

Case Teaching Notes

for

“An Interdisciplinary Challenge: The Rivas Case Study”

by

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Abstract: This is a dilemma case which is aimed for environmental sciences and agroecology introductory courses. The main character is “Don Pedro Alvarez,” a cattle farmer from Nicaragua who is facing problems with maintaining his farm productivity because his land is degrading due to agriculture intensification and pressing forces of intense climatic events. Students are encouraged to identify the main components of this socio-environmental system, their interactions and discuss the value of each component. Students are expected to use concepts previously discussed in class to comprehend Don Pedro’s situation (e.g., seasonality, scaling, and climate change), and they will provide suggestions as professionals for the improvement of production systems.

Topical areas: Agriculture, Agroecology, Climate Change, Ecology, Environmental science, Interdisciplinarity, Socio-environmental systems

Educational level: Introduction to Environmental Science, Introduction to Agroecology.

What level is this case appropriate for? Undergraduate students.

Socio-Environmental Synthesis learning goals:

- Ability to describe a socio-environmental system, including the environmental and social components and their interactions.
- Ability to communicate across disciplinary boundaries.
- Value different ways of knowing and understand the value of different knowledge sources.
- Ability to consider the importance of scale in addressing socio-environmental problems.
 - Understand that ecological and social processes often vary across differing contexts, including space, time, and conditions (e.g., economic or political).
 - Understand that ecological and social processes interact across different scales.

Overall goal: To sensitize students to the complexity of socio-ecological issues.

Objectives:

1. Familiarize students with different environmental concepts.
2. Introduce students to different international contexts.
3. Increase students' ability for critical thinking.
4. Incentivize students to think about the trade-offs in the process of solving environmental problems and their complexity.
5. Develop the student's ability to describe socio-environmental systems, by identifying their environmental, social and economic components and their interactions.
6. Determine whether students are able to internalize what has been taught in the course.
7. Foster interdisciplinary thinking through the ability to identify disciplines and approaches relevant to the study and solution of environmental problems.

Type/Method: Dilemma, Decision, Role-play

INTRODUCTION

The case is set in southwest Nicaragua, and it's based on research conducted through the international project FUNCiTree (<http://funcitree.nina.no/>) focused on applying a functional diversity ecological framework to increase sustainability and adaptability of agro-forestry systems in landscapes of semi-arid and arid ecoregions. One of the study sites for this project is in Rivas, Nicaragua, a region experiencing socio-environmental complications and high vulnerability to climate change predictions due to severe weather events. **Don Pedro** represents a cattle farmer in Rivas who is experiencing problems, as discovered through a conversation with his wife. This situation serves to identify some social, economic, and environmental issues associated with the problem they are experiencing.

The case initiates identifying the importance of interdisciplinarity in environmental problem solving and the complexity associated with trying to find common grounds for all stakeholders involved. This case was designed for an introductory environmental sciences course. It introduces students to concepts (i.e., interdisciplinarity, scaling, ecological, and socio-environmental systems) in these areas and introduces food production systems as a good example for the integration of different disciplines and the farm as a socio-environmental system. A conflict is brought up at the end when a local project is being developed, and students have to play the roles of four stakeholders and generate a discussion to develop potential a solution that meet all stakeholders' needs.

CLASSROOM MANAGEMENT

Total estimated time: Approximately 50 minutes (without modifications).

NOTE: This case was pilot tested on an Introduction to Environmental Science class of 81 students over a 50-minute class period. Modifications had to be made in order to meet the goals in the limited time provided. Initially, Part I was discussed in the form of a PowerPoint presentation and a handout was given with Don Pedro's story in class. To reduce in-class time, a hand out with Part I was provided to students beforehand.

Part I.

Total estimated time: 20 minutes

- Give students the handout in advance, using a web-based platform or during the previous class for them. Have them read the handout, answer the questions, and prepare to discuss their answers in class.
- Use the PowerPoint presentation to go over the concepts discussed in the handout. (10 mins)
- Have an instructor-led discussion of questions (1-4) related to the story of Don Pedro. (10 mins)

Part II. The Silvopastoral Project

Total estimated time: 30 minutes

- Use provided PowerPoint presentation to introduce new concepts (5 mins)
- Divide students into groups, each one representing a stakeholder. Groups work on providing answers to questions in the handout. (10 mins)
- Have an instructor-led role play discussion with student spokespersons presenting their groups' answers to the questions. (10 mins)
- Wrap up by having the instructor summarize the main points and general conclusions. (5 mins)

BLOCKS OF ANALYSIS

Part I.

Central to this exercise is for students to use a systems thinking approach and for them to have a clear understanding of what ecological systems are and how they function. In the presentation and discussion of the issue, it is important to emphasize the parallels between ecological and social-environmental systems as well as their differences. A variety of concepts must be defined prior to the discussion although other definitions will necessarily emerge from the discussion itself. It is suggested that instructors first develop the conceptual framework of this case study by exploring the perspectives of different stakeholders within the social-environmental system and what is valid from each of these perspectives. This discussion is then followed by addressing the issue of environmental seasonality and how global precipitation patterns have been changing leading to the pressing problem: severe drought events. These severe droughts represent a social problem, an environmental problem, and in turn, a management one.

Basic concepts related to the case are reviewed and the class is brought up to date on the context of Rivas using a power point presentation. **Slide 1** of the presentation shows social, economic, and environmental variables associated with food production. **Slide 2** is a photo of a Nicaraguan farm during an intense drought event and helps to illustrate the lack of vegetation and connectivity through the landscape. **Slide 3** provides de locations of Nicaragua in Central America, and the Rivas Department on the country.

When discussing **Don Pedro Alvarez** situation, students can be encouraged to imagine they are in Rivas at the farms, talking to the farmers, looking at trees, evaluating the landscape. The following are some examples of answers given by students:

1. What is the main problem that they are experiencing?

“During the drought period, the lack of precipitation limits the pasture production.”

2. What could be the reason for this problem?

“Drought leads to nutrients loss, loss of soil quality, and loss of production. The effects of drought on the cows: food supply limitations, loss of milk and meat production due to stress.”

3. How can this situation affect future generations (their kids)?

“If trends continue, vegetation cover on Rivas will decrease augmenting the degradation of the land and its natural defenses.”

4. Which are the components associated with this system?

“Farmer, trees, pastures, and livestock are the main components of the system.”

Part II. The Silvopastoral Project

Central America's native forests have been affected to the degree of only 40% cover (FAO 2006). For Nicaragua, expansions of livestock production lead to the deforestation of over 31% of the land (Pomadera 1998; Sánchez et al. 2004). As mentioned in the handout, Rivas has reduced its arboreal coverage significantly, compromising the natural capacity of its systems to withstand climatic disturbances, particularly severe drought events. **Slide 4** provides an aerial image of the area of Rivas in which we can observe vegetations residuals (note than isolated trees, live fences, and riparian forests can be easily identified) and **Slide 5** an example of how some of its landscape would look if standing on a hill.

Slide 6 contains an image of Rivas during the dry and rainy seasons. Regional climate change models for Central America predict reduction in precipitation and an increase in the drying trends (Rauscher et al. 2008). It important to talk about seasonality and how trends have been changing in terms of precipitation and then lead to the pressing problem: severe drought events. These severe droughts represent a socio-economic problem, an environmental problem, and in turn, a management one.

A solution to the mentioned problems on the Rivas landscape is the study and design of silvopastoral systems. Silvopastoral systems involve livestock production using traditional components of cattle farming such as cows and pastures, combining them with the maintenance of woody plants like shrubs or trees in the same land unit (Nair 1993). Silvopastoral systems main products are meat and milk and the grasslands support pastures and herbs that serve as food for the livestock. The woody components of the silvopastoral system (trees and shrubs) can provide many benefits such as: timber, quality wood, shelter and shade for cattle, food (i.e. fruits or nuts). They can also provide indirect environmental benefits such as wildlife habitat and carbon sequestration. Other benefits of having silvopastoral systems are: soil conservation,

improved nutrient cycling, erosion reduction, water supply regulation, biodiversity conservation and even drought tolerance. **Slide 7** provides a diagram (Young 1998) in which some the component of the systems can be identified and some of its benefits are already illustrated.

Silvopastoral systems occur on Mesoamerica as a traditional practice where trees left on farms are selected according to the benefits they provide (i.e. forage for cattle-**Slide 9**). Recent initiatives suggest the design of modern agrosilvopastoral systems based on the knowledge (traditional, technical, and scientific) of the benefits (social, economic and ecological) that plants species provide in order to increase farm productivity and sustainability (Altieri 1999). On the other hand, while some studies suggest that tree cover can benefit humidity retention for pasture production, but if it is too high it will limit pasture growth (Rusch 2013). **Slide 10** shows a graph illustrating the effect of tree coverage percentage on the farm net income. So is important to find that threshold where productivity is not compromised by tree coverage and identify species that provide multiple benefits (i.e. drought tolerance, soil quality, forage) to contribute to the systems sustainability.

Students are asked to propose a solution to the environmental problem from the perspective of a particular stakeholder (farmer, government official, scientist, non-profit organization). Students are divided into smaller groups and instructed to select one spokesperson. A handout explaining the role and questions to solve the problem is given to students and each group discusses the case and generates potential solutions. The handouts for each group included only the environmental problem and one of the stakeholders (see supplement material). Is important to emphasize that students provide solutions taking into consideration the concepts discussed, especially "interdisciplinarity" and silvopastoral systems as a "socio-environmental system".

The area of Rivas is experiencing severe drought events during the dry season. The government is providing food supplies to affected farmers. However, different stakeholders (sectors within society with a stake on the issue at hand) argue that this is just a temporary solution to the problem. Climate predictions suggest that extreme drought events are on the rise which can in turn endanger people's food supplies and their overall well being. A new project is being developed with some of the stakeholders involved to generate a strategy for severe drought mitigation, to increase tree cover, to provide cattle farmers more resistant silvopastoral systems and to meet the food production requirements.

FARMER: Imagine that you are a Rivas cattle farmer who is arguing for solutions to increase the production of their farms. What arguments would you use? What would you claim for?

GOVERNMENT OFICIAL: Imagine that you are a Nicaragua Government official in charge of agricultural policies, what possible solutions or responses would you provide to the farmers?

SCIENTIST: Imagine that you are a scientist recently hired to evaluate the current ecological situation at Rivas. What possible solutions would you propose to the farmers? What kind of data or information might be helpful to inform government official's decision?

NON-PROFIT ORGANIZATION: Imagine that you are a non-profit organization working in partnership with communities, private landowners, public land agencies, and elected officials to create effective conservation solutions. What possible solutions would you propose to solve the problem?

When time is up, each group's spokesperson will explain their group proposal to the class. A volunteer is asked to start the discussion of proposals. If there are no volunteers; one of the students is selected. Each proposal is read out loud, if the proposal is not clear guiding questions can be raised to steer students in the right direction. It is likely that the first proposal has a connection with another stakeholder. This connection is then used to suggest who the next spokesperson will be. For example, if the farmers propose to ask the government for some type of support, then the logical next turn would be to ask the government spokesperson to read their proposal and discuss if they will be able to consider the farmers claims? The idea is to create a discussion as to how to meet the needs of all stakeholders involved emphasizing the complexity of meeting everybody's needs. If the proposals are not too controversial or unrealistic, guidance may be given in the form of creating controversy and the facilitator could play the "devil's advocate" role.

Wrap Up

The final step is to wrap up the discussion by translating group comments to the concepts being discussed and integrating group proposals into 'more comprehensive solutions.' Emphasis is placed on the complexity of the problem and the fact that solutions can't be one sided (i.e., planting trees and reforestation alone is not enough, focusing on the effects of global warming alone will not bring the solution either). To address this problem a much larger combination of factors needs to be taken into account (e.g., exotic species planted at the farms, need for pasture production driven by economic factors, fragmentation, etc.). Addressing environmental issues requires interdisciplinary solutions and as such the importance of taking a holistic approach to asses some of these problems is key. Keeping track of the original objectives during the discussions is a way to ensure that this complexity issue emerges. Encouraging students to generate ideas about how to optimize different components (ecological, social, and economic) of the social-environmental system facilitates addressing the importance of complexity as well. For example, one ecological goal for the Rivas system may be to increase tree coverage and connectivity and reduce land degradation, while social and economic objectives may be to provide cattle farmers with more resilient/resistant silvopastoral systems that can meet their production requirements.

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