

80. How smart should resilience be? On the need of a transdisciplinary approach to transform pig production systems

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Abstract

Pig production is related to many societal challenges. This raises the question whether and how pig production systems can be transformed in a way that better includes animal welfare and is responsive to (other) societal concerns. In a project funded by the Netherlands Organisation for Scientific Research (NWO), we focus on the role of resilience to explore the possibilities of defining novel production systems that better match with the interests and adaptive capacities of animals. However, to play this central role, the concept of resilience needs an integrated and transdisciplinary approach. Using the ‘SmartResilience’ project as an example, we argue that to address societal challenges in livestock production it is not sufficient to view one topic through the lenses of multiple disciplines and to produce research results from each discipline which are only supplementary to one another. We argue why complex societal challenges like transforming livestock systems can only be tackled by real collaboration between different disciplines, and why this collaboration already needs to start in the design-phase of innovations. We discuss three stages of collaboration that will lead to a deepened integration of disciplines, which will ultimately result in positive societal impact: (1) identifying the underlying concepts that play a role for achieving the project aim (e.g. animal welfare, resilience); (2) making the implicit assumptions of these concepts explicit by integrating knowledge and methods from different disciplines (e.g. philosophy and animal science); and (3) translating and incorporating the explicit assumptions of concepts into practice and into further actions within the project (e.g. pig breeding or housing strategies). By doing this, we expect to prepare a route forward for more welfare-friendly and sustainable pig production that is in dialogue with society.

Keywords: livestock systems, interdisciplinarity, societal challenge, collaboration

Introduction

Current pig production in Europe, which mainly takes place in intensive indoor systems, is subject to public criticism. Societal concerns are related to animal welfare, public health risks and environmental sustainability (Giersberg and Meijboom, 2021). This raises the question whether and how pig production systems can be transformed to be responsive to these diverse concerns. In the ‘SmartResilience’- project, funded by the Netherlands Organisation for Scientific Research (NWO), a team consisting of researchers from various academic disciplines and industry partners is focusing on the role of resilience for these transformative processes. The overall aim is to develop a novel, sustainable pig production system that enhances animal resilience and welfare, and addresses societal concerns.

Joint projects, such as ‘SmartResilience’, are already the norm in many research initiatives related to topics of agriculture and food supply. In many cases, researchers find their own niches within a multidisciplinary project team and work more or less independently on the shared topic and the common research aims.

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However, for addressing complex societal challenges and changing established systems, it is not sufficient to view one topic through the lenses of multiple disciplines and to produce research results which are supplementary to one another. What is needed is a transdisciplinary approach to the key concepts of the project. By this, the project team can move beyond discipline-specific perspectives to create outcomes that are both scientifically sound and problem-solving oriented.

Using the 'SmartResilience'-project as an example, we argue why complex societal challenges like transforming livestock systems can only be tackled by being serious about collaboration among academic disciplines and relevant stakeholders. In this paper we discuss three stages of collaboration that will enable to reflect on the theoretical assumptions related to the challenge and to create practical solutions, which will ultimately result in positive societal impact. First, we address the identification of the underlying concepts that play a role for achieving the project aim. Second, we elaborate on how the integration of knowledge and methods from different disciplines can help to make the implicit assumptions of the identified key concepts explicit. Finally, we discuss the role of collaboration for translating and incorporating the explicit assumptions of concepts into practice and into further actions within the project. With this approach, we expect to facilitate the aim of the 'SmartResilience'-project and provide a framework for collaboration and deepened integration for similar societal challenge-oriented research projects.

Identifying the underlying concepts

During the first stage of collaboration, the concepts that are key for achieving the project aims have to be identified. This task may seem quite straightforward, as the consortium has typically built the study design on these very concepts. However, although the outlines of the concepts will be clear to all collaborators, determining their underlying meaning may be difficult. First, particularly in more applied agricultural and food sciences, complex concepts that concern societal challenges, such as 'sustainability', are often directly indicated in the calls of research funding bodies. Proposals may then be constructed to fit the subject of 'sustainability', without prior deeper analysis of the concept by the group of applicants. If there is no experienced need to discuss this beforehand, it can be challenging to agree on the interpretation of this concept afterwards. Second, the meaning of scientific concepts may contain ambiguities, inconsistencies and variation. Kampourakis (2018) argues that this is due to the following issues: the meaning of a term may differ depending on whether it is used in everyday language or to describe a scientific concept; scientific concepts are often presented as metaphors to explain something which is not understood completely; and the same scientific concept may have different connotations for scientist of different (sub-)disciplines. Population geneticists for instance may refer to the concept of genes as factors related to phenotypic traits, whereas molecular biologists may view genes as DNA segments coding for a specific protein. Finally, the same concept may be construed as scientific concept or as a normative concept (for the almost universal applicability of this see e.g. Natalia and Heinrichs (2020) on the concept of polycentricism).

In the following we focus on two key concepts of the 'SmartResilience'- project: resilience and animal welfare. The concept of resilience is exemplary for the potential pitfalls mentioned above: the term is used in different ways in diverse scientific disciplines, by policy makers and the wider public (Baggio *et al.*, 2015). However, although shared understandings of resilience occur, the bridging nature of this concept across disciplines seems to be limited (Baggio *et al.*, 2015). What seems to be common ground is that resilience is always associated with the capacity of a system to bounce back to normal functioning after a perturbation (Scheffer *et al.*, 2018), which is a metaphor. The same applies to the related concept of tipping point, which describes abrupt transitions in dynamic systems, often caused by minor initial changes, to a new, usually less stable and less functional state (Van Nes *et al.*, 2016). Whether resilience is an exclusively descriptive, normative or a combination of both, i.e. a hybrid concept has been discussed

controversially (e.g. Brand and Jax, 2007; Thorén and Olsson, 2018). It seems that at least the practical application of the concept of resilience will involve normative assumptions about the system it is applied to (Thorén and Olsson, 2018). The nature of conceptions of animal welfare is similarly diverse as the one of resilience (Weary and Robbins, 2019). Common interpretations include the three-circle framework of biological functioning, affective states and natural living (Fraser *et al.*, 1997) and the dynamic approach of focusing on positive welfare and the adaptive capacities of animals (Ohl and Van der Staay, 2012). In a probably less controversial way than resilience, animal welfare can be framed both as an empirically accessible scientific concept and as a moral concept, including hybrid approaches (Stafleu *et al.*, 1996).

Identifying the key concepts of the project and their varying meanings is only possible through dialogue of the multidisciplinary project team. Within one discipline, often only one interpretation of a certain concept prevails. The biologist will build a different account of resilience than the philosopher. As transforming the pig production sector is a societal challenge, the ‘SmartResilience’- project cannot restrict this to an internal debate or opt for one disciplinary interpretation. In society, all possible interpretations of resilience will be found. As a consequence this diversity has to be included in the project. If the project results and solutions are built on one account of resilience only, without the researchers being aware of it, these outcomes will likely fail in practice. Acknowledging that key concepts of a project are not mere black and white, but that their meanings may be varying or ambiguous, forms the basis for the next step of collaboration: making the assumptions linked to the respective interpretation of a concept explicit.

Making implicit assumptions of concepts explicit

Once the relevant concepts have been identified, it is important that researchers make the assumptions explicit that *they* implicate in *their* use of these concepts in order to reach the project aims. This can best be achieved by integrating the knowledge and methods from the multidisciplinary project team.

In the case of the ‘SmartResilience’-project, the for the animal scientists implicit assumptions related to the concepts of resilience and animal welfare were examined through conceptual analysis. In line with the transdisciplinary research paradigm, this analysis was applied to a conversation. During this conversation of the project team, the animal scientists were presented with counterexamples to their seemingly self-evident and unquestioned accounts of resilience and animal welfare. The fact for instance that enhancing resilience was always associated with having a positive value was challenged by the view that enhancing resilience in pigs could be a mere means to alleviate detrimental production environments, and that under ideal conditions, high resilience would not be needed. This led to the question for whom it would be positive to improve resilience: would it only be in the interest of the persons keeping the pigs, or could it be in the interest of the pigs as well? Here, the knowledge of the animal scientists is needed to determine which conditions and procedures pose challenges to the pigs, and to assess where undesirable effects of a challenge should be tackled by removing the challenge, and where resilience should be improved because removing the challenge is not possible or even undesirable. An example is the often stressful weaning of piglets, which usually takes place at a very early age for reasons of production efficiency. Instead of making piglets more resilient to early weaning, the procedure itself could be adapted, for instance by weaning piglets at a later age or more gradually. Other challenges, such as the risk of infections, may be inevitable, even under ideal housing and management conditions. The ability to cope with such challenges would be in the interest of the keeper, but also in that of the pig, who may experience its state as more positive when having the capacity of (fast) recovery. There may be even challenges that are desirable for the pig: there is evidence that providing animals with problem solving opportunities and challenging their cognitive abilities can lead to rewarding experiences, provided the animals possess the skill and the resources to solve the task (Meehan and Mench, 2007). These examples show what became explicit during the conversation: the interrelation of the concepts of resilience and

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animal welfare. How we frame animal welfare, for instance as the possibility to experience positive affective states, shapes our assumptions regarding resilience and vice versa.

For the transition to the next step of collaboration, the translation to and application of concepts in practice, further knowledge and methods of animal science are needed. To monitor and predict loss or improvement of resilience, biological processes that serve as indicators for the previously identified assumptions of the concepts have to be quantified. In the 'SmartResilience'- project, this is done by a combination of traditional physiological methods, such as the analysis of blood parameters, and sensor technologies, such as accelerometers (Van der Zande *et al.*, 2020) or computer vision (Van der Zande *et al.*, submitted). As mentioned above, societal challenges can only be tackled successfully if perspectives of society are included early on. However, the methods of philosophy and animal science are not sufficient to achieve this. It is also not a stand-alone task for social scientists, as they need to incorporate the identified concepts and their implication in the design of the indented stakeholder engagement activities. In turn, results from interviews, focus groups or other activities have to be fed back to the whole project team to enable it to take societal perspectives into account during subsequent phases of the project. In addition, the 'SmartResilience'- project involves animal scientists from the industry as relevant stakeholders in the project team and in the discussions outlined above. On the one hand, this enables the stakeholders to integrate these early project results in their long-term strategies. On the other hand, due to their unique insight into the current practice, they can indicate where the largest efforts regarding a transformation of the system have to be taken.

Translating and integrating concepts into practice

During a third phase, collaborative efforts should be directed at the implementation of the now explicit assumptions of concepts into practice and into further action within the project. The ultimate aim should be to produce functional results which do not only enhance our understanding of concepts and related phenomena, but which have the potential to create positive societal impact by transforming current systems.

As outlined above, the intention of the 'SmartResilience'- project is to improve the resilience of pigs in order to better meet their interests and not to tolerate the shortcomings of the current production system. One option to enhance the resilience of pigs in practice is to provide them with an enriched environment that offers various opportunities to perform species specific behaviours. In order to be coherent in the assumption that resilience should be improved for the pigs' own interests, the pigs need to have the physical and cognitive capacities to interact with such an environment. If this is not the case, enriched environments can lead to the opposite of what has been intended: the animals are overburdened and frustrated by these environments. A practical approach may be to implement breeding programs in which pigs are selected for their ability to thrive in complex, rewarding environments. It should be noted that a consequent translation of the animal-interest perspective of resilience into practice is likely to come at a cost of other interests. Both providing complex, enriched housing environments and breeding for enhanced capacities to interact with these environments may be at odds with the high economic efficiency of barren systems and high yielding hybrids. If the project results would suggest that the only way to keep resilient pigs would be to keep them outside, this would not be environmentally sustainable without transforming other parts of the system, for instance radically reducing the number of pigs kept. This, in turn would raise questions of food justice.

Therefore, it is important as a project team to keep reflecting on the relevant concepts and to relate their assumptions to the broader perspective of the project. Which implications do the resilient pigs in their resilient micro-environment have for the pig production sector, for the livestock system, and for the food system as a whole? Are we creating resilient pigs (in line with our assumptions of the concept) in

an overall un-resilient system (when our assumptions are applied to the broader system)? By doing so, it will be possible to adjust the scientific direction and further action within the project where necessary. It is obvious that these considerations need to be balanced and that certain assumptions have to be taken for granted to not get stuck. Constant fundamental discussion (e.g. should humans keep pigs at all?) would hamper progress and functional outcomes of this specific project (i.e. research on resilience in pigs). In the course of the project, reflecting on the underlying assumptions of concepts will narrow down, whereas the practical part will gain significance. However, an interaction of practical efforts and conceptual reflection remains necessary throughout all phases of collaboration in a transdisciplinary research project.

Conclusions

In this paper we show that in a transdisciplinary research project an integration of theoretical assumptions and practical efforts through real collaboration can be a way forward to tackle complex societal challenges. It is important to note that the three stages of collaboration presented are not meant to describe a chronological guide to successful collaboration. In practice, the phases will overlap, for instance the identification of underlying concepts will not be possible without considering the related assumptions that need to be made explicit. In fact, theoretical consideration and practical action can be viewed on a continuum throughout the course of the project, where, depending on the project phase, the focus lies on the one or the other aspect. Furthermore, consensus on the assumptions of concepts within the project team should not be overrated. Collaboration aims at conceptual understanding and not necessarily at agreement. To create socially functional outcomes, it is more important to be aware of and to acknowledge the plurality of views on the issue. For the 'SmartResilience' - project, these insights mean a route forward for a more welfare-friendly and sustainable pig production that is in dialogue with society. We encourage consortia working on similar challenge-orientated research projects to adapt, modify and add to this proposed framework of collaboration.

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