

An Interdisciplinary Challenge: The Rivas Case Study



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Part I. An Environmental Story with Interdisciplinary Implications:

First of all, what is interdisciplinarity? Have you ever heard this term before? Indeed, providing students with an education conducive to interdisciplinary thinking and problem solving is at the forefront of higher education programs across the globe.^{1, 2} Interdisciplinarity in a general sense means working across traditional disciplinary boundaries.³ This process is a necessary step when addressing real-world complex problems like the one that will be presented here. The field of environmental science is no stranger to interdisciplinarity, as environmental problems are more often than not complex usually requiring the work of experts from numerous disciplines such as engineering, ecology, sociology, geology, history, economics, and many more!

An ecological system can be defined as a community of organisms connected to each other and to their physical environment (air, water, soil) through a variety of interactions and interdependent relationships.^{4, 5} These interaction and relationships drive a many ecological processes that result in the flow of energy and materials at different spatial scales.⁶ In a departure from traditional

¹ Blake J., S. Sterling and Fumiyo Kagawa. Getting it together. Interdisciplinarity and Sustainability in the Higher Education Institution. Pedagogic Research Institute and Observatory (PedRIO), Plymouth University, Plymouth <https://www1.plymouth.ac.uk/research/pedrio/Documents/PedRIO%20Paper%204.pdf>

² National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. 2005. Facilitating interdisciplinary research. National Academy Press, Washington, D. C., USA.

³ Dalgaard, Tommy, Nicholas J. Hutchings, and John R. Porter. "Agroecology, scaling and interdisciplinarity." *Agriculture, Ecosystems & Environment* 100, no. 1 (2003): 39-51.

⁴Tansley, A. G. 1935. The use and abuse of vegetational concepts and terms. *Ecology*, 16(3), 284-307.

⁵ Molles, M. C., & Cahill, J. F. 1999. *Ecology: concepts and applications* (p. 482). Dubuque, IA: WCB/McGraw-Hill.

⁶ Odum, E. P., & Barrett, G. W. 1971. *Fundamentals of ecology*.

ecology, a growing number of ecologists and environmental scientists emphasize that a key component to the analysis of environmental processes is the recognition of humans (and their activities) as important elements of any ecological system under study.^{7, 8} This new ecological system framework or "socio-environmental system" consists of "tightly linked social and biophysical subsystems that mutually influence one another."⁹ Under this framework the decisions and behaviors of humans influence the state and function of ecosystems (e.g., air, soil or water quality) and in turn the state and quality of ecosystems influence directly or indirectly human well-being.¹⁰

A good example to connect all these concepts are issues associated with food production. The field of Agroecology studies ecological processes that drive agricultural production systems and analyses them not only from an ecological perspective, but a socio-economic one as well.^{11, 12} Issues that need to be addressed in the quest to optimize food production have environmental (soils, water climate, biodiversity), social (health, tradition, culture, gender), and economic (income, marketing, trade) elements.¹³ Agriculture socio-ecological systems are units of study that function in many hierarchies (cell-organisms-population-community-ecosystem-landscape) and spatial scales (cell-organism-animal/plant-plot-field-farm-watershed-region-nation).¹⁴ At the landscape scale, some studies try to identify how socio-ecological systems for food production can increase the connectivity of certain habitats or species across the land and promote biodiversity conservation.¹⁵ At a national scale, studies may address how changes in oil prices may influence food security and the viability of different types of agricultural systems.¹⁶

Let's take the example of the town of Rivas in Nicaragua. Located in southwestern Nicaragua, Rivas is a town mainly populated by small and medium farms whose main economic activities consist of agriculture (sugar rice, beans, maize, wheat, cane and bananas) and dual-purpose production (beef and dairy) from cattle ranching.¹⁷ As in many parts of Central America, Rivas agricultural landscape has been severely modified due to extensive agricultural and livestock production practices. Because of this, farms in the town of Rivas are usually characterized by pastures or cultivated lands and their tree cover throughout the landscape is limited to some

⁷ Redman, C.L., Grove, J.M., Kuby, L.H. 2004. Integrating social science into the long-term ecological research (LTER) network: Social dimensions of ecological change and ecological dimensions of social change. *Ecosystems*, 7, 161-171.

⁸ Monticino, M., Acevedo, M., Callicott, B., Cogdill, T., Lindquist, C., 2007. Coupled human and natural systems: A multi-agent-based approach. *Environmental Modelling & Software* 22, 656-663.

⁹ SESYNC National Socio-Environmental Synthesis Center 2013 Socio-Environmental Systems Glossary Definition Source URL: <http://www.sesync.org/socio-environmental-systems>

¹⁰ Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-Being: Biodiversity Synthesis* (Island Press, Washington, DC). [online] <http://www.unep.org/maweb/documents/document.354.aspx.pdf>

¹¹ Aitieri, M.A., 1987. *Agroecology: The Scientific Basis of Alternative Agriculture*. Westview Press, Boulder, CO, 227 pp.

¹² Dalgaard, Tommy, Nicholas J. Hutchings, and John R. Porter. "Agroecology, scaling and interdisciplinarity." *Agriculture, Ecosystems & Environment* 100, no. 1 (2003): 39-51.

¹³ McIntyre, B. D. (Ed.). 2009. *IAASTD International Assessment of Agricultural Knowledge, Science and Technology for Development: Global Report*. Island Pr..

¹⁴ Dalgaard, Tommy, Nicholas J. Hutchings, and John R. Porter. "Agroecology, scaling and interdisciplinarity." *Agriculture, Ecosystems & Environment* 100, no. 1 (2003): 39-51.

¹⁵ DeClerck, F. A., Chazdon, R., Holl, K. D., Milder, J. C., Finegan, B., Martinez-Salinas, Imbach, P., Canet, L., & Ramos, Z. 2010. Biodiversity conservation in human-modified landscapes of Mesoamerica: Past, present and future. *Biological Conservation*, 143(10), 2301-2313.

¹⁶ Heinberg, R. 2011. Soaring Oil and Food Prices Threaten Affordable Food Supply. Post Carbon Institute. December 4 2011 <http://www.postcarbon.org/article/619300-soaring-oil-and-food-prices-threaten>

¹⁷ FUNCiTree Project www.funcitree.nina

scattered trees, small patches of secondary forest, scrubland, live fences and riparian forests.¹⁸ The highly degraded, fragmented and vulnerable pastures of the Rivas landscape are subject to the seasonality of the marked drought and rainy seasons that characterized this seasonal dry forest ecosystem. On top of that, climate models for Central America predict that dry periods will be more intense (Rauscher et al. 2008).

Read the following extract and following questions and be prepared to discuss them in class:

“Pedro, a Nicaraguan cattle farmer from the small town of Rivas, is talking to his wife (Tita) over dinner about the loss of production in his farm due to the severe drought they are experiencing. The pastures are drying, and the cows do not have enough food. Because of this and the extreme heat, the milking cows are very thin and are not producing as much milk as they used to in the past. “This is even worse than the flooding we had during the last raining season!” Pedro continues to complain about the situation with his wife, “When my father owned this land, there were also more wild animals that we could eat, and one could see the lush vegetation all the way up to the Escamequita Hill! Now even Ometepe Island seems to be drying up and all of its capacity to provide food. “What are we going to live off if the cows do not give milk and we don't have enough meat to consume?”

Questions:

1. What is the main problem that they are experiencing?
2. What could be the reason for this problem?
3. How can this situation affect future generations (their kids)?
4. Which are the stakeholders associated with this system?

¹⁸ Harvey, C. A., Medina, A., Sánchez, D. M., Vílchez, S., Hernández, B., Saenz, J. C., Michel Maes, J., Casanoves, F., & Sinclair, F. L. (2006). Patterns of animal diversity in different forms of tree cover in agricultural landscapes. *Ecological Applications*, 16(5), 1986-1999.

Part II. The Silvopastoral Project

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 OFFICIAL: 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?

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