



Holistic approaches in agroecology require the incorporation of farmers' knowledge and experience.

Photo: Jan Börner

MORE INTER- AND TRANSDISCIPLINARY RESEARCH NEEDED IN AGROECOLOGY

Agroecology embraces a collection of different disciplinary fields, ranging from agriculture and ecology to political theory. A stronger recognition of agroecology in agricultural research, which often has a strong production focus, could help to achieve sustainable development if more holistic and transdisciplinary research approaches are adopted.

By Lisa Biber-Freudenberger, Manfred Denich and Cory Whitney

According to UN projections, the current population of around 7.6 billion people is expected to reach nearly ten billion by 2050. The latest assessment on land degradation by the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) forecasts a reduction of global crop yields by up to 50 per cent in different regions in Central and South America, sub-Saharan Africa and Asia by that time, mostly due to land degradation and climate change. Agroecology will play a major role in meeting the challenge to nourish the human population, taking into consideration the need for healthy functional ecosystems as a prerequisite for sustainable livelihoods. This is reflected by the increasing relevance of agro-ecological issues in current political initiatives such as IPBES and the SDGs (Sustainable Development Goals). Many of the SDGs can only

be achieved if food and feed are produced sustainably for the world's growing population. This however requires research to expand the often narrow concepts of agricultural systems. It calls for a more holistic view of the overall socio-ecological systems, the interconnectedness of their components, and the relevance of nature's contribution to people for sustainable development.

In this context, agroecological research provides a framework to assess concepts and strategies such as the water-energy-food nexus, the sustainability of national and international bioeconomies and the potential of alternative agricultural practices (such as organic farming) to nourish the world's growing population. Moreover, the field helps to identify favourable development pathways by analysing and

identifying trade-offs between food production and biodiversity conservation, between local livelihoods and global consumer interests and between short-term economic gain and long-term natural risk management. Assessments on pollination and land degradation offer examples of the need for such research capacity. In particular, the social, economic, and ecological changes in developing countries require research that considers problems from different scientific and cultural perspectives. Therefore, collaboration among diverse disciplines and actors is crucial to bringing together multi-faceted knowledge, approaches, and methods in agroecology for i) reliable estimations of developmental changes, ii) realistic assessments of the adoptability of research-based innovations, and iii) practice-oriented recommendations for rural development.

UNDERSTANDING AGROECOLOGICAL SYSTEMS

Despite recent advances, research gaps are still looming that hinder our understanding of agroecological systems and functions. The complexity and diversity of agroecological systems, together with the uncertainty of determining the benefits of ecosystem functioning and services for human development, are major challenges in agroecology research. For example, the suitability of many agroecological interventions for small farmers in Africa is not fully understood. The applicability of ecological management strategies for the control of invasive species, diseases and pests such as the fall armyworm, or complementary irrigation to adapt to changing climatic conditions, such as dry spells and shifts in the duration and timing of the rainy season, are just two examples of pressing research topics. Furthermore, a heated discussion is currently taking place on the overall sustainability benefits of different agricultural production systems such as organic, low external input supply, mixed or intercropped, conservation or conventional farming practices. Better methods to evaluate total farm productivity, integrate external effects and evaluate the non-commercial ecosystems services in agriculture are desperately needed. Diverse inter- and transdisciplinary approaches are required for understanding the trade-offs between agricultural productivity and biodiversity conservation in extensively and intensively managed agroecological systems and for consideration in land use decision-making. These can be applied in the processes of identifying research agendas, developing applications of research outputs and implementation strategies. Such approaches offer a more holistic understanding of system functions and processes, and may help to develop pathways to implement sustainable solutions. The One

INTERDISCIPLINARY AND TRANSDISCIPLINARY APPROACHES

Interdisciplinary research integrates conceptual and theoretical approaches and methods from different disciplines. It moves beyond discipline-specific approaches to address immediate and relevant issues.

Transdisciplinary research goes a step further in that it seeks to involve all stakeholder and target groups in both the planning and research phases. The multi-faceted dimensions of agroecology provide an ideal basis for applying inter- and transdisciplinary research approaches for agricultural development.



Implementation research aims to develop solutions for putting research findings into practice. It should be gender-sensitive and include the rural youth.

Photo: Detlef Overmann

Health concept, for instance, integrates environmental with animal and human wellbeing to address complex health issues in agroecosystems. The control of zoonoses (diseases that can be transmitted between animals and humans) or the mitigation of mycotoxins (toxic substances produced by fungi colonising crops) with agroecological interventions are examples of the potential benefits of inter- and transdisciplinary One Health approaches.

INTEGRATION OF TRADITIONAL KNOWLEDGE IS KEY

Holistic approaches in agroecology require the incorporation of farmers' knowledge and experience. Their knowledge often reflects the time-tested experience of rural communities. Incorporating this knowledge into the research process sustains scientific efforts by providing a locally embedded broader view on agroecology. From the perspective of agroecological research and practice, the engagement with rural communities in the research process helps all actors to define their role in working together to achieve practical solutions. It facilitates trust between scientists, policy-makers and practitioners. Farmers are considered partners in research rather than merely sources of information, objects to be researched, or adopters of technologies. Their knowledge can be used to identify and address challenges in agroecological systems so that outputs are relevant and adoptable. They also guide future research directions by determining appropriate research agendas and offering critical feedback on scientific solutions.

IMPLEMENTATION RESEARCH TO ACCOMPANY PRACTICAL APPLICATION

Much research-based agroecological knowledge has already been generated. This includes innovations such as best practices for soil management or internalising the economic value of pollination services. Yet in most cases, these innovations find their way into agricultural practice either very slowly or not at all. This is because research-based innovations and related interventions often fail to consider the traditional knowledge and practices of farmers. As a consequence, adoption of agricultural innovations can take several years (e.g. new varieties, transport facilities) or even decades (e.g. irrigation facilities). Implementation research is transdisciplinary in nature and can be applied to ensure the uptake of relevant research outputs. It aims to understand barriers and develop respective solutions for putting research findings into practice and should be done together with the stakeholders that will make use of the innovations. Considering the importance of women as well as demographic trends in many rural areas of developing regions, implementation research must be gender-sensitive and include the rural youth. It should involve researchers from a diversity of fields such as agronomists, social scientists, economists, psychologists, education researchers, social anthropologists and communication experts, among others. Besides researchers, stakeholders to be included are farmers, extension workers, local and national authorities, agricultural and trading companies, banks, wholesalers, retailers and consumers. Implementation research practices

have broad applications in agroecology. For example, the practices are indispensable for connecting the discovery and proof-of-concept phases, on the one hand, and the piloting and up-scaling phases, on the other, within the “Research-for-Development Continuum” of the CGIAR system.

NORTH-SOUTH CO-OPERATION

Agroecological problems are complex and require the engagement of all stakeholders to define meaningful research questions for local socio-economic and ecological contexts. Determining who defines and prioritises agroecological research questions is highly

relevant for North-South cooperation and for achieving development aims. Research that is demand-driven ensures the commitment of all partners and puts collaborators on equal footing. Intercultural competence is required to facilitate joint problem identification and priority setting so that realistic and applied research agendas are developed. In practical terms, this requires appropriate funding and longer timelines so that exploratory field visits and stakeholder meetings can be conducted to define meaningful research questions and to align them with farmers’ priorities. Furthermore, research findings should be shared in venues beyond scientific publications so that they are accessible to policy-makers and practitioners. At the end of the research project,

additional time, funding and continued commitment from all partners is necessary to facilitate the implementation of research outputs through science-policy, science-practice and policy-practice processes.

Lisa Biber-Freudenberger and **Manfred Denich** are scientists at the Center for Development Research (ZEF), and **Cory Whitney** is a scientist at INRES – Horticultural Sciences. The two institutes belong to the University of Bonn, Germany. Contact: m.denich@uni-bonn.de

* With inputs from Tina Beuchelt, Hannah Jaenicke, Girma Kelboro, Christine B. Schmitt and Jan Henning Sommer.

PRACTICAL EXAMPLES FROM RESEARCH AT ZEF

Research at the Center for Development Research (ZEF) covers a number of different aspects of agroecology with a focus on sustainable land use. It employs both interdisciplinary and transdisciplinary approaches (see Box on page 32) through exchanges between its three different departments on social and cultural change, economics and technological change, and ecology and natural resources management. Through this work, ZEF intends to address some of the most urgent topics regarding the implementation of the Sustainable Development Goals, and with reference to agroecological systems and challenges. ZEF researchers seek new and innovative approaches based on stakeholder demands, developed and implemented in a participatory manner. Most ZEF research projects are jointly developed with local partners from academia as well as practitioners including NGOs, the public and the private sector. Wherever possible, the implementation process is actively facilitated, monitored and researched. Doctoral students from the international doctoral programme of ZEF benefit from this inter- and transdisciplinary research environment and serve as knowledge multipliers in their home countries long after their time at ZEF.

ZEF and its partner institutions created **WASCAL**, an international organisation

that addresses various aspects of land use, especially the potential to mitigate and adapt to the impacts of climate change. It provides science-based advice generated by African and German interdisciplinary research clusters and contributes to educating the next generation of African scientists and policy-makers.

The **STRIVE** project investigates bioeconomic transition pathways and their sustainability implications on the global scale with a particular focus on trade and innovation transfer. The interdisciplinary approach integrates economics with natural and political scientific methods and qualitative as well as quantitative case studies.

The **FSS I** project uses a multi-stakeholder approach to create hands-on implementation tools to increase the potential for sustainability certification of agricultural commodities to contribute to food security while ensuring more sustainable, resilient and biodiverse production systems.

The **NutriHaf** project is a research and capacity building project that looks at the potential of farming vegetables and fruits in agroforestry systems to contribute to food security and biodiversity conservation. It employs a gender-sensitive participatory approach to ensure that the needs and

preferences of all smallholder farmers are considered to increase the adoption potential of the project outputs.

The **BiomassWeb** project aims at enhancing food and nutrition security in Africa by evaluating the food and non-food biomass contributions in complex value webs. It exemplifies different ways of implementing transdisciplinary research through joint activities with farmers on the ground, demand-driven research and development projects led by the African research community, science-policy workshops and the online platform BiomassNet targeting experts from science, policy and practice.

The **WABES** project facilitates networking and capacity-building across West Africa. It brings together interdisciplinary expertise in a science-based context and builds expert networks. It interfaces, develops and disseminates tools and approaches to support the Intergovernmental Platform for Biodiversity and Ecosystem Services by identifying sustainable approaches in agriculture. It bridges the gap between basic and applied research and the science-policy interface through the use of interdisciplinary knowledge.

For links to the projects, see online version of this article at: www.rural21.com