Agriculture-dominated Societies, Climate Change and Migration: a Case for Transdisciplinarity

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Abstract

The capability of societal systems to adapt and innovate is crucial for ensuring their viability and resilience, especially in the context of disturbances, which could originate either from within the system or from its environment. In general, migration can be conceived as one specific dimension of a multifaceted system- and transition-mechanism. Climate change, e.g., can be a driving force of migration, particularly within agriculture-dominated societies. The underlying argument is that for dealing with such complex, coupled human-environment systems, a transdisciplinary approach as a specific form of science-society collaboration has the potential to help to better understand these systems and their future transition path and to develop interventions, e.g., innovations, which are aimed to increase their resilience and – ultimately – their sustainable development.

Introduction

Knowledge without understanding is a misguided missile.
(Ackoff and Rovin, 2005: 15)

Complex societal challenges

Migration is not per se a complex challenge, instead it may be understood as a phenomenon, which ranges from linear and *continuous* developments to non-linear and *disruptive developments*. On the one hand, in an increasingly interrelated world, *mobility of labor and capital* (Biffl, 2012; Sassen, 2001) is essential for the functioning of various societal systems. Hence, migration can be conceived as part of a multifaceted system mechanism, which characterizes any societal transition. The development of the United States and Europe for example would not have been possible without immigrants; further, both will depend on within- and between-mobility of labor between them as well as regarding third countries, in terms of their future development. On the other hand, *system disturbances* such as war, climate change, hunger, resource scarcity, and health crises challenge societal systems regarding their *capabilities to adapt and innovate*. However, innovation might not only be a key mechanism in coping with disturbances, but it may itself

be a disturbance. E.g., in agriculture-dominated societies, digitalization might positively affect productivity (e.g., based on automated irrigation- and production systems), but it may also release labor force and, consequently, prompt workers to migrate to different regions within a country or even to move abroad. Current examples of system disturbances include the ongoing migration- and refugee movements to Europe (as the first mass influx of migrants/refugees to the European Union from outside its region), but also climate change induced migration. They demonstrate that not only persecution for gender, religion, conflict, and war, but also *climate change can be a driving force of migration* (e.g., increased sea levels, decreasing agricultural opportunities).

The example of *agriculture-dominated societies* also demonstrates the increasing complexity of the magnitude of change, which – with more than one interfering event co-occurring (e.g., technological impact of digitalization and climate change) – becomes increasingly difficult to predict along its future transition path. Simultaneously, since migration into urban areas is often a result of these agricultural developments, the societal development of *rural and urban areas* is affected as well.

Hence, the *understanding of coupling mechanisms* between human systems (e.g., agricultural society and labor migration) and environment systems (e.g., technological basis and ecosystems services), such as expressed in Scholz's theory of coupled human-environment systems (Scholz, 2011), is essential for the development of appropriate interventions, which strive to enhance the *resilience* of a given societal system in accordance to potential internal or external *vulnerabilities*. For innovation developments, which contribute to a more resilient society, system understanding is a prerequisite and – as a consequence – *vulnerabilities might become a source of innovation*.

Characterization of complex problems

Extending on the above described case of agriculture-dominated societies, it becomes obvious that the development of such *multilayered societal systems* in the light of *migration, technological developments, climate change, and innovation* (see Section 'Complex societal challenges' above) is an example of a real-world problem of complex nature. I.e. *complex problems* "are multifaceted, ill-defined, nonlinear, with innumerable sets of highly interdependent subsystems and elements, and they reveal dynamically changing development patterns over time" (Steiner, 2014, p. 8) (see also, e.g., Ackoff and Rovin, 2005; Meadows and Wright, 2008, pp. 181–182; Scholz and Tietje, 2002, p. 34; Steiner, 2013, p. 18; Sterman, 2000, pp. 3–39). The *adaptive capacities* of a complex system enable it to adapt dynamically and in nonlinear ways, which lead to unique *emerging properties* that distinguish it from other systems (e.g., Katz, 2006).

In the *case of agricultural production*, the introduction of new technologies might be considered positive or negative for the labor situation, depending on the overall system's capabilities to adapt. E.g., smart irrigation systems, appropriate

fertilization strategies accompanied by reforestation, which is aimed to prevent soil erosion, together with training programs for workers to acquire the competences needed to understand the holistic agricultural system (as a coupled multi-layered system), to monitor and analyze it, and to derive proper intervention scenarios, may lead to positive economic, ecological, and social effect in parallel. By contrast, one-dimensional cause-effect thinking may lead to unintended economic, ecological, or social effects.

If a societal system strives towards *sustainable development* (regarding economic, ecological, and social dimensions), it is striving towards a dynamic and not a fixed state: "Sustainable development is a proactive, ongoing inquiry (…) on system-limit management in the framework of intra- and intergenerational justice (…)" (Scholz, 2017), whereby, social norms and values affect the inquiry regarding sustainable transitioning. The *understanding* of complex systems such as agriculture-dominated societies *in the context of societal resilience and sustainable development* goes beyond comprehending the current state, but it starts with the past and is – via the current state as an interface – related to potential future transition states. Hence, the complex system itself as well as its boundaries, how it functions and malfunctions, how it is interrelated with its environment, and how it transforms over time need to be thoroughly understood. However, these complex challenges most usually cannot be dealt with by individuals only, nor by a single discipline. In addition, expert knowledge beyond that of academia and including other experts from society cannot be neglected either.

Transdisciplinarity as a means of dealing with complex real-world challenges

Complex migration challenges such as described above call for specific forms of *science-society collaboration*, which provide "science-based, state-of-the-art, socially accepted options of solutions which acknowledge uncertainties and the incompleteness of different forms of epistemics" (Scholz and Steiner, 2015a). The integration of different epistemics from science and practice, i.e. Mode 2 transdisciplinarity, seems to be a key for a potentially sustainable societal transition (a comprehensive outline of the historical development of transdisciplinarity is outlined by Scholz and Steiner, 2015a). By contrast, *Mode 1 transdisciplinarity* "aspires to develop a meta-structure that allows for a more realistic description of material-biophysical and socio-cultural, epistemic structures, which are currently dealt with separately in a myriad of disciplines in the natural and social sciences, engineering, health sciences, and the humanities" (Scholz and Steiner, 2015a, p. 537). To sum it up, whereas Mode 1 transdisciplinarity by integrating epistemic structures of different disciplines (i.e. interdisciplinarity) helps to overcome disciplinary boundaries, Mode 2 transdisciplinarity is supplementing disciplinarity and interdisciplinarity by a multi-stakeholder discourse. Mode 2 transdisciplinarity "is conceived as a *facilitated process of mutual learning between science and society*

that relates a targeted multidisciplinary or interdisciplinary research process and a multi-stakeholder discourse for *developing socially robust orientations* about a specific real-world issue" (Scholz and Steiner, 2015a, p. 531).

Transdisciplinary processes contribute to multidimensional knowledge integration by applying various transdisciplinary methods. They are meant to enable capacity building among all participants based on an equal footing throughout the whole process, i.e. problem definition and -representation, development of strategies for transforming the problem by *system innovations* (as combined form of technological and social innovations) at various levels of the coupled human-environment system. In an ideal form of transdisciplinarity, *co-leadership* between science leader(s) and practice leader(s) is realized within the whole project (i.e. within every subproject). *Accepting the "otherness of the other"* (including the differences in epistemics and modes of causation between science and practice) is fundamental for *mutual learning*, which is needed when dealing with complex real-world problems that are of societal relevance. In practice, transdisciplinary projects and processes will meet various forms of constraints and obstacles, which need to be dealt with (an comprehensive overview of obstacles within the transdisciplinary process based on the analysis of 41 mid- and large-scale transdisciplinary studies is provided by Scholz and Steiner, 2015b).

Within the transdisciplinary process, four forms of knowing and knowledge-integration are distinguished (Scholz, 2011; Scholz and Steiner, 2015a; Scholz and Tietje, 2002): (1) *Experience* as direct *experiential knowledge* (i.e. sensation- and perception-based) is of holistic nature and includes unconscious knowledge dimensions (experimental system knowledge is a particular strength of practice experts); (2) *Understanding* based on experiences as well as on empathy enables comprehending the complexity of multilayered coupled human-environment system; (3) *Conceptualizing* means relating of constituents of thought and single concepts, which also becomes the basis for a collaborative creative effort to generate innovations; (4) *Explaining* implies that past, present, and future cause and impact relationships can be sufficiently understood, which is also a prerequisite for evaluating the resilient capacities and sustainable potential of various development scenarios.

Within the transdisciplinary process, the multidimensional knowledge integration relates to five dimensions, i.e. modes of thought (i.e. intuitive and analytical thinking), (inter-)disciplinary (related to humanities, natural and social sciences), perspectives/interests, systems, and cultures (including religions).

Exemplified by the case of smallholder farmers in Kenya (Njoroge et al., 2015), the application of a transdisciplinary process led to a better understanding of the agriculture-dominated societal system (i.e. coupled human-environment system) by initiating a mutual learning process between science and society (including farmers) and the development of more sufficient management strategies for the agricultural system (e.g., from an agro-economic perspective, the transdisciplinary project design led to a yield increase of 54 %). Further, these developments followed a sustainability orientation, which encompasses economic, ecolog-

ical, and social dimensions. In more detail, the transdisciplinary process encompassed: "(1) farmers' participation in a transdisciplinary process including extension officers and local scientists to construct farm-specific fertilization strategies based on (2) farm-specific soil testing and (3) the construction of cooperative strategies for purchasing fertilizers involving farmers, traders, and financial institutions in a timely manner" (Njoroge et al., 2015, p. 601). As stated above, a transdisciplinary process design can enhance a holistic understanding of the agricultural system (as a coupled multilayered system) and may lead to simultaneous positive economic, ecological, and social effects, which also affects labor migration mechanisms.

Transdisciplinarity at Danube University Krems and Outlook

Transdisciplinarity has become more than a philosophy at Danube University Krems in Austria. It is increasingly characterizing educational and research activities as such. In the following, four selected examples of a broad variety of transdisciplinary initiatives at Danube University Krems are introduced:

(1) Danube University Krems commits itself to being a 'transdisciplinary university', which follows the principles of transdisciplinarity as described above. As such, she was the first university that included a transdisciplinarity focus in her core strategy and with implications on both teaching as well as on research.
(2) Based on its focus on postgraduate education, Danube University Krems as Public University for Continuing Education provides a specific environment for educational programs, which emphasize applied real-world topics of relevance for students who are themselves professionals in a broad variety of societal fields (e.g., most recently as part of a teaching program on digital governance).
(3) Danube University Krems and particularly the Faculty of Business and Globalization is hosting a PhD program in migration studies, which is widely based on transdisciplinary principles. Further transdisciplinary PhD programs are in the process of development.
(4) Currently, three transdisciplinary research platforms exist: 1) the 'Transdisciplinarity Laboratory Sustainable Digital Environments' (SDE TdLab), 2) the 'Transdisciplinarity Laboratory Sustainable Mineral Resources' (SMR TdLab), and 3) the 'GovLabAustria'. Additional transdisciplinary initiatives such as in the field of democracy will follow.

With examples as outlined above, migration research in general and in particular at Danube University Krems is equipped with a state-of-the art basis for doing transdisciplinary teaching and research. Science-society based approaches such as offered by transdisciplinarity provide new possibilities for research and teaching, which aims to make a difference with respect to the societal relevant challenges we are facing today.

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