4. Implementing transdisciplinary research partnerships

At least since the 1970s, policy makers and science officials have taken steps to promote participatory methods for sustainability research (Elzinga, 2008). At that time, public participation gained attention through studies on technology assessment, risk analysis and the formulation of science and technology policy. Support for participatory methods in large-scale research programmes emerged only in the 1990s, however. This was largely as part of an attempt to use new methods to tackle mounting social inequality and ecological sustainability problems. In this context, universities, communities and researchers initiated major research partnerships in various fields of research, such as environmental health, urban and agricultural landscape planning, and the social economy (Wallerstein and Duran, 2010; Enengel et al., 2012; Hall and MacPherson, 2011). Prominent examples discussed in this book illustrating this trend are the partnership between the city of Tokyo and its university for research into climate change initiatives (see also section 5.2.3 below) and the use of deliberative sustainability impact assessment methods in pilot projects throughout the world (see section 3.2.2).

Scholars of social innovation have widely documented the positive role of these participatory and collaborative methods for implementing transdisciplinary modes of research (Smith et al., 2010; Baker and Mehmood, 2014). In particular, as will be illustrated below, results of participatory methods seem especially promising for understanding and implementing transition processes to more sustainable societies. For this reason, both social actors and high-level policy makers promote knowledge co-production between experts and practitioners as a key element of initiatives for combating social exclusion and environmental degradation. This trend is also evident in the "science–policy–society" partnerships established in OECD countries, for example in the European Commission's Innovation Union Programme (BEPA, 2010) and Barack Obama's Office of Social Innovation and Civic Participation.

To support the further development of participatory approaches, researchers have analysed the various benefits of participation in more depth. Noticeable among these are the enabling of learning across all stakeholders

and researchers concerned, the empowerment of actors that are potentially excluded from the research process – such as indigenous and socially disadvantaged communities – and the promotion of social innovation. These benefits are particularly clear in fast-changing societies, in which the ability both of individuals and communities to improve their capacity to learn, and to adapt to a dynamic context, gains in importance. Indeed, as highlighted in the literature on organizational learning and in management theories, social innovation depends on the diversity of perspectives that are combined: the more "open" innovation is, allowing both inflows and outflows from foreign sources, the better equipped it will be to adapt (Chesbrough, 2006); the more inclusive and "pluralistic" leadership is, the less it will be trapped in routines and path dependency (Van de Ven et al., 1999, p. 117).

As a result of this growth in the number and quality of participatory research partnerships, participatory methods have become a well-recognized part of public policy discourse, in addition to the discussions about the conventional public policy tools of regulation and market incentives. Nevertheless, in spite of this growing recognition, many decision makers approach science–policy–society partnerships from a top-down, expert-driven perspective (Jessop et al., 2013; Innes and Booher, 2010). This top-down perspective is strongly influenced by theories of new public management and firm-level innovation analysis (Osborne and Gaebler, 1993; Wollmann, 2004; Sharif, 2006). These theories emphasize the effectiveness of the problem-solving process made possible by the new research partnerships, more than the social learning of new norms and beliefs and the empowerment of the actors. Accordingly, in spite of the use of participatory methods, major emphasis is placed on monitoring the processes through performance indicators designed by social entrepreneurs and policy officials. As a consequence, many models of participation are still implemented in a vertical, top-down, expert-driven manner (McCown, 2002; Corburn, 2003).

Indeed, in practice, the implementation of research partnerships mobilizing both academic and practitioners' knowledge is often still based on the practical routines and procedures of conventional top-down and ethically neutral science. For example, in the field of environmental health studies, participants have expressed concerns that the function of the partnerships is often limited to improving recruitment of participants into investigator-initiated and designed clinical trials, rather than making a more effective contribution to the improvement of the community health situation (Seifer and Greene-Moton, 2007). In another case, in the field of natural resource management, indigenous knowledge and farmer preferences were explicitly considered in designing an appropriate technology package for addressing underutilization of fertile soil in the Ethiopian Highlands. However, the

tests were conducted at farm plot level, with a unilateral focus on yield and income related to the adoption of bio-economic modelling. As a consequence, the research failed to involve the farmers in discussions on the way to integrate broader human welfare concerns into the model, relating to food security, health and nutrition (Jabbar et al., 2001).

Often such vertical, top-down implementation of participation is adopted, even despite recognizing the importance of involving the key social actors and practitioners in the research process. Indeed, the most traditional, expert-based view of participation contends that practitioners lack the necessary technical knowledge to understand the full complexity of collective action problems. In this limited understanding of participation, the main role of the practitioners' involvement is to improve the translation, transmission and dissemination of expert-based knowledge among social actors. A related view of participation is that local knowledge is needed to complement and enrich the policy makers' expert-based knowledge, in situations where it is difficult to obtain adequate information without the involvement of the practitioners. While these models of participation certainly contribute to improving the quality of policy making, sustainability scholars generally consider that such an approach is insufficient for governing sustainability transitions.

In response to these challenges, sustainability scholars have called for the development of more decentralized and horizontal modes of participation of citizens and non-state collective actors in social innovation (Scharpf, 1997, pp. 52–4; Heinelt, 2010). Such a horizontal perspective of social innovation is based on the view that efficient and legitimate social innovation depends not only on contributing new solutions to unresolved social problems, but also on changing the social relationships generated in this process, such as changes in modes of governance (Lévesque, 2013; Lenoble and Maesschalck, 2010) and changes in modes of collective knowledge production in social and ecological transition pathways (Cassinari et al., 2011; Lang et al., 2012).

In situations characterized by complex socio-ecological interdependencies, and in contexts of deep social controversies rooted in different cultural and individual values, vertical, expert-led approaches to participation face two important limits. The first is related to the many "unanticipated" side-effects of any policy intervention, which requires many diverse agents to be able to take informed action in response to the information they receive from many sources. Expertise plays only a small part in this process, even though professional experts can contribute to the effectiveness of collective problem solving by making sure that the relevant knowledge is available to the practitioners involved. For example, in one high-profile case in the US, an expert-led process for cleaning up a heavily polluted

site led to a 10-year delay before any effective action was taken, due to a narrow definition of the problem and the unforeseen side-effects on the local landscape (such as the drying up of a local ecological zone and the destruction of recreation areas) that resulted from implementing the plans proposed by the expert engineers. In 1996, in response to this failure, the State Department of Environmental Protection set up a collaborative multidisciplinary group, which was able to successfully reframe the technical issue into a community-led social process of inquiry, combining many perspectives on the problem and facilitating incremental, iterative problem solving (Scher, 1999).

The second limit of top-down, expert-led participation is related to the motivations of practitioners to contribute to participatory and collaborative processes. In general, in situations where users already have the capacity to learn locally adapted strategies for problem solving and to adopt and use social norms to overcome collective action problems, support from the government for research or input from external experts has not always proved to be effective. As shown in many empirical studies, an important prerequisite for success is that such research collaborations should also support the actor's intrinsic motivations, such as his/her sense of autonomy, his/her sense of fairness and equity of the rules (Muradian and Rival, 2012). Indeed, from within socio-psychological studies, self-determination theory provides some explanation of this phenomenon (Deci and Ryan, 2000). Arrangements in which individuals perceive that they have a choice and that the rules of collaboration are not imposed on them top-down may impact positively on the individual's motivation to take action based on environmental concerns, whereas, conversely, a perception that public policies control the discussion on environmental issues may lead to apathy and decrease motivation (Lavergne et al., 2010).

This contrast can be illustrated through a well-documented case of scientific advice for sustainable small-scale fishery management in Galicia (NW Spain). In the 1990s, the regional fishery administration appointed biologists as technical assistants to work with local shellfish organizations, called Cofradias, providing support with biological assessments and improving their fishery management skills in a situation of heightened economic pressure and growing demand for sustainable management (Macho et al., 2013). However, this scientific support for the co-management of the fisheries did not lead to any significant change for nearly a decade. According to the Cofradias managers, the lack of progress was due to two factors: the appointed scientists largely operated on the basis of the fishery administration's understanding of the organizations' needs, and they were also ill-trained in the issues that the Cofradias deemed important. To overcome this deadlock, the fishery administration established a new system

in 2000. Under the new rules, the Cofradias – rather than the fishery administration – were able to choose and appoint the scientists themselves and received support to host them physically in their own buildings. As a result, these so-called "barefoot fishery advisers" (Macho et al., 2013) were able to devise new research questions and ways of working directly with the local partners, even though no such research activities were initially envisaged by the administration. One new line of research in some of the Cofradias was related to the study of local market opportunities for the fisheries. Another consisted in the development of a methodology for systematic data gathering on the fisheries' resources, which involved forging new contacts with regional university partners. This research support had a major impact on the reorganization and professionalization of the sector. The main difference between the decade 1990–2000 and the decade 2000–10 was the new role given to the local actors in co-determining the planning, management and outcome of the research partnership. A similar role of community self-determination in transdisciplinary partnerships has also been documented elsewhere, such as the case of forest groups in transition to sustainable forest management in small-scale forestry in Flanders (Dedeurwaerdere, 2009), the case of participatory plant breeding (Sperling et al., 2001) and the role of local environmental knowledge in Japan (Sato and Kikuchi, 2013).

As seen in these and other studies, both the cognitive limits related to unanticipated socio-ecological interdependencies and the importance of the actors' self-determination seriously limit the effectiveness of top-down approaches to implementing participatory research arrangements. Consequently, the top-down approach is clearly not sufficient for generating the transition towards strong sustainability envisioned in this book. Indeed, in spite of giving a bigger role to stakeholders and practitioners, such an approach still treats partnerships with practitioners in an external/control-oriented fashion and does not address the question of the intrinsic unpredictability of the transition processes and the quest for fairness and equity among all the partners. First, it emphasizes entrepreneurial solution-oriented agency, thus ignoring the specific limitations of scientific and professionals'/experts' knowledge for steering open-ended and highly unpredictable transition processes. Second, it neglects the aspects of social innovation that are most difficult to assess from the observer's perspective, such as the role of the actor's intrinsic motivations or the perspectives of the most disadvantaged and less resourceful actors.

With a view to overcoming these and other challenges in implementing research partnerships for sustainability, researchers and communities have designed various collective decision-making mechanisms that better address such issues as social relevance, community sovereignty, data

ownership and external validity of results. This chapter reviews the role of these mechanisms in three high-profile partnership models for research in three countries: the environmental health research partnerships in the US, the transition research at the National Institute for Agricultural Research in France and the community–university research partnerships in the field of social economy in Canada. Obviously, many other initiatives have been undertaken to tackle the unprecedented sustainability crisis within a trans-disciplinary research framework. These three models have been chosen for their broad diversity in designing transformative science programmes, ranging from specific community-related knowledge co-production to more regional and national research programmes. However, wherever relevant, analysis of the cases will be complemented with the conclusions presented in major reviews of transdisciplinary sustainability science published over the last decade (Thompson Klein et al., 2001; Hirsch Hadorn et al., 2008; Brandt et al., 2013). For each of these models, we address the following questions: "What are the specific features of the problem situation identified by the community and the researchers that call for a transdisciplinary science approach?"; "What governance mechanisms were designed by the partners to address the specific challenges raised by trans-disciplinary research procedures?" and "How, as a result, was scientific output improved through these partnership arrangements?".

4.1 IMPROVING ENVIRONMENTAL HEALTH THROUGH COMMUNITY-BASED EPIDEMIOLOGICAL SURVEYS

Transdisciplinary research partnerships offer great potential for improving scientific research in situations where access to field data is difficult or where causal relationships are difficult to establish, because of the complexity of socio-ecological interactions. For instance, researchers working with indigenous peoples or urban ethnic communities often have to overcome deeply engrained histories of mistrust resulting from neglect or social exclusion (Harding et al., 2012). In other cases, large-scale statistical data has proved to be insufficient to understand complex causal pathways, such as when relating environmental pollution to its deeper-lying causes or its impact on human and ecosystem health (Brody et al., 2007). In such situations, a high level of collaboration is crucial in the research design so as to address important issues such as sovereign rights of the actors and the understanding of the real-world possibilities of social transition.

The failure of traditional epidemiological study designs to capture the importance of complex causal pathways (relating to local housing

conditions or occupancy, for instance) has led to the development of participatory research methodologies by local communities taking independent action to understand the occurrence of major medical problems such as asthma, cancer or birth defects. Such initiatives were often followed, in a second stage, by publicly funded research programmes supporting scientific research in partnership with these affected communities. In the United States, in particular, grants supporting research involving community participation have increased dramatically and have gained academic respectability since 1996, when the National Institute of Environmental Health Sciences (NIEHS) started funding this kind of research (Brown et al., 2012). The core principles of these new research programmes are equal participation by all partners in all aspects of the research and recognition that community-based participatory research is a collaborative process that is mutually beneficial to all those involved. As such, this model provides orientation and an overall research approach, which equalizes power relationships between academic and community research partners, rather than guidelines for choosing specific qualitative or quantitative research methods (Wallerstein and Duran, 2010). Since the inception of the programme, community-based participatory research has received substantial additional funding from the Centres for Disease Control and Prevention and various foundations, which has helped to advance this field of science. In addition to funding support and recognition for reducing racial/ethnic health disparities, community-based participatory research has gained recognition in academia, with the Institute of Medicine naming community-based participatory research as one of the eight areas in which all public health professionals need to be trained (Gebbie et al., 2003).

A well-documented case illustrating the failures of top-down, expert-led research for data gathering in complex socio-ecological systems is the Jason Corburn study of environmental health justice in the Williamsburg neighbourhood of New York City, in south-east Manhattan (Corburn, 2005). The context of this study is the alarming phenomenon that asthma-related hospital admissions in the United States and asthma-related morbidity rates are twice as high among non-whites as compared to whites. In New York City in particular, a *New York Daily News* investigative report (Calderone et al., 1998) revealed that in some ethnic neighbourhoods, asthma was the leading cause of school absenteeism. Even though the causes of this phenomenon are as yet not well understood, analysis of data from the Environmental Protection Agency shows that Latinos and African-Americans are more likely to live in areas that exceed federal standards for many pollutants such as lead, ozone, carbon monoxide and particulates (Wernette and Nieves, 1992). This has led researchers to explore the relationship between respiratory illnesses and environmental

pollution as an important factor for explaining asthma occurrence in addition to genetically determined hypersensitivity and exposure to specific allergens.

In this context, a conflict over the operation of an incinerator in the heavily industrialized Williamsburg neighbourhood led to a highly contested neighbourhood health study. Commissioned in 1992 by the New York City Department of Environmental Protection, this study has triggered a whole set of community–research partnerships into the health–environmental pollution nexus that was inaccurately reflected in this first study. In the 1992 study, the Department of Community Health and Social Medicine of the City University of New York Medical School (CUNY-CHASM), along with the New York City Department of Health (DOH), concluded that there did not appear to be an asthma problem in the neighbourhood, even though the authors of the study recognized the limits of the adopted methodology, based on an analysis of the statistics produced by the local hospital (Kaminsky et al., 1993). As noted by Corburn in his field work, from the outset the residents "dismissed the study for failing to aggregate results by age, gender and ethnicity and, perhaps most importantly, for only using hospitalization data from a local hospital which most neighbourhood residents rarely if ever visited" (Corburn, 2005, p. 119). By ignoring such crucial local knowledge, the CUNY-CHASM/DOH study not only compiled very poor scientific evidence, but, more importantly, further alienated the residents from professional decision makers and scientific experts.

In response to community concerns, El Puente, a local high school and community organization, along with CIET (Community Information and Epidemiological Technologies), a non-profit research organization specializing in epidemiological research, organized three community-wide surveys between 1995 and 1999, which culminated in radically different research results (Corburn, 2005, pp. 120–35). In the first survey, with 1065 responses from residents, an overwhelming number of respondents identified asthma as their main health concern. The second survey, with 2311 responses from residents, delved deeper into these results and, more specifically, was able to show high asthma rates among sub-groups of the community, most prominently among women over 45. Follow-up focus groups were able to relate this high prevalence to the women's occupations in laundries, dry cleaners, beauty salons or sweatshop-like textile factories. The third survey, with 3015 residents' responses, was able to gather data on the remedies used in the community, in particular the importance of homemade remedies from various cultural traditions. Even though these results have been recognized in mainstream science, for instance through publication in the *American Journal of Public Health* (Ledogar et al., 1999;

2000), the intention of the community research partnership was not just to gather knowledge merely to challenge the experts from CUNY-CHASM/ DOH, but also to improve the lives of the neighbourhood residents. For instance, after learning from the second survey that adults – and not just children – in the community also suffered from asthma, an asthma plan for adults was developed by the community organization. Another innovative community outcome was a programme for professional healthcare providers to learn about asthma home remedies and their cultural significance. This made it possible to tackle the alienating behaviour of dismissing these practices from the outset as irrelevant to improving the communities' healthcare situation.

As clearly documented by Corburn, none of the major scientific results of the study could have been obtained by a traditional top-down, principal investigator-led, epidemiological study into asthma prevalence and its environmental causes. The main reason is that to overcome distrust, the research team trained by El Puente and CIET had to act as community-health workers and not just survey administrators (Corburn, 2005, p. 127). According to Cecilia Iglesias-Garden, one of the coordinators of the research team, health workers had to be able to speak credibly about more issues than just asthma. If the researchers could not answer questions that residents had on health and social issues other than asthma – or at least refer them to someone who could answer – the residents were not going to trust them or talk to them. Since the survey administrators needed to have an intimate "local knowledge" of the neighbourhood, El Puente therefore recruited 10 community members with a personal or family stake in asthma and trained them with the help of the New York City Department of Health (DOH) and public health professionals from Hunter College at the City University of New York.

The second major challenge concerns responsible reporting of results to study participants and their communities when the health and policy implications of the studies on environmental pollution and community health interactions are still uncertain. Even though the basic ethical principle of community-based research is the right to know as a basis for self-determination, researchers have to consider potential harm to the community. This can take various forms, such as increasing feelings of fear or social stigma resulting from the reporting of the study outcomes; legal end economic complications; or the promotion of unnecessary or counterproductive interventions (Brody et al., 2007). In the case of the environmental health studies organized by El Puente, after each of the three community surveys mentioned above, the results were disseminated to and discussed with the community. The success of solutions implemented after one round of surveys was measured over time and topics for investigation

were gradually broadened (Corburn, 2005, p. 121). Using this kind of iterative process, the information gathered during one phase provides the basis for a critical dialogue on the results, their local relevance and their relationship to the larger research questions. On this basis, the researchers and actors determine the research questions to be tackled in subsequent phases of the research.

The analysis by Corburn of the community-based research partnerships in the Williamsburg neighbourhood of New York highlights three key features of successful data gathering and analysis in complex and uncertain fields like the environmental–community health nexus: first, the reliance on community partners with an important stake in the issue at hand; second, the equal importance attached to the scientific research outputs and improvement of community welfare; and, third, the involvement of community members in the interpretation and analysis of the collected data. Similar features have been found in other community-based research partnerships in various fields and countries, such as collaborative planning of water management in California (Innes and Booher, 2010), research on indigenous potato varieties in the Andes (Van der Ploeg, 1993), or the study of the socio-ecological features of Spanish shellfish organizations briefly introduced above (Macho et al., 2013). However, few public funding programmes have recognized and supported community-based data gathering and interpretation in such a systematic and encompassing way as the environmental health programme supported by the United States and by various public administrations throughout the world. Community-based environmental health research therefore offers a wealth of lessons on success and failure that can be used to advance the transdisciplinary and ethically deliberative vision of sustainability science advocated in this book. Further background on this field of research can be found in the journals *Progress in Community Health Partnerships* and *Action Research* and the collective works by Minkler and Wallerstein (2008) and Israel et al. (2005).

4.2   OVERCOMING DEADLOCK IN SILVO-PASTORAL MANAGEMENT THROUGH PARTICIPATORY MODELLING

A second important type of implementation of transdisciplinary research is the case of stakeholder-based modelling. As indicated above, since the 1970s, policy makers and science officials have initiated various forms of environmental assessment and various modelling methods in the context of technology assessment and risk analysis. Although stakeholder

involvement in such modelling exercises has almost become a "must", in far too many cases stakeholders and policy makers have merely been paying lip service and the transdisciplinary nature of the research has often remained purely rhetorical. Nevertheless, modellers and software designers generally agree that better decisions are implemented with less conflict and more success when they are driven by stakeholders and those actors who will be bearing the consequences of the adopted policies (Voinov and Bousquet, 2010). In addition, as shown in many studies, the collaborative learning among stakeholders and modellers leads to improved understanding of the systems and their dynamics under various environmental and social conditions (see, for example, Lynam et al., 2010; Campo et al., 2010).

The benefits of participatory modelling can be illustrated by an important "brand" of participatory modelling, called companion modelling, which has received extensive support from various research programmes developed at the French National Institute for Agricultural Research (INRA) (Etienne, 2011). Companion modelling – where the model is only a "companion" or "support" to the actors – is an environmental assessment and modelling methodology that provides a better understanding of the consequences of various management actions for the evolution of complex socio-ecological systems. In this methodology, a group of model development facilitators use agent-based modelling to simulate the outcomes of various patterns of interaction between multiple and autonomous heterogeneous agents. The object of this exercise is to foster social learning among these actors, in situations where there is no evident solution to environmental and socio-economic trade-offs between the various interests. The process is both iterative and participative, as illustrated in Figure 4.1. In an adaptive process, actors identify the key questions, co-construct the initial agent-based model, learn about the outcomes generated by the simulations, collaboratively evaluate the impact of these outcomes on the initial problem and propose an adaptation of the scenarios considered in the model for a second round of participatory modelling. Through a set of iterations, actors can adjust their viewpoints and objectives, based on increased awareness of the intended and unintended consequences of actions undertaken by themselves and by other players, who might have different viewpoints and objectives. This approach has been tested and improved over the last ten years to tackle issues regarding decision processes and coordination between actors in various settings of natural resource management and resource-use conflicts (Bousquet et al., 2005; Worrapimphong et al., 2010; Lagabrielle et al., 2010).

Companion modelling has proved very effective in cases where conventional top-down advice from government or academic experts is unable to provide an accurate understanding of socio-ecological dynamics and
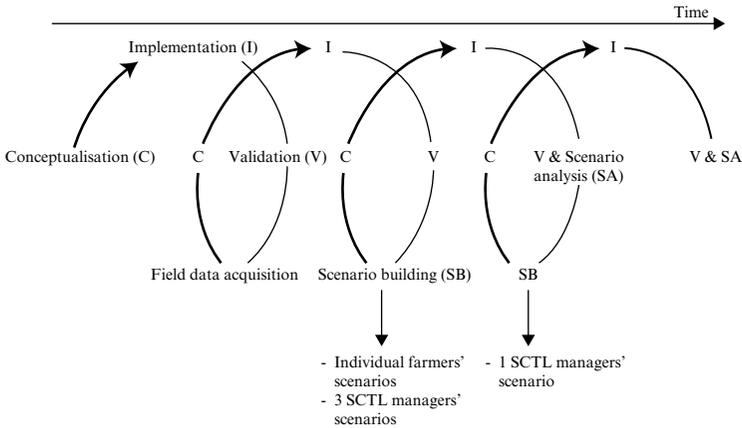
Note: 1st Iteration from initial conceptualization (C) to scenario building (SB); 2nd iteration from scenario building (SB) to second scenario building (SB); 3rd iteration from second scenario building to final validation and scenario analysis.

Source: Simon and Etienne (2010, p. 1377).

Figure 4.1   Successive iterations in companion modelling

thereby fails to adequately support local decision processes. A case in point is the participatory modelling exercise commissioned by the Larzac Land Trust (*Société Civile des Terres du Larzac*), close to the Cévennes National Park in Southern France.

The objective of the companion modelling in the Larzac area was to solve a problem of encroachment of pine forest on grazing land, which brought local livestock farmers into conflict with the forest managers (Simon and Etienne, 2010). In 2003, the Larzac Land Trust started looking for new approaches and solutions for managing its 6300 ha area of land. This followed five years of inaction after the Trust sought the assistance of a conventional forestry expert, who had established a 15-year forest management plan in accordance with French forestry regulations. The expert's plan was based on an optimization exercise that organized cuttings to achieve either a forestry or a grazing objective. In the proposed model, grazing and forestry objectives were never considered to be implemented on the same plot of land and the plan only proposed to take action where optimum management was feasible, whether for grazing or for forestry. After this plan failed to address the problems identified by the livestock farmers and local forest managers, researchers and stakeholders engaged in a participatory modelling exercise, with the support of research teams at the French National Institute for Agricultural Research (INRA) and the

French Livestock Institute in Montpellier. From 2004 to 2005 they developed an agent-based model, collected new field data and adjusted the envisioned scenarios in a series of three iterations with all the actors involved. The end result of this process was the adoption of a local management plan that was validated by all parties and applied in practice.

Two key methodological aspects were crucial to the success of this participatory modelling exercise. The first is a shift from abstract economic optimization to the exploration of real-world social possibilities that are nevertheless considered economically sustainable for the actors (without, however, necessarily optimizing their profit). These real-world possibilities have been found to offer a better balance between individual and collective objectives. For instance, discussions on the consequences of the scenarios after the first iteration revealed that the livestock farmers' activities possibly contribute to limiting the pine forest encroachment and the densification of the oak forest. This, in turn, led to a discussion on the support of the foresters for voluntary actions that the livestock farmers already undertake, in particular in relation to their harvesting and management of firewood forest stands. At the same time, the selection of forest plots based on technical feasibility, rather than economic optimization, has been shown to lead to better long-term management of the encroachment, while still being considered an acceptable scenario by the forest managers.

The second aspect that contributed to the success of the initiative is a shift in the role of the experts, from that of external advisers giving neutral technical, scientific or legal insights to that of "model facilitators" embedded in the adaptive and iterative methodological approach of the participatory modelling exercise. In the case of the Larzac Land Trust, the funding of an existing facilitator as external data collection adviser, during the third iteration, introduced a confusing complicating factor into the process, as some farmers reverted from contributing to a collective social learning exercise to relying on external expert opinion. Based on this experience, the researchers from the Institute for Agricultural Research insist on a clear and transparent separation between experts assuming the role of "model facilitators" on the one hand and external technical advisers on the other.

Companion modelling is only one example of a set of participatory modelling approaches that have been developed over the last two decades (for an overview, see, for example, Voinov and Bousquet, 2010). The main interest of these approaches for transdisciplinary sustainability research is that they result in both scientific and social objectives, which are often synergistic or at least complementary. On the one hand, participatory modelling offers many scientific benefits beyond deriving operational end results. Relevant scientific outcomes include identifying data gaps, gaining

an improved understanding of the socio-economic driving forces of the actors (which is not necessarily limited to profit-based optimization) and the incorporation of multiple perspectives on the understanding of the system (for example, related to the possible role of firewood management in the Larzac case). On the other hand, participatory modelling also contributes to a set of social objectives. Prominent among these are the equal consideration of the many actors' viewpoints in situations of complex and unpredictable socio-ecological dynamics, the elaboration of a common pool of knowledge and data that support a process of shared learning by the stakeholders, and the recognition of the local communities' knowledge and practices as they relate to their livelihood choices (Voinov and Bousquet, 2010, p. 1278).

4.3 ENABLING THE SOCIAL ECONOMY THROUGH COMMUNITY–UNIVERSITY RESEARCH PARTNERSHIPS IN CANADA

Researchers at universities and research centres played a key role in the two cases discussed above. In both, however, communities were the driving force behind the transdisciplinary partnerships for generating transition beyond socio-ecological deadlocks. This is the case for community health organizations in the Williamsburg neighbourhood, and also for the forest community organizations and livestock farmers in the Larzac region of Southern France. The third type that we will discuss moves beyond local and regional dynamics to illustrate a nationwide transdisciplinary research effort in Canada, coordinated and organized by the Social Sciences and Humanities Research Council (SSHRC).

In response to a call for universities to become more socially accountable (Reinke and Walker, 2005), the Canadian SSHRC launched a major transdisciplinary research funding initiative in 2005. The objective was to foster the building of large-scale community–university networks and consortia in areas of importance for social, cultural or economic development. This programme ran from 2005 to 2014 before being integrated as a possible funding opportunity into the new Partnership Grants programme. Community–University Research Alliances (CURAs) are defined in the context of this programme as "partnerships between community organizations and postsecondary institutions, through a process of ongoing collaboration and mutual learning, with the aim of fostering innovative research, training and the creation of new knowledge" (SSHRC, 2008). Projects are selected based on the track records of the academic and community-based partners, in their respective fields of engagement, the contribution

to research, the enrichment of teaching methods and curricula through experiential learning in partnership with the community and the reinforcement of the communities' decision-making capacities. Between 1998 and 2007 alone, 92 CURAs were funded, representing an investment of more than 58 million euros. More than 900 non-academic organizations (including associations, hospitals, the private sector, Aboriginal and charitable organizations) participated in CURAs (data from ERAWATCH, 2007, http://erawatch.jrc.ec.europa.eu).

One prominent and well-documented case is that of the university–community alliances for research on the social economy. Between 2000 and 2010, SSHRC funded seven alliances throughout Canada for supporting and advancing this research area (six regional nodes and one national hub). As underlined by researchers in this field, the need to support transdisciplinary research on the social economy has to be situated in the context of the debate between a narrow economic interpretation of the social economy and a broader interpretation in terms of human development (Jessop et al., 2013; Hall and MacPherson, 2011). Indeed, even though the social economy has long been recognized in management science or microeconomics as an important category of business activity, the challenge remains to further develop research on the social economy in its broader sense, understood as a set of innovative economic practices oriented towards human development objectives related to democratization, gender equality, sustainability and social justice. To support social economy research in its broad understanding, researchers and practitioners are therefore seeking to develop new forms of collective knowledge production organized around the social construction of the human development goals and to embed problem-oriented learning in the various social economy actor strategies and processes (Jessop et al., 2013, p. 125).

The Quebec university–community research alliance (*Alliance de recherche universités-communautés en économie sociale*, ARUC-ES) is one example that illustrates the rationale and functioning of these transdisciplinary research partnerships (Fontan et al., 2013, pp. 314–16). From 2000 to 2010 this alliance brought together a network of researchers and practitioners involved in the development of the social economy in Quebec. Approximately 150 practitioners from over 100 organizations, together with 60 researchers and about 120 students from eight universities, conducted some 200 research projects, organized over nine thematic fields (Bussières et al., 2008). As stated in the final evaluation of the partnerships, the originality and productivity of the research produced was directly related to the mode of governance of the alliance (Hall and MacPherson, 2011, pp. 37–8). In particular, practitioners and researchers were given equal representation in all the governance entities that decided

upon research activities, content of research and dissemination methods. For instance, the alliance was jointly directed by the chair of the Social Economy Network (*Chantier de l'économie sociale*) and a professor at the Université du Québec à Montréal (UQAM). The general coordination committee and the nine management committees for the thematic research areas were co-directed by and composed of members of the practitioner and researcher groups. In addition, a third group, comprising university students, was encouraged to take part in all activities involving analysis, research and knowledge mobilization, as part of their training or as a job. This allowed students to gain experience in all facets of these activities and to renew the existing curricula, in addition to the concrete research outcomes of the alliance.

Observers agree that, overall, the social economy community–university partnerships funded by the SSHRC resulted in a better understanding of what the social economy represents for Canada, and made it possible to establish a common language and formulate new public policies (Fontan et al., 2013; Hall and MacPherson, 2011). The long-term impact will probably lie in the capability of acquiring new skills for research in the field of social economy and strengthening the social networks of researchers active in this field, thereby creating larger research communities that can gain academic recognition more easily (Bussières et al., 2008). The partnerships have already played a key role in enabling:

- transformative practices in the communities: individual actors in the communities started transformative practices in ways that might otherwise have been difficult in the absence of support from researchers' new evidence;
- knowledge transfer: community–university partnerships increase opportunities for dissemination and transfer; once the research is completed, practitioners help circulate the results and transfer knowledge within their milieu and in the broader network;
- experiential learning at universities: researchers are given the chance to acquire first-hand practical knowledge of the field, to participate in social experiments and to externally validate their research results;
- training: students receive training in partnership-based research and are given the opportunity to write their Master's or PhD thesis on projects proposed by actors from the social milieu.

Overall, the alliances contributed to the formation of strong new research programmes at various universities where the emerging research field on social economy as a social innovation was not well established, and helped to strengthen the main academic societies in the field (Hall and

MacPherson, 2011). At community level, they contributed to strengthening the skills and capacities of the actors involved in the network of social economy organizations and businesses, and to broadening the range of services offered by the sector (Fontan et al., 2013).

In spite of these partnership successes, many challenges still lie ahead for the further development of similar initiatives in other regions and countries. In particular, the partnerships require a high level of motivation and involvement on the part of both community and university partners. Indeed, they are based on mutual respect, the perusal of goals that are beneficial both to the research partners and to the practitioners, and the development of a common project in the long term. Most importantly, care must be taken to ensure that the research model does not compromise the rigour and independence of the research process. This explains the important role of the government both as a funder and as a third party. In the case of the Community–University Research Alliance, the SSHRC played this role, by ensuring the rigour as well as the transparency of research collaboration (Fontan et al., 2013, p. 317). In a similar way to the other two types of participatory research discussed above, transdisciplinary research therefore needs to be embedded in a proper institutionalized development process, which provides for evaluation, support and adjustment of the evolving partnerships.