives well, and be prepared to make reasoned arguments. Yelling won't help, but careful negotiating and a solid grasp of the background reading will. If you play nice, and don't stick up for your own interests, be prepared to lose this negotiation. *Read your stakeholder team's scoring instructions for your region carefully*. Optionally, you may keep it secret from opposing teams! If they see it, they may have a negotiating advantage over you.

The Objective

Your objective in the simulation game is to accumulate more points than the other stakeholder teams in your group by the end of the negotiation. Different players

[i] A grayscale version of this map might be distributed (Appendix II), if that is the case, the shades of gray are defined in the legend.

Table 1. Scoring

BASE SCORING:	
Farm square	1 point per 10-hectare square
PES SCORE MODIFIERS FOR FARMERS:	
Agroforestry (yellow-colored marker*)	+1 point to farm income
Timber (blue-colored marker*)	+0 point to farm income
Conservation (green-colored marker*)	-1 point to farm income
FINAL SCORE:	
Base score + PES score modifiers for farmers + Bonus points	
**colors may depend on your instructor's set-up.*	

earn points in different ways. For large and small farmers, points come from farm square income and some bonus points, which represent your personal preferences and desires. For town council members, points come from road trade and farmer income (your constituents). For the reforestation program manager, points come from giving out PES contracts.

The Rules: How To Play

1. To start, each player should count the farm squares to know their stakeholder team's starting base points; each farm square is ten hectares. Farmers make a base number of points per ten hectares (a large farm is forty hectares in size, or four squares = 4 points).
2. Review your stakeholder team's possible bonus point scenarios for your region. Optionally, these detailed scoring rules for different stakeholders may be kept a secret from other players.
3. Before you start negotiating, take a moment to think about what type of PES payment you want on the farms, and where you might want it. Your instructor might ask you to fill out a blank map sheet with your ideal outcome. This may be collected but, regardless, it's a good idea to make one anyway.
4. The game begins when the PES program representative team makes an offer to a farmer team to alter one or more agricultural square's income with a PES payment. If accepted, the representatives will have a bag of colored tokens or pins to mark what type of PES that property receives. After the first offer, negotiations can be initiated by any team. Offers agreed to a majority of members are binding on a team.
5. This is a free-for-all negotiation: farmers can say no, town council can counter-offer, and so on. All contracts are final only after the last PES contract has been given out.
6. The entire negotiation is over once 15 colored PES markers are on the board, you reach an impasse, or the instructor calls time.
7. Once the negotiation is over, use the group scoring sheet tally up your score. You will score points for your final base score and for any bonus point modifiers you have earned through PES contract negotiation (see your stakeholder scoring sheet).
8. If possible, take a photo of your region's completed board for later reflection.

Frequently Asked Questions:

1. Q: Is bribery permitted?
   A: This is up to your instructor. But side deals, secrets, cartels, cabals—all fine.
2. Q: Can the town council veto my offer/deal?
   A: Yes. The town council has five vetoes.
3. Q: What do the points mean, really?
   A: Points are an approximation of economic utility: how much something benefits you, either monetarily or otherwise.
4. Q: Is this game a good approximation of reality in the tropics?
   A: That's a great question. This game is an over-simplified model of stakeholders, policies, and incentives, designed to highlight some common trade-offs associated with tropical reforestation. Where is it least realistic? Hmm, that would make a great discussion question afterwards...
5. Q: Is "Nueva Puerta" a real island?
   A: Yes.
   Q: Is "Nueva Puerta" a real place or country?
   A: Nope, not at all.

HANDOUT 1: STAKEHOLDER SCORING INSTRUCTIONS: REFORESTATION PROGRAM REPRESENTATIVE

This is your big promotion! And keeping it just depends on keeping the international NGO (non-governmental organization) donors to your national government happy while convincing the people you grew up with to adopt the PES program. You have two objectives: you want to enroll properties in the PES program, and you want to do as conservation-friendly reforestation as possible.

Scoring and Rules:

1. Base points: You get one point for every square you enroll in the PES program.
2. PES points: You get additional points if the selected PES option is conservation-friendly:
   - Agroforestry (+0 bonus)
   - Timber (+1 bonus per square)
   - Conservation (+2 bonus per square)
3. Bonus points: You get one bonus point per square if the PES properties are adjacent to (i.e., touching) natural forests. Note, touching is referring to the entire side of a square, not just a corner. Extra bonus points can be earned according to your region (see below).
4. Non-completion penalty: You only have enough program money to pay to enroll 15 property squares in PES. Choose wisely. If you do not enroll 15 properties, subtract the remaining number of PES contracts from your final point score. It is possible to put PES on town squares, with town council permission.

Guide to Regions

REGION	REFORESTATION OPTIONS	SPECIAL REGION-SPECIFIC RULES FOR BONUS POINTS
Monte Azul	A: Shade coffee T: Cypress plantations C. Natural regeneration	Creating forests to border and protect the rivers is especially important for water quality. You get one extra bonus point for *timber or conservation* PES that touch *water* squares.
Llanos	A: Oil palm T: *Melina* plantations C: Native mountain-ash plantations	Establishing farms that will export products easily is valuable. You get one extra bonus point for *agroforestry or timber* PES in squares that touch *roads*.
Pocosol	A: Green fences T: Teak plantations C: Diverse native plantings	Creating wooded habitat to connect and buffer isolated forests is valuable. You get one extra bonus point for *conservation* PES that touch *forest* squares.
Vista del Mar	A: Silvopastoral systems T: *Leucaena* plantations C: Fencing riparian forests	Reaching small farms that lack access to infrastructure is important. You get one extra bonus point for *agroforestry or timber* PES in squares that *don't* touch roads.

Personal Scoring Guide

BASE SCORE	PES SCORE	BONUS AND PENALTY POINTS	TOTAL
# PES squares placed =	(# conservation×2) + # timber =	One point per square of PES adjacent to forests = See your region's special rules for bonus points = Subtract one point for each PES payment you do not place	

HANDOUT 2: STAKEHOLDER SCORING INSTRUCTIONS: SMALL FARMERS

You are barely making ends meet each day. The PES program may or may not benefit you, and the large farmers and the town council may or may not negotiate in your best interest. Work with your fellow smallholders to achieve a profitable and just solution for yourselves! You have one objective: maximize the return for small farms across the entire board (the total *small* farmer's points at the end of the negotiation is the key to your success).

Scoring and Rules:

1. Base points: You receive one point for each square small farmers collectively own.
2. PES points: You can gain or lose additional points from certain types of PES reforestation contracts:
   - Agroforestry (+1 point per square)
   - Timber (+0 points per square)
   - Conservation (-1 points per square)
3. Conservation bonus points: You support conservation, especially when other people do it at no cost to you. Collect one bonus point for each large farm square that has a conservation PES at the end of the game.
4. Completion bonus: At the end of the game, if all 15 of the PES contracts are assigned, you get a completion bonus of 5 points. This reflects an increase in your reputation for supporting conservation: ecotourism money begins to flow to your small farmers.

Personal Scoring Guide

	BASE SCORE	PES SCORE	BONUS POINTS	TOTAL
Small farmers	20 points	(# agroforestry on small farms) – (# conservation on small farms) =	# conservation on large farms = If all 15 PES contracts placed, add 5 points.	

Reforestation Options

REGION	AGROFORESTRY	TIMBER	CONSERVATION
Monte Azul	Shade coffee	Cypress plantations	Natural regeneration
Llanos	Oil palm	*Melina* plantations	Native mountain-ash plantations
Pocosol	Green fences	Teak plantations	Diverse native plantings
Vista del Mar	Silvopastoral systems	*Leucaena* plantations	Fencing riparian forests

HANDOUT 3: STAKEHOLDER SCORING INSTRUCTIONS: LARGE FARMERS

As wealthier members of your community, you are pro-conservation and welcome the PES program, as long as it doesn't detract from your profitable business as usual. You have two objectives: maximize the PES enrollment while maximizing the profit from large farms across the board (the total large farmer's points at the end of the negotiation is the key to your success).

Scoring and Rules:

1. Base points: You receive one point for every ten hectares you own, and there are four ten-hectare plots per farm.
2. PES points: You can gain or lose additional points from certain types of PES reforestation contracts:
   - Agroforestry (+1 point per square)
   - Timber (+0 points per square)
   - Conservation (-1 points per square)

   PES contracts can be placed on any ten-hectare plot within your forty-hectare farms.
3. Bonus points: You support conservation, especially when other people do it at no cost to you. Collect one bonus point for each small farm that has a conservation PES at the end of the game.
4. Non-completion penalty: At the end of the game, if all 15 of the PES contracts are not assigned, you receive a non-completion penalty of 5 points. This represents a decline in your reputation for supporting sustainable agriculture and conservation. You large farmers have benefited from recent fertilizer subsidies from the national government and if the new national PES program fails here, that fertilizer support from the government will go somewhere else.

Personal Scoring Guide

	BASE SCORE	PES SCORE	BONUS POINTS	TOTAL
Large farmers	40 points	(# agroforestry on large farms) – (# conservation on large farms) =	# conservation on small farms = If fewer than 15 PES contracts placed, subtract 5 points.	

Reforestation Options

REGION	AGROFORESTRY	TIMBER	CONSERVATION
Monte Azul	Shade coffee	Cypress plantations	Natural regeneration
Llanos	Oil palm	*Melina* plantations	Native mountain-ash plantations
Pocosol	Green fences	Teak plantations	Diverse native plantings
Vista del Mar	Silvopastoral systems	*Leucaena* plantations	Fencing riparian forests

HANDOUT 4: STAKEHOLDER SCORING INSTRUCTIONS: LOCAL TOWN COUNCIL

Oh no! Commerce is your town's livelihood, and change is often a threat to that livelihood. The new PES program may or may not be a help in that process, but you worry the program's eco-friendly conservation options will lower agricultural productivity and take money out of your constituent's pockets. You have one objective: to maximize the income of farmers in your area.

Scoring and Rules:

1. Base points: You must advocate for all your constituents: your final point score is the *lower* of either the large or small farmers' total base points + PES modifiers. This does *NOT* include their additional bonus points.
2. Trade bonus: Having economic resources that are accessible to the town is good. At the end of the negotiation, you get two bonus points for each farm that receives an agroforestry or timber PES that touches a city or road. Note, the selected PES land squares must share an entire side to be considered touching, not just a corner.
3. Permitting: If the PES program creates political ill will by hurting the local economy, it matters for your well-being and job security. Therefore, if the town council doesn't agree with a PES contract location, they can revoke its agricultural tax permit: that is, you have veto power and can veto up to five PES placements. When you veto the PES placement, you have 1–2 options, depending on your instructor:
    1. Let the farmers and PES coordinator work out a new farm location;
    2. (or, under optional bribery rules) Offer the PES program coordinator the ability to place their vetoed PES contract on a town square. You receive three points per PES contract placed on a town square, which effectively is a bribe to the town council. It is your choice whether you wish to be honest or corrupt as a local government. While government corruption can exist in any country, its effects can be particularly harmful in less developed countries.

Personal Scoring Guide

	BASE SCORE	PES SCORE	BONUS POINTS	TOTAL
Town council	Lower score of (large or small) farmers' (base + PES) =	Not applicable	# agroforestry or timber touching road x 2 = *Optional*: *# of PES payments on towns x 3 =*	

Reforestation Options

REGION	AGROFORESTRY	TIMBER	CONSERVATION
Monte Azul	Shade coffee	Cypress plantations	Natural regeneration
Llanos	Oil palm	*Melina* plantations	Native mountain-ash plantations
Pocosol	Green fences	Teak plantations	Diverse native plantings
Vista del Mar	Silvopastoral systems	*Leucaena* plantations	Fencing riparian forests

HANDOUT 5: GROUP SCORING SHEET:

NAME OF REGION: _____

Fill in this table to summarize the placement of PES programs on the map:

NUMBER OF PES	AGROFORESTRY	TIMBER	CONSERVATION	TOTAL
Small farms				
Large farms				
Total				

Fill in this table to calculate or record each stakeholder's score:

	BASE SCORE	PES SCORE	BONUS POINTS	TOTAL
Large farmers	40 points	(# agroforestry on large farms) – (# conservation on large farms) =	# conservation on small farms = If less than 15 PES contracts placed, subtract 5 points.	
Small farmers	20 points	(# agroforestry on small farms) – (# conservation on small farms) =	# conservation on large farms = If all 15 PES contracts placed, add 5 points.	
Town council	Lower score of (large or small) farmers' base + PES =	Not applicable	# agroforestry/timber touching road x 2 = (*Optional*) # of PES payments on towns x 3 =	
PES program representative	# PES squares placed	(# conservation ×2) + # timber =	One point per square of PES adjacent to forests. See your region's special rules for bonus points. Subtract one point for each PES payment you do not place.	

POST-GAME QUESTIONS FOR DISCUSSION IN YOUR GROUPS (OR HOMEWORK)

Please discuss and then answer here in one sentence per question (some have multiple questions):

1. How well did you do in this game? How could you have done better?
2. If multiple regions were played, how did the maps end up differing between the different parts of the island? Look at final maps for other regions, and talk to the players in each region to learn why.
3. How did the town council and its vetoes affect your game play?
4. If bribery had been permitted for all stakeholder groups, how different would your discussion have been? How fair and legitimate would the contract process have seemed to you? What would you have thought about conservation?
5. If government corruption was rampant and enforcement of laws and contracts poor ("weak governance"), what would be the fate of the PES program over the long term?
6. How likely would a farmer with weak land tenure (i.e., no formal, enforceable land title) be to join this program?
7. Small farmers in rural areas often have the least power and money in developing countries. Do you think the negotiation game you completed reflected that reality? How might a small farmer increase their profitability or ability to affect government policy?
8. In the game, small and large farmers act together as a group. In the real world, some farmers do act as groups, forming co-operatives. But most farmers do not. Why would a farmer, large or small, who is not part of a larger co-operative ever choose conservation PES as an option?
9. How might an influx of eco-tourists into Nueva Puerta change the national economy? Do you think ecotourism money might change the local attitudes of both farmers and townsfolk in your region towards conservation PES?
10. In the real world, how does access to roads and markets change the farming economy—would each farmer make more or less? How does road access change the ability of farmers receiving PES to plant trees and extract timber and agroforestry products? In general, how has road access affected deforestation around the tropics? Please research your answer to the last question.
11. Hilly and mountainous areas are harder to access. How likely, do you think, are hilly and mountainous areas to be under agriculture? Are they more or less likely to be abandoned and left to reforest than flat areas the same distance from a road? Where does coffee grow?
12. If you had to come up with one new game rule, what would it be?

REFLECTION QUESTIONS

These are intended as homework, and the starred questions may be assigned as optional reflection essays(**). Your instructor will give you additional instructions.

1. Tell a quick story about how your region's negotiation map got created. Why did the pins fall where they did? Include the photo of your game board in your answer.
2. What did you like most about the game? What did you like least?
3. Give two examples of ecological trade-offs (ecological benefits and drawbacks) for a specific type of reforestation. Remember that reforestation includes secondary forests, timber plantations, tree crops, and agroforestry.
4. What would a successful PES program look like, twenty years down the road? How much would it cost, relative to the starting cost? Pretend for a moment that you are pitching the PES program to a small country: how are they going to pay for it?
5. Conservation is not equal everywhere. Why would conservation payments be better targeted by forests, or by rivers, or on steep slopes? Research the definition of an ecological buffer zone, and of forest connectivity. Do you think it would be easier to put a conservation payment in a hilly region with low agricultural productivity, or in a flat region with high agricultural productivity? Why?
6. Winning, in the game, is hard to define. How would you define winning the game—individual success, or a successful regional outcome? In the real world, which region would be the most likely to receive

PES, in your opinion? Which region would be most likely to achieve the PES objectives?

7. From Part 1, which region did you vote for reforestation money, and why?
8. **What social and ecological trade-offs exist when tropical conservation or reforestation projects to capture carbon or preserve wildlife directly benefit global human well-being, but only bring limited local economic benefits and may decrease local control over land? Research whether conservation projects (e.g., protected areas) are always beneficial for local people; in your opinion, is benefiting local people a necessary requirement for successful conservation projects?
9. **PES systems are complex, and the success or failure of specific PES programs depends on the policies and benefits and costs to each stakeholder. What do you think are possible characteristics of a successful PES program? How might local attitudes towards a PES program differ A) in the capital city of the donating country (e.g., Norway) and B) in a low-income rural region receiving the PES?
10. **Do you feel the game is realistic? Why or why not? What biases or assumptions in the rules of the game created this realism or lack of realism? For example, small farmers worked together in groups in the game, but in the real-world farmer co-operatives are rare. Also, in this game, conservation schemes entailed no benefits for farmers, but under a different set of rules, they could provide cultural and food services to local and indigenous landowners.
11. **This game glosses over complexities that are very important: there are other kinds of incentives than cash, and tradeoffs both locally and globally. A game mindset discourages collaboration and encourages "fend for ourselves" and "get as much money as possible" behavior. Research how have PES programs performed in the real world—what challenges do they face? Examine a couple examples we didn't discuss in class. The Wikipedia page for "Payments for ecosystem services" is a good jumping off point: bonus points for non-Wiki examples.
12. **If Exxon Mobil (or a company of your choice which you disapprove of) offered to pay for a massive PES program for the next ten years in Nueva Puerta, would you, as the government, accept their money? Why or why not?
13. **You are the environmental minister of a small developing country. Recently, a large nonprofit approached you and offered to fund a PES program in your country for the next 20 years, and potentially longer. However, you have heard there are criticisms of PES programs, and you want to know more. Research critiques of PES programs and summarize them here. This video is a good jumping off point: http://www.bioeconomies.org/enterprising-nature/.

OPTIONAL EXERCISE: VOTE FOR REFORESTATION NGO

There are many reforestation projects in tropical forests around the world. Just like in the game you played, these projects need to take into account global and local conservation priorities and competing concerns, desires, and incentives of different stakeholders. Below, you'll find a list of reforestation projects in various countries around the world. Please feel free to find other examples of reforestation projects for the class to support, as well. Read about each project on its website. Then, in the context of what you learned through this exercise, pick your favorite project and explain why you think it's the best. As a class, you can discuss and vote on the best project.

After looking at each project, as a class, vote on the project that you think best integrates and balances conservation and environmental goals with local stakeholder priorities. If your instructor chooses, either they or the class can donate some funds to the organization that students favor.

- http://www.caminoverde.org/who-we-are
- http://weforest.org/projects/Restoring-Atlantic-Rainforest
- http://weforest.org/projects/india-empowering-women-entrepreneurs-land-restoration
- http://www.edenprojects.org/
- https://www.carbonfund.org/reforestation-and-avoided-deforestation
- http://www.treeswaterpeople.org/programs/reforestation/reforestation.html

- http://www.arkive.org/reforestation/
- https://www.paulmitchell.com/our-story/caring-for-our-planet/reforestaction/
- http://www.plowhearth.com/about/reforest_america.htm
- https://www.reforestemospatagonia.cl/en/
- http://www.reforestingscotland.org/

(Please note that websites do change, and you may need to do an online search of the names of these organizations to find the specific projects referenced above.)

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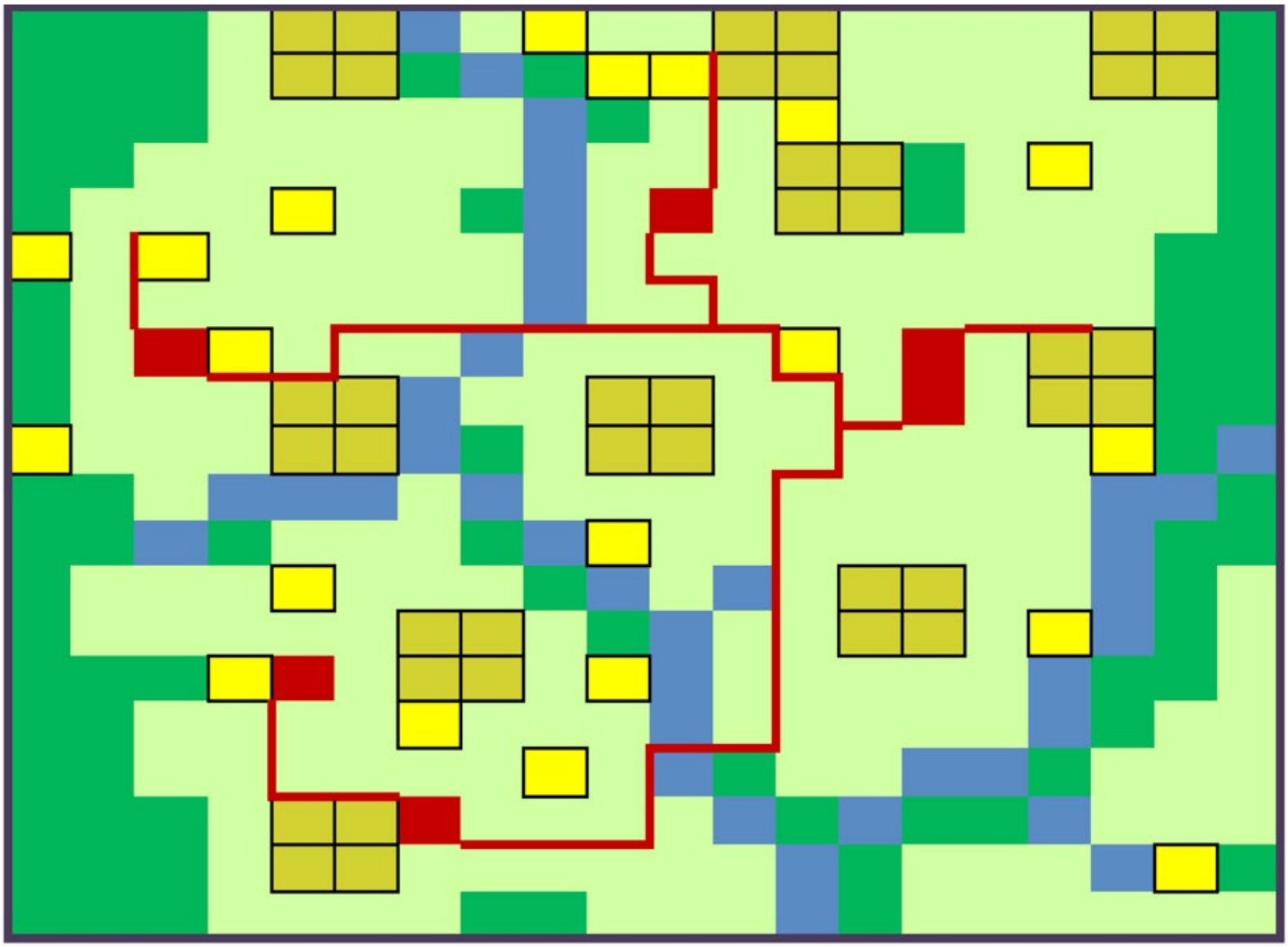
APPENDIX I: REGIONAL MAP



Legend

Forest

Farms not eligible

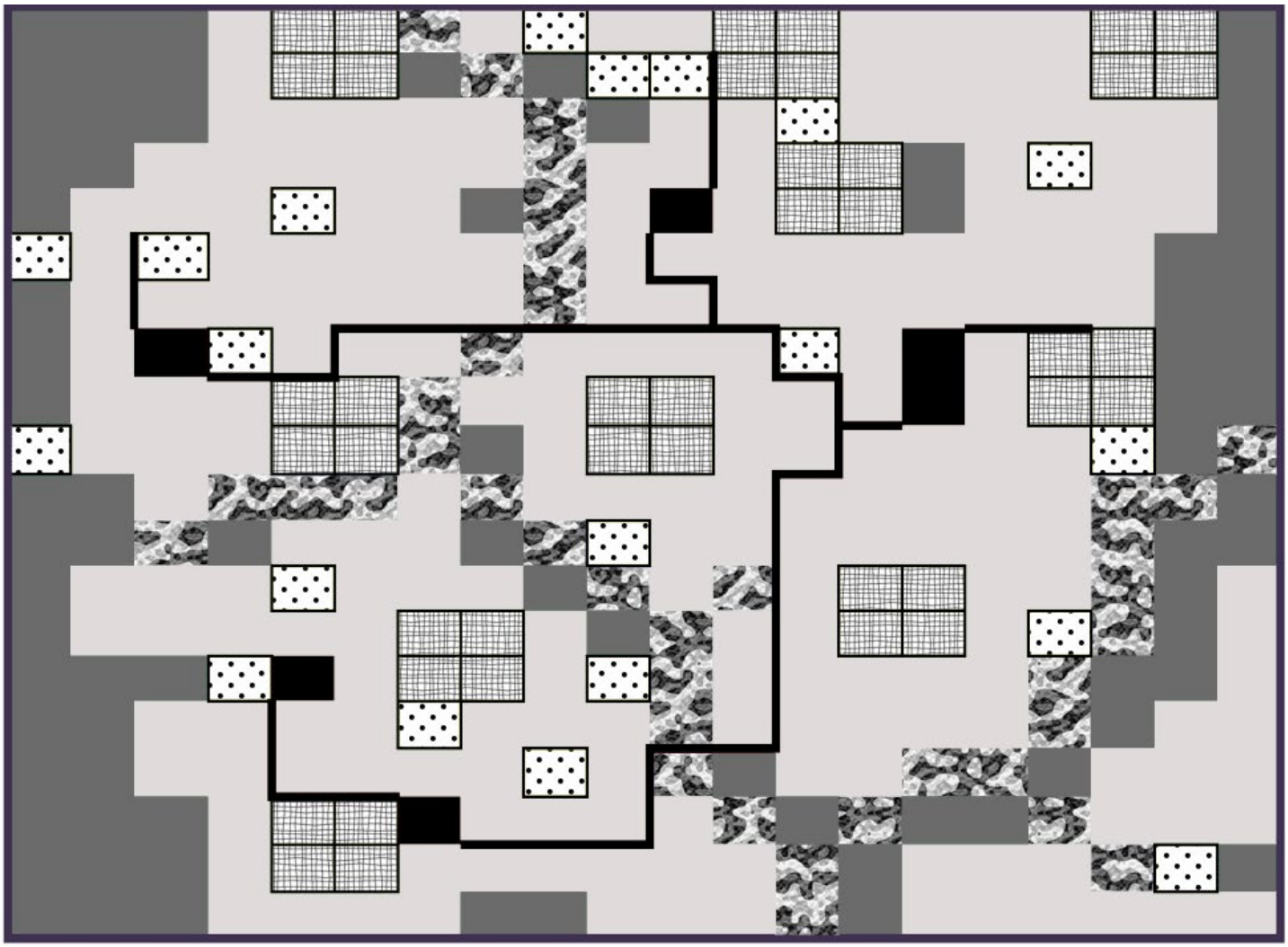
Rivers

Small farms

Large farms

Towns

APPENDIX II: REGIONAL MAP (GRAYSCALE)



Legend

Forest

Farms not eligible

Rivers

Small farms

Large farms

Towns