Innovation Systems Research

Sustainable Natural Resource Use in Least Developed Countries

Traditionally, research and development for least developed countries have focused on the transfer of technology. Innovation systems thinking, in contrast, introduces approaches that take into account regional and societal knowledge. Researchers at the University of Natural Resources and Life Sciences employ such an innovation systems perspective for sustainable natural resource use strategies.

Michael Hauser, Willibald Loiskandl, Maria Wurzinger

Innovation Systems Research. Sustainable Natural Resource Use in Least Developed Countries | *GAIA* 20/1 (2011): 70–72
Keywords: facilitation, innovation systems, poverty reduction, Research Into Use

In many least developed countries, a majority of people lives in rural areas and depends on natural resources for their livelihoods (e. g., 83 percent in Ethiopia, 72 percent in Bangladesh)[1]. There, human pressure on natural resources and the environment is high. For example, the competition for land and water resources in highly populated countries such as Rwanda or Bangladesh often exceeds the carrying capacities of land and ecosystems. Natural resource overuse and its subsequent land degradation are common (e. g., in sub-Saharan Africa 25 percent of the available agricultural land is severely or very severely degraded; in Asia and the Pacific 29 percent respectively). For decades, technological innovations have been considered one of the keys for reversing natural resource overuse and degradation. Yet the scientific literature is rich in examples of inappropriate or poorly targeted innovations in agriculture and natural resource management. For example, permanent cropping and terracing recommended in Laos did not address the main problem for farmers, namely weed infestation; therefore, they have not increased agricultural productivity as initially planned (Pretty 1995). Many years the transfer of livestock breeds from temperate climates to the tropics has been promoted to boost livestock productivity (see figure). Such innovations often failed as local production conditions, vulnerabilities, and risks associated to farming in the target countries were neglected (Nimbkar et al. 2008). At the same time, there are cases where farmers, together with the public and the private sector, take charge for resource conservation. In Kenya, the combined effect of policy processes, land conservation measures, and tenure arrangement, despite high population densities, resulted in more sustainable natural resources management regimes (Kabubo-Mariara 2007). Such and similar findings suggest that population pressure does not necessarily result in natural resource overuse and depletion, but that social systems have an intrinsic capability to actively manage natural resource constraints. In such cases, appropriate technologies, alternative forms of social organization, new attitudes and practices often go together.

The Centre for Development Research

In the agricultural development debate, innovation communicates "change" and "transition" from non-sustainable to ecologically sound and socially acceptable modes for natural resource management. Some authors (e. g., Sulaiman et al. 2006, Hall et al. 2010) understand innovations as changes that take place in societies, when knowledge, technology, and information are made available and put into socially and economically productive use. In much of its work on sustainable natural resource use strategies, the newly established Centre for Development Research (CDR) at the

Contact authors: *DI Dr. Michael Hauser* | University of Natural Resources and Life Sciences | Centre for Development Research (CDR) | Vienna | Austria | E-Mail: michael.hauser@boku.ac.at

Univ.Prof. DI Dr. Willibald Loiskandl | University of Natural Resources and Life Sciences | Institute of Hydraulics and Rural Water Management | Vienna | Austria | E-Mail: willibald.loiskandl@boku.ac.at

DI Dr. Maria Wurzinger | University of Natural Resources and Life Sciences | Institute for Livestock Sciences | Vienna | Austria | E-Mail: maria.wurzinger@boku.ac.at

Contact Österreich-Konsortium *GAIA*:
Dr. Christian Smoliner | Federal Ministry for Science and Research | Rosengasse 4 | 1014 Vienna | Austria | Tel.: +43 1 531206353 | E-Mail: christian.smoliner@bmwf.gv.at

1 See table on http://data.worldbank.org/indicator/SP.RUR.TOTL.ZS.

University of Natural Resources and Life Sciences, Vienna (Universität für Bodenkultur Wien, BOKU), employs an innovation systems perspective. It frames innovation as a collective action arrangement around a new idea that ensures the realization of the same at a wider geographical or societal scale.

For example, a single farm practicing sustainable agriculture in the Ethiopian highlands is not sufficient to safeguard natural resources with well-being effects for the entire region. It is the combined effect of sustainable agricultural practices of a majority of farmers in a given watershed that makes a difference for people and their environment: breeding programs for livestock or crops work only when farmers decide to collaborate, pool resources, share ideas, and realize them through vision-led collaborative arrangements. There are distinct interconnections between the social and technical dimensions of innovation; none of the two would work in isolation. Or, as Hellström (2007) puts it: "Technological innovations, in order to succeed, must build on relevant social structures and be able to influence these structures. Innovation therefore necessitates simultaneous technological and social change".

All relevant technological and social processes, interwoven with economic, institutional, political factors, constitute an innovation system. Multi-stakeholder partnerships that bring together natural resources user, ministries, the private sector, and research are the key for effective innovation system processes. Moreover, innovation processes promote the development of a real community of practice, if multi-stakeholder partnerships such as governmental agencies, non-governmental organizations, research institutes, business and consumer groups and, of course, farmers are involved (Waters-Bayer et al. 2007). In innovation systems research, particularly the integration of human, social, and natural factors helps to unlock peoples' ability to respond to natural resource management challenges.

Heterogeneity in Systems

Innovation systems research recognizes that innovation takes place within complex adaptive systems. This contradicts the classical mechanistic world view, which assumes clear and predictable procedures in development, diffusion, and adoption of technologies (Rip 1995). In reality, however, social processes, and organizational settings are influenced by ecological, social, or economic factors that cannot be understood from a reductionistic perspective. Such systems are comprised by a dynamic network of system components which act and react in association with each other. Interactions (and interdependencies) are typically non-linear, they are influenced by a range of decentralized decisions taken. These systems are labelled "adaptive", as they adapt (i. e., respond) to changing ecological or economic conditions and stress.

Such conceptualization of innovation is important for research in the field of sustainable natural resource use, as ecological, environmental, and economic conditions under which smallholder farmers operate are extremely heterogeneous. Heterogeneity is understood as a significant variation of conditions in both time and space. For instance, soil qualities vary in space, often within a few hundred meters. In practice, this means that crop varieties or mineral fertilizer application rates do not match with natural resource requirements. Hence there is a constant need for farmers to adopt and adapt technologies to match with the changing needs and requirements of agriculture.

Integrating Knowledge

Given the complexity of innovation systems, innovation processes must be examined from different disciplinary perspectives. The CDR, together with its partners and members, takes a cross-disciplinary orientation aimed at a better understanding of social and technological change that emphasizes sustainable natural resource management arrangements. Particularly, three research lines are of interest.

1. Innovation processes that improve the sustainable management of natural resource management, notably soils, water, crops, trees, and livestock (with a focus on socio-ecological dynamics that bring about new technologies and practices at communal level).
2. Facilitation of innovation through effective extension services, project and program approaches (with a focus on the necessary services, social networks as well as policies that altogether form a conducive atmosphere for innovation and change).
3. Impact assessment of innovation processes (with a focus on intra-household and intra-communal social, economic and ecological consequences of innovation and change).

As important it is to understand successful innovation processes ("learning from good cases"), it is equally critical to analyze failed attempts. The CDR draws on and contributes to innovation thinking by integrating natural and social science insights gained in Africa, Asia, and Latin America. Scientific partners from across university departments provide the necessary sector competences (e. g., soil management, irrigation, livestock). This works best in research projects with clearly defined system boundaries, allocation of tasks, budgets, and information sharing procedures.

Putting Ideas to Work

Next to the necessary interdisciplinary integration, the Centre also functions as a hub for transdisciplinary working arrangements with development partners in the south. Through partnerships with civil society, the private sector, international agricultural research, and higher education, we seek ways to put research insights into use. >

FIGURE: A crossbred dairy cow in Uganda.

In a recent research and development project granted by Europe Aid, researchers and development partners work side by side on adaptive small scale farming systems in rainfed areas in India, Nepal, and Bangladesh. Within the framework of the BOKU-DOC-funded doctoral study on innovation in livestock breeding, we hope to better understand the socio-economic conditions that help to put in place adequate breeding strategies for different production systems.

The aim of another project is to assess the impact of the Austrian-funded *Integrated Livestock Development Project (ILDP)* in Gondar, Ethiopia. It investigates the types of livestock-related technologies taken up by farmers, and assesses if and how these technologies have been modified and adapted by farmers in order to fit the local conditions. These results inform other development projects about the principal enabling conditions required for successful technology adaptation.

In the water sector, we deal with anthropogenic impacts on water quantity (overuse and non-sustainable excessive exploitation) and quality (contaminations of all kind). Irrigation development, for example, must be set into an integrated water management strategy to ensure that one achievement does not contradict other user requirements. The effective use of water and water productivity (Molden 2007) as well as safeguarding the resource water is a key factor for further development (see also Lord Selborne's work on water ethics; Selborne 2000).

All these examples employ a systems perspective that helps to understand the role of innovation in agriculture and natural resource management.

Institutional Innovation

Embracing innovation systems thinking in its academic work, the CDR supports the institutionalization and strengthens inter- and transdisciplinary development research and training within the university. The introduction and further development of the centre itself can therefore be referred to as an institutional innovation. In order to succeed, it requires the visionled interplay of researchers, research managers and university administration. Working in an innovation systems mode also requires rethinking the role of agricultural scientists. The difficulty of conventionally trained scientists to overcome the technology-supply push to innovation system thinking is certainly a challenge (Röling 2009). Most recent joint research projects suggest that such new forms of social organization are possible and will be rewarded. Drawing on innovation systems thinking is hence not only important to overcome classical transfer of technology approaches – it also helps to reorganize the way research is practiced.

References

Hall, A., J. Dijkman, S.V. Rasheed. 2010. *Research into use. Investigating the relationship between agricultural research and innovation.* Working paper 2010-44. Maastricht: United Nations University.

Hellström, T. 2007. Dimensions of environmentally sustainable innovation: The structure of eco-innovation concepts. *Sustainable Development* 15: 148–159.

Kabubo-Mariara, J. 2007. Land conservation and tenure security in Kenya: Boserup's hypothesis revisited. *Ecological Economics* 64/1: 25–35.

Molden, D. (Ed.). 2007. *Water for food, water for life. A comprehensive assessment of water management in agriculture.* London: Earthscan.

Nimbkar, C., J. Gibson, M. Okeyo, P. Boettcher, J. Sölkner. 2008. *Sustainable use and genetic improvement.* FAO Animal Genetic Resources Information 42. Rome: FAO (Food and Agricultural Organization of the United Nations). 49–65.

Pretty, J. N. 1995. *Regenerating agriculture.* London: Earthscan.

Rip, A. 1995. Introduction of new technology. Making use of recent insights from sociology and economics of technology. *Technology Analysis & Strategic Management* 7: 417–431.

Röling, N. 2009. Pathways for impact: Scientists' different perspectives on agricultural innovation. *International Journal of Agricultural Sustainability* 7/2: 83–94.

Selborne, Lord. 2000. *The ethics of freshwater use: A survey.* Paris: UNESCO (United Nations Educational, Scientific and Cultural Organization).

Sulaiman, R., A. Hall, R. Raina. 2006. *From disseminating technologies to promoting innovation. Implications for agricultural extension.* Paper presented at SAIC Regional Workshop on Research-Extension Linkages for Effective Delivery of Agricultural Technologies in SAARC Countries. Hyderabad, November 20–22.

Waters-Bayer, A., C. Wettasinha, L. van Veldhuizen. 2007. *PROLINNOVA: Building partnerships to promote local innovation processes.* Paper presented at the session on Building Networks and Partnerships for Change: Power and Relationships, Farmer First Revisited Workshop. Brighton, December 12–14.

GAIA ECOLOGICAL PERSPECTIVES FOR SCIENCE AND SOCIETY

HAUPTHERAUSGEBERIN
Verena Winiwarter | Wien
(verantwortlich im Sinne des Presserechts)

REDAKTION
Dr. Susanna Bucher/Dr. Almut Jödicke | ETH Zentrum | Postfach CAB 42 | 8092 Zürich | Schweiz | Tel.: +41 52 2222805 | E-Mail: redgaia@env.ethz.ch

Dr. Ulrike Sehy | oekom verlag | Hagenbuchrain 13 | 8047 Zürich | Schweiz | Tel.: +41 43 3110785 | E-Mail: sehy@oekom.ch

Tobias Mickler | oekom verlag | Waltherstr. 29 | 80337 München | Deutschland | Tel.: +49 89 54418445 | E-Mail: mickler@oekom.de

GRAFISCHE GESTALTUNG UND SATZ
Heike Tiller | München | E-Mail: h.tiller@freenet.de

VERLAG
oekom verlag – Gesellschaft für ökologische Kommunikation mbH | Waltherstr. 29 | 80337 München | Deutschland | www.oekom.de | Gesellschafter und Anteile: *Jacob Radloff,* Feldafing, 77 Prozent, und *Christoph von Braun,* München, 23 Prozent

ANZEIGEN
Stefanie Ott (verantwortlich) | oekom GmbH | Tel.: +49 89 54418425 | E-Mail: anzeigen@oekom.de

DRUCK
Kessler Druck + Medien | 86399 Bobingen | Deutschland | www.kesslerdruck.de

ERSCHEINUNGSWEISE Viermal im Jahr.

BEZUGSBEDINGUNGEN
Probeabonnement (2 Ausgaben inkl. Versand, nur in Deutschland): 20,50 EUR | Jahresabonnement: 98,70 EUR für Privatpersonen; 172,90 EUR für Unternehmen, Institutionen, Bibliotheken; 66,80 EUR für Studierende, Auszubildende, Schüler(innen) (jährlicher Nachweis erforderlich) | Einzelheft 26,80 EUR. Alle Preise inkl. MwSt., zzgl. Porto- und Versandkosten. Abbestellungen sechs Wochen vor Ablauf des Abonnementjahres. Zahlungen im Voraus.

BESTELLUNG, ABOVERWALTUNG, VERTRIEB
Rhenus Medien Logistik GmbH & Co. KG | Auslieferung oekom verlag | 86899 Landsberg am Lech | Deutschland | Tel.: +49 8191 97000608 | Fax: +49 8191 97000405 | E-Mail: oekom@de.rhenus.com
www.oekom.de/gaia/abonnement

KONTO für Deutschland: Postbank München | BLZ 700 100 80 | Konto 358 744 803
für die Schweiz: PostFinance SWISS POST | BLZ 300 011 01 | Konto 40-344357-9

oekom ist der erste klimaneutrale Verlag Deutschlands.

ClimatePartner°

ISSN 0940-5550
Printed in Germany.
Gedruckt auf FSC-zertifiziertem Papier.

FSC www.fsc.org MIX Papier aus verantwortungsvollen Quellen FSC® C004192