



## CASE REPORT

# A reflexive assessment of a regional initiative in the agri-food system to test whether and how it meets the premises of transdisciplinary research

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## Abstract

In recent sustainability assessments, transdisciplinary approaches have been used to bridge contested normative views among many societal actors, policymakers and researchers. Transdisciplinary research is mainly based on three premises: (1) various perspectives need to be incorporated and discussed to empower actors, (2) the collaboration and co-creation of knowledge between academic and societal actors allows to better grasp the complexity of a real-world problem, and (3) a mutual learning process arises which could increase the legitimacy of decisions and their implementation in practice. Despite many examples of transdisciplinary projects, few assessments have been done that question whether such a project fulfils the premises of transdisciplinary research. Therefore, we report on a reflexive assessment of an initiative set up to foster the transformation of the Flemish agri-food system towards sustainability. The case study involved both scientific and societal actors with different views, making it possible to implement a transdisciplinary process, evaluate the expectations and give suggestions for future processes. Evaluation criteria are linked to context, process and outcomes. Analysis of the qualitative and quantitative data indicates that the initiative did empower the transformation towards sustainability. Furthermore, results show that, in this case, a transdisciplinary approach can fulfil its premises. However, some critical factors are identified, such as the importance of the context specificity and a flexible, adaptive and iterative process.

**Keywords** Reflexive assessment · Transdisciplinary research · Transdisciplinary approach · Case study analysis · Flemish agri-food system

## Introduction

Although societal actors in research and policy have long been underrepresented, transdisciplinary research is increasingly implemented to bridge the domains of science, policy

and society (Pohl 2008; Lang et al. 2012; Luyet et al. 2012; Brandt et al. 2013). Various transdisciplinary approaches cover many themes such as landscape development (Staufacher et al. 2008), regional development (Kelly et al. 2007) or energy efficiency (Miah et al. 2015). Also in sustainability studies, a transdisciplinary approach is important since sustainability is a contested normative concept (Pretty 1995; Pohl et al. 2010; Hermans 2011; Brandt et al. 2013).

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A collaboration between researchers and practitioners to jointly define and manage complex problems is essential within transdisciplinary research. Common elements are a joint problem definition, mutual learning, knowledge co-creation, capacity and consensus building (Mobjörk 2010; Lang et al. 2012; Brandt et al. 2013). Transdisciplinary terminology can differ, i.e. many synonyms for transdisciplinary research exist, such as participatory approach (Blackstock et al. 2007, 2012), public participation (Grant and Curtis 2004), community-based research (Savan and Sider 2003), integrated research (van Kerkhoff 2005) or joint knowledge production (Hegger et al. 2012). Informed by other researchers (Pohl 2005, 2008; Hadorn et al. 2006; Mobjörk 2010; Jahn et al. 2012; Lang et al. 2012; Miah et al. 2015), we define transdisciplinary research as a reflexive research approach focusing on collaboration between academic and non-academic actors to develop a shared solution for a complex societal problem.

Three premises exist to implement transdisciplinary research in sustainability science. First, transdisciplinary projects create better solutions to complex problems because they integrate various perspectives throughout the collaboration process which could empower the actors (normative premise) (Pohl and Hadorn 2007; Walter et al. 2007; Aeberhard and Rist 2009; Mobjörk 2010; Lang et al. 2012). Second, transdisciplinary approaches co-create and exchange knowledge between scientists and practitioners by combining scientific and societal knowledge which increases system understanding (cognitive premise) (Pohl and Hadorn 2007; Mobjörk 2010). Third, transdisciplinary projects create a mutual learning process due to the collaboration process which could stimulate the implementation in practice, overcome the knowledge-action gap, increase the legitimacy of decisions, and increase the ownership of results (Reed 2008; Pohl et al. 2010; Enengel et al. 2011; Lang et al. 2012). However, developing an approach that fulfills these premises is challenging. Moreover, assessments of goals and outcomes of transdisciplinary approaches are limited or even lacking (Burgess and Chilvers 2006; Blackstock et al. 2007, 2012; Walter et al. 2007; Wiek et al. 2014; Binder et al. 2015; Schmid et al. 2016) and its effects remain vague or understudied in most reported empirical cases (Luyet et al. 2012; Brandt et al. 2013). The increased implementation of transdisciplinary research has spurred funding organizations, policymakers and researchers to examine its effectiveness which can be evaluated by the context, process, outcomes and output of transdisciplinary processes (Hermans et al. 2011; Wiek et al. 2014).

To address the gap regarding evaluations in sustainability science and with the aim of contributing to improve future transdisciplinary approaches, we report on the evaluation of a recent initiative within Flanders (the northern part of Belgium) aimed at discussing transformation pathways towards

a more sustainable agri-food system. The agri-food system consists of a sophisticated supply chain that comprises multiple actors such as input suppliers, farmers, processors and retailers, all with different visions. Furthermore, various socioeconomic and environmental pressures such as scarcity of resources, concentration and price volatility are all encouraging the agri-food system and its actors to transform towards sustainability (Potter and Tilzey 2005; Foresight 2011; Dicks et al. 2013). These characteristics make this case appropriate for implementing and evaluating a transdisciplinary approach.

Unlike conventional project evaluations, the focus of our evaluation is on the context, the process and the outcomes rather than on the output. Not the output in practice as such is evaluated, i.e. the impact of a strategic action plan, but the strengths and pitfalls and impact of the transdisciplinary project. Transdisciplinary research is therefore the object and not the methodological framework of this study. “**A regional transformation initiative**” describes the case study, “**Transdisciplinary approach**” the transdisciplinary project and “**Assessment method**” the assessment methodology. “**Results**” describes the resulting lessons learned and “**Discussion**” reflects upon the premises of transdisciplinary research, the critical factors hindering or enabling translation of the lessons into action and the used framework. “**Conclusion**” gives some general conclusions.

## A regional transformation initiative

Similar to agri-food systems in other industrialized regions, the Flemish agri-food system is exposed to pressures such as an ageing population and price volatility (Hubeau et al. 2015b). Since 2002, different initiatives focusing on the transformation of the agri-food system towards sustainability were set up. Transformation towards sustainability refers to systemic changes in institutional, relational and cultural aspects of agri-food systems that result in a more sustainable system state (O’Brien 2012; Patterson et al. 2015; Luederitz et al. 2016a). As sustainability is a normative concept with uncertainty about values and methodological approaches, not one possible pathway nor one “sustainable” system state exists (Grosskurth and Rotmans 2005; Jahn et al. 2012; Hurlbert and Gupta 2015; Hubeau et al. 2017).

In 2002, the first initiative was entitled ‘On tomorrow’s ground’, lasted 5 years and resulted in the publication of a book about a possible transition of the Flemish agricultural sector by 2020 and conclusions how to stimulate adoption of sustainable practices (STEDULA 2006).

In 2010, a group of representatives of NGOs, policy and scientific actors started an initiative ‘The New Food Frontier’. The goal of this second initiative was to convince a large group of relevant stakeholders that re-orientation of the

system was required and that a long-term shared vision and an action framework within the respective organizations was essential. However, in 2012, the representatives of the agri-food actors decided to leave the initiative. The main reason for withdrawal was an article in the agricultural press of a researcher, NGO, and policy actor that mentioned the ongoing processes of the agri-food system using the metaphor of ‘failure’ of the system. The agri-food actors disagreed with the description of the current system as being-in-error. Therefore, the initiative of *The New Food Frontier* ended with a motion of distrust (TNFF 2013). However, the agri-food supply chain actors recognized the urge for a more sustainable system and started a new initiative in 2013. This third, in 2017 still ongoing, initiative ‘The Flemish agri-food system transforms towards sustainability’ is the object of this study.

The main differences with the previous initiatives are (1) initiators are the agri-food industry actors, such as associations of farmers, processors and retailers, who took an active role to manage the process instead of scientists (initiative 1) or scientists, NGOs and policymakers (initiative 2), and (2) the initiators emphasize action and experiments instead of shared vision development. They requested a sound research approach and asked scientists to govern a transdisciplinary implementation. The initiative started in May 2013 and was co-funded by the Government of Flanders, industry partners and a research institute.

## Transdisciplinary approach

### Transdisciplinary design

The transdisciplinary project was designed using the principles of transdisciplinary research in sustainability science by Lang et al. (2012) (Table 1).

### Who is involved, why and how?

The transdisciplinary project covered interaction between five stakeholders groups with their own composition, role and interaction moments, i.e. (1) key chain delegates, (2) a research team, (3) an academic advisory group, (4) chain representatives, and (5) a reference group. They represented all the categories of the social pentagon, namely government, companies, NGOs, knowledge institutes and intermediaries (Rotmans and Loorbach 2008).

First, the agri-food industry partners or ‘key chain delegates’ initiated the project and were representatives of key actors of the agri-food system who are able to influence the strategies of the sector and the policy decision process. The group consisted of one member of an input supplier association, two of farmers’ unions, two of food industry

associations, one of a retail federation, two of NGOs (nature and consumer oriented) and two policy actors. This group initiated the contact with governmental institutions for resources and advice but retained control on how resources were used. They defined the problem and identified the project objectives. Moreover, they shared ownership of the results.

Second, the research team, consisting of five researchers, had a threefold role: to provide scientific expertise (role of reflexive researcher), to mediate between stakeholders visions and perspectives (role of intermediary) and to initiate a mutual learning process to help stakeholders to address the challenges with openness (role of facilitator) (Pohl et al. 2010). The selection criteria of the research team were: (1) scientific knowledge and expertise, (2) practical knowledge about the agri-food system and (3) previous experience in transdisciplinary processes.

Third, an interdisciplinary academic advisory group of three professors from different universities advised the research team. These actors were selected based on knowledge and expertise about agri-food system and/or transdisciplinary processes. Moreover, one professor was selected due to its active role in the previous initiative ‘The New Food Frontier’. They verified the process and outcomes and provided advice on the transdisciplinary approach.

Fourth, the key chain delegates were supported by representatives, i.e. ‘the chain representatives’. This group consisted of 14 farm advisors, 19 food processors, three retailers and three NGO representatives (two consumer and one agriculture oriented). The representatives were selected based on (1) their practical expertise and experience, (2) their involvement and engagement and (3) their position and influence in the agri-food system. Through thematic focus groups, the main purpose of this group was validating the output and increasing the support base of the results.

The fifth and last group of stakeholders is ‘the reference group’, a large diverse group of 30 stakeholders from industry, policy and NGOs: five farmers, five food processors, five input suppliers, five retailers, five NGOs and five policy actors were involved. The reference group is composed based on a widespread personal invitation of the key chain delegates to practitioners for a first workshop. Moreover, the following workshops were based on the participants of the first workshop. Through interactive workshops, they shared their insights and practical expertise.

The interaction process consisted of five iterative phases: (1) description of the present sustainability state of the agri-food system, (2) sustainability visioning, (3) identification of sustainability initiatives, (4) formulation of shared transformation pathways, and (5) development of a strategic action plan. The role of practitioners was twofold. In the first three phases, stakeholders fulfilled the role of local experts to give unique insights based on their experience. In phase 4 and 5,

**Table 1** Realization of design principles for transdisciplinary research (Lang et al. 2012) in the assessed transdisciplinary project

Design principles	Realization transdisciplinary approach
<b>PHASE A: Design principles for collaborative problem framing and building a collaborative research team</b>	
A.1 Build a collaborative research team	A collaborative team involving researchers and practitioners. A majority of the researchers and practitioners had previous experience with collaboration between academic and societal actors in projects related to a sustainable transformation
A.2 Create joint understanding and definition of the sustainability problem to be addressed	Strong focus on joint problem definition and description with all involved actors: 'Although the Flemish agri-food system is a highly productive and intensified production system which is demand driven and provides sufficient qualitative food products, it faces persistent sustainability challenges. Short-term solutions or technical innovations do not sufficiently address these challenges. Moreover, a long-term vision and strategies across the whole supply chain are lacking'
A.3 Collaboratively define the boundary/research object, research objectives as well as specific research questions and success criteria	All stakeholders agreed upon the research objective and specific research questions. Research objective: 'To realize an effective transformation towards a sustainable agri-food system'. Effective is defined as systemic changes within the agri-food system regarding ecological, economic, social or cultural aspects' Specific research questions regarding the research objective and focusing on practice and science Where do we stand today? System analysis of sustainability state of agri-food system -> Development of conceptual framework to assess sustainability state Where do we want to go? Development of a shared long-term vision How do we want to achieve that? Identification of shared transformation pathways -> Development of new agri-food sustainability systems approach How shall we achieve it? Development of a strategic action plan -> Development of monitoring instrument at chain level What can we learn from best practices? Set-up of sustainability experiments in practice -> Identification of success factors of collaboration
A.4 Design a methodological framework for collaborative knowledge production and integration	Research questions guide methodological framework development. Collaboration during the whole process and adaptation of the methodological framework to observed needs. Moreover, framework is holistic and iterative
<b>PHASE B: Design principles for co-creation of solution-oriented and transferable knowledge through collaborative research</b>	
B.1 Assign and support appropriate roles for participants	Involving of different stakeholder groups with each group having a specific composition, role, interaction and degree of involvement (further elaborated in 3.2.)
B.2 Apply and adjust integrative research methods and transdisciplinary settings for knowledge co-creation	The process, methods and tools are designed and selected by a group of four researchers (research triangulation). Furthermore, an interdisciplinary academic advisory group of three academics validates the process and results
<b>PHASE C: Design principles for (re-)integrating and applying the created knowledge</b>	
C.1 Realize two-dimensional (re-)integration	A strong link between research questions and output based on integrative systems approach is attained: e.g. a strategic action plan is implemented into practice and new developed frameworks are integrated into scientific body of knowledge
C.2 Generate targeted "products" for both parties	For practitioners: report and communication on sustainability system state, strategic action plan and follow-up of four sustainability experiments in practice For researchers: various scientific publications: A1 scientific publication development new agri-food sustainability approach; A1 scientific publication success factors of collaboration of sustainability experiments, scientific communication at conferences
C.3 Evaluate societal and scientific impact	Three observed impacts: initiation of new sustainability experiments, inclusion of strategic action plan in policy measures and use of conceptual framework in other projects

**Table 1** (continued)

Design principles	Realization transdisciplinary approach
General design principles	
G.1 Facilitate continuous formative evaluation	Continuous reflexive evaluations and adjustments of process with both academic and societal actors, and with the academic advisory group
G.2 Mitigate conflict constellations	Within the collaborative research team of academic and societal actors, no conflicts occurred as all participants agreed on the joint problem definition and relevance. However, possible sources of conflicts were present but were tackled by finding compromises concerning the formulation of actions to ensure all actors could agree upon the results. During process, various discussions were held to continuously re-affirm the common language and understandings
G.3 Enhance capabilities for and interest in participation	Facilitation of interaction moments, monitoring frequency of interaction and regular updates through blog posts

stakeholders took the role of representatives for a certain segment and helped to identify the political issues (Hermans et al. 2011).

The first phase resulted in the description of the current sustainability state of the agri-food system. The output of this phase, a system description, can serve as a sustainability benchmark (Hubeau et al. 2015b). All five groups co-created knowledge during interviews, different workshops and discussion groups facilitated by the researchers.

During the second phase, a shared long-term sustainability vision, already formulated in the previous initiative (*The New Food Frontier*) (TNFF 2013; Crivits et al. 2017), was reaffirmed during a discussion group facilitated by the researchers. Deliberative sessions and image forming helped to formulate the sustainability vision (Table 2).

In the third phase, all possible initiatives that could contribute towards a sustainability transformation were listed. These initiatives are both technological (e.g. vertical agriculture) and market innovations (e.g. CSA). Hereby, even

conflicting initiatives, such as ‘Thursday veggie day’ or ‘Fresh meat from Belgium’ are included (Hubeau et al. 2017). The initiatives overview was collected during thematic focus group and from a literature review.

During the fourth phase, seven shared transformation pathways with a mid-term focus (10 years) were formulated (Table 3). An iterative process continued until consensus was reached. First, the researchers categorized the sustainability initiatives into transformation pathways. Second, during the workshops, the reference group discussed and re-formulated every transformation pathway. Thereafter, during focus groups, the chain representatives re-adjusted the formulation of the pathways which finally the key chain delegates approved during a discussion group.

The fifth and final phase was designed like phase four and consisted of the development of a strategic action plan. The strategic action plan consists of 10 strategies, 29 sub-strategies and 53 actions which should be initiated or completed within 5 years (Hubeau et al. 2015a).

**Table 2** Shared vision of Flemish agri-food system (Hubeau et al. 2017)

A sustainable agri-food system...
Is resilient, dynamic and focused on the long term
Is a forerunner regarding diversity
Allows to innovate and undertake businesses
Consists of clearly defined components characterized by partnerships with respectful and transparent relationships
Ensures access to adequate nutrition allowing a healthy life
Is internationally fair
Is efficient, not harmful to society and environment and considerate regarding the use of resources
Provides an ecological, economic, cultural and social (ethical) value, is economically viable for all system actors, partly by applying a correct price
Gives meaning to food
Exists for consumers who choose a healthy lifestyle



**Table 3** Seven shared transformation pathways (Hubeau et al. 2017)

1. Stimulate experiments on radical innovations
2. Incremental innovations to increase efficiency and resilience of the agri-food system
3. The maximal closing of mineral cycles
4. Reduce the use of scarce resources and increase the use of renewable resources
5. Establish equitable relationships by knowledge and information exchange and increased transparency
6. Stimulate the co-creation of knowledge regarding sustainability practices in the agri-food system
7. Increase community involvement and social well-being

## Assessment method

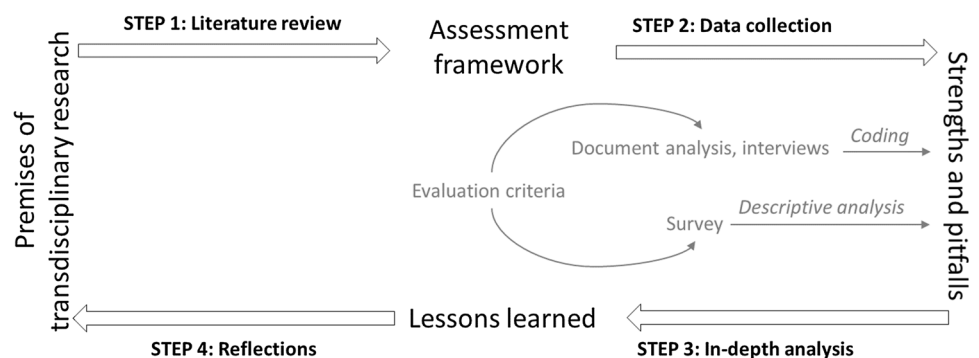
Transdisciplinary research combines quantifiable output and qualitative outcomes. Project evaluations focusing solely on output, instead of context, process and outcomes, are insufficient for monitoring and assessing a transdisciplinary approach (Roux et al. 2010). We chose to perform case study research (Yin 2003) of one case to explore and deeply reflect upon its pitfalls and strengths and to assess whether and how the approach can fulfil the three general premises of transdisciplinary research. We followed a four-step methodology (Fig. 1) to assess and critically reflect upon the transdisciplinary project within a regional initiative.

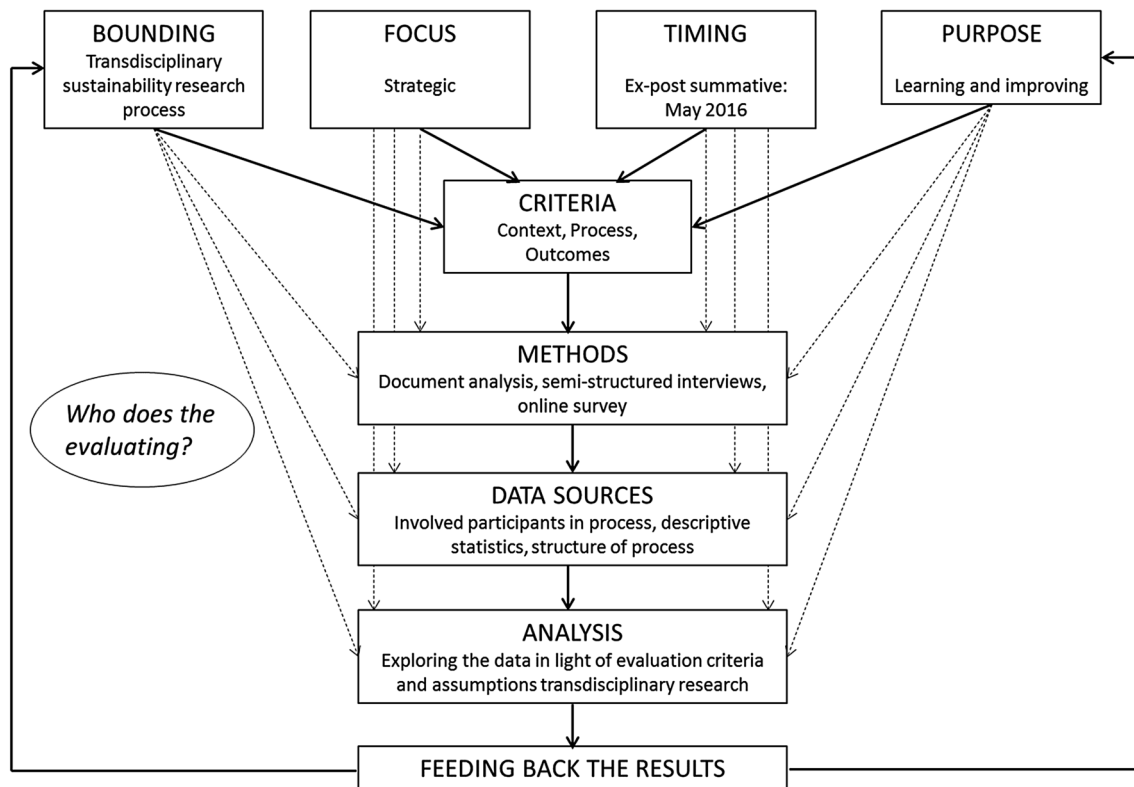
The first step was a literature review to select an assessment framework based on four selection criteria: (1) to evaluate a whole approach (i.e. context, process and outcomes), (2) to allow a mixed method design and ex-post evaluation, (3) to focus on collaborative practices and co-creation of knowledge and (4) to allow self-reflection. Different conceptual frameworks to evaluate transdisciplinary approaches (e.g. Burgess and Chilvers 2006; Blackstock et al. 2007; Walter et al. 2007; Hegger et al. 2012; Wiek et al. 2014) were compared based on their goal, focus and description of evaluation criteria. The framework of Burgess and Chilvers (2006) allows to evaluate context, process and outcomes. However, their focus is rather narrow and considers a process as a series of inputs, outputs and outcomes and is applied in a solely qualitative approach. Other frameworks are more process oriented; they either analyse the knowledge

production process based on credibility, salience and legitimacy (Hegger et al. 2012) or measure the societal effects of a transdisciplinary process (outcome oriented; Walter et al. 2007; Wiek et al. 2014). We selected the framework of Blackstock et al. (2007) as it met all aforementioned selection criteria. Also, previous empirical research proved the applicability of the framework in sustainability processes (e.g. Blackstock et al. 2007; Kelly et al. 2007; Triste et al. 2014).

Figure 2 illustrates the structure of the framework of Blackstock et al. (2007) adapted to our assessment. The specific object of the assessment is described by bounding, focus, timing and purpose. Bounding delineates the objective of the evaluation itself. Our objective is to reflect upon a transdisciplinary project by evaluating its context, process and outcomes. The context specifies the socioeconomic, cultural, institutional and historical setting that helps to understand the environment of the project. Process represents the transdisciplinary design and the involved stakeholders and outcomes refers to the learning and stakeholder relations (Hermans et al. 2011). The output, i.e. the effectiveness and impact of the tangible products such as strategic action plan were not evaluated as our aim is to identify its strengths and pitfalls. The focus of our assessment is strategic; i.e. we investigated whether the approach could meet the general premises of transdisciplinary research. The purpose of the assessment is to learn and improve, i.e. to reflect upon the capacities and learning effects of the participants and improve the transdisciplinary project.

**Fig. 1** Four step assessment





**Fig. 2** Assessment framework, based on Blackstock et al. (2007)

The framework continues with the selection of evaluation criteria and the choice of a methodology to gather and analyse data (Blackstock et al. 2007). Because of the subjective nature of assessing transdisciplinary approaches, the selection and operationalization of evaluation criteria is one of the main challenges (Blackstock et al. 2007). Based on a literature review (Brinkerhoff 2002; Schulz et al. 2003; Grant and Curtis 2004; Burgess and Chilvers 2006; Blackstock et al. 2007; Kelly et al. 2007; Neef and Neubert 2010; Hermans et al. 2011; Wiek et al. 2014; Triste et al. 2014; Luederitz et al. 2016b), we drafted a list of evaluation criteria. Thereafter, we performed semi-structured interviews which allowed (1) new evaluation criteria to arise, such as splitting communication into internal and external communication, (2) to eliminate certain criteria, such as the removal of evaluation criteria cost effectiveness, (3) to categorize evaluation criteria under context, process and outcomes, for instance, the capacity to participate could be categorized under process or outcomes. In our case, stakeholders perceived it as part of the process, as the change in capacity to participate occurred during and influenced the process and (4) to group certain criteria which are interdependent, such as leadership which was highly interdependent with institutional context in our case. Table 4 presents the final list of evaluation criteria, their description, assessment

feature, data collection methods and the conceptualization of the normative (P1), cognitive (P2) and instrumental (P3) premises of transdisciplinary research. The most frequent data source is the stakeholders' perspective. For instance, the evaluation criteria 'recognized impact' is assessed based on how the participants perceived change to undertake new actions in practice and their perceptions attributed to the process. The use of stakeholders' perspectives can stimulate (self-)reflection and include their opinions and views.

In step two, data gathering occurred through documents (e.g. meeting reports, progress reports and policy reports), semi-structured interviews and an online survey. Nine semi-structured interviews were carried out after the finalization of the strategic action plan (June–September 2015) with stakeholders of the agri-food system that were involved during the whole process (one policymaker, one NGO and seven representatives of the industry, including two from agriculture, two from industry, one input supplier and one retail representative). The interviews covered four themes: (1) nature of involvement, (2) perceived impact on themselves and other stakeholders, (3) perceived impact of process and outcomes and (4) strengths, pitfalls, opportunities and challenges of the approach. All interviews and documents were transcribed, coded and analysed using NVIVO 11 based on the evaluation criteria. The online survey was based on

**Table 4** List of evaluation criteria, their description, assessment features, data collection and premises of transdisciplinary research (SP: stakeholders' perspective)

Evaluation criteria	Description (based on Blackstock et al. 2007; Walter et al. 2007; Wiek et al. 2014)	Assessment feature	Data collection methods					Pre-mises
			Interviews	Reports	Meeting minutes	Structure analysis	Survey	
<b>Context</b>								
Institutional context	The structure in which participants collaborate in accordance to their role and formal and informal rules of the game	Organizational structure Governance	X	X		X		P3
Leadership	Leadership explicates the role of stakeholders	Stakeholder analysis, stakeholders' perspective (SP)	X			X		P2–P3
Historical context	The attitudes, perceptions and relationships that exist at the start of the process based on previous events and activities	Stakeholders' attitude Previous relationships	X	X				P3
<b>Process</b>								
Conflict resolution	Solution of conflict between participants and number of conflicts that occurred due to diversity of views	No. of conflicts Cause of conflicts	X		X			P1–P2
Representation	The diversity of views of actors	SP	X		X		X	P1
Legitimacy	Perceived legitimacy, i.e. are outcomes perceived as valid?	SP	X		X		X	P3
Capacity to participate	The stakeholder skills 'valuing different points of view' and 'willingness to learn'	SP	X		X		X	P1
Internal communication	Frequency and quality of flow of information	Frequency; SP	X	X		X	X	P2
Capacity to influence	How the stakeholders influence the output and outcomes of the process	SP	X	X		X	X	P1–P3
Transparency	Actors understand the reasoning behind decision making	Information sharing; SP	X	X		X	X	P1–P2
External communication	Frequency and quality of information brought to the outside world and degree to which the output is widely supported by the wider society	Frequency; news feeds; SP	X				X	P3
<b>Outcomes</b>								
Capacity building	Improvement of skills and relationships for participating in future processes	SP	X				X	P1



**Table 4** (continued)

Evaluation criteria	Description (based on Blackstock et al. 2007; Walter et al. 2007; Wiek et al. 2014)	Assessment feature	Data collection methods					Pre-mises
			Interviews	Reports	Meeting minutes	Structure analysis	Survey	
Recognized impact	Changes in stakeholder perceptions attributed to the process	SP	X				X	P1–P2
Individual and transformative learning	How collaboration changed a stakeholders' perspective, attitude, vision and behaviour or future actions	SP	X				X	P3
Relationships	Change in social capital due to new social networks and collaboration	SP	X				X	P1

the evaluation criteria and consisted of five parts: (1) biographical information, (2) perceived impact on participant, (3) mutual learning process (e.g. relationships with other participants, collaboration), (4) perceived impact of process and outcomes (e.g. perceived implementation, actions) and (5) strengths, pitfalls, challenges and opportunities of the approach. The survey was sent one year after the finalization of the strategic action plan (May 2016) to all participants that participated in at least one project activity ( $n = 58$ ). A certain time lag is recommended, as the time span should be long enough to allow effects to arise, but short enough for stakeholders to remember the most important facts and their involvement (Walter et al. 2007). One year after date excludes an overoptimistic view immediately after the process and includes possible impacts and outcomes of the process. In total, 35 stakeholders completed the survey, representing a response rate of 60%. Although the sample size may seem rather small for conducting quantitative analysis, the response rate is high. Furthermore, the aim of this quantification is to further illustrate and support the qualitative

findings or to observe contradictory findings. Table 5 represents the empirical basis of the respondents of the online survey analysed with descriptive statistics.

In step 3, the in-depth analysis included categorization of concepts and codes of the semi-structured interviews, linking them to the evaluation criteria and grouping of the strengths and pitfalls which revealed lessons learned. Based on these results, the fourth and last step reflects how the transdisciplinary project fulfills the three general premises of transdisciplinary research.

The combination of these various data sources and methods allows data and research triangulation (Golafshani 2003; Koro-Ljungberg 2008). For instance, triangulation was ensured using data from survey, semi-structured interviews, reports and literature to analyse the evaluation criteria or combining qualitative and quantitative research methods and comparing their results. Research triangulation was done as the authors represent three scientists who were involved in the process and two who were partly involved in the investigated transdisciplinary project. Three scientists

**Table 5** Empirical basis of the survey

Topic	Category	Rate; $n = 35$	Topic	Category	Rate; $n = 35$	Topic	Category	Rate; $n = 35$
Sex	Female	15	Sector	Input supplier	3	Stakeholder group	Research team	4
	Male	20		Agriculture	6		chain representatives	9
Age of participants (years)	21–30	5	Food industry	5	Key chain delegates		8	
	31–40	8	Retail	4	Reference group		11	
	41–50	10	Civil society	7	Academic advisory		3	
	51–60	12	Research	7				
			Government	3				

fulfilled all the roles of process facilitator, (self-)reflexive scientist and intermediary. Although this can cause friction between the different roles, it is common in action research (Wittmayer and Schöpke 2014). Regular reflection moments between the researchers, and consultation of the academic advisory committee were installed to tackle this friction. Furthermore, self-reflection allows to re-adjust goals and processes by inviting multiple interpretations (Wittmayer and Schöpke 2014).

## Results

Results are described qualitatively for the context, process and outcomes, using the evaluation criteria in Table 4. Where relevant, we add numbers from the survey. Strengths and pitfalls are indicated with (+) and (–) respectively. All these strengths and pitfalls are summarized in Table 6 to derive the main lessons learned for transdisciplinary research linked to our observations.

## Context

In our case, a well-structured institutional context with a clear distinction between the roles of the five different groups of stakeholders existed, i.e. each group knew their specific role (+). Within the key chain delegates, two informal coordinators or ‘visioning leaders’ stood up. They played an important role to create an open atmosphere for discussion and to motivate and convince other stakeholders to participate (+). A downside was that they had a strong influence on the outcomes and the decision-making process (–). Throughout the process, the institutional context of the process was flexible and adaptable (+). For instance, the group of chain representatives was created after reflection, as the key chain delegates expressed a need for broader support and wished to stimulate its dispersion. Also the facilitators observed a need to collect input from more stakeholders than initially planned, mainly to validate the input of the reference group. Their involvement in the process increased the chain representatives’ motivation and the range of stakeholders (+).

During the process, the actors of the NGOs collectively distanced themselves from the initiative before the release of the strategic action plan. The most important reason is the historical context and strategic purposes, i.e. a previous 2-year initiative (*The New Food Frontier*) ended with a motion of distrust by the agri-food industry actors. Although the facilitators tried to find a solution, no reconciliation was possible as the differences in vision between the collective of NGOs and the other members of the key chain delegates were insurmountable (–). Strategic purposes arose as some NGOs stated that further participation in the initiative

would decrease their legitimacy. Cooperation with the current regime actors could reduce their credibility as social movement campaigning for radical transitions. However, other NGOs recognized the efforts of the industry actors and agreed to be consulted ad hoc. The specific effects of this exit of the NGOs are described in detail below.

## Process

During the process, multiple discussions or small conflicts arose and were solved by the mutual respect between stakeholders and an open atmosphere (+) (conflict resolution). However, as already mentioned above, one conflict was unresolvable. The exit of the NGOs affected representation and legitimacy. In the beginning of the process, stakeholders represented three discourses of the Flemish agri-food system (+), namely ecological modernization that focuses on a highly technological and eco-efficient agri-food system, a de-commodification discourse that aims to reintroduce the value of labor and new consumer–producer relationships, and a sufficiency discourse that addresses ecological boundaries as a stimulus to initiate new socio-cultural and socioeconomic relation (Crivits et al. 2010, 2017). Moreover, stakeholders were selected based on a wide representation of different discourses (+). After the exit of the NGOs, however, the representation was affected which reduced the overall legitimacy (–). Apart from this incident, participants felt power asymmetries within the reference group and throughout the process of decision making, balanced in favour of the informal coordinators who represented the ecological modernization discourse and key chain delegates (–). Furthermore, during the workshops within the reference group, stakeholders felt a divergence between stakeholders, i.e. professional lobbyist (e.g. NGOs) were stronger in formulating their opinion and representing their views in comparison to practitioners such as farmers or food manufacturers (–). However, many stakeholders perceived that alternation between mixed workshops and separate focus groups was able to tackle this power asymmetry to some extent (+). The introduction of thematic focus groups with more homogenous stakeholders (e.g. farmers and NGOs separately) allowed practitioners to express their opinions in a more familiar environment (+).

Stakeholders recognized the different viewpoints and considered this diversity as an added value of the process (+) (capacity to participate). Furthermore, stakeholders stated that collaboration with other sectors broadened their view on sustainability, as they now recognized that every group of actors has its specific sustainability challenges. As such, the interaction between sectors was one of the major benefits. The latter was confirmed by the survey in which 57% (20 participants) indicated “networking with participants of other sectors” as the most positive outcome of the process

**Table 6** Summary with lessons learned, corresponding strengths and pitfalls, concepts and evaluation criteria

Lessons learned for transdisciplinary research	Strengths (+) and pitfalls (–)	Observations	Evaluation criteria
1. Identify formal coordinator(s) with explicit role	+ Role of coordinator to motivate support base – High control of coordinators – Large influence of informal coordinators and key chain delegates	Two actors take the role of coordinators Two informal coordinators Asymmetry of authorization between groups	Context Institutional context, leadership Process Conflict resolution, representation, legitimacy
2. Engage competent facilitators to guide process	+ Competent facilitators to co-create knowledge + Create open atmosphere	Research institute as process facilitator Mutual respect between stakeholders	Context Institutional context Outcomes Relationships
3. Engage critical outsiders to validate results and process	+ Presence of independent validation	Academic advisory as critical outsider	Context Institutional context
4. Focus on multi-stakeholder selection	+ Presence of different views + Broad support base for output + Multiple views are added value + Well-thought stakeholder selection – Selection of stakeholders with different communication skills + Select wide range of actors – Choose stakeholders willing to learn and accept differences + Well-considered stakeholder selection	Different stakeholder groups involved Alternation between participatory methods Diversity of perspectives and visions are present Diversity of perspectives and visions are present Divergence between discussion capacities actors Networking with actors of other sectors Wide range of attitudes Long-term relationship and increased trust	Context Institutional context Context Institutional context Process: representation + Legitimacy Process: representation + Legitimacy Process: representation + Legitimacy Process Capacity to participate Outcomes Learning Outcomes Relationships
5. Enable adaptive project planning	+ Possibility to adapt process + Occasion to tackle power dynamics + Different types of participation level + Discussion improves knowledge exchange + Create open atmosphere to co-create knowledge	Different stakeholder groups Alternation between participatory methods Multi-stakeholder process with various groups Knowledge generation and exchange Enhanced learning process	Context Institutional context Context Institutional context Process: conflict resolution + representation Process Capacity to participate Outcomes: learning
6. Take historical context into account	– Lack of new means to resolve conflicts	Exit of NGOs in final phase	Context: historical context + Conflict resolution
7. Communicate in a transparent and frequent way	+ Regular information exchange + Take stakeholders input into account	Flow of information on a regular basis Stakeholders' opinions influenced results	Process Internal communication + Transparency Process Capacity to influence
8. Document decision making	– Lack of transparency of reasoning in decision making	Reasoning behind data processing is insufficient	Process Internal communication + Transparency
9. Motivate stakeholders by 'What's in it for me?'	– Motivate broad support base	Communication to wider support base insufficient	Process: external communication
10. Increase capacity building of stakeholders	+ Improved confidence and persuasiveness of stakeholders + Stakeholders are willing to learn from each other	Improved capacity to engage in other processes Change in vision to transform agri-food system	Outcomes Capacity building Outcomes Recognized impact

**Table 6** (continued)

Lessons learned for transdisciplinary research	Strengths (+) and pitfalls (–)	Observations	Evaluation criteria
11. Involve multiple stakeholders to increase implementation	+ Change in actions through involvement + Motivation to change actions	Change in professional or personal actions Willingness to take actions	Outcomes Recognized impact Outcomes: learning
12. Increase impact of results into practice	+ Perceived impact into practice	Observed impact on transformation	Outcomes Recognized impact

and 69% (24 participants) specified “knowledge exchange between participants of other sectors” as the most common type of interactions. Next to the positive outcomes, also points of improvements were assessed. A quarter of the participants (26%; 9 participants) perceived no improvements regarding the process. Seven participants (20%) would increase the focus on action into practice and six participants (17%) formulated improvements of the interaction methods, such as smaller discussion groups or less time-consuming meetings.

The internal communication was mainly the responsibility of the facilitators. The information flow and feedback of the participatory meetings occurred on a regular basis through reports and were evaluated as adequate (+). Moreover, participants felt they could express their opinion, were heard and different views were welcomed (+) (capacity to influence). However, a lack of transparency between the workshops and final results are perceived; stakeholders mentioned that the reasoning behind the processing of their input and the decision making was insufficient (–).

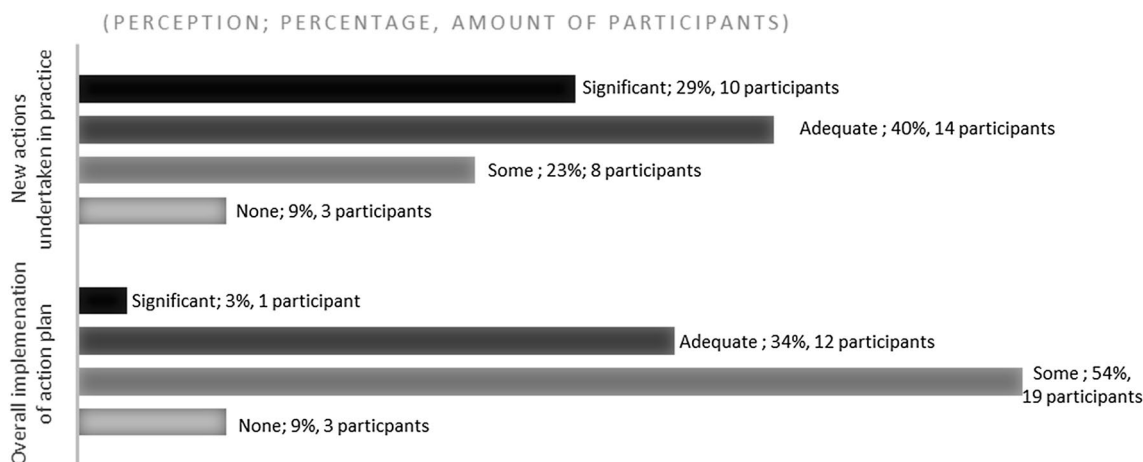
In contrast to the internal communication, the external communication was mainly inadequate. Insufficient communication to a wider support base occurred (–). Although a website with regular updates through blog posts existed, too few outside actors found their way to the information.

The website contained short articles, interviews, videos etc. The support base was not encouraged; sustainability is often seen as a threat, and the ‘what’s in it for me’-question was not communicated clearly (–). A tight budget and time constraints were important hindering factors.

### Outcomes

In general, most participants (> 90%, 32 participants) stated at least ‘some change’ in their capacity to engage in future processes and only three participants experienced no change (+) (capacity building). More specifically, participants expressed an improved confidence and stronger persuasiveness (+). Additionally, the recognized impact is analysed based on the perceptions to undertake new actions and to implement the strategic action plan in practice (Fig. 3). One year after the process, > 90% (32 participants) stated that they took at least some new actions based on the strategic action plan. The same amount of participants perceived that the action plan was implemented within the agri-food chain to some extent, as they have observed some changes in organizational or cultural practices.

Individual learning reflects the generation of knowledge through individual reflection while participating in a social process and the elaboration of individual experience in light



**Fig. 3** Perceived impact of outcomes, i.e. How many new actions did you undertake in practice as a result of your participation?, and the perceived implementation, i.e. To what extent is the action plan implemented into practice?

of exchanges with others. Most participants (77%; 27 participants) expressed at least ‘adequate learning’. More specifically, 17% (6 participants) experienced some learning, 23% (8 participants) adequate learning, 49% (17 participants) a lot of learning, 6% (2 participants) extensive learning and only 6% (2 participants) no learning. Moreover, participants perceived a significant increase in their knowledge about the topic ‘transformation of the agri-food system towards sustainability’ ( $p < 0.001$ , Wilcoxon signed rank test) which can indicate a learning effect throughout the process (+).

In addition, stakeholders understand their own and others’ interests, values and beliefs (transformative learning). In Fig. 4, the perceived change (neither positive nor negative) in their sustainability vision and everyday personal and professional actions is represented. A large majority (86%) specified that their vision regarding the transformation of the agri-food system has changed (+). Moreover, an open attitude has a positively influence. In our case, participants recalled their attitude at the beginning of the process. Initially, 11% (4 participants) had a critical attitude, 11% (4 participants) neutral-critical, 6% (2 participants) neutral, 46% (16 participants) neutral-positive, and only 26% (13 participants) positive open-minded. As most of the participants had been involved in the initiative ‘The New Food Frontier’, they were likely to be more cautious and critical this time around. After the process, 20% (7 participants) became more critical and 34% (12 participants) became more positive. In general, a strong mutual respect between the participants was observed and the participants evaluated their diversity as an added value (+).

Although most of the stakeholders (> 50%) already knew each other before the process, and less than 10% did not know any other participant, stakeholders expressed an increased trust and an increased willingness to collaborate (+) (relationships).

## Discussion

In this section, we reflect on the results linked to the three premises. Second, we identify three critical factors based on the lessons learned that can either benefit or impede future transdisciplinary approaches. Finally, we discuss the used methodology and give some recommendations for future research.

### Premises of transdisciplinary research

The first premise states that including different visions and perceptions of stakeholders creates better solutions for complex problems, i.e. they should have a voice in the transformation of the agri-food system. Furthermore, it could empower the stakeholders and improve their decision-making capacities. Stakeholder empowerment and continuous participation is often one of the main difficulties of transdisciplinary research (e.g. Lang et al. 2012; Brandt et al. 2013). Overall, in our case study, stakeholders perceived this premise as fulfilled, i.e. they were more active and empowered throughout the process as they perceived that their capacity to influence increased and that their input was valued. They reported a change in their actions, capacity building and improved learning concerning the topic of transformation of the agri-food system.

The second premise states that the co-creation of knowledge between researchers and practitioners allows to grasp the complexity and to analyse the sustainability problem. In our case study, knowledge exchange was clearly present and even evaluated as the most positive outcomes. This confirms other studies where successful integration of knowledge was noted as an advantage of transdisciplinary research (Vandermeulen and Van Huylenbroeck 2008; Reed 2008).

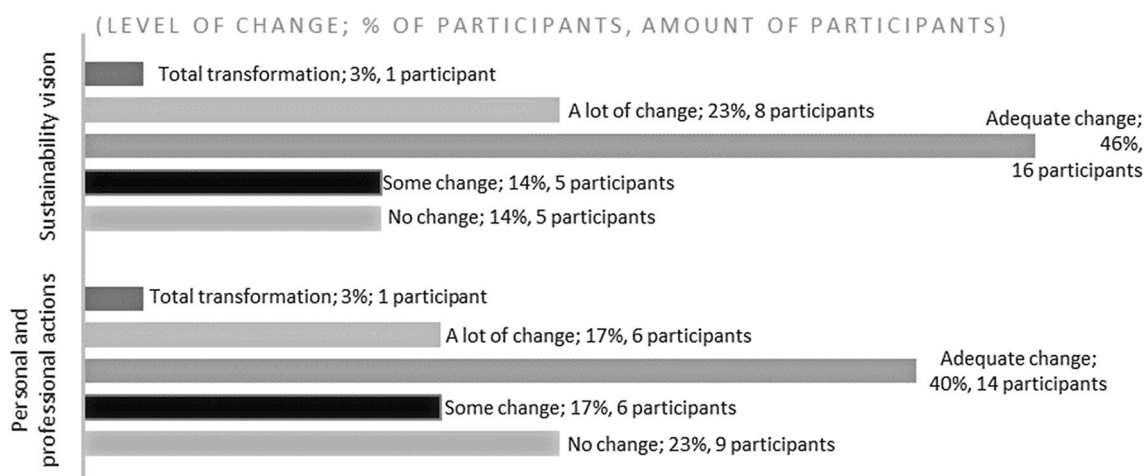


Fig. 4 Perceived change of their sustainability vision and action related to their participation

Moreover, stakeholders indicated a change in their sustainability vision based on insights of chain-wide sustainability issues and the presence of different perceptions. The latter were incorporated and integrated into tangible outputs, such as the strategic action plan.

The last premise states that a mutual learning process between researchers and practitioners stimulates the implementation in practice, which could increase the legitimacy and overcome the knowledge–action gap. In our case, a mutual learning process did occur. Knowledge exchange was positively evaluated and stakeholders stated that the interaction and discussions with other stakeholders broadened their view. As a result, collaborations arose and continue until today; such collaboration could indicate an impact and implementation of the process. However, as also suggested by Walter et al. (2007), future evaluation should be repeated to measure the longer term outcomes as our case study was not designed to evaluate the practical impact of the initiative in the transformation of the Flemish agri-food system towards sustainability. Additionally, a possible risk of transdisciplinary research could be that the co-creation of sustainability solutions could lead to less sustainable solutions due to the attraction of easy, short-term solutions which are not the most sustainable and innovative solutions (Roux et al. 2017). However, in our opinion, this risk could be tackled, at least partly, by collaborating and creating a mutual learning process. For instance, in our case, a shared vision is identified at long term (> 20 years), shared transformation pathways are identified at midterm (> 10 years) and a more practice-oriented strategic action plan is developed at short term (> 5 years).

### Critical factors for future transdisciplinary approaches

Overall, in our opinion, our transdisciplinary project was, at least to a certain extent, able to meet the premises of transdisciplinary research. However, based on our insights, the lessons learned and confirmation from the transdisciplinary literature, we identify three critical factors that can be taken into account to design future transdisciplinary approaches.

#### Context matters

Transdisciplinary research in sustainability science needs to incorporate the institutional, political and social context (Hadorn et al. 2008; Roux et al. 2010; Blackstock et al. 2012; Lang et al. 2012; Leventon et al. 2016). In addition, the historical context of previous collaborations and individual experiences should also be considered (lesson 6, Table 6), which is also highlighted by a few researchers (Grant and Curtis 2004; Roux et al. 2017). In our case study, the previous initiatives had both positive and negative consequences.

First, the shared vision had already been developed in a previous trajectory, *The New Food Frontier*. This made it possible to take the next step and develop shared transformation pathways. However, strategic purposes and the rather critical attitude of some participants could be traced back to previous trajectories and interactions. One can take institutional, political, social and historical context into account (Schulz et al. 2003; Reed 2008; Reed et al. 2009; Luyet et al. 2012) by selecting an appropriate and representative stakeholder group (lesson 4, Table 6) with stakeholders willing to learn and become involved in a mutual learning process (as required by Luyet et al. 2012; Mobjörk 2010). One of the main risks of stakeholder selection is the bias of self-selection, as educated participants have easier access to information in comparison to those with a disadvantaged background (Buttel 1985; Roux et al. 2017). Stakeholder analysis or actor analysis are helpful methods for identifying and selecting relevant actors (Hermans et al. 2011; Lang et al. 2012) taking into account stakeholders' representation, legitimacy and knowledge (Reed 2008).

#### Institutionalize and formalize a transdisciplinary process

Lang et al. (2012) identified challenges to design a transdisciplinary approach according to the design principles in sustainability science. Some of the main challenges are discontinuous participation, vagueness and ambiguity of results. A possible measure to address these challenges is the institutionalization and formalization of a transdisciplinary process which implies three features, (1) explicit roles, (2) explicit documentation of decision making and transparent communication, and (3) realistic stakeholder expectations. In our case, some stakeholders perceived the control of informal coordinators as disturbing. A transparent role division and task description could have helped to overcome such frustrations and misunderstandings (Lesson 1, Table 6). The various role of stakeholders and stakeholder groups should have been more explicitly and formally described (lesson 3, Table 6), which is also advised by other researchers (Reed et al. 2013; Triste et al. 2014). Second, explicit documentation of decision making and transparent communication are required to increase the transparency and stakeholder motivation (lessons 7 and 8, Table 6). Our results also show that stakeholders often missed the reasoning behind the processing of their input and lacked a transparent decision-making process. The external facilitators failed to clearly relate the tangible experience-based examples of the stakeholders to the issues at stake (lesson 2, Table 6), which is also highlighted as a challenge for researchers in transdisciplinary research (Pohl et al. 2010; Wiek et al. 2014).

Communication was essential for the whole process, confirming other research findings (Wickson et al. 2006; Carew and Wickson 2010; Binder et al. 2015). In our case,



communication between the key chain delegates was successful: regular meetings were held and frequent communication through e-mail and telephone occurred. However, a time lag of 6 months existed between workshops. Although reports were sent between workshops, together with ‘save the date’ e-mails and intermediate results, stakeholders stated that their motivation decreased slightly during these periods and more direct communication such as person-to-group communication could have been helpful (lesson 9, Table 6). As other researchers highlight (Wickson et al. 2006; Wittmayer and Schöpke 2014; Binder et al. 2015), communication should be planned. In our case, although an external communication firm was involved, the communication was limited for financial reasons. However, external communication is important to increase the impact into practice (lesson 12, Table 6). Last, the stakeholders’ expectations should be realistic within the scope of an initiative. Therefore, at the initial phase, the goal and the boundaries should be delineated with all groups of stakeholders (instead of solely the core team) to create realistic expectations and avoid the misunderstanding and frustrations (Reed 2008; Lang et al. 2012; Luyet et al. 2012; Wiek et al. 2012). Moreover, Lang et al. (2012) also identified the lack of insufficient problem framing and insufficient legitimacy of the actors as main challenges of joint problem framing and team building. In our case study, we involved stakeholders from the initial phase to identify a common understanding of the sustainability challenge at stake (lesson 11, Table 6). Despite the presence of various, possibly conflicting visions and epistemologies, the focus was on identifying shared transformation pathways. During the process, win–win situations were searched to answer the question ‘What’s in it for me?’ by actively involving the stakeholders (lesson 10, Table 6), as proposed by Hegger et al. (2012).

### Develop an adaptive, flexible and iterative process design

The last critical factor which could help to design future transdisciplinary processes is the design of an adaptive, flexible and iterative process. A flexible process design refers to the adjustment of the process based on momentary observations (Lesson 5, Table 6). More specifically, the process should be open to change and flexible in time with multiple feedback loops which is also observed by other researchers (Walter et al. 2007; Giest and Howlett 2014; Hurlbert and Gupta 2015; Porter et al. 2015). Additionally, an adaptive process design refers to the focus on learning by doing and doing by learning which is also acknowledged in transition management (e.g. Rotmans 2003; Scholz et al. 2006; Rotmans and Loorbach 2008) and transdisciplinary approaches (e.g. Pohl et al. 2010; Lang et al. 2012; Triste et al. 2014). An iterative process refers to returning to problem framing

and readjusting or reaffirming some key concept meanings as these can be frequently questioned.

### Epistemological reflections

We used Blackstock et al. (2007) as assessment framework which allowed to structure our assessment. The framework helped to choose appropriate methods to gather and analyse data and to select the evaluation criteria. We did notice that the criteria accountability, authority, politics and power were indirectly present. For instance, a discrepancy between professional (e.g. lobbyist) and non-professional discussants (e.g. farmers) was observed. The facilitators addressed this challenge by organizing alternating workshops with all stakeholders together and focus groups with stakeholders separately. Alternating the participatory methods was evaluated as positive by the stakeholders but increased the transparency challenges mentioned above. Therefore, future research could more explicitly explore the role of these criteria.

Additionally, the researchers had a diversity of roles, which is often the case in transdisciplinary research (Wittmayer and Schöpke 2014). The research team was part of the key chain delegates, who owned the results of the transdisciplinary project and had a final say in the publication of the strategic action plan. As most authors were involved in the transdisciplinary project, our assessment is based on input of most of the participating stakeholders (60%, which is a high response rate). Moreover, the data was validated using various forms of data collection.

As this initiative was owned and initiated by the industry instead of researchers solely, this case study made it a good test of whether a regional transdisciplinary project can meet the general premises of transdisciplinary research in sustainability science. Although our insights are based on empirical findings of only one implemented case in combination with existing literature, which is often done in transdisciplinary research (e.g. Pohl et al. 2010; Hermans et al. 2011; Lang et al. 2012; Polk 2014; Triste et al. 2014; Roux et al. 2017), lessons learned and critical factors may be applicable and useful for future transdisciplinary processes. However, future assessments and reflections on other cases should confirm our findings and help to validate our choice of evaluation criteria and assessment method.

### Conclusion

Transdisciplinary research is problem driven and solution oriented. It tackles complex real-world problems such as the transformation of the agri-food system towards sustainability. Transdisciplinary research is being increasingly applied, but its impact on research and society still remains unclear.

In this study, an assessment of a 2-year transdisciplinary project was performed to fully reflect on the three premises of transdisciplinary research and its strengths and pitfalls. The assessment helped to refine the understanding of the societal effects of a transdisciplinary approach. Based on our analysis, we can conclude that a regional transdisciplinary project could meet the three premises of transdisciplinary research in sustainability if three critical factors are addressed properly: (1) institutional, social, political and historical context should be taken into account when designing a transdisciplinary approach; (2) the institutionalization and formalization of a transdisciplinary process and (3) an adaptive, iterative and flexible process. These critical factors are relevant for policymakers, researchers and other actors to improve future transdisciplinary approaches. Furthermore, the proposed methodology to perform this assessment can be a model for monitoring future processes and to enhance the understanding of impacts of future transdisciplinary processes. The use of this validated assessment framework increased the replicability of the study. To draw general conclusions for transdisciplinary research, other case study assessments should be cross-compared and longer-term effects of the impact should be studied.

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