Transdisciplinary research for sustainability: scoping for project potential

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1. Introduction

In response to sustainability challenges, the UN launched the 17 Sustainable Development Goals (SDGs) in 2015, seeking to tackle both environmental and social issues (UN General Assembly 2015). The SDGs explicitly seek integrated approaches to their analysis and implementation. However, there are no guiding frameworks in place to support the integration process. Sustainability problems and solutions, such as those addressed under the SDG umbrella, are complex and therefore require new types of research approaches (Leemans 2017; Miller *et al*. 2014; Wiek *et al*. 2012). One important component of such research efforts is the ability to account for input from various communities of knowledge to "ensure that the essential knowledge from all relevant disciplines and actor groups related to the problem is incorporated" (Lang *et al*. 2012, p.26). Other critical components include the need to find durable solutions, to enable social learning processes, and to involve citizens and stakeholders in science (Wiek *et al*. 2012).

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Transdisciplinary research (TDR) is one promising approach in this context, responding to these critical aspects in a coherent way. One broad definition of transdisciplinarity by Lang *et al*. (2012, p.26) states that:

> Transdisciplinarity is a reflexive, integrative, method-driven scientific principle aiming at the solution or transition of societal problems and concurrently of related scientific problems by differentiating and integrating knowledge from various scientific and societal bodies of knowledge.

TDR comes in many forms and includes, for example, participatory action research, practices that support the integration of indigenous/local knowledge with western sciences, collaborative adaptive management, and recent forms of citizen science (Knapp *et al*. 2019). There are differences between European and US TDR traditions; the former includes both cross-disciplinarity and stakeholder involvement, whereas the latter is more focused on interdisciplinary research, which mainly involves academics (Knapp *et al*. 2019). In a review on the historical roots and various approaches of TDR,

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Knapp *et al*. (2019) found that TDR projects usually have three features in common:

- answering the research question requires knowledge inputs from multiple disciplines,
- the process supports co-production of knowledge, and
- the solution-oriented outcome is useful for real world problems.

Similarly, Lang *et al*. (2012) formulated a set of principles for guiding an "ideal-typical" TDR process, organised into three phases:

1. Joint problem framing and building of a collaborative research team.
2. Co-creation of solution-oriented and transferable knowledge through participatory research.
3. Reintegration and application of the co-created knowledge.

Despite the generalisable TDR features and principles mentioned above, TDR scholars emphasise the context-specific nature of each TDR project, and the lack of a "blueprint" approach(Lang *et al*. 2012; Westberg and Polk 2016).

Solution-oriented approaches imply a different role for the researcher than traditional research methodologies (Wittmayer and Schäpke 2014). While uncommon in the purely academic research environment, TDR projects need to address key issues of ownership, sustainability, power, and action in the project space. Therefore, some proposed roles for the researcher engaged in TDR projects are change agent, knowledge broker, reflective scientist, self-reflexive scientist and process facilitator (ibid). In a study on success factors for 56 sustainability experiments in Europe on local or regional levels, van der Heiligenberg *et al*. (2017) state that stakeholder involvement is the most important one. Other important factors are close cooperation with local and regional networks, integration with local/regional governmental policies, dissemination of learning experiences, and the existence and ownership of a local or regional vision of the future (ibid).

However, despite the promising core principles and practices in TDR, there are a number of challenges related to initiating, carrying out, and following up on such research projects.[1] For example, a challenge for sustainability TDR science is "how can research and education institutions facilitate transdisciplinary research and education and enable social learning?", when the structure of traditional academic systems favours disciplinary and intradisciplinary research over TDR approaches (Miller *et al*. 2014, p.243). Research results are frequently a priority over education or the need for societal relevance and co-creation (European project Social Innovation Community).[2] As a result, TDR projects are often initiated in academic environments that are siloed, where TDR projects are not frequently carried out. Researchers in such environments face institutional and organisational barriers (e.g., funding, time constraints, siloed expertise), but may also be personally reluctant to leave the familiar role of the traditional researcher to initiate TDR. Early-career researchers face unique challenges in conducting TDR, mainly due to their lack of experience and established position within academia (Jaeger-Erben *et al*. 2018). Jaeger-Erben *et al*. (2018) and Haider *et al*. (2016) outline recommendations for how early-career sustainability researchers can navigate such processes within academic environments, and Søgaard Jørgensen *et al*. (2019) highlight the intergenerational and interdisciplinary perspectives that they can contribute to global sustainability initiatives.

Of particular importance is the scoping phase, where the research questions and the local concerns need to come together in the definition of the transdisciplinary projects' aims and expected outcomes. Lang *et al*. (2012) point out how insufficient problem framing and unbalanced problem ownership (i.e., between researchers and local actors) are often challenges encountered in the first phase of the TDR process, and suggest conducting a preliminary study in order to build problem awareness. We argue that although the "scoping" component of the TDR initiation phase is important because it can facilitate a balanced problem-framing process, it has not been adequately addressed by TDR scholars. In the present paper, we respond to this challenge by sharing our experience from setting the basis for scoping for transdisciplinary research projects at a local context. The guiding research question is: how to scout and stimulate TDR sustainability projects starting in a traditional, disciplinary research environment? The paper outlines the approach taken and the lessons learned, in the hope that it could help other researchers and practitioners in setting up TDR projects. The novelty

lies in combining tools from system sciences, and in providing a case study application, which is often lacking in contributions to TDR methodology (Woltersdorf *et al*. 2019). The paper is organised in two sections. The first section lays out the approach we took in scoping for TDR projects for sustainability, starting with insights on the context this work developed in, giving an overview of the selected TDR tools we applied, and showing the results of applying those tools to our case study. The second section discusses and reflects on the findings, on challenges and success factors of the presented approach, as well as on the generalisability for other TDR projects on sustainability.

2. Approach to TDR scoping

2.1 Setting the stage

The results of this study grew out of a collaborative effort by a team of early-career researchers (PhD and masters students) at Stockholm University (SU) to organise a PhD course in transdisciplinary research for sustainability. This initiative was based on the common interest in interconnected sustainability issues that span across the natural and social sciences, and often require co-production of knowledge with "non-researchers". Due to a lack of learning opportunities for this type of research at our university, we initiated and ran a course consisting of a theoretical part and a practical part.

The theoretical part of the course (spring semester 2018, 12 participants) included 19 seminars. Lecturers were selected and invited based on their experience in TDR and by snowballing methods among the participants and supporting senior researchers. The literature-based seminars had a twofold educational aim: on the one hand to act as a learning platform (collaboratively identified topics of interest included among others epistemology of TDR, stakeholder analysis, facilitation, research funding for transdisciplinary projects, citizen science); and on the other hand to act as an acquaintance platform with transdisciplinary tools and methodologies which could be used during the applied fieldwork part of the course.

The practical part of the course was designed and implemented by seven of the course participants. It consisted of one week of fieldwork with the main aim of identifying TDR opportunities in

FIGURE 1. Location of the practical part of the TDR course and case study in this paper: Navarino Environmental Observatory (NEO) in South West Messinia, Greece.

Messinia, Greece. In this region, the main economic activities are agriculture (constituting the main occupation for 44 per cent of the population living in the area) and coastal tourism (the main source of employment for 10 per cent of the population) (GPC 2011). The agricultural sector is mainly oriented towards olive groves. In fact, Messinia has the biggest number of planted olive trees in Greece (13,545,000), with most of the olive farms using conventional farming practices (Berg *et al*. 2018). In 2010, the development and operation of Costa Navarino, comprising several resorts and golf courses, put Messinia on the global touristic map.

Since 2010, SU in collaboration with Greek partners from the academia and the private sector has established the Navarino Environmental Observatory (NEO),[3] a collaborative partnership dedicated to research and education on climate change and the environment in the Mediterranean region. The field station is located in South West Messinia (Figure 1). NEO is a well-established initiative with a growing local and international network contributing to a mix of academic outputs,

educational activities, and public outreach. One example is the EU H2020 research and innovation project COASTAL (Collaborative land-sea integration platform)[4] that started in 2018, with the aim of improving coastal-rural synergy to foster rural and coastal development while preserving the environment. The establishment of NEO, along with the increased tourism in the region, has triggered discussions around sustainability among the local population. We started from the assumption that different stakeholders might hold different perspectives on what sustainability in Messinia entails, and since transdisciplinary research seeks to account for diverse perspectives (Knapp *et al*. 2019), we consider it highly relevant for the context of NEO and its surrounding areas.

2.2 Tools for TDR scoping

2.2.1. *Stakeholder identification*

Adaptive co-learning between local stakeholders and researchers is fundamental to building TDR potential in relation to sustainable resource management and development (van den Heiligenberg *et al*. 2017). Local stakeholders in Messinia, researchers at SU, and other NEO research partners with previous and ongoing projects in the region were identified according to the methods and principles presented by Reed *et al*. (2009).

The identification of researchers that had previously worked in the area was done: (1) by screening the NEO publication database (Navarino Environmental Observatory 2019); (2) through a literature search in the SCOPUS database (using the keywords Gialova, Yalova, Messinia, Messenia, Peloponnese, Navarino, NEO (Navarino Environmental Observatory)); and (3) by consulting the NEO station manager.

The NEO station manager was a key informant also when it came to the identification of local stakeholders.The initial sample provided by the station manager was extended with stakeholders identified from the literature and during the interviews with researchers. Since economic activity plays a central role in shaping the development of the region, as it provides local livelihoods and has an impact on inland and coastal ecosystems (Granit *et al*. 2017), one of the selection criteria for the local stakeholders was their occupation, in an attempt to cover the main socio-economic activities in the area. Moreover, snowball sampling was applied in each stakeholder interview to identify actors that might have been overlooked in the initial selection. In this way, the "science" of stakeholder identification was combined with the "art" of stakeholder identification, such as the use of intuition and past experience, as described by Colvin *et al*. (2016).

2.2.2. *Interviews*

A two-step semi-structured interview process was employed to examine the interest of the identified stakeholders (researchers and local actors) to engage in transdisciplinary research (Bryman 2008). The first phase of interviewing researchers took place in October 2018, before the practical fieldwork in Greece. The semi-structured interview guide centred around three main themes: (a) their background and information about the research that they have conducted in the area; (b) their views on interdisciplinary and transdisciplinary research; and (c) the local ecosystem services (ESS) that are important for their research (see Appendix 1). Most of the interviews were conducted face to face at the facilities of Stockholm University or via Skype. In some cases, the interview guide was sent and a written reply was received. The second step of the interviews took place in Messinia during the fieldwork. A semi-structured interview guide was developed to explore the concerns of the local actors (see Appendix 1). The guide was organised according to two overarching themes (background information and TDR potential) and included open-ended questions regarding the regional drivers of change, their vision for the development of the region and questions that were specifically developed in relation to their occupation.

2.2.3. *Causal loop diagrams*

To describe and analyse the stakeholders' perspective on ongoing local development dynamics and their visions about the future of their sector (e.g., agriculture, tourism) and the Messinia region, causal loop diagrams (CLDs) were developed based on the outcomes from the interviews. CLDs are a common tool for system analysis (Lane 2008; Morecroft 1982). The translation of the interviews into the causal map structure followed recommendations by Kim and Andersen (2012). All students of our team participated in this process as a group to ensure direct triangulation of analysts' perspectives (Figure 2). The CLDs were simplified by aggregating similarities, while maintaining

FIGURE 2. Field visit and interviews at the olive farm cooperative (left). Summarising the results after one of the fieldwork days (right) [Colour figure can be viewed at wileyonlinelibrary.com]

differences to balance understandability and communication with preserving the complex interlinked socio-environmental system dynamics. The diagrams were used as a representation of the information captured by the interviews, i.e., the stakeholders' perspectives on socio-economic and environmental developments in the region. Further, from the CLDs, we identified issues of concern and gaps where knowledge or perspectives about the system are lacking (Eden 2004).

2.2.4. Gap-mapping

To identify and illustrate how local needs and research could be integrated in future TDR projects, we combined our results into a "gap-map". The "gap-map" is a matrix showcasing gaps and overlaps between the research that previously has been (or could be) carried out, the research interests of those engaged in this research, and the needs of the local community. The matrix builds directly on stakeholder identification, interviews and CLDs. It is to be seen as a basis for discussion, and as a way to improve understanding of what different disciplines can be added to an integrated sustainability project aiming to address local needs with a TDR approach.

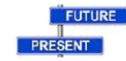
2.3 Results: scoping for TDR potential in Messinia

2.3.1. Overview of local stakeholders

In total, eight stakeholders from Messinia were interviewed. Table 1 provides an overview of the participants, structured according to McCall's (2005) intersectionality framework. The sectors of food production and tourism which, as mentioned above, are the main economic activities in the case study area, were well represented in our stakeholder sample. The stakeholders providing tourist services were located on the coast while food producers were located more inland. The scale of their activities varied, from being locally rooted to more regionally oriented. Another key area covered by our stakeholder sample is water governance, with one of the interviewees representing the local water agency. All our stakeholders were presently active at the time of the interviews, most of them owned the capital/assets they were working with, and a majority were male. Finally, while our sample covers key economic activities in the area, it is not exhaustive. Some actors that could have been included to a further extent are, for example, consumers, public service providers, and policy-makers. Since the area has an important environmental value (Maneas *et al*. 2019) we would also have liked to interview environmental managers, but at the time of our fieldwork, no such stakeholders were active in the area.

In addition to the local stakeholders, 12 academic stakeholders with previous or ongoing projects in Messinia were interviewed. The academic stakeholders included both master's students and senior researchers, and their research focus covers a range of topics (Table 2).

TABLE 1. Overview of the Messinian stakeholders according to McCall's (2005) intersectionality framework

Interviewed stakeholder	Gender	Location (coastal/inland)	Ownership	Function	Scale of activities (local-regional)	time: past-present-future generations
Operations Manager of large hotel				Tourism		
Olive farmer, head of farmers' cooperative				Food producer		
Olive farmer				Food producer		
Water Agency representative				Regulatory, public service provider		
Restaurant owner, Pylos association of enterprises for touristic development.				Tourist services supplier		
Local organic olive farmer				Food producer		
Owner of small hotel in Gialova				Tourist services supplier		
Outdoor activities manager				Tourist services supplier		

Note. The symbols per column from left to right in order of appearance indicate: woman, man, coastal, inland, owner of the assets/capital for the activities he/she is engaged with (hand with key), regional (map), local (pointer).

TABLE 2. Research focus in Messinia area and number of interviewed researchers per different research activity In brackets the number of researchers we contacted

Research focus in Messinia area	*Number of interviewed researchers*
Hydrology, water resources	4 (5)
Past climate variability	3 (5)
Atmospheric composition	1 (1)
Geology	0 (2)
Biodiversity, ecology, ecosystem services	3 (3)
Environmental management (social perspective)	1 (1)

2.3.2. *Causal loop analysis of stakeholders' systems perspective*

Figure 3 captures the aggregated dynamics between the main components of the socio-environmental system in Messinia as perceived by the local stakeholders and researchers interviewed. The regional sustainability dynamics identified related to seven distinctive sectors: tourism, agriculture,

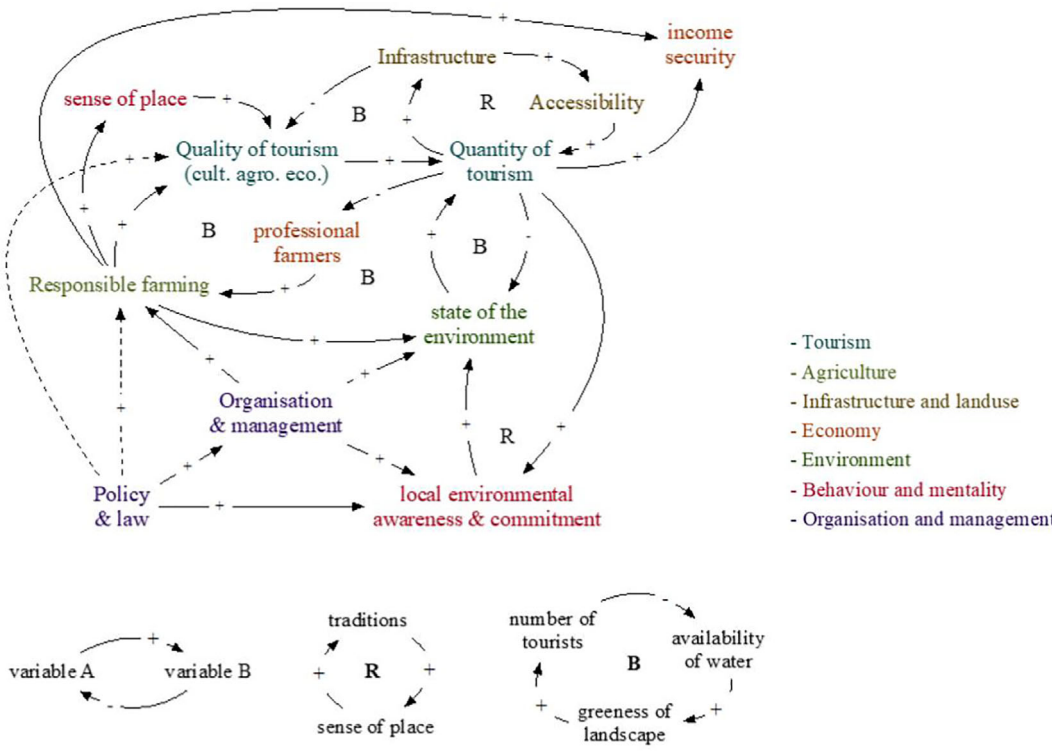


FIGURE 3. Causal loop diagram (CLD) presenting the aggregated dynamics between the main components of the socio-environmental system in Messinia as perceived by local stakeholders [Colour figure can be viewed at wileyonlinelibrary.com]
Note. In a CLD, arrows denote the nature of interaction between two variables. If an arrow from variable A to variable B has a plus sign, then a change in variable A will lead to a change in the same direction in variable B, e.g., increase in infrastructure causes an increase in accessibility. If the arrow has a minus sign, a change in variable A will lead to a change in the opposite direction for variable B, e.g., an increase in infrastructure causes a decrease in quality of tourism. The causal connections between two or more variables can create loops, meaning the nature of their interaction involves feedback and is not only linear. B stands for a balancing loop and R stands for a reinforcing loop.

infrastructure and land use, economy, environment, behaviour and mentality, and organisation and management. We developed detailed CLDs per sector, as well as one complete comprehensive CLD that can be found in Appendix 2. The CLDs of the identified sectors often showed more causal links and feedback loops between them (Figure 3 and Appendix 2) than within them, meaning that the socio-environmental system in Messinia is highly connected across sectors and actors. Therefore, sustainability projects need to consider the positive and negative impacts they can have on connected sectors. For example, a sense of place through traditions and the agricultural landscape provides economic opportunities in high quality tourism. In addition to increased demand for local food, this type of tourism raises local inhabitants' awareness to the importance of their region's environmental assets. Policies, legal enforcement, and regional organisation of economic activities could boost these positive feedback loops in creating a sustainable, desirable tourist development. Likewise, they could boost innovative and responsible farming practices and recover the attractiveness of farming as a profession, which in turn can contribute to high-quality tourist development in the region.

2.3.3. Gap-mapping

The main reason for creating a gap-map (Figure 4) was to identify gaps and overlaps between research in the area and local concerns. Most research in the area has been conducted in collaboration with NEO (Berg *et al*. 2018; Destouni and Prieto, 2018; Finne *et al*. 2017; Katrantsiotis *et al*. 2019; Klein

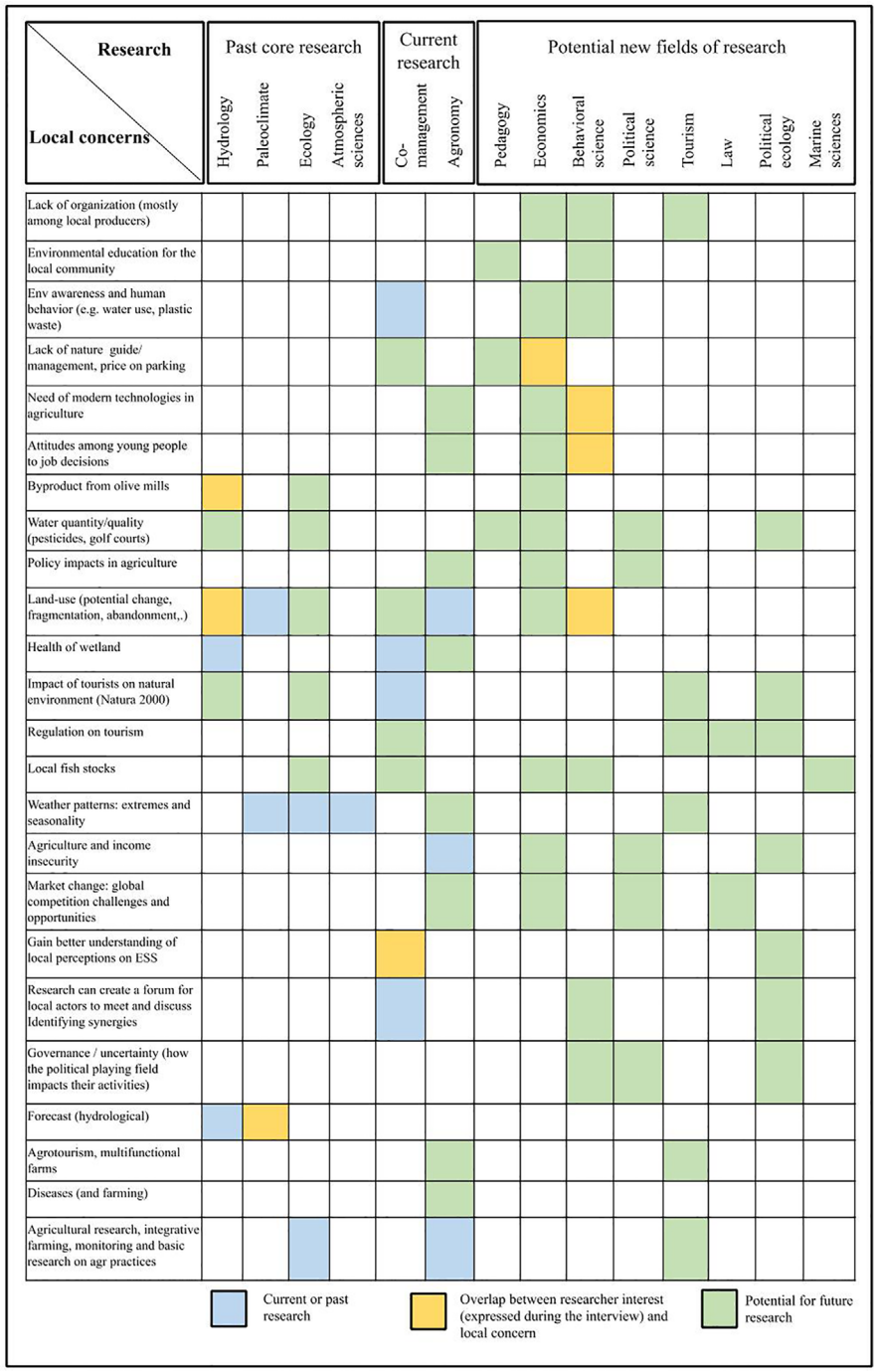


FIGURE 4. Gap-map presenting TDR project potential for the Messinia region [Colour figure can be viewed at wileyonlinelibrary.com]
Note. The horizontal axis displays research themes or disciplines. The vertical axis includes the local research needs, as identified during our interviews with the actors in the region. "Overlap between researcher interest and local concern" is marked in yellow, "Potential for future research" is marked in green and "Current or past research" is marked in blue.

et al. 2015; Krejci *et al*., 2018; Maneas *et al*. 2019). In order to bridge the gap of missing data from that part of the world, NEO started with basic research focusing on the fields of hydrology (e.g., sea water intrusion into coastal aquifers), atmospheric composition (e.g., aerosols and their role to climate), geology and past climate variability. This research is fundamental for understanding the physical and natural dynamics in the area, and the effects of climate change on the natural environment and human activities in the Mediterranean region. However, since the local stakeholders interviewed were linked mainly to agriculture and tourism (see CLDs in Figure 3 and Appendix 2), it was rather anticipated that these research activities would not overlap much with the current local concerns (as perceived by the stakeholders interviewed), except from some research conducted in the field of "hydrology" (e.g., "hydrological forecast", marked as blue in Figure 4). For example, "paleoclimate" and "atmospheric sciences" often address problems at spatial and temporal scales which are not directly relevant to local actors.

On the other hand, research initiatives, covering topics such as the effect of agriculture on biodiversity and water resources, and the co-management of ecosystem services in Natura 2000 areas, which demand an interdisciplinary research approach and focus on a local level, had more overlaps with local concerns. However, TDR is more than an interdisciplinary approach – it is research that is co-produced with stakeholders. While it is not a panacea for all research fields, it is useful in sustainability science because of its intrinsic normative goal to contribute with a positive, sustainable impact on society and environment.

From the gap-map we could identify TDR project potential in the Messinia region by matching the local concerns with relevant research fields and approaches (marked green on the matrix, Figure 4). Some interesting topics that were raised by stakeholders and could be inputs for future TDR projects were "Interest in reducing environmental footprint of tourist operations" and "Interest in participating in research projects contributing to olive farm improvements". Since most of the local needs (Figure 4) require an interdisciplinary approach, another finding from this exercise was the perceived need for social science research to address these concerns. For example, the concern about the lack of "modern technologies in agriculture and the attitudes among youth and job decisions" would be relevant to a number of disciplines, each providing useful tools and frameworks; agronomy (rural development), hydrology (water resources management), sociology/behavioural science (e.g., "what factors affect the decision of young people to abandon farming?"), economics (changes in the labour market and its implications). We also identified overlap of specific research interests (based on our interviews with 12 researchers) and local concerns (marked in yellow in Figure 4). For example, one of our researcher interviewees expressed interest in conducting research on how olive mill by-products affect the hydrology of the region, which matches a sustainability concern expressed by a local stakeholder. The difference between the yellow and green intersections (Figure 4) is that the former includes existing overlap between researcher and local interviewees' interests, whereas the latter includes overlap between local concerns and what we perceive as a potential contribution from academic disciplines, that could lead to a TDR project.

3. Discussion

3.1 TDR potential in Messinia

The parallel approach used to identify researchers' interests and local stakeholders' concerns around the sustainable future in Messinia reveals insights that can be used to foster local TDR projects. Some of the research activities and interests identified in the gap-map address problems at spatial and temporal scales which are not directly relevant to local actors, for example "paleoclimate" and "atmospheric sciences", and thus are difficult to be identified and recognised by them. For such scientific fields and study topics, it is difficult to engage stakeholders in TDR projects. Further, the gap-map shows that past research has focused exclusively on natural science research, while most stakeholders´ interests concern socio-economic disciplines (e.g., economics and behavioural sciences). Although we represented the research topics in the conventional disciplinary compartments, the CLD highlights how sectors and societal domains are highly interconnected and that there is a growing need for interdisciplinary approaches. Therefore, although we connected local concerns with conventional disciplines in the gap-map, the first important insight is that, beyond more research being needed, a higher

integration of disciplines is also needed to produce more problem-oriented research. Interdisciplinary research can also be a first step for researchers to engage with local problems before moving beyond academia to embrace transdisciplinarity.

In fact, current local research at NEO is already exploring socio-environmental topics related to farming practices in agriculture (Berg *et al*. 2018; Myers *et al*. 2019), the impact of tourism in water resources (Klein *et al*., 2015), the impact of land use change and human activities and interventions on water resources and biodiversity of Natura 2000 sites (Maneas *et al*. 2019; Manzoni *et al*. 2019), and how to improve coastal-rural synergies to foster rural and coastal development while preserving the environment (COASTAL 2018).

These studies have been crucial to build a network of local actors and researchers, bringing up the necessity of transdisciplinarity and initiating the collaborative process that led to this study.

The need to expand the research focus to social sciences might not seem surprising since the NEO core research has developed from a collaboration between natural scientists. But this is not necessarily always the case. In other regions, it could be measurements for quantitative data that are missing. For example, in a number of TDR with indigenous communities in northern Sweden, with both strong social and natural science components (summarised in: Klöcker Larsen *et al*. 2016; Klöcker Larsen *et al*. 2020), further advancements have been impossible in some respects as there is a lack of available natural science-data. More specifically, Rosqvist *et al*. (in preparation) demonstrated how weather data from current meteorological stations have been placed in irrelevant locations for traditional indigenous land use. The TDR research efforts by Rosqvist *et al*. (in preparation) with local communities have now resulted in new locations of weather stations to be used in natural resource management. These two opposing starting points (quantitative vs. qualitative data availability and research experience) indicate that one is not necessarily better equipped to initiate TDR projects than the other. However, an interdisciplinary collaboration between the social and natural sciences are necessary for continued, successful TDR projects.

The outcome of this work could be used to inform the next research opportunities at NEO and in the Messinia region; however, a surprising finding suggests that research community collaborations can go beyond "more research is needed", and highlights the importance of other kinds of support that researchers can provide, such as specific training (e.g., extension services to foster the adoption of sustainable agricultural practices), discussion forums that bring together diverse stakeholders, and networking opportunities. Although research is necessary to identify leverage points, analyse the system dynamics, and provide policy recommendations, it is not always sufficient to address complex sustainability issues. The intensification of inland human activities to meet societal demands, combined with the lack of understanding of how ecosystems are linked (e.g., key flows of water, sediment, pollutants, biota and ecosystem services) could lead to the degradation of ecosystems along a continuum from source to sea (Granit *et al*. 2017), and the loss of ecosystem services. However, governance and management arrangements are not well suited to address the flows and ensure sustainability and resilience of the combined source-to-sea systems (Granit *et al*. 2017). Local, regional and national policy makers can use the insights from the gap-map to promote and subsidise sustainability initiatives involving both research and practice. Particularly useful in this direction is the creation of a forum for local actors to meet and discuss, identifying synergies and raising concerns on sustainability issues. This could, for example, address one of the overlapping topics, "Environmental awareness and human behaviour (e.g., water use, plastic waste)". These kinds of fora, although not strictly relevant to research, could sensitise the local community to environmental sustainability concerns (e.g., plastic pollution) and generate acquaintance and trust between researchers and locals, thus building the necessary space for collaboration.

For example, the implementation of COASTAL EU project gave the opportunity to researchers and actors from different sectors (i.e., agriculture, fishing, local industry, tourism and public sectors) to meet and discuss land-sea interactions for the first time (COASTAL 2018). The process was highly appreciated by all participants, indicating that such structures could create space for engagement and collaboration (Maneas *et al*. 2020). To that end, the concept of ESS, could provide the links between nature and people (Diaz *et al*. 2015). ESS are the benefits of the environment to the society (MEA, 2005),

and an ESS assessment could further foster the communication between science-policy-society by leveraging the value of ESS provided by nature (wetlands, agricultural land, coasts, etc.) to create a common understanding between these three pillars.

3.2 Reflections on challenges and success factors from the project scoping

In this section we briefly reflect on the strengths and weaknesses of the self-reflexive approach to TDR scoping undertaken in the Messinia case study. Success factors included an interdisciplinary motivated team and institutional support. The main challenges include a language barrier, time constraints and the unstructured nature of the collaboration in the team.

Both a strong learning motivation and interdisciplinary, systems-thinking backgrounds contributed to what we consider to be a successful interdisciplinary teamwork. As mentioned in section 2.1, the research project was initiated through a self-driven course on TDR at Stockholm University, and there was a shared interest in exploring the dimensions of transdisciplinary research and how it can be applied in the context of sustainability science. Further, we were all familiar with interdisciplinary collaborations from our professional and/or early academic environments, an increasingly common characteristic of early-career sustainability scholars (Haider *et al*. 2018). Experience in interdisciplinary working environments develops a set of competences that enable team work (Arnold and Wade 2015). We all shared an understanding of systems-thinking theory (as described by Meadows 2008). Wiek *et al*. (2011) argue that systems-thinking competence is very useful for addressing sustainability issues, "across different domains (society, environment, economy, etc.) and across different scales (local to global)" (ibid, p.207).

Secondly, broad institutional support from both SU and NEO contributed to the successful case study for TDR scoping in Messinia. This was a clear benefit compared to many other TDR projects, which often experience difficulties in receiving support from their academic institutions (Gaziulusoy *et al*. 2016; Miller *et al*. 2014). Departmental (SU) support was crucial for the initiation of the TDR course. It included financial resources, available infrastructure, administrative support, and guidance from senior researchers for its preparation, on-site field work costs, and expert lectures. The NEO-network researchers and the local stakeholders in Messinia were collaborative in sharing their experiences. Because the gatekeeper was part of the TDR scoping team, the stakeholder identification-contact process was easy and time efficient, stakeholder fatigue could be avoided, and there was a noticeable trust relationship between interviewees and interviewers. Since this scoping case study was part of bigger ongoing research and sustainability processes at NEO, we could build on previous work, aspire to contribute to future endeavours, and shift the focus from immediate results to the process of TDR scoping.

The challenges we faced were mostly related to the fieldwork in Greece. The scoping process could have benefited from a larger number of perspectives being represented. Language barriers posed a challenge to most members of the team. Further, time constraints (one week for field application) limited the number of stakeholder interviews we were able to carry out. Time constraints also limited the way of interacting with stakeholders to semi-structured interviews. With more time, we would have experimented with other stakeholder interaction methods such as focus groups, group model building, and photo-voice (Wang and Burris 1997).

Finally, some success factors of our interdisciplinary, non-hierarchical team can also be identified as challenges (Nancarrow *et al*. 2013). For example, the collaborative non-structured nature of our project, although enriching, was often inefficient, since none of the team members was solely working on this project. Further, having the gatekeeper as part of our team limited the range of stakeholders to the ones in his network. Moreover, the gatekeeper's previous knowledge and experience in the area could be a bias in the interpretation of the interviews and the local system. It is important to mention that our experience is only from the scoping step, and as a result our challenges do not include the typical challenges faced by TDR.

3.3 Generalised approach to scoping for TDR sustainability projects

Despite the importance of and dependency on the local context in any TDR project, we argue that the steps taken above (section 2.2 "Selected tools") are

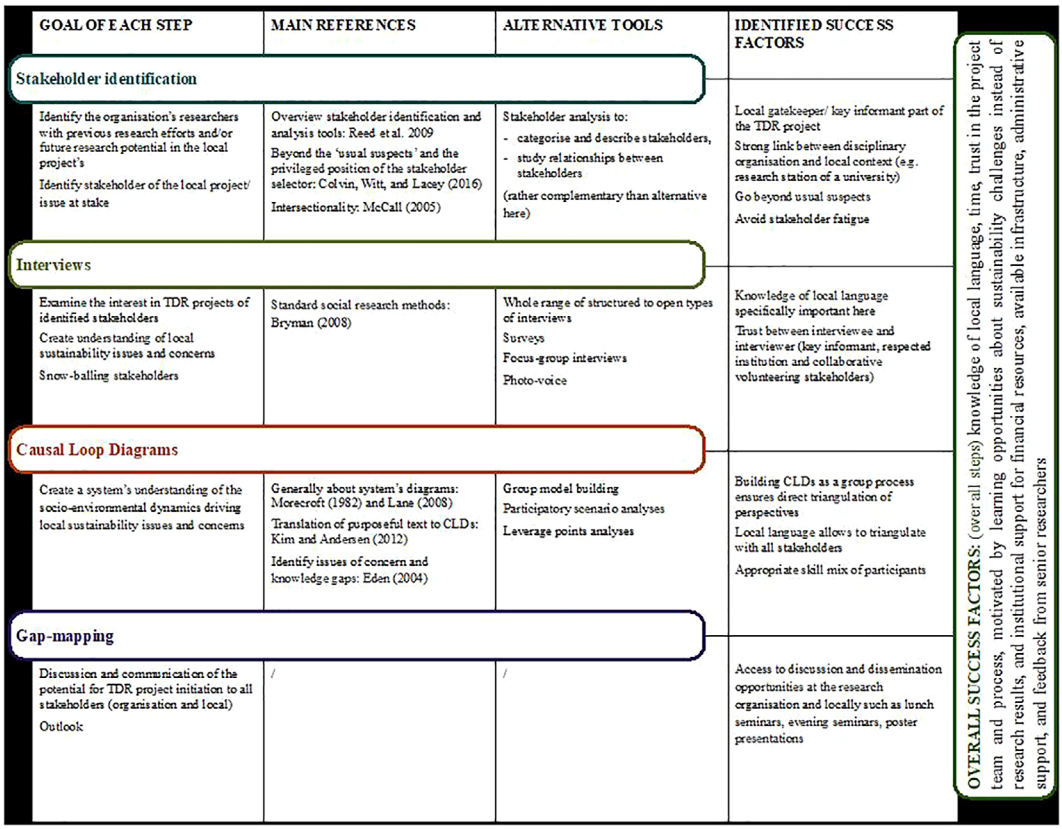


FIGURE 5. Generalised approach to scoping local transdisciplinary research potential within disciplinary research organisations [Colour figure can be viewed at wileyonlinelibrary.com]
Note. The proposed step and its goals, useful methodological references, potential alternative tools for this step, and identified success factors for that step.

generalisable to other contexts where disciplinary-organised research or project organisations would like to initiate local TDR sustainability projects. Figure 5 presents the generalisable approach to scoping for transdisciplinary research potential for sustainability projects from a systems perspective. It describes the goal(s) of each step, indicates some of the main methodological references we found very helpful in each step, provides alternative tools for variations to our method, and important success factors of each step. The arrows in the figure indicate that the proposed approach to identify TDR potential is not a linear stepwise process. Reflection in each step contributes to previous steps by revising or expanding them.

The proposed approach stresses and integrates the importance of system's understanding for TDR projects on sustainability in two ways. First, "local sustainability concerns" in this approach is defined as a problem that crosses the ecological, economic and social pillars of sustainability. The CLD step of the approach showed that the socio-ecological system in Messinia is highly connected across sectors and actors, and that sustainability projects and actors need to consider the positive and negative impacts of their efforts on connected sectors. To contribute to sustainable development/transformation at the local level, it is important to understand and harness the reinforcing power of positive feedback loops and balancing power of negative feedback loops, disclosed by the CLDs.

Secondly, it considers the (idea for a) TDR project as part of the system of local change and of the system of the research organisation involved. It acknowledges all previous, ongoing

and potential future research at the organisation valuable to a local TDR project to ensure that no-one is left behind; i.e., all interest in TDR engagement is welcomed and incorporated, and no existing project work or ideas are overridden by TDR initiation efforts. The approach provides an opportunity for co-learning about and co-initiation of TDR sustainability projects, adjusted to efforts that are already ongoing locally and at the research organisation. It ensures that you as a project participant reflect on your contribution from a systems perspective. As a project participant, you happen to be in a specific place at a specific time: people and projects came before you and people will come after you. To reflect on your position within the system of a research organisation or sustainability project allows you to build on previous work, and to create the best possibilities for successful, continued projects. We propose this TDR scoping approach mainly for research organisations interested in initiating transdisciplinary sustainability projects without any transdisciplinary background, network, lab, or expertise to build upon.

4. Conclusion

We presented a novel approach to scoping for transdisciplinary research by reflecting on a local project conducted in Messinia (Greece). A set of three types of characteristics were identified as enabling conditions for the initiation of transdisciplinary research projects in general: (a) a team composition with mixed appropriate skills and shared visions; (b) institutional support from university departments; (c) a gate-keeper to key stakeholders as part of the research group. The suggested methodological approach provides generalised steps for scoping for transdisciplinary research potential concerning sustainability issues in traditional academic organisations. A cornerstone in our approach was a systems understanding, where stakeholder identification, interviews, causal loop diagramming and gap-mapping were useful tools. Furthermore, we suggest that research groups aiming to pursue transdisciplinary research projects should consider the initiation of such projects a component of long-term transformational change, which has implications for the way the methodology is applied.

As early-career researchers in a traditional academic setting, we took the leap to broaden our research and understanding. We hope that more academics like us will be inspired to do the same.

Appendix 1: Semi-structured interview guides researcher and local stakeholders

A. Researcher stakeholder - interview guide

Theme: background

Can you describe your field/area of working?

How would you describe this region? What do you see there, context/research potential?

What type of research have you been conducting at NEO/Greece?

What were your research questions?

What were your methods?

What was your underlying motivation (what type of problems did you want to address, knowledge gaps, why)?

Why the specific context of NEO?

Does your research directly or indirectly benefit the local community, and if yes, in what ways?

Theme: TDR potential

Would more perspectives be beneficial for your research, do you see any potential for interdisciplinary/transdisciplinary research connected to your work?

Why/why not?

Are you already working in this direction, and if so, how?

What are the hindrances/barriers you experience in regards to conducting more ID/TD research?

In your research, are you interacting with local actors, why/why not?

Theme: ecosystem services

Please name a few ESS (definition: the benefits humans obtain from the ecosystem, (MEA, 2005)) that you recognise in the region.

From the ESS you identified, do you see any drivers that affect the provision of the ES or the demand for that service?

(From the ESS you identified, which one is most important for you specifically?)

B. Local stakeholder - interview guide

Introduce ourselves:

Early-career researchers from Stockholm University, trying to identify research needed by locals, what are the needs, making the research station more useful for the locals

Theme: background

Describe your area of working. What do you do here? What did you do before, what happened here before?

Natural resources use/management and land use composition (supplies, demands, worries, limitations, contestations)

(Perception of) underlying drivers (why)?

How does every type of actor interact and drive changes?

Who do you collaborate with, where do you turn to if you need something, who do you sell to? (dependence on other actors or drivers)

What is driving these changes?

Why do they use the resources/land as they are doing it now?

Who has the power/influence to change?

Who should have the power?

Theme: TDR potential

Future view/vision of the area

What kind of research/knowledge is missing in your opinion?

Is there any project you would like to test? Be specific about your needs

Willingness/potential to cooperate in research

If we have valuable information according to your identified needs, how would you like us to communicate these with you, any suggestions or ideas, how can you create a good network, a network of trust?

Snowballing: other interesting actors for environmental/resources users/actors, alternative actors such as young women

Round up

Tell them we will provide them with our outcomes afterwards

If you have any ideas or comments on our conversation later, you can always contact us or Giorgos

Appendix 2: Complete causal loop diagram

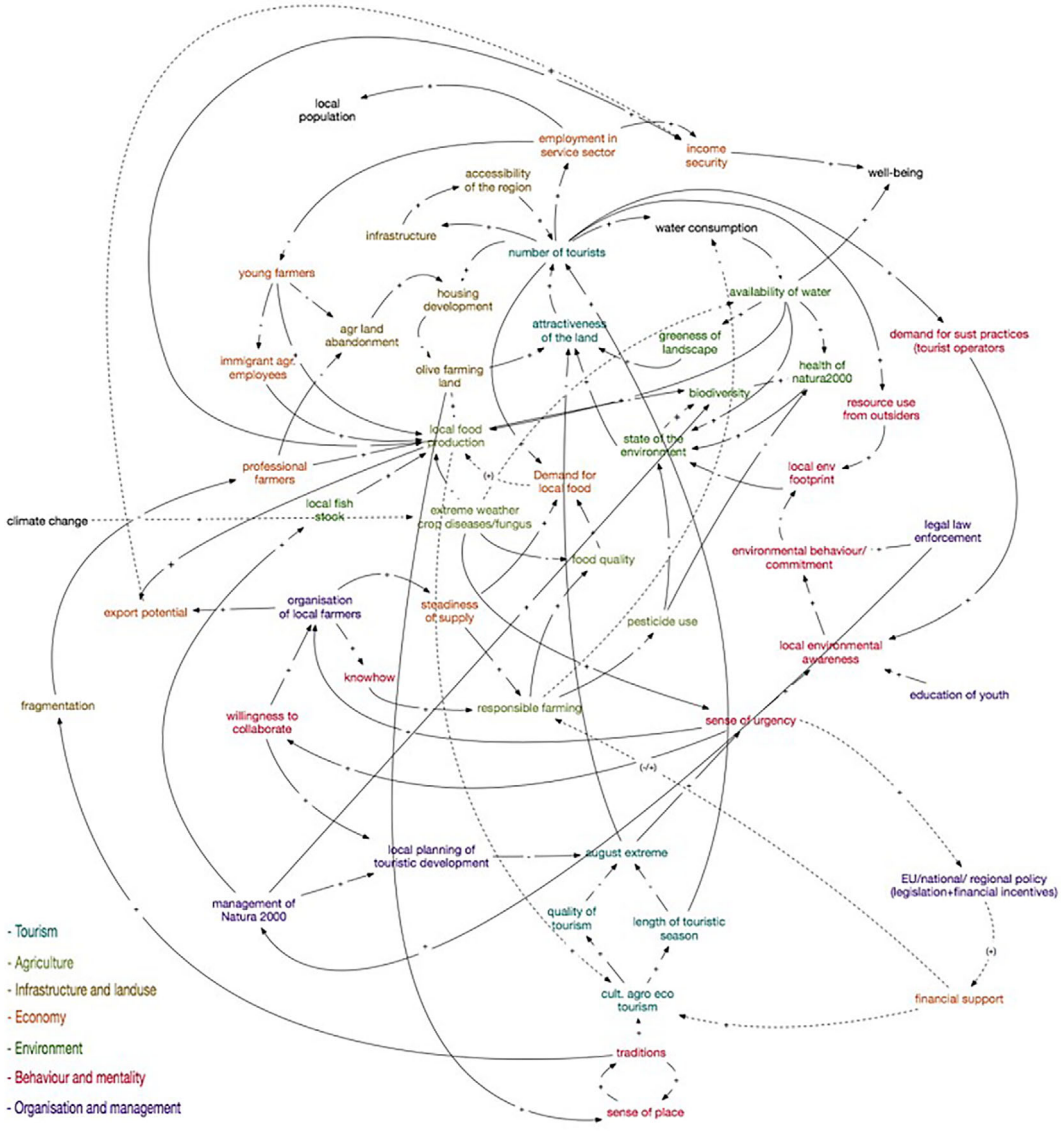


FIGURE 6. Complete causal loop diagram [Colour figure can be viewed at wileyonlinelibrary.com]
Note. The dashed lines indicate causal link that we as researchers added to show possible extra causal links not mentioned by the local perspectives. The different colours depict the different sectors. The same CLD is split up below in six of the identified sectors to increase understanding and transparency of the findings. See Figure 3 on how to read a CLD.

Notes

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1. In spite of the challenges in conducting TDR, academic initiatives and innovations to overcome them also exist, such as the TD-net (Swiss Academies of Arts and Sciences, www.transdisciplinarity.ch), or social innovation labs at universities that have been initiated globally (European project Social Innovation Community, www.siceurope.eu/).

2. More information about the European project Social Innovation Community field station can be found at www.siceurope.eu.

3. More information about the NEO field station can be found at www.navarinoneo.gr.

4. More information about the COASTAL project can be found at www.h2020-coastal.eu.

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