10 Interdisciplinary Approaches in Research for Sustainable Development

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Abstract

The complexity of sustainable development cannot be adequately addressed by research approaches restricted to single scientific disciplines. Comprehensive assessments in the realms of natural resources, environmental sanitation, health, and social development must consider multiple internal and external perspectives on the object of inquiry, all of which relate to systems and institutional frameworks that are dealt with in different ways. We analyse three examples of integrated research approaches developed within the framework of the Swiss National Centre of Competence in Research (NCCR) North-South. Along with combining social and natural sciences, these approaches also involved the development and application of transdisciplinary methods, including participatory processes and the integration of local knowledge. The present analysis shows that extending research in this way requires a careful, stepwise approach. Epistemologies in the disciplines involved diverge greatly, requiring comprehensive analysis and debate in order to come up with joint research questions and methods. Moreover, participatory transdisciplinary processes follow their own epistemologies, requiring special attention. Without ignoring these issues, taking a 'utilitarian' stance, we demonstrate how integrated approaches enabled us to gain a better understanding of the issues under study, which would not have been possible had we restricted ourselves to disciplinary research. These findings contribute to a pragmatic integrated approach to development research, which can be flexibly adapted to different contexts and thematic foci.

Keywords: Interdisciplinary approach; natural sciences; social sciences; epistemology; local knowledge; added value; development research.

10.1 Introduction

The complexity of sustainable development cannot be adequately addressed by research approaches restricted to single scientific disciplines (Waltner-Toews and Wall 1997; Ostrom 2007). Comprehensive assessments in the realms of natural resources, environmental sanitation, health, and social development must address multiple external (professional) and internal (population concerned, stakeholders) perspectives (Zinsstag 2007). Both types of perspectives relate to systems and institutional frameworks that are dealt with in different ways by those involved in the knowledge production process, depending on their respective epistemologies. We analyse three examples of integrated research approaches developed within the Swiss National Centre of Competence in Research (NCCR) North-South that combined geography, sanitation, and health sciences with anthropology and sociology and, in addition, involved the development and application of transdisciplinary methods (Hirsch Hadorn et al 2008), including participatory processes. Some of these approaches also incorporated the use of local knowledge. The present article addresses the following questions:

1. What research questions are addressed using integrated approaches, often combining the social and natural sciences?
2. What practical approaches do multi- and interdisciplinary studies choose with respect to specific topics?
3. How are results from different disciplines compared?
4. What is the added value of different disciplines addressing the same theme?
5. Are there common denominators that could provide a basis for an integrated research approach to sustainable development encompassing social, economic, and environmental dimensions at the same time?
6. Are there any major epistemological divergences and conflicts of interpretation?

10.2 Promoting sustainable land management in the Ethiopian Highlands

10.2.1 Research questions

Land degradation in the Ethiopian Highlands is a longstanding problem of paramount importance. Over 80% of the population lives on small-scale farms in subsistence-oriented crop and livestock agricultural systems. However, with few exceptions, farmers have not perceived erosion process-

es as imminently threatening; traditionally they have taken no immediate soil and water conservation measures (Hurni 1993). Accentuated household vulnerability to hunger and famine may result in widespread destitution if no relief measures are taken. The need for sustainable land management (SLM) was recognised by the government and external agencies already some 35 years ago, after a devastating famine in the northeastern provinces in 1972/1973. Research into soil and water conservation was initiated at that point as well, mostly in support of actions taken by multiple actors such as researchers, farmers, technicians, and policymakers (Hurni 1975; Virgo and Munro 1977; SCRP 1984). Over the years, numerous research questions were developed and addressed, more or less in the following order:

1. What are the severity and extent of land and soil degradation, and how can their characteristics be explained?
2. What are the processes and dynamics of soil erosion and catchment sedimentation?
3. What measures have farmers taken against soil erosion and soil degradation?
4. Which soil and water conservation technologies and approaches are best suited for adaptation to farming conditions in the Ethiopian Highlands?
5. What actions are taken by institutions, and on what information and knowledge do they base their decision-making?
6. How can farmers and institutions be brought together to jointly develop best practices of SLM?

In the course of addressing these questions, research in support of SLM approaches became increasingly integrative and interdisciplinary, involving not only natural, but also social scientists, and gradually also inviting farmers to participate in formulating research questions and developing appropriate measures to combat soil erosion and land degradation. Research questions 1 and 2 were addressed primarily by natural scientists or agronomists (Hurni 1979; Krauer 1988; Hurni 1990; Belay Tegene 1992; Solomon Abate 1994; Gete Zeleke 2000). Research question 3 was addressed by natural scientists as well, who observed and described practices that had been carried out by farmers. However, the involvement of social scientists was felt to be important already in the early years of soil conservation research, that is, as of 1981, with a view to addressing issues such as farmers' attitudes towards soil erosion and soil conservation, their means and abilities to take action, and factors favouring or discouraging investment in the land (Galizia 1986; Tsehai Berhane Selassie 1994; Yohannes Gebre Michael and Herweg 2000).

Research question 4, regarding the development of adapted measures to combat soil erosion, called for an interdisciplinary approach, including participatory elements, to determine best practices that would be ecologically sustainable, economically viable, and socially acceptable. Attaining this goal proved to be much more difficult than anticipated at the beginning (Hurni 1982). It soon became obvious that technologies fulfilling the biophysical requirements of ecological sustainability were usually not economical from a farmer's point of view, and hence not socially acceptable to farmers, their families, and the community at large. Unfortunately, the government and external institutions nevertheless continued to apply these technologies, which in turn were often destroyed by farmers once the programmes were discontinued (Herweg 1993). These shortcomings led to a great number of social and economic studies being carried out in the 1990s. Many of them were critical of past experiences but fell short of proposing better approaches, not to mention more appropriate technologies.

10.2.2 Interdisciplinary approach

As a consequence of the above-mentioned discrepancies in research approaches in support of SLM, in 2001 the NCCR North-South initiated a number of interdisciplinary studies involving natural scientists, agronomists, economists, and political and social scientists in order to address research questions 5 and 6. Taking a transdisciplinary approach, these teams met with farmers and other stakeholders and negotiated appropriate research questions and methodologies for finding pathways towards SLM through integrated biophysical and social science research (Yacob Arsano et al 2004).

Birru Yitaferu (2007), in his assessment of land degradation and options for SLM in the Lake Tana Basin, applied primarily biophysical methods to study land resource changes. He later changed to theory-based approaches when identifying drivers of land resource changes, and applied participatory elements when appraising mitigation technologies and strategies for SLM. In the latter phase he interviewed farmers, development agents, and agricultural researchers, emphasising in his findings that there were major differences in technological preferences among these three actor categories. It is interesting to note that farmers and development agents, who work more closely together in daily activities, were closer in their appraisal of technologies, while the views of the third group – agricultural researchers – differed considerably from those of the other two groups.

A primarily social science based approach was taken by Amare Bantider (2007) in his study of landscape transformation and opportunities for SLM along the Eastern Escarpment of Wello. While he addressed land use and land cover change using remote sensing techniques, as Birru Yitaferu had done in his Lake Tana Basin study, Amare Bantider's assessment of the dynamics of change was supported by oral history, that is, farmers' narratives of landscape evolution, and his appraisal of SLM technologies included an assessment of farmers' willingness to apply them on their land. This study made the diverse conditions of a farmer's household the central focus, while Birru Yitaferu's study focused on technologies as the starting point for assessment by different stakeholders.

10.2.3 Added value

Both of the above studies attempted to determine the best options for SLM in their particular case study areas. Although they started from different scientific backgrounds – that is, agricultural engineering on the one hand and social geography on the other – their results are nevertheless consistent with each other. Both came to the conclusion that the best potential technologies are those acceptable to and preferred by farmers and extension workers (Amare Bantider 2007; Birru Yitaferu 2007). This example shows that different disciplinary approaches can converge to produce similar results by identifying the most acceptable technologies for farmers and extension workers. In this sense the two studies cross-validate each other's results. Both demonstrate the importance of a transdisciplinary approach, involving farmers and extension workers, for the development of integrated intervention towards SLM. If individual researchers keep this vision in mind, and if they are supported by adequate theoretical and methodological tools, they will not fall back into their scientific speciality but almost automatically be guided towards more comprehensive approaches to syndrome mitigation (Hurni et al 2004)

10.3 Moving from a strictly engineering perspective to an integrated approach in urban environmental sanitation

10.3.1 Research questions

The fact that 2.6 billion people still live without access to basic sanitation facilities is strong evidence that approaches used in the past to address envi-

ronmental sanitation problems fail to cover a large proportion of humanity. The consequences are dramatic: 2.2 million deaths annually (mostly children under the age of 5); 200 million people infected with schistosomiasis; and more than 1 billion people suffering from soil-transmitted helminth infections. A comparison of health and other benefits with the required costs has shown that an investment of USD 1 produces an economic return of USD 3 to USD 34, depending on the region (Hutton et al 2007).

The driver for drastic change in hygiene behaviour and improved sanitation facilities was the realisation that dramatic increase in population density is coupled with deterioration in public hygiene (Schertenleib and Gujer 2000) – a fact already known to the ancient Romans and cited in the Old Testament (Deuteronomy 23:12–14). Apart from creating aesthetic problems, increasing contamination of drinking water resources over the centuries ultimately resulted in widespread epidemics such as the London cholera epidemic of 1854. Discharge of wastewater into surface waters and an increase in pollution load due to the rapid growth of urban areas led to a situation where pollution exceeded the assimilation and self-purifying capacities of rivers and lakes. At this point, engineers began designing and constructing sewage treatment plants. Water-flush toilets connected to a water-borne sewer system and centralised wastewater treatment facilities became the norm in solving sanitation problems in the urban areas of the global North. Consequently, they were also seen as the recipe for solving sanitation problems in rapidly growing urban areas in the global South (Schertenleib 2005).

Due to the very different socio-economic and climatic conditions prevailing in developing countries, this engineering-driven, top-down approach has not been able to make a significant dent in the service backlog still existing throughout most of the developing world. Furthermore, centralised sewer-based sanitation systems usually treat nutrients such as phosphorus and nitrogen as waste rather than resources. These aspects obviously contradict the basic criteria of sustainability, and with changes in market prices for energy as well as nitrogen and phosphorus fertilisers, these issues are now also being addressed by specialists in other disciplines such as resource economics. For instance, it is estimated that global phosphorus reserves will last only some 50–100 years if they continue to be depleted at the present rate; at the same time, intensive agricultural production is severely depleting soil organic matter (Rosemarin et al 2008).

For these reasons, an increasing number of professionals and researchers specialising in different sectors have come to realise that there is an urgent

need not only to develop alternative technologies but also to establish more holistic and transdisciplinary approaches to planning, constructing, and operating sanitation systems. Experts today widely acknowledge that any sanitation approach should be based on the following principles: decision-making should involve participation of all stakeholders; waste should be considered a resource; and sanitation problems should be solved as closely as possible to where they arise (WSSCC and Eawag/Sandec 2000).

10.3.2 Interdisciplinary approach

For many years, research on new sanitation approaches focused mainly on the development of alternative technologies for the decentralised treatment of wastewater and faecal sludge (Sasse 1998; Strauss et al 2000; Foxon 2004). One outcome of this research, which was partly conducted within the NCCR North-South, was the establishment of technical design criteria for improved septic tanks and faecal sludge treatment in constructed wetlands. At the same time, the Household-Centred Environmental Sanitation (HCES) approach was developed, focusing on an integrated system framework and following principles of closed-loop resource management as well as multi-stakeholder planning steps (WSSCC and Eawag/Sandec 1999; Schertenleib et al 2004). The HCES planning approach is a radical departure from past centralised and engineering-driven planning approaches. It places the household and the neighbourhood at the core of the planning process and thereby responds directly to the needs and demands of users, rather than central planners' frequently ill-informed opinions about them. Decisions are reached through consultation with all stakeholders affected by them, and problems are solved as closely as possible to their source. Within the framework of the NCCR North-South, the HCES approach has been tested in different regions in close collaboration with social scientists (Lüthi et al 2009).

Crucial aspects of the multi-stakeholder process in the HCES approach are the joint establishment of the baseline situation (situation analysis and system description) and joint identification of the most suitable sanitation options based on the users' needs and preferences as well as the effects on health, the environment, and use of natural resources. The impacts of different possible scenarios on the environment and on natural resources can be assessed by means of a Material Flow Analysis (MFA). This method describes how resources are used and transformed as they flow through a system (Montangero et al 2007). However, MFA cannot be used to assess impacts on health and to identify the critical control points related to disease transmission. Therefore, the method is now being expanded in collaboration

with epidemiologists and health specialists, taking into account the flow and the reduction or growth of pathogens in a sanitation system, and applying the methodology of Quantitative Microbiological Risk Assessment (QMRA) to quantify the health risk under different sanitation scenarios based on stakeholder exposure (frequency and dose) (Nguyen Viet et al 2009).

10.3.3 Added value

A sanitation system is geared to protecting and promoting human health by providing a clean environment and breaking the cycle of disease. A future-oriented sustainable sanitation system must not only be economically viable, socially acceptable, and technically and institutionally appropriate; it should also protect the environment and natural resources. As such, it provides an excellent example of how experts from a wide range of disciplines (e.g. social sciences, natural sciences, and engineering) must work together in an integrated manner to attain these objectives. Awareness of this need for inter- and transdisciplinary cooperation, however, was gained through a slow process of trial and error, and, although it is recognised by all experts, many policymakers, researchers, and practitioners around the world still do not always act accordingly. Restriction to an engineering-only approach to sanitation clearly fails to respond to locally perceived needs and possibilities. Only a combined approach as described above can yield meaningful and feasible locally adapted solutions to environmental sanitation.

10.4 Health care for nomadic populations

10.4.1 Research questions

Nomadic pastoralists in the African Sahel, the high steppes of Central Asia (including the Tibetan Plateau and Mongolia), parts of the Near and Middle East, the Arabian Peninsula, and India use mobility to manage uncertainty and risk in arid and semi-arid ecosystems (Scoones 1994). In many countries, nomadic people lag behind sedentary people in education and access to public services. Hence, key research questions are: What is the health status of nomadic populations? What is their perception of health and health care priorities? How can effective public services be designed that are acceptable to the population concerned and adapted to their mobile way of life (Zinsstag et al 2006)?

10.4.2 Interdisciplinary approach

This case study is rooted in a decade of experience (1986–1996) with health care reform in two Chadian regions, during which it was observed that large nomadic pastoralist populations in this area had no access to health care. The general approach was not guided by an interdisciplinary concept but merely by a vision of the need for interdisciplinary knowledge. Initial pilot studies undertaken by the geographer Martin Wiese indicated the extent of hundreds of kilometres of seasonal migration and the close interactions between animals and humans. This inspired an approach based on the 'one medicine' concept of Calvin Schwabe (1984), which involved developing a team of veterinarians, medical doctors, and microbiologists to assess the health of humans and animals simultaneously (Schelling et al 2003; Schelling et al 2005; Diguimbaye-Djaibé et al 2006a, 2006b). This approach was extended at the outset by a geographical health study addressing determinants of the vulnerability of these populations (Wiese 2004) and a first anthropological study investigating illness perception, meaning, and behaviour, using the example of zoonotic diseases among Fulbe pastoralists (Krönke 2001).

In addition, health service concepts (Wyss and Zinsstag 2000) and health care utilisation (Donnat 2000) were investigated. Based on the first epidemiological results, novel integrated human and animal health services were developed and tested within the framework of the NCCR North-South (Béchir et al 2004; Schelling et al 2007a). Further studies addressed institutional aspects (Fokou et al 2004) and comparative perception and explanatory models of tuberculosis among Mauritanian Bedouins and Chadian camel breeders. Studies were further extended to investigate cultural aspects of illness among Kel Tamacheq women and children in Mali (Münch et al 2007). A comprehensive integrated approach focused on extensive pastoral systems (Bonfoh et al 2007) and added components of pasture management, zoonoses control, and institutional reform.

Currently participatory processes are being used to develop an adaptation of the WHO tuberculosis control strategy to the way of life of nomadic pastoralists (Zinsstag et al 2006). From a single research group this work expanded into North–South research partnerships in several Sahelian countries and Kyrgyzstan, involving training of numerous African, Central Asian, and European scientists. The research process was not restricted to academic planning alone but was connected to the population concerned and the relevant authorities from the outset. In a decade of research (1998–2008) five participatory stakeholder seminars took place in N'Djaména and on the shore

of Lake Chad (Gredaya), providing the setting for a transdisciplinary process (Schelling et al 2007b). During these meetings results were presented, local priorities defined, and approaches negotiated. Ultimately, the Chadian Ministry of Planning took up the research outcomes to develop a new policy for nomadic pastoralists, together with ten other ministries. Best-practice studies are currently being carried out on behalf of the World Initiative for Sustainable Pastoralism and the International Committee of the Red Cross.

Comparison of results was not planned in a comprehensive way. We can distinguish two types of comparison and connection between studies, as follows: 1) yielding new insight and new knowledge, of which a good part could not have been acquired without inter- and transdisciplinary work (see below), and 2) producing different insights that cannot be directly compared. Outcomes of the work were highly variable and revealed, for example, the extent of molecular genetic variability of human and animal tuberculosis strains, but also a highly diversified vocabulary for local names of tuberculosis and lung disease. Different epistemological roots of the involved disciplines require a careful and stepwise rapprochement.

On the other hand, the need for pragmatic solutions is evident and calls for a focus on connecting points and common interests. For example, childhood mortality among the Kel Tamacheq assessed by a standardised questionnaire administered by a male medical doctor yielded much lower values than analyses of participant observations by a cultural scientist over a period of several months. But interactions between communities and scientists were not straightforward either and revealed highly variable perceived priorities. Transdisciplinary processes democratise knowledge generation. Scientists lose power and the primacy of knowledge by recognising the value and importance of local knowledge of communities and authorities.

10.4.3 Added value

Although conceptual interdisciplinary connections are not simple, the added value of the different disciplines working together is highly evident. Connecting animal and human health revealed that livestock vaccination coverage was much higher compared to vaccination coverage among children, which was virtually zero. This finding was at the origin of new joint human and animal vaccination services for nomadic people (Schelling et al 2007a). Considering reports by pastoralists about the side effects of locally produced anthrax vaccine led to the discovery of contamination of these vaccines in

Chad and Mali, which in turn led to projects to rehabilitate vaccine quality. Molecular analysis of tuberculosis in cattle indicates a high level of clustering of *Mycobacterium bovis*; however, no *M. bovis* has been identified so far in humans (Diguimbaye-Djaibé et al 2006a, 2006b). Furthermore, specific vocabularies of tuberculosis-like syndromes in humans led to culturally adapted health education (Ould Taleb 2008). Studies in Chad (Krönke 2001) and Mali (Münch et al 2007) showed very high self-control among the Fulbe and Kel Tamacheq communities in terms of concealing pain and discomfort.

This finding has important consequences for the planning of health services, since people often report to health centres so late that it is no longer possible to help them, which in turn leads to the false perception that health centres are 'only places to die'. Discussions with nomadic women and men revealed the importance of institutional arrangements to manage water wells or pastures (Fokou et al 2004) as a basis for the development of social services, including health and education. In conclusion, we can state that inter- and transdisciplinary approaches are actually a sine qua non for identifying innovative avenues to improving the health and well-being of nomadic pastoralist communities and their animals.

10.5 Analysis and synthesis of case studies

10.5.1 Questions addressed

Primary questions addressed in the above examples were typically technical at the outset: How to address soil erosion and the degradation of agricultural land, how to tackle environmental sanitation in poor urban areas, how to provide health care to nomadic pastoralists virtually excluded from all social services? While over long periods research questions were restricted to an external natural-science perspective and intervention planning remained largely in the hands of central government authorities and academic research, huge gaps between development planning, development action, and actual adherence by communities became increasingly evident.

10.5.2 Practical approach

Recognition of these gaps between knowledge generated from an external perspective, on the one hand, and actual development processes, on the other, resulted in a new awareness and, eventually, in the incorporation

of other disciplines to provide broader social, behavioural, and economic perspectives on the various technical issues under study. In all three case studies, research projects moved towards interdisciplinary collaboration and participatory stakeholder involvement as a transdisciplinary process, but the temporal dynamics varied from case to case. In all three examples, the involved scientists, community members, and decision-makers today recognise the power of integrated approaches to development research and the better cohesion between knowledge generation and development action they help to achieve.

10.5.3 Comparison of results

At the outset of the three research projects described, distinct methods relating the natural and social sciences involved barely existed. In the land management example, qualitative comparisons proved results from agricultural engineering and social geography to be consistent with each other; although the two studies highlighted different aspects, their results did not fundamentally differ. In all three case studies a basic consensus emerged that all dimensions of a research question should be considered, rather than limiting considerations to one discipline. Similarly, it is recognised that not only academic knowledge but all available knowledge and wisdom, in particular indigenous knowledge, contributes to problem-solving in development research, often in unexpected ways. However, once results from different disciplines and from participatory processes are available, we most often lack formal ways to integrate, link, or merge them. This opens up a whole new field of method development, depending on the specific complex research questions. Together with partners in the health sciences, a conceptual framework combining health, ecological, socio-economic, and cultural assessments in environmental sanitation was developed (Nguyen Viet et al 2009). Further work on integrating the natural and social sciences and participatory knowledge generation is certainly warranted, and it can build on a growing body of methods such as those described, for example, for the ecohealth initiative (Forget and Lebel 2001), or embedded case study methods that link qualitative and quantitative methods in scenario analyses, and their extensions (Scholz and Tietje 2002; Binder 2007).

10.5.4 Added value

Fundamental critics of interdisciplinary research argue that combinations of distant disciplines result in mediocre methods yielding diffuse or even use-

less outputs. Yet the need for interdisciplinary research is evident from the above examples. We have assessed its outcomes using a 'utilitarian' criterion, simply asking: What do we know more, understand better, and apply that we would not if we had restricted ourselves to disciplinary research alone? Other criteria could emphasise methods connecting two disciplines to gain additional insights and explanations for findings that could not be interpreted otherwise (see section 10.5.3).

Applicable solutions in land management require knowledge of the physical erosion process connected with in-depth knowledge of farmer preferences and the views of all stakeholders involved. Locally planned sanitation systems are beginning to become effective and to replace environmental sanitation solutions based purely on central-authority planning and engineering. Intersectoral health service provision to nomadic pastoralists would not have become possible without comprehensively relating human and animal health and social sciences. In all three examples, the inter- and transdisciplinary extension of research has clearly cross-linked science and development research by relating scientific results to development problems and generating new scientific hypotheses from the outcomes of development research.

10.5.5 Common denominator

While the research questions, methods, and disciplines involved in the three case studies differed greatly, researchers in all three cases reached a remarkable consensus about the need for involving other disciplines in knowledge generation to address a given problem. Moreover, in all case studies researchers recognised the need for transdisciplinary participatory approaches and applied them successfully, albeit in more or less structured ways. This process made it possible to generate mutually agreed systems and transformation knowledge, linking science and development, and often resulted in useful shortcuts between policy and application (Zinsstag 2007). Scientists, development agents, communities, and decision-makers negotiated their objectives and priorities, resulting in a democratisation of the research and decision process, which is uncommon in many of the countries where the research took place. Mutually agreed interventions based on this participatory approach have a high potential to be implemented and accepted by the communities concerned. From a methodological perspective, the interfaces between scientific disciplines remain a weak point in the approach, but, as indicated above, perspectives on integrative method development are underway. Further work is needed to assess the strengths and

weaknesses of different transdisciplinary experiences by developing best practices. Summarising common experiences, we can state certain basic requirements for and steps towards successful inter- and transdisciplinary research (see Box). Ultimately, actors involved in development research connect research and development institutions at both the governmental and the non-governmental levels.

Box: Basic requirements for successful inter- and transdisciplinary development research

- Ensure that researchers remain firmly rooted in one discipline
- Develop social and intercultural competence in communication and motivation
- Identify interfaces with other disciplines and actors concerned at an early stage (timing)
- Address issues of divergent knowledge theory and develop methods of interaction
- Ensure that excellence is maintained at disciplinary level, continuously increase gender and ethical standards
- Recognise and use power of knowledge in transdisciplinary process, establish iterative cycle of research and application
- Convert systems and target knowledge into transformation knowledge
- Build a bridge between knowledge generation and development action

10.5.6 Epistemological divergences

As shown above, extending research beyond disciplinary boundaries requires a careful, step-by-step approach. On the one hand, theories of knowledge in different disciplines diverge to an extent that requires comprehensive analysis and epistemological debate in order to reach a mutually agreed consensus as a basis for developing common research questions and possibly interconnected methods. Ideally, interdisciplinary research planning should begin with a dialogue between the various scientific fields involved. At this point, we must acknowledge that within the NCCR North-South, this debate took place partially and in a fragmented way or not at all. All three case studies described here agree regarding the benefits of participatory transdisciplinary processes. These processes should be followed up with great care, as they entail their own epistemologies, whose social dimensions need to be studied in order to understand social and political processes of group deliberation and group decision-making (Hirsch Hadorn et al 2008). Further efforts to help harmonise diverging epistemological orientations and tackle the dynamics of transdisciplinary processes is warranted for future theoretical underpinning of this work (Ostrom 2007).

10.5.7 Outlook

Epistemological divergences should not slow down or prevent inter- and transdisciplinary development research; instead, we argue that these divergences should temporarily be bridged by adopting a pragmatic, 'utilitarian' approach. Summarising the whole study, we state that fragmentation of disciplines is not congruent with the needs of knowledge generation for solving complex development problems. Disciplinary excellence, which will continue to drive cutting-edge fundamental research, should be increasingly matched with cross-disciplinary connectivity. Interdisciplinary approaches have already become indispensable in development research. Facing the exponential growth of knowledge in all scientific fields, it is, however, clearly impossible to keep an up-to-date overview, even within one discipline or sub-discipline. The body of scientific knowledge resembles a tree branching into ever smaller sub-branches; the interdisciplinary process described here can be seen as a spider (the generalist) building a web of interdisciplinary methods anchored on the branches of individual disciplines. The interdisciplinary web is capable of catching insects or dew, representing insights into complex problems, which could not be caught otherwise. In the same way, development-oriented research should not only be connected to the disciplinary branches of the tree of academic knowledge but also to the branches of local and indigenous knowledge, decision-making, and development action.

Endnotes

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