



Proyecto

Transformative research and capacity building in the education sector to protect livelihoods and biodiversity in Costa Rica

Investigación transformadora y desarrollo de capacidades en el sector educativo para proteger los medios de subsistencia y la biodiversidad en Costa Rica

Pesquisa transformadora e desenvolvimento de capacidade no setor educacional para proteger os meios de subsistência e a biodiversidade na Costa Rica

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Abstract

Osnabrück University and Universidad Técnica Nacional develop inter- and transdisciplinary approaches in research and education to restore and protect biodiversity. In Costa Rica, many persistent social-ecological conflicts can be observed. The case of the Gulf of Nicoya offers a suitable testing ground for the approaches developed as part of this partnership. This article introduces



the project's focus on the relationship between cultural, economic and political aspects related to conservation, sustainable land use and community development. Currently, the project conducts research on social-ecological conflicts in the Costa Rican pineapple production and its impacts on biological diversity across the land-sea interface. The inter- and transdisciplinary project approach to research and education generates tangible knowledge among researchers, students, and non-scientific local actors.

Keywords: Biodiversity Conservation, Research, Education, Socio-ecological Conflicts, Sustainability.

Resumen

La Universidad de Osnabrück y la Universidad Técnica Nacional desarrollan enfoques inter y transdisciplinarios en investigación y educación para restaurar y proteger la biodiversidad. En Costa Rica se observan numerosos conflictos socioecológicos persistentes. El caso del Golfo de Nicoya ofrece un campo de pruebas adecuado para los enfoques desarrollados en el marco de esta asociación. Este artículo presenta el enfoque del proyecto sobre la relación entre los aspectos culturales, económicos y políticos relacionados con la conservación, el uso sostenible de la tierra y el desarrollo comunitario. En la actualidad, el proyecto investiga los conflictos socioecológicos en la producción de piña en Costa Rica y su impacto en la diversidad biológica en la interfaz tierra-mar. El enfoque inter y transdisciplinario del proyecto en materia de investigación y educación genera conocimientos tangibles entre investigadores, estudiantes y actores locales no científicos.

Palabras claves: Conservación de la Biodiversidad, Investigación, Educación, Conflictos Socioecológicos, Sostenibilidad.

Resumo

A Universidade de Osnabrück e a Universidade Técnica Nacional desenvolvem abordagens inter e transdisciplinares na investigação e educação para restaurar e proteger a biodiversidade. Na Costa Rica, podem observar-se muitos conflitos socio-ecológicos persistentes. O caso do Golfo de Nicoya oferece um campo de ensaio adequado para as abordagens desenvolvidas no âmbito desta parceria. Este artigo apresenta o enfoque do projeto na relação



entre aspectos culturais, económicos e políticos relacionados com a conservação, a utilização sustentável da terra e o desenvolvimento comunitário. Atualmente, o projeto realiza investigação sobre conflitos socioecológicos na produção de ananás da Costa Rica e os seus impactos na diversidade biológica na interface terra-mar. A abordagem inter e transdisciplinar do projeto à investigação e à educação gera conhecimentos tangíveis entre investigadores, estudantes e actores locais não científicos.

Palavras-chave: Conservação da Biodiversidade, Investigação, Educação, Conflitos Socio-ecológicos, Sustentabilidade.

Background

The Global Assessment Report on Biodiversity and Ecosystem Services (IPBES, 2019) calls out for transformative changes to halt the steady decline in biodiversity and ecosystem services. The Costa Rican-German project “Transformative research and capacity building to protect livelihoods and biodiversity in Costa Rica” (CRLiveDiverse) develops inter- and transdisciplinary approaches in research and education to involve stakeholders in the generation of holistic knowledge and the implementation of actions to restore and protect biodiversity in Costa Rica.

Costa Rica is known as a biodiversity hotspot and, in contrast to other countries in the region, has invested heavily in environmental protection over the past two decades. In 2019, the Central American nation received the Champions of the Earth award, the UN’s highest environmental honour, for its role in the protection of nature and its commitment to ambitious policies to combat climate change. Thus, Costa Rica is internationally recognized as a world leader in sustainability placing environmental concerns at the core of its policies. However, the country is struggling with a series of persistent social-ecological conflicts that are difficult to resolve (Estado de la Nación 2019). These conflicts are characterized mainly by competition between various sectors that together guarantee the country's economic prosperity as well as by trade-offs between biodiversity protection and economic development, increasingly to the detriment of the former.

The International Convention on Biological Diversity highlights the challenge of developing viable strategies for biodiversity protection (UN, 1992; CBC,



2000). This challenge particularly includes the integration of local knowledge in research, public awareness raising and the involvement of stakeholders in decision-making. The global assessment report on biodiversity and ecosystem services further stresses that transformative changes are required to halt the steady decline in biodiversity and ecosystem services (IPBES, 2019). Inter- and transdisciplinary research can play a key role here to involve stakeholders in the generation of holistic knowledge and implementation of actions to preserve biological diversity whilst sustaining local livelihoods.

A German-Costa Rican Cooperation in Research and Education

CRLiveDiverse is jointly carried out by the Osnabrück University (UOS) in Germany and Universidad Técnica Nacional (UTN) in Costa Rica.

UTN strives towards having a transformative impact through the development of business models in sustainable agriculture and aquaculture and their transfer into practice. This involves offering educational programs to develop leadership skills in students. At UTN, the Center Sustainable Development Studies (CEDS) was recently established. It is conceived as an academic body of the highest level, whose main function is to provide scientific and technological criteria to contribute to the reduction of the asymmetries presented by the current development model and its impact on the environment and society. The concepts of sustainable development and fundamental human needs as well as the Sustainable Development Goals (SDGs) serve as a frame of reference. With its actions, it seeks to strengthen research, transfer, implementation of education and training programs, informative modules, publications, sale of services as well as to serve as an institutional platform for the implementation of academic activities related to sustainable development, which implies ecological balance and economic and human development in an integral manner.

At UOS, the Institute of Environmental Systems Research (IUSF) is a multi-departmental institution comprising members from Mathematics, Economics, Geography, Computer Science, Biology, Cultural Studies and Geosciences. Changes in environmental systems, problems ensuing from these changes and their solutions are the focus of the institute's activities. IUSF understands environmental systems as dynamic interplay between nature and society. The institute develops the knowledge base for understanding, assessing and transforming concrete systems. A variety of methods is used in an integrated



manner, and developed further. A specific current focus is on human-environmental problems linked to biodiversity protection, often with a focus on water, energy and food systems, using systems science methods in order to find integrated and locally-adapted solution strategies (e.g., Pahl-Wostl, 2015; Gorris, 2019; Halbe and Adamowski, 2019). Moreover, research addresses human-environment interactions through narrative analysis (e.g., Schlünder, 2018, Koch et al., 2021). In all its work, IUSF strives to combine disciplinary depth with a holistic understanding of environmental systems, also at the level of young scientists, and thus to contribute effectively in interdisciplinary teams to solving important social and ecological challenges. This partnership creates strong synergies.

UTN has extensive experience in supporting the development of practical sustainability innovations and facilitation of leadership, while UOS has a long tradition in systems science and inter- and transdisciplinary cooperation. Through the exchange on sustainability innovation and leadership skills, this partnership promotes transformational change in Costa Rica in terms of the protection of biodiversity and ecosystem services. This collaboration also supports education in these areas at both universities by allowing students and researchers to gain experience in and a good understanding of the linkages between biodiversity and development issues through first-hand experience in research and teaching. Through the exchange on sustainability innovation and leadership skills, this partnership contributes to accelerate transformational change in Costa Rica as well as in Germany in terms of the protection of biodiversity and ecosystem services.

The Gulf of Nicoya: An example for the challenge to reconcile biodiversity conservation objectives and sustaining local livelihoods based on natural resources

Costa Rica has invested heavily in environmental protection and is a forerunner in Central America. However, what is perceived as trade-offs between the SDGs, particularly SDG1 'End Poverty' and SDG 15 'Life on Land', underline the paramount challenges to navigating between socio-economic development and biodiversity protection. The case of the Gulf of Nicoya offers a suitable testing ground for the approaches developed as part of this partnership.





The Gulf of Nicoya on the west coast of Costa Rica, one of the most productive tropical estuaries in the world, is a paradigmatic example of such a social-ecological conflict and associated trade-offs. The Gulf is Costa Rica's main fishing area for artisanal fishing and highly attractive for tourism due to its high level of biodiversity (Herrera Ulloa et al., 2011). However, declining tourist numbers in recent decades have forced local communities to find alternative sources of income in the fishing and agriculture sectors, often with adverse effects on biodiversity. The depletion of fish stocks has forced authorities to implement a strict fishing moratorium to protect aquatic biodiversity, which has however further constrained the livelihood opportunities of local communities. Thus, innovative strategies and measures are needed to achieve poverty reduction (SDG 1) and protection of maritime and terrestrial biodiversity (SDGs 14 and 15). The worldwide plunge in foreign direct investments by 40 percent due to the Corona pandemic (UN, 2020) intensified social-ecological conflicts, due to the reliance of the country's tourism and food processing industries on these funds.

Overfishing and continued illegal fishing have had a negative impact on the marine ecosystem in the Gulf of Nicoya (Láscarez 2012; Palacios & Villalobos 2007), which is relevant for over 15,000 fishers. Mangroves in the gulf host high levels of biodiversity and are under stress, while they form economically and environmentally important ecosystems as they are essential for the breeding of long-lived high-trophic-level fish whose nuisance can lead to a significant loss in fish stocks (Alms & Wolff 2019). The main tributary to the gulf, the Tempisque River, is called "a slowly dying giant". It is not only the main tributary to the gulf but also the main source of water for Costa Rica's most important intensively farmed province, Guanacaste. This province has the largest sized farms in the country, 82% of which are applying fertilizers and 90% using pesticides. Agricultural pollution and water consumption have a significant impact on freshwater systems which in consequence also leads to pollution of the maritime ecosystem in the gulf. Approximately 24,000 hectares of sugar cane (55% of Costa Rica's output), 5,300 hectares of melon, and 25% of the country's rice production depend on the river (FAO 2019).

With around half of its water resources allocated to sugar cane plantations, 90% of Tempisque's water is allocated to agriculture. Additionally, there is illegal pumping, sewage pollution, pesticides and deforestation affecting this and other tributary rivers to the Gulf. At the same time subsistence farming is





important to the livelihoods of many in the region and should receive more attention. As a consequence of climate change, droughts are increasing, which further exacerbates the problems that these farmers are facing: Due to the El Niño phenomenon, Costa Rica experienced the most severe drought in 75 years between 2014 and 2016. Tourism serves as another source of income in Costa Rica and has an ambiguous effect on the environment. On the one hand, together with altering land-use patterns, it acts as a driver of excessive water consumption and pollution. On the other hand, ecotourism tends to have a positive effect on livelihoods and the protection of the environment. There is a common understanding among international donors, development agencies and the Costa Rican public that alternative employment strategies and further sources of income are needed. Accordingly, new jobs and services are seen as key to successful conservation efforts in the Gulf's region.

An underlying cause for persistent social-ecological conflicts is the lack of participation in environmental management (Calvo 2018). Therefore, an interdisciplinary systemic perspective is to be taken and work is to be carried out on an interdisciplinary basis using various empirical research methods and participatory processes that bring together different stakeholders to establish efficient management structures for these complex social-ecological networks (e.g., Pahl-Wostl, 2015; Heimann, 2018, Kluger et al. 2020). Various studies have shown the importance of cultural factors on participatory processes in environmental conflicts (e.g., Schilling-Vacaflor & Vollrath, 2012). To be able to fully explore the specific social and cultural factors underlying social-ecological conflicts, joint contributions from natural sciences, political sciences and humanities are necessary. Research topics include, for example, how municipalities work together; how the inter-sectoral and inter-municipal cooperation of relevant actors (e.g. from the food, energy and water sectors) can be promoted through inclusive management processes; the importance of discourses, narratives and culturally determined attitudes and behaviours in the population when it comes to solving environmental and resource problems locally; what opportunities are offered by technological innovation and transformation; what are relevant actors for environmental governance; and which strategies are suitable for establishing cooperative management structures and facilitating exchange in (new) stakeholder networks. Especially with regard to the interdependencies of food, water, employment and their vast implications for environmental quality, a nexus-perspective should be applied (Pahl-Wostl et al. 2021). In particular, the governance dimension of



this nexus-perspective should be considered to address the complexity of human-environment relationships, which again can be guided by the Narrative Policy Framework (e.g., Ingram et al., 2019) that includes the impacts of power-related, economical and socio-cultural narratives.

Importantly, our transdisciplinary approach actively involves stakeholders in research, links research to local processes of (social and technological) innovation by carrying out transformative research and empowers students and lecturers on both the Costa Rican and German side to become “change agents” or “transition intermediaries”. This is supported through the partnership by helping participants to develop entrepreneurial skills, learn about managing transitions and explore new business models based on state-of-the-art science and local practices. Moreover, linking up with local initiatives will help in building transformative networks between science and society.

Inter- and transdisciplinary education in practice

Several activities are realized to promote inter- and transdisciplinary education. These include, for instance, exchanges between students, the creation and implementation of joint learning modules with interdisciplinary focusses, and summer schools in both countries. For instance, a 12-day-long summer school on ‘livelihoods and biodiversity in Costa Rica’ was organized by the project in Atenas. The participants were students of Bachelor and Master programs at UOS and UTN. The students learned about the interrelationship of cultural, economic and political aspects related to conservation, sustainable land use, community development and livelihood protection in class room sessions and field trips. The program consisted of introductory talks and exercises complemented by student projects in small groups on the interplay between livelihoods, land use and aquatic as well as terrestrial biodiversity. Moreover, inter- and transdisciplinary methods for research were taught focusing on participatory methods that allow for stakeholder engagement and integrated analysis of social-ecological problems. These methods included, for instance, participatory modelling using causal loop diagrams and fuzzy cognitive mapping. The field trips provided students with insights into the potential and challenges for joint implementation of biodiversity conservation and transformative change towards more sustainable livelihoods in order to support experience-based learning and allow for in-depth reflection on solution strategies.





Impressions from the summer school on 'livelihoods and biodiversity in Costa Rica'. Photos taken by A. Schilling-Vacaflor

The following reports some selected insights from the educational field trips during the summer school. Tourism is one of the sectors that generates the highest annual revenue for the country, but at the same time, it has suffered a great tendency to industrialization, which implies the implementation of large international hotel chains, and leave aside sustainable practices in favour of economic gains. This industrialization of tourism may negatively affect rural tourism in Costa Rica, for instance due to the fact that small tourist centers see their annual rate of visitors reduced. Therefore, solutions to address this problem by promoting more environmentally-friendly tourism are needed to transform current practices towards more sustainable pathways. Semi-structured interviews were carried out by the students to explore aspects that facilitate and obstruct local small-scale businesses' engagement in sustainable tourism and obtain concrete business ideas.

One group focused on Costa de Pájaros, a coastal community bordering the Gulf of Nicoya. The interviews revealed the importance of working together in the community and setting up external business networks to attract customers and exchange experiences. Moreover, the interviews with local entrepreneurs showed the students an impressive engagement. Students gained first-hand insights into the local sustainable agroforestry system to produce crops and

local measures for protecting the fish stocks around Costa de Pájaros. A particularly interesting insight was the production of upcycled plastic products made from locally collected waste in the environment as a business model. It was also evident that, despite local efforts to build an attractive social and environmental community context locally to facilitate sustainable tourism with low environmental impact, external funds, and technical support (e.g., from the state and/or universities) are needed to further develop and promote the local projects properly. Moreover, the various organizations are not yet networked well with each other and do not bundle their strengths and knowledge, although there is potential for cooperation. An example includes that the owners of a lodge could buy handicrafts from an association to decorate their rooms or the restaurant area and, in return, allow the vendor a space to sell the handicrafts to the tourists in the lodge. Mutually beneficial synergies between the business models could thus be created.

The other group visited the two communities of Pozo de Agua and Matambú. Pozo de Agua is a small village near the Gulf of Nicoya that is greatly impacted by the Rio Tempisque flowing nearby. Its tidal shifts overflows large portions of the surrounding areas, turning them into swamps for long periods of the year. Naturally, this attracts many species of endemic birds, reptiles, amphibians, and plants as well as migrating birds. However, because of economic interests, investors seek to use these wetlands for their own benefit by cultivating crops and cattle.

The main tourist attraction of Pozo de Agua is a small island in the swamps, called El Tieso, with a rustic restaurant run by locals. The staff is part of an association of more than sixty women from local communities in Guanacaste, who promote and sell corn-related products often produced using ancestral techniques. The products can range from corn seeds or corn flours to cultural experiences like El Tieso. On 'El Tieso', they mainly serve traditional dishes, such as locally caught fish and many variations of corn-based food and drinks. As the village is in a very remote area, the people try to earn additional money by accommodating tourists in private homes for a small fare. This has added benefit in that it allows the community to distribute earnings among more villagers (e.g., by selling locally produced food, drinks or handicrafts).

Moreover, the students visited a tourist facility in the indigenous territory of Matambú. Under their tourism brand 'Namu Nekupe', three members of the



Chorotega tribe offer insight into the traditional lifestyle of their ancestors by showing and explaining musical instruments, games, food and drinks, their traditional homes, and traditional handicrafts like pottery. The interviews with local entrepreneurs and community members show, yet again, the particular problem of low tourist numbers to sustain the low impact local tourism. The reasons are locally seen in the lack of infrastructure, which includes missing internet, bad access to public transport, and in the case of El Tieso the lack of clean water and electricity on the island. Moreover, in Pozo de Agua there are additional aspects complicating attracting tourists, such as the reliance of tourists on private residences for accommodation. Another specific challenge, according to the local informants, relates to insufficient education and knowledge in both communities. Operating tourism business requires a certain media know-how to promote the business online on social media platforms, as well as basic English language skills to communicate with foreigners. Learning new business management techniques would almost certainly help ensure a secure income for a community that does not exclusively rely on domestic tourists. The lack of identity within the community, especially among the youth, was reported to be another problem for tourism. This is further aggravated by a scarcity of governmental support for indigenous culture, resulting in youth migration movements towards the cities, which offer better professional perspectives. Furthermore, the lack of governmental and institutional support hinders indigenous communities such as the one in Matambú to further improve their businesses. As a means of promotion, local entrepreneurs had asked tourism centres and hotels to recommend their facility to tourists, since they struggle with media presence and, as of now, mainly rely on word-of-mouth support. In almost all cases, their requests were denied.

Local concerns also relate to environmental integrity. Land grabbing and unsustainable land use in the area were highlighted in the interviews. For instance, neighbouring real estate construction by investors lead to substantial ecological problems, which include extreme sedimentation and erosion along rivers, higher nutrient input into the water and soil resulting in algae blooms, and a reduction in water availability. Such damage to the local ecosystem results in significant disadvantages for nature-based tourism activities. If the tourists' expectations cannot be met, local entrepreneurs involved in nature-based tourism will not be able to sustain their businesses.





This summer school not only provided students with valuable theoretical and practical insights, but also resulted in sharing expertise in research methods and teaching practices among senior researchers of UOS and UTN. Junior as well as senior researchers from both partners functioned as organizers, lecturers and supervisors of the student research projects. In that way, tangible knowledge was generated and exchanged among researchers, students and non-scientific local actors.

Outlook

Trade-offs between biodiversity conservation and economic well-being are frequently encountered in Costa Rica. A stronger emphasis on economic development compared with the protection of biodiversity can, for instance, be observed along the national pineapple production. Whereas large parts of the agricultural sector were based on subsistence farming until the 1980s, Costa Rica is now one of the leading pineapple exporters and, at the same time, reportedly the world leader in pesticide usage per unit of food produced (Morataya Montenegro and Batista Solís, 2020, 94). Nevertheless, the pineapple production is promoted as ecologically sustainable to consumers (Del Monte 2021, Kifa and Andraka, n.d.) and promises the Costa Rican population sustainable economic growth through the use of technology. This narrative, however, downplays the destructive side effects of pineapple production (León Araya, 2021,122). The fact that an agricultural production method that contaminates entire areas and displaces traditional production methods is labelled as “sustainable” warrants an examination of the underlying sustainability concept. Recent research has shown that the strong economic orientation of the prevailing sustainability paradigm can provide explanatory approaches here (Gutiérrez Arguedas and Granados Chaverri, 2020, Herrera Rodríguez, 2013, Isla, 2015, León Araya, 2022, Monge Hernández, 2015, Ramírez Cover, 2020). The strong role economic well-being plays within the sustainable development paradigm, and its primary definition as economic growth, has been criticized early on (Escobar, 1995, Sachs, 1991, Sachs, 2000, Schmieder, 2010) and is at the centre of current debates on the dominant sustainability concept in Costa Rica and elsewhere (Bendell, 2022, Mariño Jiménez et al., 2018, Rivera Hernández, 2017, Santamarina et al., 2015, Wanner, 2015). This neoliberal approach segregates spaces of socio-ecological unity into the designated “pristine areas” for promoting ecotourism on the one hand, and economic areas fostering economic growth on the other.

Such an approach encompasses contradictory practices and ignores the interplay between sectors.

The results of our analysis of Costa Rican pineapple production in the context of the Sustainable Development agenda will be compiled in a special issue published in Revista Arjé in 2024. The articles include various perspectives from the fields of social, environmental, cultural, and literary sciences. The results illustrate contradictions in the country's sustainability reputation, highlight negative environmental consequences along various dimensions of the national pineapple production and explore promising pathways to better balance economic growth with biodiversity conservation.

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