A novice's guide to transdisciplinarity

The Global TraPs Project
Transdisciplinary Processes for Sustainable Phosphorus Management (2010–2015)

Transdisciplinarity (td) is a key term of the Global TraPs project. All activities of the project on all three levels of the project are transdisciplinary processes: the 'Umbrella project', the Nodes of the phosphorus (P) supply chain including the Trade and Finance Node, as well as the case studies which are launched to better define or to close the knowledge gaps on sustainably P management. In this brief, we 1) provide a brief definition of td, 2) outline one of the twenty-five td case studies that have been successfully conducted at ETH NSSI since 1993; and 3) provide a "model" for a brief description of a planned td case study in Vietnam.

1 *What is transdisciplinarity?*

Transdisciplinarity is a third mode of doing science complementing **disciplinarity** and **interdisciplinarity**. It was developed during the last two decades in Europe and is now well accepted in the European academic community.

Whereas **interdisciplinarity** means the integration of concepts and methods from different **disciplines**, **td** integrates additionally different epistemics (i.e. ways of knowing) from science/theory and practice/stakeholders. Td starts from the assumption that scientists and practitioners are experts of different kinds of knowledge where both sides may benefit from a mutual learning process. Thus, co-leadership among science and practice based on equal footing on all levels of the project (i.e. the umbrella project, the nodes and the case studies) are needed to assure that the interests and capacities of theory and practice are equally acknowledged.

Transdisciplinary processes (td-processes) target the generation of knowledge for a *sustainable transition of complex, societally relevant real world problems*.

Td-processes include joint (1) problem definition, (2) problem representation and (3) preparation for sustainable transitions (see [1]). In general, td-processes provide an improved problem understanding and robust orientations on policy options or business decisions for the practitioners. Scientists benefit by getting in-depth insight into the dynamics of complex systems and mechanisms of sustainable transitions.

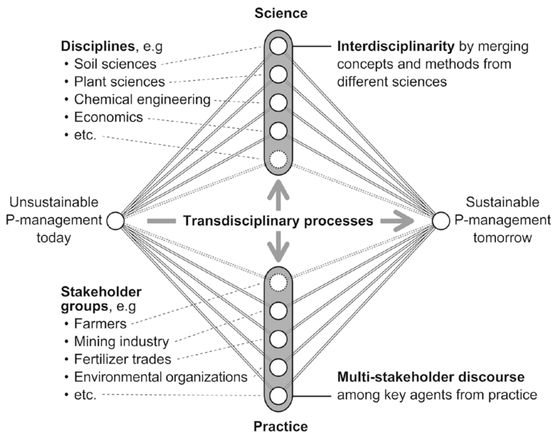

Figure 1: Disciplines, interdisciplinarity, multi-stakeholder discourses and transdisciplinarity

2 *A Successful Example: "Sustainable Future of Traditional Industries" in a rural pre-alpine area*

Building partnership[1]: Both, the president Hans Altherr of the small pre-alpine Swiss state Appenzell Ausserhoden (AR), and ETH professor Roland W. Scholz, were interested in understanding mechanisms of sustaining traditional industries in rural regions. Jointly, they decided to run a transdisciplinary case study and to take *co-leadership* on equal footing for a td-process.

(1) **Joint problem definition**: Key representatives (e.g. presidents of industry associations and unions as well as representatives of the communities) formed the steering board. A challenge was to negotiate and define the **guiding question**. It reads: ***What are the prerequisites for a sustainable regional economy meeting environmental and socioeconomic needs?*** Further, three industries, i.e. textile, dairy and sawmilling industry, were selected for in-depth understanding of key mechanisms of sustainable transitions. In addition a Knowledge Integration Group was built to identify communalities and specificities of the three industries.

[1] Please note that this step also should include a thorough actor analysis identifying "legitimized decision makers" who may become co-leaders of the case study and of the stakeholders who should be involved in the case study.

(3) **Preparing for sustainable transitions**: By means of a scientific method (i.e. Formative Scenario Analysis), for each industry a *set of different business strategies* (including state, community, and multi-stakeholder activities) were constructed. These strategies were evaluated by the different stakeholder groups to gain insights into dissent and consent within and between them. Scientists analyzed these evaluations, compared them to a "data-based multi-criteria sustainability assessment", and discussed the results with key actors and further interested people. For each industry meaningful business options as well as related latent conflicts (between companies, economic and environmental impacts) were identified. Based on this, a process of mutual understanding was moderated so that consensus could be formed on many issues. The Knowledge Integration Group integrated these results and – together with the head officials of AR – identified potential policy options for the state. The results were published in a book targeting practitioners at regional and national level [2].

(4) **Outcomes and follow-ups**: The knowledge generated in the process was used by the practitioners involved in their daily business and policy decisions. Based on the AR-study, the Swiss textile industry launched a study to utilize the favorite strategy from the td-process for new business models [3]. Various concrete projects such as a new wastewater treatment plant for the textile industry, new cooperatives for the dairy industry and (cantonal) forest management followed the study. The study allowed for robust scientific publications on sustainable regional wood flows [4], business strategies of traditional industries [5] or the methodology of transdisciplinary case studies [6].

Roland W. Scholz, November 2011

3 An example of how a transdisciplinary case study in the Use Node may look like:

"The Yen Chau - Hiep Hoa case study: Avoiding P fertilizer overuse and underuse in Vietnamese smallholder systems"[2]

The problem

Globally, unsustainable P fertilizer management challenges for farmers fall primarily into two P use regimes. First, many farmers engaged in intensified production to meet market demand for food, apply P fertilizer at high rates in order to maintain production, However, they may fail to utilize best management practices which can result in significant P losses through surface water run-off and soil erosion. This group includes smallholder farmers engaged in intensified agricultural production of cereals, fruits and vegetables and who often produce two to three crops (e.g. rice, vegetables) per year on the same land area. We may find this overuse in particular urban agriculture or for smallholder farmers who have good access to local traders and markets.

Another large group of poor subsistence smallholders cannot gain access to fertilizers; here P fertilizer is underused, leading to soil degradation exacerbating poverty. Therefore, viable options for economically and environmentally efficient P resource use and recycling in such smallholder agro-ecosystems need special attention. Vietnam's smallholder systems in the Red River Delta (fertilizer-overuse, market-oriented) and in the Northwest Mountain Region (fertilizer-underuse, subsistence) will be used as example cases for two contrasting P use regimes (overuse and underuse).

(1) Building partnership and Td organization

Science-practice co-leaders: Both, presumably the chairmen/chairwomen of Province's People Committees in Son La and Bac Giang provinces , and researchers from ETH.NSSI (Prof. Scholz/Dr. Le) are interested in understanding mechanisms of sustaining traditional industries in rural regions. Jointly, they will decide to run a Td case study and to take *co-leadership* on equal footing for a td-process. The co-leaders preside over the steering group.

Steering group: The group consists of representatives of the scientific disciplines involved in the study topic (e.g. soil and crop scientists from Vietnam Soils and Fertilizer Research Institute, environmental chemists from Research Center for Environmental Technology and Sustainable Development at Hanoi University, Natural Science, scientists human-environment system scientists from NSSI/ETH Zurich), as well as the representatives of the two provinces. During the problem definition process, representatives of few (2-3) selected districts/communes will join the steering group. As the study progresses, the steering group will identify additional participants who should be involved in each phase of the project based on the nature of the work [7]. For this, it seems meaningful/necessary that both locations, i.e. Yen Chau and Hiep Hoa about 12-16 farmers make commitment to be involved in the study and the mutual learning process. These farmers will be key members of the reference groups.

Project groups – Reference groups: The scientific work will take place in project groups of which there are as many as there are case facets (see session Case Faceting below). The project groups are counterbalanced on the case side with so-called reference groups, which are the committees of stakeholders relevant for the respective case facet [7]. The reference group regularly meets their corresponding project group to discuss the results and subsequent steps of the work.

[2] This case description is an very early. Provisional draft of potential case study of the Global TraPs 2013-2014 core phase. It should serve Global TraPs members to get a better impression how a case description may look like and how transdisciplinarity may look like.

Table 1: Regional settings of the two study areas

Aspect	Hiep Hoa district (P fertilizer overused)	Yen Chau district (P fertilizer underused)
World regional farming system/climate zone [8]	Lowland rice-based farming system in Eastern Asian tropical monsoon climate. About 71 million ha, mainly located in flood-plains of South and Central East China, Korean peninsula and Southeast Asia.	Highland extensive mixed farming system in Eastern Asian tropical monsoon climate. About 8 million ha, mainly located in mountains of Southeast Asia.
Cultivation area	28.5 thousand ha	201 thousand ha
Agricultural population	216 thousand people (95% of total population) (2008)	65 thousand people (95% of total population) (2009)
Main soil (FAO-UNESCO) and land form	Plinthic Acrisols River floodplain	Ferrasols, Acrisols Complex mountain
Key components of smallholder farming system	Crop: Paddy rice (80% of total crop area), maize, beans, vegetables. Livestock: pig (high density), poultry, cattle. Aquaculture: fish ponds.	Crop: Maize (70-60%), paddy and upland rice, cassava, beans, vegetable, fruit trees. Livestock: pig, cattle (open raising, extensive care). Aquaculture: fish ponds.
General livelihood strategy	Market-oriented. Both crop and livestock productions are important sources of cash income. Vegetable is increasingly grown to meet the increasing market demand.	Subsistence. Maize, rice and cassava are important food crop. No/weak market links for some marketable crop (maize and fruits).
Existing fertilizer use and nutrient management	Intensive uses of inorganic fertilizers, combined with some manures. Nutrient loop between crop-livestock-fish in some households. About 80% of animal manure is discharged to the environment.	Compound NPK, Urea and K fertilizers are used only for a very small share of cropland. Almost no P ferti-lizer for hillside crops. Manure is seldom used. Nutri-ent recycling or soil conservation practice is hardly observed.
Prevalence of food insecurity and poverty	Medium	Very high (poverty hotspot in Vietnam)
Key problems	(1) lost yield if no or less use of fertilizer, (2) low fertilizer use efficiency, (2) high livelihood vulnerability to increase in fertilizer cost, (3) water pollution.	(1) degraded soil and declining crop yield, (2) very low household income, (3) knowledge, cultural and labor constraints for nutrient recycling practices, (4) lack of access to fertilizer and food market, financial services.

(2) Joint problem definition

The steering group members (which includes the main stakeholder groups) will negotiate and define guiding question , goal and the case areas (system boundaries).

Guiding questions: As a result of science-practice discussion, examples of possible guiding questions could be:

Project year 2013:
*What are science-based and society-relevant strategies for P resource use that help improve soil fertility, food productivity and profitability for Vietnamese smallholders of two contrasting P use regimes? What options/pathways/means are available for the transition of current smallholders' P use to a sustainable use of P?***Goal**: Based on these questions, the goal of the case study can be defined such as to provide (strategic) orientations for future development of smallholders regarding P use.

Case definition: The case is should allow to better understand "overuse" and "underuse" of P under certain constraints. The case's characteristics and contextual factors should allow some generalization for other cases (we are investigating cases for something of general interest). Based on reviewing the existing classification of world farming systems [8], the global pattern of agronomic P balance [9], and national patterns of climate, soil, demography and land uses, the steering group – presumably interacting with regional case actors - identifies case areas in the Hiep Hoa and Yen Chau districts. Characteristics of these areas are in Table 1. Based on extensive farm survey across the selected areas, a limited numbers of farms (about 6-8 farms/site) representing major farm types will be selected for further considerations.

Case faceting: The goal of faceting is the formulation of a research concept, which is written by the scientists in collaboration with practitioners. Together with the stakeholders, the involved scientists create a general model of smallholder farming system in the two districts with a focus on P uses, which allow the application of relevant disciplinary fields and their theories. In order to reduce the complexity and to better analyze the farming practices a 'faceting' of the case should be done. Facets (which have to be discussed) could be: 'Crop-Livestock Production including P fertilizer use and flows', 'Household Decision', and 'Policy, Finance and Market'. Consequently, three corresponding project groups should be formed here. For each case facet, P-use related scientific tasks (subprojects) will be identified. In the presented case, there may be an additional project group which focuses on integrating/synthesizing the results from the subprojects, i.e. the so-called "Integrated Assessment" group.. It is expected that the case faceting will jointly identify a couple (common) disciplinary sub-tasks with particularly disciplinary foci, such as:

Crop-Livestock Production, P fertilizer use and Flows
- Current state of P use and cycle in the study smallholder systems
- Problems in P fertilizer use, P cycle management with respect to sustaining soil fertility and crop/livestock production

- Potential alternatives for P use technology/practice and (on-farm) recycling

Household Decisions

- Social-policy, economic, ecological factors that affect farmers' decision about nutrient use and management
- Interferences between farmer's decision-making and other important human agents at higher levels (e.g. provincial department of agriculture and rural development, rural credit agencies, traders)

Policy, Finance and Market

- Constraints in policy (e.g. subsidy), finance institution (e.g. rural loans/credit institution) and market (e.g. prices of farming inputs and outputs) with respect to smallholder's P uses
- Potential alternatives for improving these factors.

Integrated assessment

- Integrated Assessment including conceptual and parameterized system model that integrates the above-mentioned facets
- Scenarios of soil fertility, food productivity & profitability vs. P use strategies, evaluation of trade-offs.

(3) Joint problem representation

System analysis: A special challenge of the td-process is to collaborate with the decision makers and the stakeholders in a way that the system model and what is focused can be understood by all key (practice) case agents. system model should represent the smallholder agro-ecosystem in a way that all can understand the dynamics of soil fertility and food production in response to changes in P uses and other related drivers (e.g. fertilizer subsidies, market prices). The system model will serve as a basis for the construction of case scenarios in the next steps. Moreover, the joint system model construction will result in a shared representation of the constructed case study. This shared constructive aspect should greatly enhance the mutual learning process.

Scenario construction: For each case area, through Td workshops, stakeholders will jointly identify a set of different alternative P use strategies that they would like to evaluate. By means of either the computerized system model or a scientific participatory method so-called Formative Scenarios Analysis [10], future scenarios of identified outcome variables corresponding to the alternative strategies will be constructed. The scenarios will also be presented in a verbal or visual form, that it can be understood by the stakeholders and all case agents involved.

(4) Assessment and preparing for sustainable transitions

The above-mentioned strategies will be evaluated by referring to scientific data. to gain insights into trade-offs e.g. between costs and benefits or environmental impacts and economical cost driven by the alternative strategies. Further and complementary to that, participatory Multi-Criteria Assessment [10] will be used. Different stakeholder groups will evaluate the different scenarios. This will serve to identify trade-offs between the stakeholder groups and between different aspects of p-use that may be improved. Tor each meaningful scenario, tradeoffs (between social, economic and environmental impacts; between different preference systems of stakeholder groups) will be identified. Based on this, a process of mutual understanding will be moderated and consensus can potentially be formed on many issues.

(5) Outcomes and follow-ups

In the final Td workshops, stakeholders will discuss how the knowledge generated in the process should be used for different societal processes, such as farming practices, policy decisions, sustainability learning in higher education systems, framing of follow-up research activities. As one important follow-up, written products will be prepared both for practice partners (e.g. practice manuals, policy briefs) and scientists (articles in academic journals).

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