Cross-Disciplinary Approaches to Action Research and Action Learning

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Chapter 12
Using Transdisciplinary Action Research Toward Sustainable Management of Vineyard Management and Tourism in the Negev Highlands

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ABSTRACT

Communities often lack a framework to guide research and action by which to mitigate complex socio-ecological challenges in the face of conflicting interests and poorly understood ecological and socio-political mechanisms. In an effort to provide such a framework, this article offers an approach for the systematic analysis of societal interactions with the landscape as well as for the structure and function of the ecosystem. Using an approach informed both by transdisciplinary research (TdR) and participatory action research (PAR), modeling is employed to identify trajectories of human influence on the ecosystem, which is illustrated using a case from the Negev Highlands of Israel. The approach identifies several cascades of effects, allowing diverse stakeholders to better understand the mechanisms by which human activities change the capacity of the ecosystem to support human well-being over time, as well as building capacity for stakeholder cooperation for sustainable management.

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INTRODUCTION

Coupled Socio-Ecological Systems as a Framework for Sustainable Management

Modeling the human environment as a coupled social-ecological system has become popular as a conceptual tool in recent years (Turner, Georgiou & Fisher, 2008). This view conceptualizes the social system as interlinked with the ecological system, which are both dynamic, due to internal processes and external drivers (Pickett, Kolasa & Jones, 1994; Collins et al., 2011; Landsberg et al., 2011). The benefits the social system derives from the ecological system have come to be known as "ecosystem services". Ongoing pressures and events caused by human behavior change the structure and functioning of the ecological system, and affect the composition and abundance of the ecosystem services it provides (Azapagic, 2010).

Sustainability, according to this theory of socio-ecological systems, is defined as the resilience of the socio-ecological system; namely, its ability to absorb shocks while maintaining its essential functions (Plummer and Armitage, 2007). We use sustainability to refer to the preservation of the system's ability to adapt to change (although not necessarily the preservation of the status quo) (Griggs et al., 2013).

While the meaning of sustainability was always intended to encompass the range of interconnected environmental and social factors, this has long been a challenge, both theoretically and in the context of policy and management (Orenstein and Shach-Pinsly, 2015). One reason for this difficulty has been attributed to the separateness of natural scientists, social scientists, and others and their related disciplines (Liu et al., 2007). Even though it is now accepted that human societies are inextricably linked with the biophysical environment, it is difficult for some to leave behind the dichotomy between "man and nature", long popular as a dominant belief in Western civilization (Pickett, Kolasa & Jones, 1994; Berkes and Folke, 2000; Keiny, 2004). The idea of the coupled socio-ecological system arose concurrently in multiple disciplines as an effort to bridge this disconnect (Singh et al., 2012). This is a conceptual framework in which, ideally, natural scientists and social scientists collaborate in an effort to understand how human behaviors can affect ecosystems and alter their structure and function in a way that damages or enhances its ability to provide ecosystem services; that is, to continue to support the social system (Folke 2006; Azapagic, 2010).

Despite the aspiration to bridge and create a meaningful knowledge exchange among researchers from different disciplines, many socio-ecological models focus primarily on ecosystem processes and relate to social processes as drivers of ecological change without analyzing the underlying causes of individual, social, and political behavior. For example, when a complex socio-ecological issue was modeled using the type of ecological model known as DPSIR (drivers, pressures, states, impacts, and responses), the social drivers that were identified as affecting the greater socio-ecological system (environmental ethics, meat consumption, animal welfare regulations, meat export demand, energy use, and transport, in this study) were identified in a highly simplified fashion (Niemeijer & de Groot, 2008). This kind of analysis, while emphasizing the importance of understanding the entire socio-ecological system, does not provide much insight into the complexity of the social system or the feedback between the two systems. In addition to the links between a given social system and ecosystem, socio-ecological research should explore the underlying motivations, beliefs, and behaviors that drive social phenomena (such as environmental ethics, meat consumption, etc.).

MAIN FOCUS OF THE CHAPTER

In this chapter, we use a case study of a socio-ecological system in Israel's arid Negev Highlands to describe how an environmentally damaging farming practice became the trigger for a new collaboration between scientists and stakeholders. Over the last several decades, as population density increased in central Israel, agriculture expanded to the country's arid zone, which is considered the periphery of the country. When farmers began to have problems of erosion and soil salination, researchers initiated an active learning and participatory action research program in order to tackle socio-ecological problems, leveraging ancient agricultural knowledge whose infrastructure still exists in the form of ancient terraces and dams. One of the motivations behind this collaboration was the desire to create opportunities for greater stakeholder agency in understanding the socio-ecological systems by harnessing knowledge of local residents. We use this case to advocate for a process of transdisciplinary action research that links ecological and social research as well as meaningful stakeholder participation.

Lack of Integrated Knowledge and the Need for a Transdisciplinary Approach

Failure to understand underlying drivers of ecological and social processes may lead to an incomplete understanding of the social-ecological system as a whole, which in turn may lead to ill-conceived approaches to sustainable management (Burns & Worsley, 2015). Unsustainable practices can result for multiple reasons, such as lack of information, a lack of long-term thinking, the prevalence of profit motive over multiple stakeholder interests, and conflicts of interest among stakeholders (Dick, 2011). Transdisciplinary research (TdR) begins with a real-world challenge, and, in an ideal scenario, engages academics, practitioners, and stakeholders to develop new conceptual frameworks, set a research agenda, and conduct research, to produce knowledge needed for policy and management (Mauser et al., 2013). TdR has long been touted as most suitable for complex, high-stakes issues (Funtowicz & Ravetz, 1993). Importantly, TdR encourages scientists not only to work together across disciplines, but to engage other stakeholders as partners in setting the research agenda, and in long-term ongoing research.

Transdisciplinary research can be defined as an approach to problem-solving that coordinates a variety of scientific and non-scientific actors, including stakeholders, to integrate diverse types of knowledge, consider risks and consequences of possible solutions, and generate practical solutions that may be implemented. Ecologists have promoted interdisciplinary (collaborations between academics from different fields) and transdisciplinary (academics working with members of other sectors) research approaches in the hope that it will allow them to better translate scientific knowledge to the realm of policy and management (Orenstein & Groner, 2014). Transdisciplinary action research (TDAR) is a variation of this approach. This term developed out of the planning literature, and describes meta-research -- research that reflects upon a transdisciplinary research process, including the process of developing and conducting research projects as well as translating knowledge into decision making processes and policy (Stokols, 2006).

The Need to Make Stakeholders Real Partners

There has been evidence over recent decades that the most effective solutions to environmental challenges are often those that are researched, developed, and implemented together with stakeholders (Burns and Worsley, 2015; Clark, 2011; Shipley and Utz, 2012). Participatory action research (PAR) developed to

better engage local and marginalized people, first to enhance and express their knowledge of an issue affecting them, and then to plan, prioritize, monitor, evaluate and take action on the issue (Chambers 1997, 2008). It is a community development approach in which facilitators work with vulnerable populations to identify problems, and to develop and implement a plan of action to solve those problems (de Negri & Ilinigumugabo, 1998; Swantz, 2008). PAR emphasizes collaboration, equality, and interpretation and criticism, and can be an effective approach for identifying and implementing culturally appropriate solutions to planning in situations of uncertainty (Zuber-Skerritt, 2012). PAR often describes a process in which a non-profit organization works closely with a marginalized group of locals to identify and implement a solution to a problem. By contrast, we use a PAR approach with the aim not only of engaging stakeholders but of allowing them to *drive the process of agenda-setting* for research.

PAR also provides a framework for participants to reflect upon their beliefs and assumptions and how these are linked to social behavior and reality, and by extension, to impacts on the socio-ecological system. This concept is referred to as a theory of action (ToA), in which actors in a social system identify the complex of interrelated (and often unconsciously held) assumptions that govern their behavior in order for the individual or group to achieve their goals (Putnam, 2014). According to Argyris and Schön (1974), creating knowledge that is useful for practice demands a process in which actors reflect upon underlying values, norms, or frames and alter their behavior accordingly. TdR also encourages reflective behavior among researchers -- about the research process -- drawing upon various methods from different disciplines. We demonstrate in the case study below that using ToA to analyze the assumptions held by various stakeholders can be an effective strategy in the context of TdR.

Demand Emerges for a Comprehensive Socio-Ecological Study of the Negev Highlands

In the autumn of 2015, a group of scientists began the process of establishing the Negev Highlands region as Long-Term Socio Ecological Research (LTSER) platform. LTSER platforms are currently being advanced around the world as hubs of interdisciplinary and transdisciplinary research, as part of a global research network focused on producing integrated socio-ecological knowledge about areas representative of global socio-ecological systems (Mirtl et al., 2013). The Negev Highlands LTSER Platform, currently in a start-up phase, is located in the central Negev desert in southern Israel.

Over twenty years ago, a local initiative produced a plan to develop an agro-tourism park in a region adjacent to the town of Mitzpe Ramon (population approx. 5000), in an effort to increase tourism and build up agriculture as a new livelihood in the area. The plan was to set aside 1,200 dunams of rocky desert adjacent to an existing nature reserve, for vacation rentals, vineyards, and olive groves. About a third of the park area was designated for agriculture and tourism entrepreneurs. Much of the land marked for these projects lay within a dry streambed containing ancient relics of Byzantine farms (1400 CE) (Evenari, Shanan & Tadmor, 1982). The project aimed to promote the integration of tourism and agriculture in the desert environment while supporting natural, heritage, and structural conservation. Although this initiative was never formalized, several wineries were established in the designated area. Most of the entrepreneurs are middle class individuals without much experience in agriculture.

Over the years, farmers experienced accelerated soil erosion and salination, and their olive trees and vines were uprooted by floods. Since the Drainage Authority is responsible for regulating the drainage infrastructure in the area, farmers repeatedly requested help from the Drainage Authority to cope with soil degradation processes. The initiative to start this process came from the Drainage Authority, one of

the institutional stakeholders of the newly established Negev Highlands LTSER Platform. The Drainage Authority approached platform researchers in the autumn of 2015, which at the time, was composed primarily of ecologists who were eager to expand research collaborations to enable a more interdisciplinary research approach for the platform. The Drainage Authority, with an interest in explicitly socio-ecological research, requested that the scientists conduct an initial survey of farmers to better understand land management practices and the challenges farmers were experiencing in developing agriculture under the hydro-ecological conditions of a rocky desert. Based on observations of water flow in the basin and interviews with stakeholders, the scientists concluded that the issues of erosion and salination were related to interference with the natural water flow pattern in the desert watershed. They determined that farmers contributed to this problem due to their lack of knowledge and experience in managing local runoff systems (Avriel-Avni et al., 2016). The farmers' irrigation methods were effectively degrading the quality (by salinization) and stability (by soil erosion) of the soil. In the language of ecosystem services, farmers had degraded some ecosystem services related to soil function and runoff regulation in pursuit of increasing certain provisioning services, paradoxically harming their livelihood. This presented a potential ethical challenge, because the farmers were privately benefitting from the increased provision services in the short term, while degrading regulating services, which are both a shared resource and are crucial to the farmers' economic wellbeing in the long term.

As a direct result of the research and in recognition of its policy relevance, the Drainage Authority set out to create rules for sustainable management of the environment, which became the trigger for more in-depth social-ecological research. The director of the platform (and the first author of this article) exploited this opportunity to engage stakeholders using a transdisciplinary PAR approach. In other words, at this point, there was recognition by the Drainage Authority that a comprehensive, transdisciplinary study was needed to reconcile economic activities conducted in the watershed with ecological impacts and the social implications resulting from changes in ecosystem services.

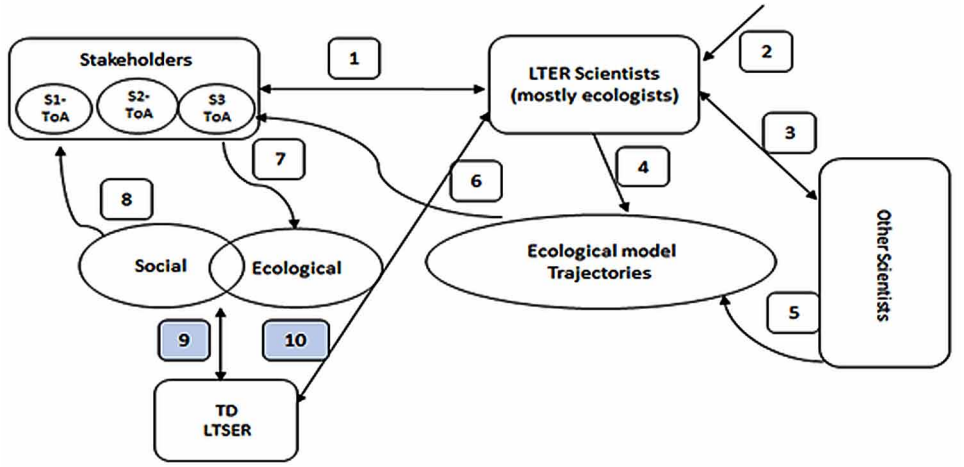
Using an integrated approach (which we refer to as TD-PAR) platform scientists queried a range of stakeholders and experts, first in one-on-one interviews, and subsequently in group meetings, in an attempt to define key issues in this arid agro-ecosystem and identify the information and knowledge needed to address these issues. Figure 1 depicts the partnership-building process at the Negev Highlands platform, described in the following section.

The numbers indicate the steps of development of a Transdisciplinary- Participatory-Action Research framework. Numbers in the diagram are elaborated in the description below. (Key: S (1-3) ToA - Stakeholder Theory of Action; LTER- Long Term Ecological Research; LTSER - Long Term Social-Ecological Research platform)

Phase 1: Setting the Foundation for Transdisciplinary Research

Following a request by the Drainage Authority, the LTSER researchers (the authors of this chapter) began to gather physical, ecological and social information about the area (step 1). At the same time, the researchers began to collect information about similar processes around the world, as well as examples for modeling such situations (step 2). They engaged additional scientists for help refining socio-ecological models (step 3). Some of these connections with new scientists would result in their long-term engagement in the process as advisors (step 5). These socio-ecological models described the trajectories of the impact of human activities such as fencing vineyards and planting vines, and how these activities

Figure 1. Building TD-PAR of stakeholders and multi research disciplines researcher



impacted the structure and function of the local ecosystem and affected its continued ability to provide essential ecosystem services.

Phase 2: Establishing Active Learning and Action Research

Data collection relied upon a series of convergent interviews with farmers (step 1). Convergent interviewing is a method that uses a structured process with open-ended questions, and which analyzes interview data as the interviews take place (Dick, 1990). Data analysis from these interviews revealed a larger number of direct and indirect stakeholders than originally assumed. Interviews also showed that each stakeholder (labeled S1 etc. in Figure 1) had a unique understanding of the ideal socio-ecological situation and what it would take to get there; in other words, his own theory of action (ToA). These interviews served to engage stakeholders in dialogue, creating an atmosphere of trust between researchers and local stakeholders (step 6), and the interview process signaled the start of an active learning and action research approach around the issue of vineyard cultivation in the Negev Highlands. As scientists from multiple disciplines checked facts with farmers on the ground, a process of mutual learning began (steps 7 and 8). This learning process enabled the creation of models that visualized the flow of decisions and actions around vineyard cultivation in the region.

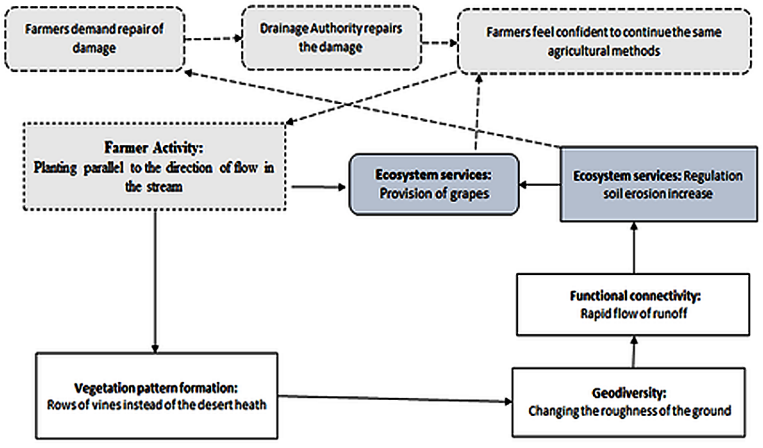
An example is illustrated in Figure 2. Planting vineyards involves plowing, removal of native vegetation, and planting rows of grapevines along the flow path of ephemeral river beds (also known wadis, washes, or arroyos) of the desert land. Vineyards were first planted in the area about 20 years ago (notwithstanding agricultural activities of ancient civilizations), reflecting local, national, and global socio-economic influences. Population growth and increased human population density in the center of Israel created an incentive for new farmers to move to desert areas in the periphery of the country. Global economic conditions helped increase demand for boutique wines. Large temperature differentials between summer and winter, low humidity, and lack of pests contributed to a perception of the Ministry of Agriculture, subsequently adopted by farmers, that this area was highly suitable for growing wine grapes. Preparing the land for agriculture was supported in-kind by quasi-governmental organizations like the Jewish National Fund, which helped prepare the land for agricultural uses, and the National

Drainage Authority, which repaired damage that occurred on agricultural land as a result of soil erosion after rain events. Farmers' perceptions seemed to be corroborated when they found the remains of ancient agricultural systems on their land. However, because they had no previous experience using runoff water for agriculture, they ignored the ancient agricultural system, designed to regulate soil erosion and soil salinity (Avriel Avni et al. 2016).[1] Most farmers also chose to remove all natural vegetation, which they understood as competing with their domestic crops for water, but the removal of vegetation had the unintended consequence of increasing soil erosion. As a result of the soil erosion, some farmers stopped planting in the dry riverbed and instead planted their vineyards on the more saline banks. One reason for this was based on the perception that methods from modern agriculture would provide solutions to any problems that might arise. In reality, after a rain event created soil erosion damage, farmers would request aid from the Drainage Authority and would receive it. This social dynamic reinforced the perceptions mentioned earlier, preserving unsustainable agricultural methods. Feedback from various stakeholders was incorporated into the trajectories model, improving the accuracy of the models and creating a forum for dialogue. Systematic mapping was undertaken to identify key actors and their interests, and to begin dialogue among researchers and stakeholders.

The model depicts the interactions (arrows) and components (boxes) of a social-ecological system driven by framers activity (light gray boxes) aiming at ecosystem services of provision of grapes (dark gray box number 1) in a desert based on conventional agricultural methods. Farmers activity affect the dynamics of the ecological system (white boxes) by modulating geodiversity, vegetation pattern and functional connectivity of surface runoff water (solid arrows). This result in modifying a natural ecosystem service of soil erosion regulation (dark gray box number 2). The Drainage Authority's willingness to repair the damage of soil erosion, causing a positive feedback which preserves the existing agricultural method (dashed arrows).

Interviews also revealed that the availability of unlimited water for irrigation (which is expensive, but offered to farmers at a discount), led the new farmers to see themselves as largely independent from the reality of desert conditions, which allowed them to perpetuate their perceptions about the possibilities of farming in this desert ecosystem, including ignoring the ancient agricultural methods for mitigating

Figure 2. The current situation: a socio-ecological model of farming in the Negev Highlands



soil erosion and soil salinity. Here, the willingness of the Water Authority to provide farmers with an unlimited supply of water enabled farmers to perpetuate their beliefs and unsustainable practices.

The current understanding of ecologists and social scientists affiliated with the Negev Highlands LTSER platform led them to initiate a series of meetings with farmers in order to figure out together how actors can alter their behaviors and reverse the negative feedbacks that have been perpetuating activities that increase soil erosion.

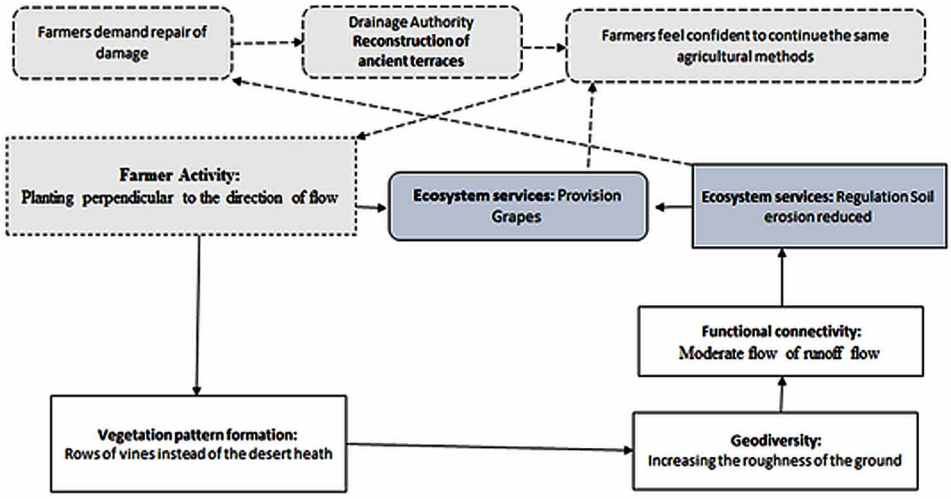
Phase 3: Using Transdisciplinary-Participatory Action Research (TD-PAR) Toward Sustainable Management

In this phase, collaborative active learning between researchers and farmers led to understanding how to educate actors about the misinformation that perpetuates the ideas and actions that increase soil erosion in farmers' fields. Figure 3 illustrates this new understanding. The light gray boxes and the dashed lines describe the social dynamics that must change in order to achieve the reduction of soil erosion, an increase in the supply of grapes, and a rise in farm productivity.

The model depicts the interactions (arrows) and components (boxes) and feed backs from ecosystem services to the socio-ecological system, aiming at restoration of ecosystem services demerge. Two activities are altered by understanding the social-ecological system: 1) Drainage Authority recovers ancient agricultural terraces to prevent continued soil erosion 2) farmers are planting perpendicular to the direction of runoff flow. As a result the impact cascade of human activity on the ecosystem is altered and the ability of the ecosystem to provide regulation and provision services are restored.

It is important to note that the change in social dynamics requires cooperation with other stakeholders in the area, including Bedouin shepherds, tour operators and the local council. Actors should aim to achieve a shared understanding of the coupled socio-ecological system in order to establish a strong transdisciplinary partnership (steps 9 and 10).

Figure 3. The product of the TD-PAR process: a socio-ecological model of farming in the Negev Highlands



Phase 4: Next Steps

At this point, the Negev Highlands LTSER platform has created structures, processes, relationships, and tools needed for advancing sustainable outcomes in the region. Moving forward, greater attention should be placed on additional regional sustainability issues and their social, political, and economic dynamics that affect ecosystem structure and function. Patterns of thinking, behavioral norms, and economic and political pressures should be analyzed in an effort to identify differences in ToAs between various stakeholders and ultimately, facilitate dialogue that helps stakeholders to create a participatory action theory.

Advanced stages of TD-PAR should result in an integrated social-ecological model, replacing the ecological model. This model should include a detailed analysis of the social dynamics which give rise to particular land use practices, combined with their bio-physical and social trajectories. One of the benefits of an integrated model is that it should aid actors in better understand each other's theories of action, which can instigate a process of developing a common model shared by all collaborators that may better aid progress toward mutual learning, research and management.

CONCLUSION

Using conceptual frameworks drawn from various fields, in particular transdisciplinary research as defined by the field of socio-ecological systems science, and PAR, we have demonstrated how ecologists, social scientists, institutional stakeholders and local stakeholders (such as small-scale farmers) can use an iterative process for building of socio-ecological models to increase understanding of science and local knowledge and practice, becoming familiar with perspectives of diverse stakeholders, building relationships and dialogue, and normalizing active learning.

Ideally, the process of compiling the knowledge needed to build these models, building them, incorporating diverse feedbacks and modifying them to ensure accuracy, and finally using them for educational purposes, sets the groundwork and builds skills to enable diverse actors to collaborate. This itself is a significant precedent, for it can set the stage for collaborative decision making.

However, this type of work is often rife with conflict on several levels (Norris et al., 2016). First, interviews revealed that it can be challenging for ecologists to collaborate with other types of natural scientists because of conflicting scientific paradigms and goals. Further, ecologists may be charged with working directly with stakeholders to revise and refine the socio-ecological model, but ecologists may have a tendency to focus primarily on the ecological model. Ideally, in the case above for example, the research team, now composed of two ecologists, would become a larger, more interdisciplinary group, which might force a more integrated approach to formulating and defining problems and building models. An additional challenge is that institutional and local stakeholders, such as the small-scale farmers in the Negev Highlands, may resist the process in various ways. The central challenge of the process to date has been for LTSER scientists to involve farmers so that the stakeholders would begin to take ownership of the process and take it upon themselves to drive the process forward.

Despite such challenges, the TD-PAR approach has already transformed the collaboration process in the Negev Highlands. It has already facilitated new dialogues across disciplinary divides (among scientists) and across the scientist-stakeholder divide. Reflexive exercises informed by PAR helped actors to identify and understand their respective theories of change, and take steps toward a new, more widely shared theory of change. The Negev Highlands LTSER platform has built social capital, sowing seeds of a shared vision, uncovering facts, and exchanging expertise gleaned from research and experience. In short, the TD-PAR approach has already helped the LTSER scientific team to coordinate a productive process, and moving forward, these authors hope to report transformations not only within the process but also transformations of socio-economic realities, toward sustainable agriculture, tourism, and environmental management in the Negev Highlands.

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ENDNOTE

[1] These 1600-year-old Byzantine agricultural engineering works are comprised of rows of stones laid across the wash, designed to distribute the water across the area and thereby reduce the power of water flow during flood events.