Integrating scientific and local knowledge to address environmental conflicts: the role of academia

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Abstract
The world is witnessing an increase in environmental conflicts (ECs) caused by the overexploitation and pollution of natural resources. We argue that addressing the unsustainable and vicious cycle of most contemporary human-nature interactions fuelling these conflicts requires a shift towards inter- and transdisciplinary research. Through critical reflection upon six case studies, we conclude that transdisciplinary approaches often require academic researchers to not only integrate local and scientific forms of knowledge but also to open the research process to changes of epistemological assumptions and initial research designs in conjunction with local populations. We suggest that addressing ECs from a transdisciplinary viewpoint requires academia to review its role from ontological and epistemological perspectives through theoretical and procedural standards, to the reward and funding systems.

Keywords Environmental conflicts · Natural resources · Social struggle · Interdisciplinarity · Transdisciplinarity · Dialogue of knowledge(s)

Introduction
A development model based on perpetual economic growth and the appropriation of nature has put an inordinate amount of stress on socio-ecological systems all over the world through overexploitation and pollution of natural resources such as land and water (Fairhead et al., 2012; Gudynas, 2021). Local communities often take the role of stewards for resource and biodiversity conservation; in particular, the rights of indigenous peoples are intrinsically entangled with the use and conservation of about 40% of all terrestrial protected areas (Garnett et al., 2018). Although these communities are under pressure to preserve their surrounding environment and livelihoods, they increasingly find themselves engulfed in environmental conflicts (ECs) both internally and with external actors, such as corporations and states (Arsel et al., 2016; Raftopoulos, 2017; Svampa, 2019). The Environmental Justice Atlas, which documents ECs based on participatory registration, documented an average of more than 300 cases per year between 2011 and March 2021 worldwide (Scheidel et al., 2020; https://ejatlas.org).

Academic discussion on the root causes of ECs and on their evolving character has acquired urgency and importance as they spread across a large and complex set of social, economic, and political factors. Libiszewski (1992) and van Jaarsveld & Bob (2010), for example, identified anthropogenic environmental change as a major reason for social disruptions and decline in people’s economic conditions that are further exacerbated by discord among different interest groups in the use and distribution of natural resources. The material and energy flows (i.e., social metabolism) of the economic process are major concerns for Martinez-Alier (2002), who posits that ecological distribution conflicts have increased due to the intensification of resource extraction,
leading to new hazards of waste and pollution. Escobar
(2008) points to struggles over meanings and ontological
differences and identify conflicts as not only economic and
ecological but also cultural. Gudynas (2021) defines conflict
as contending collective actions, which emerge out of dispara-
rate valuations, perceptions, or meanings accorded to eco-
nomic and ecological dynamics. In light of these concepts,
we here define ECs as complex social struggles over natural
resources at the intersection of social, ecological, cultural,
and political relations.

We aim to critically explore the role of academia in creat-
ing knowledge to better understand the complexities of ECs
and support informed decision-making at the local level.
We focus on inter- and transdisciplinarity as core concepts
and highlight benefits and challenges of both approaches.
Interdisciplinary research is based on broad comprehen-
sion of social-ecological systems and the ability to integrate
approaches and methods from different disciplines (Biber-
Freudenberger et al., 2018). This includes, for example,
mixed methods approaches or integrated modelling. Trans-
disciplinary research goes one step further and “seeks to
involve all stakeholder and target groups in the planning and
research phases” (ibid.: 32). In this regard, the cross-fertil-
ization of ideas, co-production of knowledge, participatory
research and analysis as well as other approaches to explore
the space between academic methods and local knowledge
and management practices is likely to provide findings with
greater potential to identify, monitor, understand, and solve
real life challenges and ECs as the understanding of eco-
logical, cultural, and economic determinants of conflicts
become clearer throughout the research process.

We first discuss the relevance, pitfalls and benefits of
inter- and transdisciplinary research on ECs, and elaborate
insights in the context of six case studies that applied inter-
and/or transdisciplinary research methods to examine
practices in natural resource management among projec-
ts based at the Center for Development Research (ZEF)
of the University of Bonn from 2015 to 2021 (Table 1). Al-
though there is a large number of projects applying these
approaches, the researchers in these specific cases discussed
them at length during the Tropentag Conference of 2019 in
Kassel, Germany, and subsequently, through an iterative
process of reflection on which this paper is grounded.
As academic researchers interested in advancing transdiscipli-
narity in our work, these experiences led us to reflect on our
role in fostering social change, especially as envisaged in
transdisciplinary approaches. We understand that, given the
complexity of factors involved in ECs, only striving for inte-
gration and mutual interdependence of knowledge systems
and epistemologies (Davis, 2006) has the potential to make
ECs more evident and comprehensible to the larger society
and thus to contribute more effectively to their resolution.

We begin with a brief introduction to inter- and transdiscipli-
nary research, followed by the presentation of the six case studies: (i) methods and practices of participatory
assessment and mapping, (ii) the challenges of engaging in
local consultations in conflicting settings and, (iii) experi-
ences bridging academic research methods and local knowl-
edge and perspectives. This leads us to a discussion of the
lessons learned in applying inter- and transdisciplinary
approaches in the field. We conclude by reflecting on the
role of academia in disentangling the complexity of socio-
environmental factors contributing to ECs through inter-
and transdisciplinary research.

**Inter and trans-disciplinary approaches in
natural resource management**

Reflections on inter- and transdisciplinary research for the
most part do not focus on the research cycle (MacLeod,
2016; Pohl, 2021), particularly on the challenges faced by
researchers in the field. Here, we focus on the inter- and
transdisciplinary research process and argue that if aca-
demia is to fulfill its role of illuminating alternative ways of
thinking and knowing, beyond requiring new epistemologi-
cal perspectives, we will need a profound discussion about
the difficult choices that researchers must make in the field
and about their academic requirements in the process of co-
creating knowledge.

**Trends and challenges of inter- and
transdisciplinary approaches**

The modern Cartesian divide has defined the methodologi-
cal, ontological, and epistemological underpinnings of aca-
demic disciplines of natural and social sciences (Berkes,
1999). It has also created an almost water-tight hierarchi-
cal separation among disciplines – ‘hard’ sciences, which strive
towards objectivity, neutrality, and generalisation in knowl-
edge production through scientific reasoning are often kept
isolated from ‘soft’ sciences or humanities, which stress
context specificity and a relative reach of subjectively inter-
preted research results. This kind of compartmentalization
has led to a somewhat surly territoriality towards theories
and schools of thought that are the preserves of particular
disciplines (geography, as the discipline of well-known
polymaths such as Alexander von Humboldt might be an
exception here). Regrettably, this undermines the potential
for shared ideas and explorations across disciplines as well
as within them. Related to this territoriality of disciplines
(Friman, 2010; Molina, 2008) is the reductionist perspec-
tive on research both in social and natural sciences leading
to oversimplification of complex realities, often obscuring
or distorting them. A more productive arrangement could be the cross-fertilization of ideas and practices between hard and soft sciences along with open channels of inclusion for non-academic or local knowledge and the wisdom to benefit from the lived experiences of people at the grassroots level.

Many strands in complexity study have shown that the knowledge domain of disciplines is limited and that not all interdisciplinary approaches necessarily adopt a transdisciplinary research approach fostering collective, inclusive, and context-driven co-production of knowledge (Klein, 2004). But transdisciplinary research by definition encompasses different disciplinary and interdisciplinary methods (Max-Neef, 2005; Ramadier, 2004). As Lawrence (2010) and Ramadier (2004) have argued, transdisciplinarity does not automatically follow interdisciplinary research but requires the involvement of non-academic stakeholders and the integration of other forms of knowledge; it requires a dialogue of knowledge(s) (Vargas-Madrazo, 2015). Research on biodiversity conservation planning, for example, can be studied in an interdisciplinary way including disciplines such as economics, social science, and ecology (Freudenberger et al., 2013), transdisciplinary approaches however, require the involvement of decision makers and stakeholders (Arkema & Ruckelshaus, 2017). Participatory Action Research (PAR), for example, aims to involve local people and researchers in group-dynamic processes throughout the planning, implementation, and analysis stages (Fals Borda, 2015). Research is designed to develop solutions with those most affected by the jointly defined problems (Chambers, 2008). In development, sustainability, and integrated environmental research, several participatory methods have been developed to let local realities guide the research process. Inspired by authors such as Freire (2014) and Fals Borda (2015), these participatory research methods gained prominence in international and development cooperation to support communities in changing their environments in their own ways.

For the academic community, the incorporation of local knowledge means not only enriched solution-oriented research but a challenge to the assumption of universal validity of scientific theory and methodology. From this challenge derives the importance of reflecting on one’s own position in the participatory research process; without this perspective, the views of marginalized people may be ignored and the knowledge of local populations may be misunderstood and misused for purposes unhelpful to their interests. In order to also implement a transdisciplinary research project collaboratively and to break down power relations between researchers and communities, long-term projects are preferable to, for example, Rapid Rural appraisals, as suggested by Wentz Diver (2014).

While providing promising approaches for solving complex environmental conflicts, inter- and transdisciplinary research are also characterized by distinct as well as common challenges and problems. Problems in interdisciplinary research are often related to (a) the social and political embeddedness of knowledge production and (b) difficulties attending the creation of a common language and an enabling environment for knowledge exchange (cf. Donaldson et al., 2010; Mollinga, 2008). Given the role played by important political and private sector entities in initiating and even commissioning most interdisciplinary environmental research projects, there is always an emphasis on clearly formulated objectives and the process of achieving them. These projects, understandably, stick to common epistemologies, which target a well-modulated exchange and integration of data produced by multiple disciplines (Donaldson et al., 2010). Exceptions to the agreed upon epistemologies are uncommon. The question arises as to whether these functional and instrumental modes of interdisciplinary studies are sufficient and effective in untangling and clarifying the messy realities of ECs, often informed and driven as they are by political and social contestations. For the study of environmental problems, Donaldson et al., (2010) suggest the application of less functional and thus instrumental modes of interdisciplinary studies, more ‘radical’ or ‘reflexive’ ones, in the sense of Burawoy (2005).

Radical and/or reflexive interdisciplinarity includes non-academic actors in knowledge production (co-production of knowledge), accepts different epistemologies, and allows for scrutiny of scientific ‘taken for granted’ assumptions. Thus, to engage in these radical/reflexive forms would take theoretical questions besides empirical solutions into consideration and be even more productive for scientific reasoning (Donaldson et al., 2010). A transgression of disciplinary norms by opening up of accepted ontological and epistemological assumptions helps integrate non-academic knowledge into research, and engage in transformative and participatory action to address ECs.

Transdisciplinary research for environmental conflicts

The potential “real-world” impact of a scientific approach ranges from supporting knowledge-based or evidence-based policy-making (Sutherland et al., 2004; Shepherd et al., 2015) to transforming societal behaviour. However, contemporary scientific research is often facing a dual crisis of relevance and communication (Polk & Diver, 2020). Firstly, its preoccupations are found to be far removed from the concerns of society and decision-makers. Because traditional disciplinary research approaches tend to oversimplify and ignore important socio-ecological interlinkages
we often experience a disconnect between the research priorities of the scientific community and other stakeholders. Secondly, the results of the research are in most cases communicated exclusively in a technical jargon that is incomprehensible and inaccessible to most people outside of academia. Published material of this sort remains confined to peer-reviewed journals and decision-makers and society rarely becomes aware of these findings.

One of the most significant challenges researchers are facing today is that of maintaining and promoting methodological rigor, while staying relevant to diverse real-world practice contexts (Geng et al., 2017). Investigating complex issues, such as ECs, requires transdisciplinary research approaches, which are time-consuming and not always considered by standard academic reward systems (e.g. publications in scientific journals, citations).

As a result, communities and policy advisers have often been reduced to subjects in many research projects or they are only consulted towards the end of a project as they are seen merely as recipients of knowledge (Pagliarino & Rolfo, 2021; Sulifoa & Cox, 2020). As a result, as Chambers et al., (2021) report, the potential of case studies with a focus on providing knowledge to initiative shifts in decision making is rather limited. However, to get a more comprehensive and system-oriented understanding of ECs, stakeholders should be seen as partners in research projects right from the beginning, participating in problem phrasing and team building, as well as finding common definitions for important nomenclatures like “sustainability.” This approach would facilitate a stronger focus on the conflict rather than the method (Lang et al., 2012), and stakeholders would develop a sense of co-ownership of the research rather than as mere research subjects or sources of data. Finally, targeted research outputs for different stakeholder groups and their needs as well as holistic and system-oriented assessments would further strengthen the relationship with stakeholders (Lang et al., 2012).

Rather than being mutually exclusive, inter- and transdisciplinary research are complementary approaches to research design and implementation. Most importantly, they can act as drivers for each other, and while interdisciplinary research is not necessarily relevant if it does not relate to the decisions that policymakers, business owners, and land users have to make every day, transdisciplinary research requires interdisciplinary approaches covering all dimensions of decision-making (Brown et al., 2015).

Mapping, assessing, and dialoguing: examples of inter- and transdisciplinary approaches in environmental conflict settings

Our six case studies applied inter- and/or transdisciplinary research practices in natural resource management among projects based at the Center for Development Research (ZEF) of the University of Bonn (Table 1) and we chose them to showcase the relevance and challenges presented by these approaches, particularly when a dialogue of knowledge among academic researchers and local actors is pursued in settings marked by environmental conflict.

The cases are diverse because they address either ongoing or potential ECs, they were conducted either by one or a group of researchers, and they adopt different methods. What they have in common as inter- and/or transdisciplinary research (Hoffmann et al., 2019; Rigolot, 2020) is: (1) channels of inclusion for non-academic knowledge were open to change the course of the research outputs, in some cases this included the research objectives and methodology; (2) new knowledge was produced through a dialogue established with the local population along the different research stages, and this was clearly reflected in the research results; (3) they were inherently problem and solution-oriented; (4) complex socio-ecological relations were addressed through a combination of two or more disciplines either by one researcher or by a team; and (5) governmental decision-makers were included in the conversation and co-produced knowledge was made available for them to take action in practice.

We first describe cases from Ecuador and South Asia (India and Nepal) to reflect on participatory assessing tools and mapping as methodologies to approach potential ECs. These examples underline our broad attempts at initiating a dialogue with forms of knowledge that do not necessarily fit into the current models of academia. The second set of cases from Brazil and Peru reveal the often-contrasting ways in which various stakeholders perceive and value natural resources, and how those divergent meanings pose a challenge to researchers using transdisciplinary approaches. Finally, two case studies on deforestation and tree plantations respectively in Mexico and Chile illustrate how transdisciplinary dialogues can bring scientific research and social demands closer to each other to facilitate more effective decision-making.

Participatory mapping for forest management in Ecuador

Many indigenous communities across the world are or have been highly dependent on forests for their physical as well as socio-cultural sustenance. The rhythms and patterns of their
lives revolve around continued access to ecosystem services (ES) such as fuel-wood, timber, useful plants, and wildlife that the forests provide. Often - as in this case study - local livelihoods are also dependent on traditional agroforestry systems called “chakra” as well as different types of crop-lands where the forest is cleared (Delgado-Aguilar et al., 2017). Consequently, forest uses and protected areas designated and endorsed without consulting the concerned communities can initiate EC processes. Many scientific studies use expert assessment to evaluate the capacity of a forest to provide different kinds of ES and come up with suggestions for sustainable use. However, these studies frequently fail to reflect local perspectives of forest uses and the spatial distribution of actual resource use (Delgado-Aguilar et al., 2019).

Delgado-Aguilar et al., (2017) provide an example of the use of participatory mapping and spatial analysis of local forest uses, which helped identify hotspots of environmental services that call for the development of management plans in cooperation with the local communities. The Sumaco Biosphere Reserve (SBR) in the central-northern part of Ecuador (Napo province) is a protected area afflicted by conflicts over forest use and management because of population pressure and intensifying forest and land uses. They first conducted 15 semi-structured interviews with experts to identify the most important ecosystem services used by the communities in the study area. In a second step, using a 3-D map, 208 members of 24 communities were asked to identify where they utilise the different ES (food, wood, water, tourism, hunting). The highlighted localities were digitised and then analysed with statistical and GIS techniques. The results showed that the ES locations were not randomly distributed, but were most abundant four kilometres or less from roads, which led to the identification of the hotspots under significant pressure by local demands for ES.

As the identification of management practices leading to forest degradation falls in the domains of different disciplines, the combination of participatory mapping and spatial pattern analysis allowed the identification of priority areas in need of formal or informal forest management agreements. However, Delgado-Aguilar and colleagues concluded that developing and negotiating such agreements
would require a more long-term engagement in the study area due to the complexity of SBR administration and the lack of clarity related to land tenure for both communal and individual titles. Forging a longer-term relationship with the indigenous communities would also enable their involvement in data evaluation along with data collection (see Schmitt & Mukungu 2019). Moreover, a continuous and long-term task that goes beyond the capacities and time frame of most scientific projects or programs would have enabled engagement not only with the local communities but also with local organisations and protected area authorities to develop management solutions that meet local as well as conservation expectations.

**Environmental flows: acknowledging the complex relationships between humans and rivers in South Asia**

Harnessing water from rivers and streams is crucial to meeting the modern developmental needs of society, be it for domestic, agricultural, industrial, or commercial purposes. It is, therefore, necessary to build a dependable information base on the quantity, quality, and timing of the water flows required to sustain freshwater ecosystems, known as Environmental Flows (EF) (Sharma et al., 2020). EF “describe the quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems, which in turn support human cultures, economies, sustainable livelihoods and well-being” (The Brisbane Declaration, 2007, in Arthington et al., 2018: 2). Local knowledge helps build a holistic perspective on water flow management improving human livelihoods through flood control, fresh water availability, fish harvesting, and climate change mitigation. The science of EF is a rapidly advancing field with new concepts, methods, and tools being added to an ever-expanding knowledge base. Although there is general acceptance and agreement on the importance of maintaining river health, there is still lack of clarity on the implementation and enforcement of EF, particularly in South Asia. The first-ever holistic EF assessment in that region was conducted in 2007 on the iconic Ganges River, in India. Given the spiritual significance of the river, the project focused as much on livelihood and cultural practices along the Ganges as on ecological concerns.

Sapkota et al., (2013) utilized the Building Block Methodology (BBM) in their Upper Ganges Basin Indian project, which determines the flow regime of a river by segregating it into distinct components that can be described in terms of timing, duration, frequency and magnitude. BBM is based on the following: (i) undertake a stakeholder consultation process to set objectives for the environmental condition of the river; (ii) assess a modified flow regime that will meet these objectives; (iii) use flow-dependent indicators (e.g., fish, invertebrates, aquatic plants) and non-consumptive water requirements, as well as water quality metrics and sediment transport, to identify water depths, velocities, river widths and substrate types that will provide the required habitats and conditions and; (iv) identify critical components (Building Blocks) of the flow regime that govern environmental conditions. This was the first time that “spiritual flows,” that is, flow requirements for spiritual practices, including the volume of water required for ritual purifications, using surveys and focus group discussions, were included in EF assessments (O’Keeffe et al., 2012). The comprehensive focus of the EF study on social as well as ecological issues generated much interest within the Indian government and has been accepted by The National Clean Ganga Mission.

In neighbouring Nepal, Tachamo et al. (2019) used a novel EF calculator that combined the assessment of livelihood requirements with the use of invertebrates as indicators of river health in the rivers of the Western Himalayas. While this EF calculator is still to be used in river basin management regulation in the country, it has been disseminated to relevant stakeholders, especially irrigation and hydropower planners, and has even been mentioned in the National Irrigation Master Plan in Nepal. The South Asian explorations of the EF model raised the visibility of the technique and its research outputs, while initiating national level plans as well as influencing policy makers. The path-breaking feature of the project, though, was the inclusion of spiritual flows with the involvement of non-academic actors in EF assessments, a move outside the boundaries of the existing scientific approach.

**Research(er) dilemmas in contexts of socio environmental conflicts: cases from Peru and Brazil**

Adopting inter- and transdisciplinary approaches in EC settings can become a challenge for researchers at different stages of the research process. We discuss two research experiences in mining-related cases, the first, in the Peruvian central Andes, addresses a latent conflict, while the second, in Minas Gerais, Brazil, reveals a history of contestation rife with rage, mistrust, and perceptions of injustice.

Quispe-Zuniga and colleagues (2018, 2019, 2020), encountered the challenge of integrating local knowledge(s), values, and perceptions into their research at the outset of their project to analyse the socio-environmental roots of conflicts between mining companies and local communities in the Peruvian Andes. They began with in-depth interviews with these stakeholders, which required previously obtaining their informed consent, being granted prior permissions of local authorities, and sharing information with central governmental institutions. Only after they established a
dialogue with all the conflicting parties were they able to persuade their initially suspicious potential informants to relax and join the research process with enthusiasm. Bureaucrats and other government representatives collaborated with the research team only after several joint meetings were held, but ongoing collaboration was fraught with lapses and backsliding, such as frequently not showing up for the interviews and focus groups due to budget limitations or lack of willingness to meet other stakeholders (2020). The interviews served as the entry point to establish and execute a participatory mapping and analysis of heavy metal concentrations in water and soil (2019). The data from the interviews and laboratory analysis were later complemented by a semi-structured survey to further elucidate the roots of conflict (2018, 2020). Finally, the research team used a multi-criteria decision analysis to integrate all results by building a risk index for scenario simulations. Given the interdependency of the qualitative and quantitative methods, this case study highlights the need for detailed and structured methodological planning. However, the lead researcher conducting the study, a chemist, had to step out of the comfort of her laboratory and soil samples, and to engage in conversations tainted by mistrust. Another challenge arose with the analysis of the collected data since the research represented various fields of specialization. Ultimately, the engineers and biologists were able to agree upon a common language with the anthropologists to produce their joint publications.

The research of Freire (1987 [1970]) and Baum and colleagues (2006: 854) on the Minas-Rio iron ore mining conflict in Minas Gerais, Brazil, focused on producing the knowledge and information demanded by the actors involved through a participatory action research approach. They started with the initial objective of understanding the grassroots resistance movements that opposed the mining project and the role they played within the environmental licensing process. After several interactions with the local communities and other research participants, their objective expanded to the understanding of the legal process through which the state environmental authorities granted environmental permits to the mining project (Barbosa Pereira, 2019). This expansion bolstered locals’ trust in the researchers and enabled collaboration from research participants for co-production of knowledge and data collection. As in the Peruvian case, the next challenge emerged during the analysis and sharing of data. The dual responsibility of producing a final academic report and a document of practical use to the participant communities (Cancian, 1993; Hale, 2006) could not be fulfilled within a single document. The researcher faced the conflicting choice of producing immediate available information and guidance to the actors involved in the EC or publishing peer-reviewed papers. While the need to provide useful information to the impacted communities had an immediate urgency as the conflict continued, academic publication required a longer process for verifying results, discussion within the scientific community, and engagement in the iterative process of revisions. The researchers undertook the passing on of processed information to the community and governmental officers and the Brazilian researcher Barbosa Pereira (2019) helped to elaborate an interdisciplinary assessment of the conflict for the Inter-American Human Rights Commission in 2016. The frequent and urgent demands for knowledge and processed information in these cases had a different rhythm to those of scientific production demanded by academia. In effect, despite the increase of scientific production in the last decades (Frith, 2019), its potential to support local communities in resolving immediate conflicts remains limited (Yoon & Copeland, 2019).

In these studies, the research participants became co-constructors of knowledge and collaborated non-hierarchically in the research process much beyond their typical role as study objects or information providers (Baum et al., 2006; Barbosa Pereira, 2019; Reason & Bradbury, 2001). This demanded a high degree of adaptability to the inputs from research participants, particularly to their knowledge and interpretations of local issues and events. The flexibility in the research plans made the transdisciplinary research efforts not only more time-consuming but also more interdependent on local collaboration and potentially of more practical use to the studied communities.

**Ethnographic and participatory methods in studying tree plantations and forest conversion: cases from Chile and Mexico.**

A study on forest conversion in Mexico and another on monoculture tree plantations in Chile illustrate how the use of interdisciplinary and participatory methods helps to disentangle the perpetual struggle between local and external interests, which often triggers ECs, and how difficult it can be for academic research to navigate between divergent perceptions of development.

Ethnographic research can help in the successful design and execution of environmental interventions (e.g., forest policies) by incorporating ideas and inputs from local populations without which such interventions often flounder. Gunsenheimer & Petersheim (2019) included local perspectives in their case study of La Montaña, Campeche, Mexico, to elucidate the rationale behind economic activities that could appear to be in conflict to outside experts. For example, the local community was investing the profits from a conservation project that promoted honey production as an ecologically beneficial alternative to cattle production in cattle production. Engaging the participation of the local population as well as forest engineers, NGO representatives,
and public officers during their iterative visits also revealed worrying mismatches between Mexican forestry legislation and the local conditions in forest communities (Petersheim, 2018): the high cost and effort involved in obtaining logging permits simply led to an increase in illegal logging. Here, ethnographic research proved to be appropriate to identify local values, perceptions, and interests relevant to deforestation that are frequently overlooked by those designing projects and policies aiming to stop forest destruction.

In southern Chile, Mora-Motta (2018) and Mora-Motta & Stellmacher (2020) found the expansion of large-scale pine and eucalyptus plantations is disrupting the way of life of indigenous Mapuche and peasant communities. They adopted a mixed-methods approach including interviews, participant observation, participatory mapping, and well-being evaluation workshops (Guillen-Royo, 2016; Spiering & Barrera, 2020) under a participatory action research methodology (Fals Borda, 2015) to identify core elements of the environmental and territorial conflict. In this case, large logging companies, supported by the state, used a combination of mechanisms to appropriate nature (mainly land and water) to develop plantations. The logging companies that were involved in the transformation of the territory to monocultures presented themselves as nature conservation actors because they possess native forest land. The researchers started with the often-ignored perspective of local peasant and indigenous inhabitants for their participatory action research approach. Collectively, the communities and the researcher(s) agreed to initiate a dialogue of knowledge(s), values, and perceptions using participatory methods to organise the discussions. In this sense, both the study’s objectives were available for local review and feedback, and subsequent adaptation of the research methods. The strength of this approach was to facilitate the co-creation of new knowledge about the on-going EC and a dialogue about questions, methods, research practices, and results.

In these examples, ethnography and participatory action research frameworks were fundamental to avoid the imposition of inappropriate, misleading, or incomplete concepts (e.g., the official concept ‘forest’ is contested locally).

The ethnographic research in Mexico was conducted over six research visits with durations of three to five months, which allowed the establishment of a meaningful relationship with the inhabitants of La Montaña, Campeche, as well as other stakeholders. Not only was it possible to communicate the preliminary findings to the local population, but candid discussions on some poorly designed development initiatives with the local NGO led to appropriate adjustments.

The participatory action research methodology in Chile found the effective implementation of the mixed-methods approach crucial for transdisciplinary work. From the outset, it created opportunities for forging relationships with the local mixed peasant and indigenous communities and initiated a dialogue that was not just limited to the research questions. As a result, research benefitted from critical feedback from local participants. Such an approach facilitated the integration of different knowledge(s), values and perceptions, as well as the possibility of an open, two-sided feedback mechanism ensuring a fruitful long-term dialogue between researchers and the peasant and indigenous participants.

In sum, the diversity of ethnographic and participatory methods helped foster open dialogue between local communities and researchers in both Chile and Mexico. By their willingness to review the predesigned methods and objectives, the researchers opened up space for learning from the accumulated and lived knowledge of the local people. Participatory methods, such as mapping, provided opportunities for collective interaction of the participants, leading to crucial real time feedback and helping researchers acquire a robust understanding of the local situations. Additionally, as these interactions were spread over long periods, they helped build a relationship of trust among researchers and research participants. In contrast, methods aimed at individual actors did not offer these positive outcomes, even though they had their own advantages in capturing the nuances of local realities. At the final stages of the research and despite the obvious advantages of the process of co-production of knowledge, the information that emerged has either been ignored or considered problematic by local government authorities. Moreover, the process was often characterized by tension and unwelcome reception by local authorities, a situation that researchers often face when applying transdisciplinary research to ECs as they deal with stakeholders with strong differences in opinions, interests, and even worldviews.

Discussion

Our primary aim is to highlight the value and importance of inter- and transdisciplinary approaches in understanding ECs and the challenges faced by the academic researchers in this process. To avoid speaking for local communities and for the Earth itself (Escobar, 1995) is a thoughtful and bold contrast to the existing marginalization of indigenous knowledge that as Davis (2006: 147) observes, is the result of ‘particular bureaucratic-administrative machinery of government.’ This ‘machinery’ privileges forms of knowledge such as science and law, supporting claims of ‘truth and authority’ (ibid.). The marginalization of indigenous and non-indigenous local community knowledge extends to the exclusion of their practical experiences as well as their
perceptions and valuation of the environment, delaying the possibility of a productive engagement on ECs.

The case studies we have presented illustrate the value of building trust with research participants, and consequently assessing the complexities of ECs under study with the additional and indispensable benefit of the local perspective. In the case of South Asia and Peru, for instance, a team of researchers from different academic backgrounds were involved, while in Mexico and Ecuador individual scientists carried out the analysis. When it came to covering different disciplines, the social scientists in Mexico explored economic dynamics and agro-forestry, while the natural scientists in Ecuador used participatory methods involving the community’s values and perceptions. Either as part of a team or individually, the researcher has to be conscious that the research is about the conflict, and the various methods being used are only the means to understanding it.

Transdisciplinarity (Brown et al., 2015; Biber-Freudenberger et al., 2018; Donaldson et al., 2010) can be challenging given the complex questions that researchers need to address – what kind of input does the local population provide to the research process? Did we accurately understand, document, and convey people’s profound relationship with their natural environment and the spiritual and physical value they ascribe to it to the wider academic community and government bureaucracies? Did the research attain an adequate balance between the academic imperative for verifiable results and the co-creation of evidence that goes beyond the ‘objective’ world?

The cases we present point to four important lessons. First, the dialogue of knowledge(s) needs trust, and to gain trust among local people can be a complicated and long process requiring time, openness, and empathy. Existing mistrust in conflict settings can challenge researchers to enhance their social skills to add to the already burgeoning toolbox of analytical and intellectual expertise they need to wield in the field. The fiercely contested interests related to mining in Peru and Brazil, and the lack of regulations, regular disputes, and patterns of exploitation that generated mistrust towards the researchers from various stakeholders are illustrative of that point. In most cases, local community participants and researchers were able to forge a relationship based on purposeful cooperation in their quest to understand and address ECs that motivated the researchers to promptly and regularly share and communicate the results of their work with the local population, often returning to the field to do that. It was, however, not always possible to share the research results, and often not quite expeditiously as the local population demanded.

Short-term surveys and sporadic meetings, particularly in the case of advanced conflicts, cannot replace living and working together in the field where emotional and identity factors play a central role. A complication can emerge here for the researchers as they could be perceived as ‘non-scientific’ by their peers, or, on the other hand, by sticking predominantly to measurable observations (e.g., heavy metals content in soil samples or percentage of population affected by the EC), the researcher’s contribution could become irrelevant to the local actors. For example, the case of Peru shows that water and soil analysis only had meaning to local communities when linked to extractive mining operations and its impact on their own farming activities.

A second lesson pertains to the space accorded to the co-creation of knowledge in the research process – was it a genuine effort and did it start at the outset? In the cases of South Asia and Ecuador, employing participatory methods fulfilled the research objective of identifying optimal local water and forest use and management, while using interdisciplinary analysis allowed the researchers to address potential conflicts. In the other four cases, however, what was compelling was the flexibility with which the project was able to modify the research objectives, questions, and methods without compromising academic rigour. It is true that the researchers face time and budget constraints. A constant process of reflection and interactions with the local communities lead researchers to engage in unplanned activities, such as informative workshops and conversations about the results. The argument that self-reflection and a reflexive approach are a necessary prerequisite to qualitative research (Holmes, 2020) has more compelling grounds in transdisciplinary research on ECs, where values and interests collide and events may change rapidly over time.

A third lesson is that, even within time and budget limits, academic research has the potential to co-create relevant evidence to disentangle ECs, understand them better and contribute to the process of addressing them. The decisive factors in our examples were the initial research design and the researchers’ enduring commitment to transdisciplinary study. They convincingly prove scientific analysis helps to
address the complexities of ECs, and that non-academic knowledge is necessary for research to be relevant to local communities and governmental authorities alike. It is always unlikely that a research project can meet multiple expectations, but it can still shed light on the socio-ecological dynamics involved, the politics and power at play, and the different interpretations and interests embedded in the ECs.

Lastly, a fourth lesson is that, although academia increasingly co-produces knowledge with local populations, they have little control over how this knowledge will affect decision-makers. Government authorities have their own biases, and sometimes unwittingly (or not) dismiss academic knowledge that does not fit their political agendas (Barbosa Pereira & Laube, 2018). How to make science more influential in the political arena, where many powerful economic interests have a decisive role, is a challenge that remains open regardless of the research approach. In the case of Mexico, for example, given the inertia that characterized the government machinery, the researcher concluded that his findings on the disconnect between the federal forestry laws and the local circumstances would not lead to any change in forestry legislation. Researchers’ attempts to make a meaningful contribution do not only encounter local indifference or resistance, they are frequently not accompanied by patterns of academic hierarchies and organization (Calhoun, 2008).

Ultimately, EC researchers have the dual responsibility of producing a final report that not only conforms to academic requirements and methodology but is also of practical use to the participating communities (Cancian, 1993; Hale, 2006). This can rarely be done with a single document, and generally adds time and effort to a project.

Conclusions

We have critically reflected upon the research praxis of six case studies that illustrate the processes of co-creation of knowledge emerging from the dialogue of researchers and local non-academic actors. The key point of this reflection has centred upon our position within academia, and consequently, we have critically explored its role in the process of knowledge generation. We have outlined that academia has a fundamental role in understanding the dynamics of ECs and claimed that inter- and transdisciplinary approaches offer the appropriate tools needed for understanding and addressing complex disputes over the use and conservation of natural resources. For us, however, the implication of addressing ECs from a transdisciplinary viewpoint is that academia has to review its role, from the epistemological perspective, through the theoretical and procedural standards, to the reward and funding systems of academic research (i.e., what products or activities are considered scientific).

Our examples are chosen to show that while the role of academia in integrating local and scientific knowledge to address ECs is crucial, it needs more support in achieving its objectives than is possible only through transdisciplinary methodologies and researchers’ commitment. It requires the added understanding and concurrence of organizations oriented to funding research because time and budget are more demanding in transdisciplinary research. Often, the activities that differentiate transdisciplinarity from interdisciplinarity fall outside funding organisations’ evaluative criteria and considerations partly because of the predominant idea of the research process ending with academic outputs (i.e., thesis, report, or scientific articles). Transdisciplinary research has the potential to make important contributions to policy making and as well as the lives of the local population through academic outputs like, for example, a didactical tool explaining a complex law; a kind of contribution that should gain weight in the academic reward system. This also implies that transdisciplinary researchers take a step away from overspecialisation of academic theory and methodology to move in the direction of more dispersed and diverse forms of knowledge and information.

In conclusion, we argue that transdisciplinarity should be at the core of higher education and training. This, obviously, will require a new approach to the conception and practice of academic research for which the critical view to the ontological and epistemological assumptions we have presented can play a meaningful role. It is our conviction that the interactive dialogue of knowledge between academia and local populations can create strong and viable evidence for policy makers to craft locally appropriate and effective approaches for managing ECs.

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Declarations

Conflict of interest The author declares no conflict that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent The research did not involve medical trials in humans or animals. The results and discussions in the article rely on previous social and development research projects.
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