THE SCHOOL FOR FIELD STUDIES

Principles of Resource Management
SFS 3740

The School for Field Studies (SFS)
Center for Sustainable Development Studies (CSDS)
Atenas, Costa Rica

This syllabus may develop or change over time based on local conditions, learning opportunities, and faculty expertise. Course content may vary from semester to semester.

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COURSE CONTENT SUBJECT TO CHANGE

Please note that this is a copy of a recent syllabus. A final syllabus will be provided to students on the first day of academic programming.

SFS programs are different from other travel or study abroad programs. Each iteration of a program is unique and often cannot be implemented exactly as planned for a variety of reasons. There are factors which, although monitored closely, are beyond our control. For example:

- Changes in access to or expiration or change in terms of permits to the highly regulated and sensitive environments in which we work;

- Changes in social/political conditions or tenuous weather situations/natural disasters may require changes to sites or plans, often with little notice;

- Some aspects of programs depend on the current faculty team as well as the goodwill and generosity of individuals, communities, and institutions which lend support.

Please be advised that these or other variables may require changes before or during the program. Part of the SFS experience is adapting to changing conditions and overcoming the obstacles that may be present. In other words, the elephants are not always where we want them to be, so be flexible!

Course Overview

Our world is changing at unprecedented rates. Continuous population growth, increased life expectancy and declining poverty rates indicate that humanity is prospering. At the same time environmental degradation and climate change are undermining human development, especially in poorer regions of the world. The concept of sustainable development has been around for about 30 years with the goal to reconcile development and the rational use of natural resources in an equitable way. Although sustainability is now an integral component of everyday environmental discourse, as well as of national and international policies, the concept still often appears elusive, or as some even argue in the case of 'sustainable development', an oxymoron. This is at least partially due to the fact that sustainability cannot be ultimately achieved in a changing world. Appropriate sustainable development strategies differ on regional or even local scales and in addition we are challenged to continuously adapt.

Although the cliché statement that "we are all connected" through the processes of globalization appears to be logical, we have in fact a regionalized array of diverse actors and interests. Different models of development at the national level determine the impact on natural resources as a consequence of growing economies and free trade agreements. For instance, land under monoculture plantations is expanding rapidly in Costa Rica, as a result of increasing exports of profitable crops, such as pineapple. These large-scale, intensified production systems exert great pressure on water resources, degrade the soil and pollute the environment. In addition, population growth, unplanned urban expansion and real estate development generate environmental instability which exacerbates vulnerabilities to climate variability, climate change and natural disasters.

In contrast to agricultural lands, protected areas are managed under the paradigm of ecotourism and conservation in Costa Rica. The establishment of protected areas has permitted many developing countries to capitalize on biodiversity for revenue. Thus, conservation of nature and its concomitant generation of income for local economies appear to match the sustainable development rationale. Costa Rica promotes its leadership in conservation policies, emphasizing that over 25% of the national territory is protected. This promotion has resulted in 3 million international visitors, generating nearly $3 billion in 2017. Paradoxically, the natural resources, both within and outside protected areas, continue to be under serious pressure, because increasing visitation is poorly managed. Furthermore, deteriorated infrastructure in combination with weak regulations and enforcement is creating severe pollution and water scarcity in many parts of the country. Even though ecotourism is considered a low impact activity that could balance revenue generation and protection of the environment, it needs regulation and planning. Thus, some protected areas and municipalities are now developing management plans to minimize the negative environmental impacts of accelerated development.

This inter-disciplinary course focuses on principles and applications of natural resources management, exploring alternative ways to ensure equity and sustainability among the actors involved in the use of these resources. The course will introduce the challenges faced by managers of natural resources at the global level, with emphasis on Costa Rica, within the context of climate change, the tourism boom, urban expansion and trade liberalization. Based on specific case studies, illustrated during classes and field trips, the course will show concepts and tools used for addressing complex environmental issues such as conservation of biodiversity, climate change adaptation and mitigation, solid waste management and water management problems.

Learning Objectives

1. An introduction to basic principles of natural resources management in the tropics in a globalized world.
2. An awareness of the priorities of sustainable use of natural resources in a developing country, such as Costa Rica.
3. An understanding of the importance of balancing biodiversity conservation and natural resource use for human development.

CSDS Research Direction

How can Costa Rica respond to local and global challenges while securing the functionality of its natural and human systems?

During the semester, each course will cover two thematic components:

I. Conservation and economic development

II. Ecosystem function and connectivity

These themes will address specific local issues including tourism, water management, the Costa Rican conservation system, agriculture and land-use change, among others. These specific issues will frame the analyses and discussions within each course and will help focus our research:

How does Costa Rican society integrate conservation into current development strategies? The successful integration of conservation and development in fact remains a constant challenge for the country. In this context we are going to discuss the achievements and defects of the national system of protected areas and aspects of the national climate change mitigation and adaptation plan. While new global threats arise, due to increasing pressure on natural resources and environmental change, many old problems have remained unresolved for decades. Among those we are going to focus on waste and water resources management illustrated by Costa Rica's largest river basin, the Rio Grande de Tárcoles, and will analyze potential solutions at different levels (communities and municipalities, private sector, national government).

How does land use affect ecosystem function under current and future socio-economic and environmental conditions? After an introduction to the fundamentals of soil science and tropical agroecology we are going to analyze the environmental and economic impact of some of the region's most important crops (e.g. bananas and coffee) and discuss sustainable alternatives such as organic agriculture and agroforestry systems and their role in climate change mitigation and adaptation. In recent years, urban sprawl and real estate development in rural areas has become a major threat to Costa Rica's ecosystems, especially in scenic areas along the Pacific coast and the Central Valley; therefore its impacts on the environment and on sustainable development options are covered.

Our visit to Panama will give us the opportunity to compare sustainability perspectives between two Central American neighbor countries which face contrasting socioeconomic realities, but share a wealth of natural resources, biological diversity and a high potential for implementing successful sustainable development strategies.

Assessment

Assessment Item	Value (%)
Midterm Exam	25
Final Exam	25
Field Exercise (FEX)	20
Participation	15
Field Lab (FLAB)	15
TOTAL	**100**

Field Exercise (20%): Applying Integrated Pest Management in an organically managed orchard
Currently, the Center makes an effort to improve the sustainability of its operations. Among other initiatives, we have been growing our crops (mostly oranges and mangoes) organically during the last years. Giving up agrochemical use represents a serious challenge, especially under tropical conditions, and requires the development of an integrated pest management (IPM) program. IPM consists of three steps: prevention, monitoring and control. The objective of this exercise is to design and conduct a study about organic management of insects and / or diseases in our orchards over a period of approximately three weeks. For this study you are going to collect your own data, but you will also have access to information compiled during several years of monitoring insects, diseases and climate data on our farm. For this assignment it is expected that you: 1. Develop a well-documented, clear and repeatable research protocol; 2. Collect data of sufficient quality and quantity to support the conclusions you draw from the study; and 3. Prepare a brief report, following the standard outline of a scientific paper.

Field Lab (15%): Mapping exercise at a coffee farm
Sustainable farming often requires a diversification of economic activities, such as intercropping, offering innovative products with added value (e.g. roasted, high-quality coffee), or agro-tourism and education. Mapping represents an essential tool for managing multifunctional farming operations, as it facilitates land-use and conservation planning, crop production, as well as recreational and educatinal activities. In this field lab we will survey the trails and land-use of a coffee farm near Boquete in Panama. We are going to use GPS receivers and GIS software to generate a comprehensive map of the farm.

Participation (15%): Everybody should be prepared for each academic session. This implies reading assigned materials with enough detail to be able to ask relevant questions; and to participate in analytical discussions about key issues. Participation will be evaluated during classes and discussions, considering quality and quantity of your contributions.

Grade corrections for any of the above items should be requested in writing to the professor within 24 hours after assignments are returned. No corrections will be considered afterwards.

Grading Scheme

A	95.00 – 100.00%	B+	86.00 - 89.99%	C+	76.00 - 79.99%	D	60.00 - 69.99%
A-	90.00 - 94.99%	B	83.00 - 85.99%	C	73.00 - 75.99%	F	0.00 – 59.99%
		B-	80.00 - 82.99%	C-	70.00 - 72.99%		

General Reminders

Plagiarism: Using the ideas or material of others without giving due credit – is cheating and will not be tolerated. A grade of zero will be assigned for anyone caught cheating or aiding another person to cheat either actively or passively.

Deadlines for written and oral assignments are instated to promote equity among students and to allow faculty ample time to review and return assignments before others are due. As such, deadlines are firm; extensions will only be considered under extreme circumstances. Late assignments will incur a penalty of 10% of your grade for each day you are late. After two days past the deadline assignments will not be accepted anymore. Assignments will be handed back to students after a one-week grading period.

Since we offer a program that is likely more intensive than you might be used to at your home institution, missing even one lecture can have a proportionally greater effect on your final grade simply because there is little room to make up for lost time. Participation in all components of the course is mandatory, it is important that you are prompt for all activities, bring the necessary equipment for field exercises and class activities, and simply get involved.

Course Content

Key- L: Lecture, **FL:** Field Lecture, **FEX:** Field Experiment, **D:** Discussion, **GL:** Guest Lecture, **O:** Orientation/Context information, **FLAB:** Field Lab, **LAB**: Lab, workshop

No.	*Type*	*Time (hrs)*	*Course Title*	*Objectives*	*Readings*
NRM 01	L	1	Introduction to the Natural Resources Management course	– Course overview, syllabus – Field trips	---
NRM 02	L	1:30	History of conservation in CR	– Socio-economic drivers of deforestation in CR – History of Conservation – Evolution of the National System of Protected areas (SINAC)	---
NRM 03	O	1:30	Orientation hike at Braulio Carillo	– Tropical lowland rainforest: Natural history and ecological basis for conservation and management	---
NRM 04	O/FL	2:30	El Progreso farm tour	– Agroecosystems in the humid tropics – Sustainable agricultural practices – Organic farming	Hunter, M.C. et al. 2017. Agriculture in 2050: Recalibrating targets for sustainable intensification. *BioScience* 67: 386-391.
NRM 05	FL/GL	2:30	Visit to pineapple plantation	– Visit a pineapple plantation – Pinneaple cultivation and history from the company's perspective	Shaver, I. et al. 2015. Coupled social and ecological outcomes of agricultural intensification in Costa Rica (…). *Global Environmental Change* 32: 74-86.
NRM 06	L	1	CSDS Rainforest Alliance Certification	– Implementation and challenges of sustainable practices at CSDS – RFA programs and activities	---
NRM 07	LAB	2:30	Descriptive data analysis workshop	– Organize data using Excel – Measures of location and dispersion – Graphic representation of data	---

No.	Type	Time (hrs)	Course Title	Objectives	Readings
NRM 08	L	1:30	Tropical soils	– Physical and chemical properties of different tropical soils – Nutrient cycling in tropical forests – Soil degradation	---
NRM 09	L	1:30	Agroecology	– Basic concepts – Nutrient cycling and hydrology in agro-ecosystems – Productivity and food security – Sustainable agriculture in the tropics	See above : Hunter, M.C. et al. (2017)
NRM 10		0:30	Briefing Monteverde		
NRM 11	O	1:30	Orientation hike Monteverde on Monteverde Field Station trails	– Premontane forest: Natural history and ecological basis for conservation and management	---
NRM 12	FL/GL	3	Guest Lecture and Farm tour at Life Monteverde	– Sustainable agricultural practices, conservation and agro-ecotourism in the Monteverde area	---
NRM 13	O	1:30	Orientation hike Monteverde	– Cloud Forests: Natural history and ecological basis for conservation and management	---
NRM 14	D	1:30	Water and waste management in Costa Rica	– Two of the greatest challenges for NRM in CR: Waste and water management – Ecological and socioeconomic impacts – Integrated Water Resources Management	Bower, K.M. (2014). Water supply and sanitation in CR. *Environmental Earth Sciences* 71: 107-123 Schoeman, J. et al. (2014). A new paradigm for water? A comparative review (…). *Intl. Journal of Water Resources Development* 30: 377-390.

No.	Type	Time (hrs)	Course Title	Objectives	Readings
NRM 15	FL	1	Pollution of the Tárcoles basin	– A case study: Success and failures of attempts to clean up Tárcoles River – Top down vs. integrated bottom up watershed management approaches	See above: Bower (2014), Schoeman et al. (2014)
NRM 16	O	1:30	Orientation hike at Carara NP	– Pacific lowland transitional forest (tropical dry to moist): Natural history and ecological basis for conservation and management	---
NRM 17	L	1:30	Climate change 1: Scientific basis	– Global energy balance – Carbon cycle – Anthropogenic components of radiative forcing – Feedback mechanisms and land use	IPCC (2013). Summary for Policymakers. *In:* Climate Change 2013: The Physical Science Basis. Contribution of WG I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY.
NRM 18	FL/D	1	Urban Ecology (Class with TE)	– Urban biological corridors: Concepts, planning and management	Peng, J. et al. (2017). Urban ecological corridors construction: A review. *Acta Ecologica Sinica*, 37: 23-30.
NRM 19	LAB	3	Integrated pest management (IPM) – Lab at the SFS orchards	- Sustainable agriculture and integrated management of pests and diseases – Field Methods for monitoring pests and diseases	---
NRM 20	FEX	3	Applied agroecology: Designing and conducting a study about organic management of insects and diseases at the SFS orchards	– Develop a well-documented, repeatable research protocol that allows to evaluate integrated management of insects and diseases over a period of several weeks Collect data of sufficient quality and quantity to support your conclusions	---

No.	Type	Time (hrs)	Course Title	Objectives	Readings
NRM 21	D	1:30	Globalization and Natural Resources	– Trade liberalization and sustainable development – NRM in CR and CAFTA – Free trade, fair trade, forced trade?	---
NRM 22	GL	1:30	Insects as food	– Potential of insect farming as a sustainable source of protein in the context of global food security	van Huis, A. (2015). Edible insects contributing to food security? *Agriculture and Food Security* 4: 20-28.
NRM 23	FEX	1:30	FEX study design proposal	– Discuss the methodological approach for the FEX developed by each group of students	---
NRM 24	FEX	1:30	FEX data collection and analysis		---
NRM 25		1	Review NRM		
NRM 26			**Midterm Exam NRM**		
NRM 27		1:30	FEX data collection and analysis		---
NRM 28	L	1:30	Climate change 2: Adaptation and mitigation	– Vulnerability, scenarios and strategies for Central America – Current international policy framework	Smith, P. et al. (2013). How much land-based greenhouse gas mitigation can be achieved without compromising food security and environmental goals? *Global Change Biology* 19: 2285-2302.
NRM 29	L	1	Intro to NRM in Panama	– Biogeographic, political and socioeconomic context of conservation and NRM in Panama	Sardain et al. (2016). Towards a dashboard of sustainability indicators for Panama. A participatory approach. *Ecological Indicators* 70: 545-556.
NRM 30		1	Briefing Panama		---
NRM 31	L	1	FLAB Instructions		---

No.	Type	Time (hrs)	Course Title	Objectives	Readings
NRM 32	LAB	3:30	Mapping exercise at a coffee farm (Boquete, Panama)	– Operation of GPS receivers – How to generate field data: mapping points of interest, the trail system and trail conditions	---
NRM 33	D	1	Panama: Strategies for sustainable development	– Compare sustainability perspectives in Panama and Costa Rica – Discuss alternative strategies to achieve sustainable development	---
NRM 34	LAB	3:30	FLAB – GIS workshop	– Elaborate a map suitable for recreation and protected area management from data generated in the field – Introduction to free, open source GIS software	---
NRM 35	FL	2:30	Sustainable coffee production	– Sustainable agricultural practices on small farms Organic farming	---
NRM 36	D	1	The role of agroforestry in climate change adaptation and mitigation	– Agroforestry and C-storage potential – Agroforestry and resilience to climate change – The role of functional diversity: potential synergies between conservation and climate change adaptation and mitigation	Häger, A. and G. Avalos. (2017). Do functional diversity and trait dominance determine carbon storage in an altered tropical landscape? *Oecologia* 184: 569-581.
NRM 37		1	Review NRM		
NRM 38			**Final Exam NRM**	–	
TOTAL		**60**			

Reading List

*Readings are listed in the order in which they appear in the above table

Shaver, I. et al. 2015. Coupled social and ecological outcomes of agricultural intensification in Costa Rica and the future of biodiversity conservation in tropical agricultural regions. Global Environmental Change 32: 74-86.

Hunter, M.C. et al. 2017. Agriculture in 2050: Recalibrating targets for sustainable intensification. BioScience 67: 386-391.

Bower, K.M. 2014. Water supply and sanitation in Costa Rica. Environmental Earth Sciences 71: 107-123

Schoeman, J. et al. 2014. A new paradigm for water? A comparative review of integrated, adaptive and ecosystem-based water management in the Anthropocene. Intl. Journal of Water Resources Development 30: 377-390.

IPCC 2013. Summary for Policymakers. *In:* Climate Change 2013: The Physical Science Basis. Contribution of WG I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY.

Jacobsen, S.E. et al. 2013. Feeding the world: genetically modified crops versus agricultural biodiversity. Agronomy for Sustainable Development 33: 651-662.

Klümper, W. and M. Quaim. 2014. A meta-analysis of the impacts of genetically modified crops. PLoS One 9: e111629.

Peng, J. et al. 2017. Urban ecological corridors construction: A review. Acta Ecologica Sinica, 37: 23-30.

Smith, P. et al. 2013. How much land-based greenhouse gas mitigation can be achieved without compromising food security and environmental goals? Global Change Biology 19: 2285-2302.

Sardain, A. et al. 2016. Towards a dashboard of sustainability indicators for Panama: A participatory approach. Ecological Indicators 70: 545-556.

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