

**Exploring multi-stakeholder learning:  
pathways to sustainable livestock  
futures in Burkina Faso, Ethiopia and  
Tanzania**

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# Abstract

There are a wealth of modelling and collaboration tools to support sustainable agricultural and livestock development and transformation. Yet, users struggle to apply the tools to their multi-faceted experience and knowledge. This thesis therefore observes and critically explores how social learning can support meaningful knowledge sharing between diverse stakeholders and with decision support tools so that the knowledge produced by using the decision support tool is useful, relevant and applicable. To do so, the thesis uses a case study of embedding a decision support tool in a social learning process for exploring options for sustainable livestock production in Burkina Faso, Ethiopia and Tanzania. Observing and analysing workshop discussions and outputs, complemented by semi-structured interviews with workshop participants, it explores how the design and facilitation of the workshop activities supported knowledge sharing and learning. It conceptualises the structural elements of social learning processes, the design and content, as structured boundary objects and found that they enable collaboration and facilitate and mediate the sharing of perspectives through developing shared vocabulary, making perspectives explicit and providing participants with some authorship. It then applies an analytical framework using the lens of constructive conflict to assess the facilitation of a social learning process, the learning dialogues and how they were facilitated, focusing on disagreements. Framing disagreements as conflict episodes and exploring the influences of outside and inside context as well as interpersonal conflict dynamics revealed how conflict opens up and closes down opportunities for learning. Taken together, the thesis provides a rigorous and structured approach, using the lenses of boundary objects and a constructive conflict, to understanding how the structure and facilitation design elements of a social learning process work together that provide enabling conditions for bridging knowledge boundaries and facilitating learning.

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# Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University.

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## PhD Publications

A version of chapter 4 has been published in:

- Joanne Morris, Jonathan E. Ensor, Catherine Pfeifer, Robert Marchant, Dawit W. Mulatu, Geoffrey Soka, Salifou Ouédraogo-Koné, Mekonnen B. Wakeyo & Corrado Topi (2020) Games as boundary objects: charting trade-offs in sustainable livestock transformation, International Journal of Agricultural Sustainability, DOI: [10.1080/14735903.2020.1738769](https://doi.org/10.1080/14735903.2020.1738769)

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Parts of the thesis also draw on the project reports presenting workshop outputs following each of the six learning workshops. I drafted the workshop reports together with Catherine Pfeifer. I took care to use only material that I contributed to the reports in this thesis, which was a synthesis of the reports provided by the workshop facilitators documenting the discussions and outputs of their workshop group. The workshop reports are as follows, and can be made available on request from [joanne.morris@york.ac.uk](mailto:joanne.morris@york.ac.uk) :

- Pfeifer, C., Mulatu, D. W., Wakeyo, M., Arbissie, B., Berhe, M., et al. (2018). *Exploring Alternatives for Livestock Production in Atsbi, Ethiopia: Playing the Transformation Game. Report of ResLeSS Workshop 2*. Stockholm Environment Institute, York. <https://cgspace.cgiar.org/handle/10568/106159>
- Ensor, J., Pfeifer, C., Morris, J. and Ouedraogo, S. (2018). *Exploring Alternatives for Livestock Production in Bama, Burkina Faso: Playing the Transformation Game. Report of ResLeSS Workshop 2*. Stockholm Environment Institute, York. <https://cgspace.cgiar.org/handle/10568/93069>
- Pfeifer, C., Morris, J., Soka, G., Moses, E. A., Mkiramweni, N. P., et al. (2018). *Exploring Alternatives for Livestock Production in Lushoto, Tanzania: Playing the Transformation Game. Report of ResLeSS Workshop 2*. Stockholm Environment Institute, York. <https://cgspace.cgiar.org/handle/10568/98356>
- Morris, J., Lannerstad, M., Soka, G., Moses, E. A. and Ensor, J. (2017). *Research and Learning for Sustainable Intensification of Smallholder Livestock Value Chains (ResLeSS) Report of Workshop I, Lushoto, Tanzania, 6-7 July 2017*. Stockholm Environment Institute, York
- Morris, J., Pfeifer, C., Mulatu, D. W., Wakeyo, M. B. and Ensor, J. (2017). *Research and Learning for Sustainable Intensification of Smallholder Livestock Value Chains (ResLeSS) Report of Workshop I, Wukro, Ethiopia, 28 – 29 June 2017*. Stockholm Environment Institute, York

- Morris, J., Pfeifer, C., Ouedraogo, S. and Ensor, J. (2017). *Research and Learning for Sustainable Intensification of Smallholder Livestock Value Chains (ResLeSS) Report of Workshop I, Bama, Burkina Faso 26 – 27 July 2017*. Stockholm Environment Institute, York

Chapter three draws on a project report on the changes in perspectives in the learning process. I confirm that I was responsible for writing and revising the report and was responsible for the theoretical framing and data analysis in the report. Jon Ensor provided guidance and comments on drafts.

- Morris, J. and Ensor, J. E. (2019). *We Learn Something New Every Day. Report on the Learning Outcomes from the ResLeSS Social Learning Process in Each Country*. Stockholm Environment Institute, York.

A detailed description of the social learning process can be found in the facilitation guide that I produced for practitioners who wish to repeat the process (Morris et al. 2019).

- Morris, J., Ensor, J. E., Topi, C. and Pfeifer, C. (2019). *Facilitating the ResLeSS Process: A Learning Process for Inclusive, Context Specific Planning in the Livestock Sector*. Stockholm Environment Institute, York.  
<https://cgspace.cgiar.org/handle/10568/106156>

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# 1 Introduction and Literature Review

## 1.1 Introduction

At a recent conference<sup>1</sup>, a minister for the environment, Dr January Makamba, applauded all the innovations happening in the GIS, smart technology and environmental modelling community to support agricultural development and transformation to be sustainable, improve livelihoods and contribute to sustainable development goals such as zero hunger and promoting sustainable use of natural resources. But he reminded the research community that until the innovations have a clearer application and link with policy, they remain toys for the modellers and computer geeks to play with. Only once they speak the language of policy and meet the needs of policy do they become tools. While this is not a new idea by any means, it is not such an easy idea to put into practice (Uran and Janssen 2003; Jakeman et al. 2006; McIntosh et al. 2011; Black et al. 2014). At the same time, it is not only policy makers at national level that use decision support tools. Tools must also meet the needs of the practitioners in food production and natural resource management. One way of addressing this is to involve the end-users for part or all of the tool development, in forms of participatory, collaborative or companion modelling approaches (Basco-Carrera et al. 2017; Etienne et al. 2011; Jakku and Thorburn 2010; Zulkafli et al. 2017). Participation and collaboration in development and natural resource management (NRM) interventions come with their own long history of trial and error in balancing the pros and cons (Hickey and Mohan 2004a). So the question remains, how to produce decision support that talks the right language and is applicable, and why is it so difficult to achieve - beyond the fact that balancing agricultural development and natural resource management is a complex question, and only one of many complex questions that policymakers are trying to solve (Poppy et al. 2014; Rockström et al. 2017). Moreover, there are connections and feedbacks

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<sup>1</sup> 4<sup>th</sup> FOSS4G conference in Dar es Salaam in August 2018, <https://2018.foss4g.org/>

between the various questions making it all a bit of a juggling act (van den Hove 2006; Liu et al. 2015). Social learning has been proposed as one solution to address the production of answers to messy questions, as social learning goes beyond participation and aims to achieve shared learning on a common issue which results in constructing a joint solution that may be different to any previously envisaged (Ison et al. 2007; Reed et al. 2010; Wals and Rodela 2014). The challenge is to understand what the right language is and create language that is applicable to both practitioners and policy makers. To do so, social learning must create a bridge across a multitude of partial and situated knowledge and expertise (Haraway 1991; Nightingale 2003b; Lowe et al. 2019). The success with which social learning processes bring together diverse actors and enable them to transfer knowledge across the boundaries between their knowledges and transform it into a shared understanding is influenced both by the facilitation of the social learning process and by the context (Cundill 2010; Collins and Ison 2009; de Vente et al. 2016; Boyd et al. 2014).

This thesis is therefore about critically exploring how social learning can support meaningful stakeholder engagement of end-users with decision support tools so that the knowledge produced by using the decision support tool is useful, relevant and applicable – so that it speaks the right language. To do so, the thesis explores a case study of embedding a decision support tool in a social learning process for exploring options for sustainable livestock production in Burkina Faso, Ethiopia and Tanzania.

## **1.2 Pros and cons of participation – why social learning?**

The advantages of participation include allowing a wider range of actors to take part in discussions and decision-making, with the advantage in theory that broader participation can help to legitimise decision-making processes and build trust, and including local perspectives and knowledge offers the opportunity to improve the decisions to be more appropriate for the local context (Pretty 1995; Blackmore 2006). There are a wide range of participatory approaches, but it is sometimes unclear what

epistemology and teleology are underpinning the participatory approaches – the inherent assumptions about what and whose knowledge is valid, and what the purpose and design are (Blackmore 2006). Robert Chambers' Participatory Rural Appraisal approach drew the concepts of participation into a toolbox that could be used and applied by practitioners in rural development, with an emphasis on including the marginalised and disadvantaged groups to avoid Western ideas and plans being imposed on local communities (Chambers 1994; cited in Kapoor 2002). However, the widespread uptake of the toolbox prompted a strongly critical backlash from the academic community, particularly from critical development studies (e.g. Cooke and Kothari 2001; Kapoor 2002). (In)famously critiquing the 'tyranny of participation', Cooke & Kothari (2001) caution that participatory approaches in practice can be "at best naive about questions of power, and at worst serve systematically to reinforce, rather than overthrow, existing inequalities", particularly if they become a blueprint technical tool that ignores the social relations and power dynamics in each location that affect how an intervention manifests (Coe et al. 2014; Pretty 1995). For example, "interaction between external and local actors often fails because professionals make their own vision prevail while local actors normally do not dare to bring their own views into the discussion" (Rist et al. 2006, p.227). Mohan & Stokke (2000) point out that the 'local' is not necessarily better, that power inequalities and injustice occur at the local level so that participation may simply reinforce a different set of injustices, for example patriarchal and parochial values. Similarly, there is the potential for 'mistaken learning', where the perception of the less influential participants changes to match that of the more powerful participants (Muro and Jeffrey 2008). Kapoor (2002) points out theoretical inconsistencies in Robert Chambers' approach, and calls for a better grounding in Habermas' (1981) theory of deliberative democracy and communicative action, to appropriately consider providing legitimate procedures to take the onus off the facilitator of ensuring fair and democratic procedures; to provide a mechanism for checking power relations and resolve conflicts with rational debate, for just outcomes;

and to be aware of the tension between coming to consensus and erasing diversity in opinions and perspectives (Kapoor 2002).

Yet, if better informed and directed, participation remains an important mechanism for creating opportunities for transformation (Hickey and Mohan 2004a). It should engage with development as an underlying process and “tie into broader projects of social justice and radical political change”, and while “it is unrealistic to expect participatory projects to transform existing patterns of power relations”, participation can be better informed and directed (Hickey and Mohan 2004b, p.13). Cornwall (2004) raises challenges to be aware of when creating a space for participation. In selecting and inviting stakeholders to participate in an activity in a created space, the external actor is exerting power on the participants, compelling them to take part, even if ostensibly letting the participants lead the process (Mirza and Perret-Clermont 2016; Cornwall 2004). In inviting people in as stakeholders, participants are constructed by those inviting them to a space, and by how they perceive their inclusion in the space – if they are put into a category for that particular space by the inviter this affects their perceived, and therefore their enacted agency in such ‘invited spaces’ (Cornwall 2004; Tschakert et al. 2016). At the same time, regardless of how well the inviters try to create the arena to be equitable, “existing relationships cannot be simply left at its boundary” (Cornwall 2004, p.80) and will to a certain extent still influence participation. As such, the space is also in part defined by the participants. Similarly, participants are actors, with agency and self-interest, and can choose what to say and how to say it (Long and Long 1992; Long 2001), and therefore can use the invited space to give validity to their agenda (Cornwall 2004). At the same time there are practical constraints to effective engagement, once actors have a seat at the table – charisma and experience of an actor, and the language used in the space, and by the actor. Language is also what we use to define and categorise our understanding of the world – and as such, it can obscure and hide the complexity in a situation as much as it reveals patterns (Jones 2009). For example, language affects how others perceive what

is said by the actor as well as how the actor thinks (s)he will be perceived for what they say (Cornwall 2004).

Another critique is of 'imminent' participatory development activities - those that are short-term, too rapid, and use participatory methodologies to tick the box and meet wider expectations – as opposed to 'immanent' activities that link into underlying programs or trends (Hickey and Mohan 2004b; Mudombi et al. 2017). Similarly, effective participation and co-production of knowledge is unlikely to happen simply by having more stakeholders in the room (Stirling et al. 2018; Reed et al. 2010; Cundill 2010). In NRM, for decision-making in messy complex situations participation alone, even transformative or active participation, may not be enough; we need to go one step further and provide the opportunity for learning (Collins and Ison 2009).

Eloquently put by Rist et al. (2006, p.220): "A major difficulty in striving for sustainability is the entirely normative character of the concept; to make it operative, individuals and groups must translate it into action-guiding ethical values." Particularly in highly uncertain settings, with complex interactions, distributed power and different views on what the goal is, sustainability means something different to each actor (Voß et al. 2007; Opstal and Hugé 2013). Furthermore, some point out that the current societal systems and decision-making processes are not suitable for tackling those challenges facing social-environmental systems, because of the structure of societal systems and underpinning assumptions and theoretical framings (Gorddard et al. 2016; Shove 2010) – we cannot use the same logic to solve the problem as that which created it. Collaborative learning, co-production or social learning processes are seen as the way forward for managing complex problems, because they recognise that complex natural resource systems are also products of the social interactions (as opposed to managing them technocratically, assuming them to be a product of ecological conditions) (Ison et al. 2007).

Social learning processes have been proposed as a solution in environmental or natural resource management (Schusler et al. 2003; Keen et al. 2005; Blackmore 2006; Ison et al. 2007), for sustainable development (Wals and Rodela 2014; Röling and Wagemakers

1998; Ramírez and Fernández 2005) and for transformational change (Cundill and Rodela 2012). Learning together about key concepts of interest to diverse stakeholders can build shared vocabulary and co-creating outputs that can be shared across knowledge domains (Roux et al. 2017). Yet proponents acknowledge that learning cannot be forced, instead we can create spaces that are conducive to learning (Collins and Ison 2009; Rist et al. 2006; Schusler et al. 2003). Learning is also not guaranteed even if all the conditions are favourable, and part of social learning is about understanding how the social context influences learning amongst individuals (Ison et al. 2013; citing Blackmore 2007). Social learning is a process, not an output or outcome (Lindley 2015), and as such social learning is essential but not enough on its own – it is a trigger, or catalyst for action, but needs to be accompanied by “appropriate structures and processes . . . to sustain learning and enable joint action” (Schusler et al. 2003, p.324). This includes skilled facilitation, identifying relevant policies and institutions and having an understanding of the history and context as this can shape the possibilities for learning and change including “a deeper understanding of the context, power dynamics, and values that influence the ability of people and organizations to manage natural resources effectively is necessary” (Reed et al. 2010; Keen et al. 2005).

### **1.3 Why sustainable livestock? Introducing the case study**

The thesis will make use of a short-term, three-year, project for its case study, to explore how a social learning process supports inclusive knowledge production and use. The ‘Research and Learning for Sustainable Intensification of Smallholder Livestock Value Chains in Burkina Faso, Ethiopia and Tanzania’ (ResLeSS) project was part of the Sustainable Intensification of Agricultural Research and Learning in Africa (SAIRLA) Programme, running from 2017-2019. It was led by the Stockholm Environment Institute (SEI), in collaboration with the International Livestock Research Institute (ILRI), Environment and Climate Research Center (ECRC) at Ethiopian Development Research Institute (EDRI), Institut de l’Environnement et de la Recherche Agricole (INERA) and

Sokoine University of Agriculture (SUA). The project worked with the CGIAR Livestock CRP Country Coordinators, ICARDA in Ethiopia, and ILRI in Tanzania and Burkina Faso. Funded by the UK Department of International Development, SAIRLA was a five-year programme (2015 to 2020) that sought to generate evidence and design tools to enable governments, investors and other key actors to deliver more effective policies and investments in sustainable agricultural intensification (SAI) that strengthen the capacity of poorer farmers', especially women and youth, to access and benefit from SAI in Burkina Faso, Ethiopia, Ghana, Malawi, Tanzania and Zambia. The SAIRLA programme was managed by WYG International Ltd and the Natural Resources Institute, University of Greenwich. More details of the case are in Chapter 2: Methods.

Agricultural production faces the competing demands to meet the Sustainable Goal of 'Zero Hunger' (UNDP n.d.) while at the same time reduce or mitigate environmental impacts such as soil fertility, water stress, pollution and biodiversity impacts associated with fertiliser and pesticide use (Poppy et al. 2014; Rockström et al. 2017). This is a complex environmental and social challenge to address – hunger and food security are not simply a matter of producing more food in a more environmentally friendly manner, but also ensuring continuous access to food and to a nutritious diet (Garnett 2014) and understanding the infrastructure and policies supporting (or undermining) the system of producing and distributing food (Sen 1981). Furthermore, the definition of a challenge and how to solve it vary between experts according to their views and interpretations (Béné et al. 2019). Livestock production in post-colonial Africa also has a long history of contention between pastoralism and commercial livestock keeping.

Livestock inevitably has some environmental impact, which tends to be higher than plant-based protein, and beef has the highest contribution (Swain et al. 2018; Nijdam et al. 2012). Yet, it very much depends on the type of livestock system and the wider context in which that livestock system is being practiced. More intensive production uses less land and the relative intensity of impact is smaller, that is, for 1 kg of meat, intensive beef production emits far less greenhouse gases (GHGs) than extensive beef production (Swain et al. 2018) and could decrease GHG emissions mainly by virtue of

avoided GHG emissions associated with land use change (Havlík et al. 2014). However, the debate about livestock impacts is based on many uncertainties and selective and contested framings and does not necessarily take into consideration other outcomes and impacts associated with different types of livestock production (Scoones 2018; citing Garnett et al. 2017). While intensive production delivers lower GHG per kg meat, its negative impacts on animal well-being and local water and air pollution have been well covered (e.g. Steinfeld et al. 2006; Glatzle 2014) - perhaps because efforts to maximize yields of milk and meat can disrupt finely balanced systems (Eisler et al. 2014). Successful intensification can lead to a rebound effect of net land expansion (Meyfroidt 2018) - for example, without robust policies, promises of reducing deforestation by reducing extensive beef rearing in Brazil may be unfounded, as the profitability of intensive means more individual investing in intensive production - and clearing forest to do so (Müller-Hansen et al. 2019; Phalan et al. 2016). Another rebound effect is the displacement of the extensive system into less productive or woodland or forest areas (Meyfroidt 2018). Replacing meat-based protein with plant-based protein also depends on the production system (Meyfroidt 2018). On the less popularised side, livestock can provide important livelihood and soil fertility functions, in crop-livestock systems (Moll 2005; Soussana and Lemaire 2014; Herrero et al. 2010). For example, in areas where there are few profitable alternative land uses, extensive livestock production offers a viable and important livestock strategy (Ran et al. 2017; Jones and Thornton 2009; Erb et al. 2016; Schader et al. 2015; Ripple et al. 2013). A large majority of smallholders still rely on livestock for ploughing, and for maintaining soil fertility (Herrero et al. 2010; Giller et al. 2011; Rufino et al. 2007). Although nutrients are cycled back to the soil less efficiently through livestock than by adding plant matter directly, manure is a better source of nutrients, and livestock provide multiple other benefits to farmers (Giller et al. 2011).

Political ecology studies of meat, milk and livestock production (e.g. Clay and Yurco 2020; Turner 2004; Bollig and Österle 2013; Gonin and Gautier 2015) unpack the historical, cultural and socio-political aspects of pastoralism and livestock keeping in



Africa and globally. Agrarian political economy and food systems studies of industrial livestock production in the North discuss the social impact of the commodification of milk and meat, including the increased reliance on capital-intensive infrastructure and the problems of over-production of milk flooding the market, animal health concerns and high environmental impact of the industrial production resulting from the narrative of 'more milk'. On the contrary, political ecology studies in Africa come from development studies and focus on cultural ecology and livelihoods, and feminist political ecology studies reveal the erasure of gender dynamics and farmer heterogeneity in the commercialisation of dairy that mean that the promises of reducing marginalisation and improving nutrition may not be met (Alston et al. 2017; Tavenner and Crane 2018; Yurco 2018). Clay and Yurco (2020) highlight the disconnect between technical, data-driven environmental footprint assessments which hide the rich history and cultural diversity of the livelihoods within which meat and milk is produced.

So, livestock development does need to be planned carefully, to avoid the problems faced by industrialised livestock production in the North and keep in touch with the social and environmental heterogeneity within livestock systems. A landscape approach grounded in local perspectives is proposed as an inclusive decision support process. The ResLeSS project held two workshops in each of the three countries, with different settings and different livestock, but the same approach (two workshops with mixed value chain stakeholders). Given the earlier discussion I want to use this case to explore how the social learning process supports local perspectives to be included when assessing the environmental impacts of scenarios and evaluating which scenarios are locally feasible taking both environmental impacts and other local priorities into consideration.

## 1.4 Research aim and questions

The aim of this thesis is to *critically explore how a social learning process supports inclusive production and use of knowledge* for more situated and relevant use of decision support tools.

The following questions contribute to answering the aim of the thesis:

1. What perspectives are brought to or present in the workshops?
2. How does the structure of the social learning process and use of workshop materials support inclusive knowledge production and use?
3. How does the facilitation of the social learning dialogue support inclusive knowledge production and use?
4. How do the structure and facilitation of learning processes support the exposing and reconciling, or not, of different perspectives in the workshops?

## 1.5 Key terms

### 1.5.1 Social learning process

A core principle or assertion in the different forms of social learning is that sharing knowledge between different stakeholders leads to shared learning (Schusler et al. 2003), based on deliberation (Maarleveld and Dangbégnon 1999) and communicative action (Rist et al. 2006) to structure communication between actors; although Cundill and Rodela (2012, p.11) note that “deliberative processes do not always led to a shared understanding, agreement upon the issue at stake and eventually to learning”. A second core principle is to extend learning beyond the individual, but also recognising an interplay between the individual and the context or situational factors that drives learning – “Behavior is certainly influenced by the environment, but people also play a role in creating this environment” (Maarleveld and Dangbégnon 1999, p.268).

There is not yet one common definition (Parson and Clark 1995; Schusler et al. 2003) - and some argue that to be true to the concept it should be emergent (Collins and Ison 2010), and therefore not pinned down to one definition. Building on Reed’s (2010)

commonly used definition, the Climate Change and Social Learning (CCSL) working group led by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) has developed the following definition of social learning (Van Epp and Garside 2014; Kristjanson et al. 2014):

*“Social learning approaches help facilitate knowledge sharing, joint learning and co-creation experiences between particular stakeholders around a shared purpose, taking learning and behaviour change beyond the individual to networks and systems. Through a facilitated iterative process of working together, in interactive dialogue, exchange, learning, action and reflection and on-going partnership new shared ways of knowing emerge that lead to changes in practice.”*

Each researcher, user or practitioner should define how they use social learning and to what purpose, but common principles are (i) co-creation of knowledge; (ii) reflection and recognition of others’ perspectives and others’ underlying goals and values; (iii) understanding complexity and interdependence, leading to (iv) (partial) convergence of goals (vision), (v) mutual agreement and (vi) collective or coordinated action creating opportunity for transformational change (Muro and Jeffrey 2008; Salvini et al. 2016; Ensor and Harvey 2015), or more simply when different actors more or less simultaneously change their ‘mindset’ in such a manner that it leads to new patterns of effective coordination of action (van Mierlo et al. 2010).

### **1.5.2 Stakeholders and actors**

In this thesis, I have used the term ‘stakeholder’ throughout, to refer to the individuals who were invited to take part in the social learning process because it is relevant to them in some way (Collins and Ison 2009). The choice of using stakeholder rather than actor is influenced by the framing of the ResLeSS project as working on livestock value chains and considering actors from the value chain as the key stakeholders.

Furthermore, participation, collaboration and learning literature commonly use the

term stakeholders (Reed 2008; Cuppen 2012; van Bruggen et al. 2019; Schwilch et al. 2012).

However, rooting my thinking in Long's actor-oriented approach (e.g. Long 2001), I also recognise that 'actors' is a more encompassing term that includes individuals or entities whose decisions impact livestock production even if they had no explicit stake. A social actor is an individual, or an entity that is capable of making a decision, so a church community or a company is a social actor, but not 'society' at large - or indeed a village or town community, unless they specifically come together to act. Even the most submissive individuals have some measure of agency, and influence how life and institutions play out, by their adhering to the institutions, or withholding action – 'weapons of the weak' and hidden texts (Scott 1985; Scott 1990) and 'everyday politics' (Kerkvliet 2009; Turner 2012).

### **1.5.3 Perspectives vs discourses**

I focus on perspectives in this thesis, as the views held by individuals, their particular attitudes towards an issue. Perspectives are informed by "the everyday practices of the actors and the way they live, give meaning, meet, communicate, and engage in activities" (Mirza and Perret-Clermont 2016, p.82). Among other things, one's perspectives are influenced by discourses to which one has been exposed, but I am more interested in drawing out the perspectives than identifying which broader discourses they belong to.

Similar to van Hulst & Yanow's (2016) framings, discourses provide a certain way of viewing the world that offers an interpretation of what information that discourse would define as common sense and what knowledge it considers as legitimate (Dryzek 1997). A discourse is made up of "a set of categories and concepts embodying specific assumptions, judgements, contentions, dispositions, and capabilities." (Dryzek and Niemeyer 2008, p.481), assigning entities as existing or relevant and whether or not they have agency and approved motives, and encodes these characterisations in

metaphors (Dryzek and Niemeyer 2008). Examples of different discourses of environmental change and biodiversity conservation in Section 1.7.2 display the implications of different assumptions and judgements on how the problem is defined and who is assigned as the victim or the villain and what should be done about it.

#### **1.5.4 Decision support tools, CLEANED-R and the Transformation Game**

Decision support tools, or decision support systems, are a means of packaging scientific information in such a way that it assists individuals or groups of individuals in their decision process, typically by helping to process large amounts of complicated data (Janssen 1992; Jakku and Thorburn 2010). They are not intended to provide an answer, as they cannot replace the judgement of individuals. Instead, they can support individuals in reaching a decision by providing information and sometimes guiding or structuring the decision process. Software-based decision support tools are underpinned by one or more models of the system or process of interest, such as a livestock system, river catchment, crop production or flood risk (Jakku and Thorburn 2010; Uran and Janssen 2003). This thesis is interested in the way information is packaged in decision support tools, and how users (decision-makers) are enabled to use the decision support tool and, therefore, the information it is offering, in the context of political ecology's interest in the production and use of knowledge (see section 1.7).

The case study used in this thesis makes use of a web-based decision support tool, CLEANED-R (Pfeifer et al. 2020; Notenbaert et al. 2016), designed to help users calculate the environmental impact of livestock production in a landscape according to what types of livestock production are present. It is underpinned by a relatively simple model that calculates, for the livestock in a landscape according to their genetics, weight and number, the water required to grow their feed, carbon dioxide equivalents (CO<sub>2</sub>e) associated with growing the livestock and the soil nutrient balance related to the production of their feed (Pfeifer et al. 2019; Pfeifer et al. 2020). It also calculates

the amount of meat, milk and manure produced by the livestock population. For the learning process, to facilitate groups to use the CLEANED-R tool, and to use it as part of a discussion, the tool was embedded in a board game, the Transformation Game (Morris et al. 2019; Morris et al. 2020), that replicated the user interface and enabled groups to collaboratively build a scenario representing the livestock population and management in their landscape. This provided the input to the CLEANED-R tool which could be run in a few minutes, providing the group with the likely change in water demand, CO<sub>2</sub>e, soil fertility and meat and milk production of their scenario compared to the present situation, so they could evaluate the changes against their expectations and priorities. They could then tweak the scenario and test it iteratively until they were satisfied with the results.

## **1.6 Thesis and chapter structure**

The rest of chapter one reviews political ecology literature on analysing the multiple inter-linked dimensions of a context, providing the foundation for the conceptual framing of the thesis. It introduces critical conceptualisations of knowledge production and use and how these influence the way in which issues are framed, problematised and acted upon, as well as how the characteristics of an issue change with the definition of scale and the relationship between historical and environmental change processes.

Chapter two outlines the research approach and methodology, describing the qualitative approach of using a comparative case study, outlining the research philosophy and theoretical framework. It then details the participant observation, reflective debriefs and semi-structured interviews that comprise the qualitative methods of data collection and analysis used, including considerations taken into account. Finally, the chapter ends with a description of the three case study sites and the social learning process used in each site.

Chapter three, the first results chapter, provides the foundation for the main analytical chapters by providing the reader with a picture of what happened in each workshop; chapters four and five then interrogate what happened from different conceptual lenses. Chapter three responds to research question one by describing the perspectives raised by each stakeholder group over the course of the workshops. Raw group discussions and outputs from workshop activities from the workshop reports are analysed to extract what could be inferred about their perspective on livestock keeping, livestock production and how they view the place and role of livestock in relation to livelihoods now and in the future. Semi-structured interviews with selected workshop participants from each stakeholder group supplement the understanding of each stakeholder group and further support the interpretation of their perspectives.

Chapters four and five are the main analytical chapters of this thesis. These two chapters are written in such a way that they sit as standalone pieces of research, which have been prepared for submission as academic papers, while still building the thesis story and answering the research questions. They follow the structure of academic papers, with their own introduction section that frames the research problem and literature review to unpack the conceptual lens used in each. The specific methods taken in each chapter are then outlined, along with case study information where required. This is followed by results and discussion, done both in relation to the chapter's conceptual lens and the thesis research questions. A short conclusion then summarises the main contributions.

Chapter four, *"Games as boundary objects: charting trade-offs in sustainable livestock transformation"*, uses the lens of boundary objects to understand how the workshop activities and use of the decision support tool by embedding it in the learning process contributed to eliciting, capturing and working with perspectives from the diverse stakeholder groups. It answers research question two, and its findings contribute key insights for answering research question four. Building on boundary objects as items flexible enough to be understood by all without having one common definition, structured boundary objects visualise actors' input in a comparable format to facilitate

knowledge sharing. The chapter assesses the benefits and challenges of using structured boundary objects in stakeholder processes to support meaningful stakeholder engagement. It describes the functions of boundary objects and, for the case, how the decision support tool provided these functions. It then discusses how the boundary objects represent stakeholder perspectives and how the findings inform our understanding of the trade-offs implicit in sustainable livestock production.

Chapter five, *“Letting conflict work for us - learning from differing perspectives on sustainable livestock production in Africa”*, uses a lens of constructive conflict to analyse when and how diverging perspectives in multi-stakeholder social learning workshops lead to productive conclusions. Drawing together insights from social learning and participation literature on designing enabling spaces for learning with literature on interpersonal conflict in groups, teams and stakeholder dialogues, it builds an analytical framework for assessing the factors contributing to constructive conflict in stakeholder dialogues. It answers research question three, and its findings contribute key insights for answering research question four. It illustrates the use of the framework by describing moments of diverging perspectives from each case study site, assessing them with the framework to understand what influenced the emergence of the conflict, how it evolved and how it was concluded. It then discusses how conflict opened up and closed down opportunities for learning and offers recommendations for practitioners on using the framework to design learning processes that invite constructive conflict.

Chapter six draws conclusions from the three results chapters to answer the overall aim of the thesis, discussing five insights that reflect cross-cutting themes of structure, design and facilitation. The five insights are discussed in relation to the literature in chapter one on knowledge production and use in political ecology and broader literature where relevant. Taken together, they produce an argument that boundary objects in a structured process and a spirit of respectful debate that fosters constructive conflict come together to create the space to articulate and challenge perspectives, and thereby support constructive discussions and learning. Then, chapter



seven gives a brief summary of the chapters and draws out the contributions of the thesis. It concludes with reflections on the research process and limitations that arose, as well as recommendations for future directions of this research.

## **1.7 Literature review**

The diverse field of political ecology was chosen to support this thesis because it highlights the multitude of social, economic, historical, cultural and political aspects that influence life choices in addition to the environmental aspects that an environmental impact assessment resource researcher might typically consider. Furthermore, it has a lot to say about individual agency, and knowledge production and use, which are key factors in a learning process. In the development literature, particularly in relation to natural resource management and agriculture, political ecology represents several disciplines<sup>2</sup> who share political ecology's interest in critically analysing the context behind a particular issues, to understand the relationship between economics, politics and nature to create productive, but sustainable landscapes (Robbins 2012, p.13). This emphasis on unveiling alternate readings of the knowledge wielded in environmental management decisions makes political ecology a good reference for what should be taken into consideration in inclusive social learning processes.

Political ecology has accumulated a valuable toolkit for analysing the multiple inter-linked dimensions of a context, both locally and situating it within a broader regional context (Birkenholtz 2012). The construction and politics of knowledge and use of scale as a socially-constructed variable have been recommended to other fields, for example for enhancing the analysis and understanding of social-ecological systems (Cote and Nightingale 2012; Ingalls and Stedman 2016) and socio-technical transitions (Lawhon

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<sup>2</sup> Disciplines represented in the field include anthropology, forestry, development studies, environmental sociology, environmental history and geography.

and Murphy 2012) by allowing an analysis of power and social processes in otherwise more environmentally-focused work.

Three themes are particularly interesting for bridging knowledges in social learning, although they are inter-linked. In particular, the historical influence runs through the production and use of knowledge and scalar processes.

- i) The *production and use of knowledge(s)* and discourses. This is important because it sets the stage for how a situation is interpreted (in the case of a development intervention, how the ‘problem’ and the ‘solution’ are defined and presented), what story gets told and acted on, and what opportunities there are for altering it
- ii) Understanding *scalar processes*, and implications for distribution. This is important for realising that impacts are not uniform – although it is easy to talk of units, such as considering the national or town or district as one unit, they are not. One needs to consider the distribution of access, allocation, voice and effects within and among units.
- iii) Exploring *history* and culture, to identify the ‘historically and culturally situated storyline’ that produces the day-to-day backdrop, including environmental change, institutional setting, cultural setting.

For this thesis, the production and use of knowledge are most relevant, but scale and history cannot be dissociated from knowledge production and use and are therefore included for the broader theoretical background they provide.

### **1.7.1 Brief history of political ecology**

Political ecology explores how environmental management decisions come to be made, who the outcomes affect and how, revealing aspects of the ‘context’ at regional, national and global level that influence or explain individual actions and impacts related to the environment at a local level. Ingalls & Stedman (2016) sum up political ecology effectively in two core assumptions: “(1) *that there is an unequal distribution of both the costs and benefits associated with environmental change, which reproduces the structural power asymmetries that were the cause of these differential distributions; and relatedly, (2) environmental degradation is both the cause and result of social marginalization, wherein asymmetrical relations of power exacerbate degradation through pressures of production on the natural environments of the poor and powerless*”. It is a vast field, but several works provide a good overview (Bryant 1998; Forsyth 2003; Perreault et al. 2015; Robbins 2012; Robbins and Monroe Bishop 2008; Turner 2014; Turner 2016b;

Walker 2005; Walker 2007). Political ecology draws on diverse theories and epistemologies including neo-Marxism, post-structuralism and post-modernism (Lawhon and Murphy 2012). Foucault's (1980a) work on knowledge and power marked a significant shift to post-structuralism. Over time, political ecology has explored how global economic drivers prompted 'mis' management of natural resources (e.g. Blaikie 1985), how power relations between peasant farmers and the elite, and within households mediate human-environment interactions (Bryant 1998), and how scientific 'facts' are constructed (Peet and Watts 1996; Peet and Watts 2004). Arturo Escobar made significant contributions from anthropology to developing a 'post-structural political ecology' (Escobar 1996a; Escobar 1996b), which has become a core pillar of political ecology. Escobar argued that if beliefs and ideology shape how we see the environment (Escobar 1996a), then the discourses<sup>3</sup> of degradation, biodiversity and development in South America for example could be traced to the industrialised, and external, perspectives of the international actors getting involved (Escobar 1995; Escobar 1996b; Escobar 1998). Linked to Escobar's work, Braun and Castree developed the concept that nature is socially constructed (Braun and Castree 1998; Castree and Braun 2001). Similarly, acknowledging that knowledge is shaped by the epistemology of those creating it means recognising that it is subject to cultural politics influencing what is knowledge and how it is produced (Bollig and Schulte 1999; Flynn 2007; Hajer and Versteeg 2005). Together, these conceptualisations of knowledge call for recognising knowledge to be local and situated, and therefore there can be a multitude of 'truths' (Adriansen 2008; Nygren 1999). For example, an "environmental problem" is only a problem if it is perceived to be so (Robbins and Monroe Bishop 2008, p.748). Drawing on insights from science and technology studies, Forsyth (2003) and others

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<sup>3</sup> Dryzek (1997) defines discourse as: "A discourse is a shared way of apprehending the world. Embedded in language, it enables those who subscribe to it to interpret bits of information and put them together into coherent studies or accounts. Each discourse rests on assumptions, judgements, and contentions that provide the basic terms for analysis, debates, agreements and disagreements, in the environmental area no less than elsewhere." (Dryzek 1997, p.8)

explore the production, use and spreading of knowledge (Forsyth and Walker 2008; Goldman et al. 2011; Kull 2004; Robbins 2007).

A rich area of research grew around the idea of questioning whose knowledge was used to define the 'environmental problem', and what factors were assumed to be important (Bryant 1998; Little 2003). It raised the importance of taking local indigenous knowledge<sup>4</sup> into account to understand the complexity and diversity of local situations (Leach and Mearns 1996). Scholars such as Agrawal (1995) and Forsyth (2003) proposed a hybrid approach to incorporate 'scientific' and 'local' knowledge where possible, and one can find examples of where the 'indigenous' knowledge or resource users' knowledge is as good or better than that of scientists' (Johannes et al. 2000; Oba and Kotile 2001). However, one should not romanticise indigenous knowledge. Indigenous knowledge should not be used without question because it is patchy, not necessarily representative and can be mis-interpreted when taken out of context because it is tied to the epistemology creating it (Briggs 2005; Opstal and Hugé 2013; Reed et al. 2008). From anthropological cases, Sillitoe (1998) noted that while 'scientific' and 'local' knowledge are different, placing priority on one or the other should not be automatic - 'scientific' knowledge is just as socially constructed as 'indigenous' knowledge (Briggs 2005).

A related anthropological insight from Vayda and Walters (1999) was the critique of political ecology for always assuming that there is a political explanation. They showed that sometimes environmental variation and suitability provides a better explanation than politics and cautioned political ecologists to be open to other explanations (Vayda and Walters 1999). From rangeland ecology came a similar insight, that there is natural and historical change in the environment, which can be shaped by society, but which shapes society in turn (Scoones 1999), thus urging political ecologists to consider ecological processes as well as social processes. Thus a plurality of vision is valuable

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<sup>4</sup> I try to distinguish between 'local' and 'indigenous' knowledge, assuming that 'indigenous' is one type of 'local' knowledge.

when studying the contexts of environmental management (Leach and Mearns 1996)<sup>5</sup>; Escobar called for 'pluriversal studies' to recognise the plural ontologies and visions of sustainability (Escobar 2011). Andrea Nightingale brought social, cultural and ecological strands together, analysing the "shifting, dialectical relationships between social and power relations, cultural beliefs and practices, and ecological processes to allow an interdisciplinary, complex assessment of social and environmental change" (2003b), also promoting a pluralist research approach (e.g. Nightingale 2003b; Nightingale 2015).

Scale in political ecology has been actively debated, from a concern about putting too much faith in the local scale, whereas political, economic, cultural and ecological processes operate simultaneously at a range of scales (Brown and Purcell 2005; Herring 2001; Mohan and Stokke 2000; Zimmerer 1994). Rather, Brown & Purcell (2005) suggested that scale is also socially constructed, and therefore it is worth investigating the social processes that negotiated a scalar arrangement and keep it 'fixed'; although, if scale is socially constructed it is always open to be reconstructed and is therefore malleable (Brenner 2001; Green 2016; Neumann 2009). Geographers reached out for insights from Bruno Latour's actor-network theory to propose a hybridity thesis to conceptualise how human and non-human agents exert their power as part of scientific, economic and political networks, rather than using Blaikie & Brookfield's (1987) 'chain of explanation' approach – the hybridity thesis would allow political ecologists to mix the insights of historical analysis with network thinking to explain relationships and power dynamics better (Rangan and Kull 2009; Robbins 2012). Rangan and Kull build on Sayre's work (Sayre 2005) considering how the construction of scale affect the perception and implications of change and difference, and therefore propose that "scale is produced by three moments of action: operation (Sayre's

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<sup>5</sup> Andrea Nightingale's use of situated knowledge to propose that climate change adaptation research use plural epistemologies and hybrid methodologies is very relevant, but outside political ecology (Nightingale 2015)

ontological moment), observation (Sayre's epistemological moment), and interpretation (the moment of translation)" whereby the moment of translation is the point at which researchers create a link between their epistemology and ontology.

### 1.7.2 Production of knowledge

*"According to Arturo Escobar (1995), discourses are produced within particular epistemological and cultural conditions, which articulate upon given historical situations." (Guthman 1997, p.46)*

Foucault's 'Truth and Power' raised that 'truth' is generated by the social systems and practices that maintain it, so "Every society has a regime of truth: that is, the types of discourse that it accepts and makes function as true." (Foucault 1980b, p.131). In environmental research, therefore, it is not enough to understand the linked social-ecological system but also how our understanding of that system was formed. What are the scientific, government and local accounts that contribute to stories about social and environmental conditions, and who is behind them, which state institutions, media companies, experts, and even families are supporting them and giving the stories power? *"How do specific ideas about nature and society limit and direct what it is taken to be true and possible?"* (Robbins 2012, p.70). From this perspective, the realist ontology of causal chain analysis restricts it from understanding the negotiations behind the political and economic structure that it reveals. A rich body of case studies in the 1990s explored these questions, producing evidence that the story on the ground was not as simple as the common-knowledge storylines of social-ecological interactions that had become (and to some extent still are) 'received wisdom'. Two aspects of knowledge production emerge – how knowledge is produced within research, and how research knowledge is produced or commissioned for actors outside of research.

### 1.7.2.1 *What are the discourses?*

By viewing the concepts that we call environmental 'problems' as historically produced discourses, rather than as objective phenomena, you can reveal the networks of actors benefiting from the actions presumed to be needed by the discourse and what has been concealed by the discourse (Escobar 1998) (drawing on science and technology studies and actor-network theory). For example, in biodiversity conservation, Escobar (1998) identified four ways of viewing and defining biodiversity conservation, which is to say four discourses of biodiversity conservation. The first two, the globalocentric and sovereignty perspectives of resource management, are produced by dominant global institutions such as the World Bank and international organisations, and embody Western ideals of market economics such as capital, individual accumulation and protecting that through intellectual property rights. The focus is on the symptoms (biodiversity loss) rather than the causes, offering prescriptive solutions including scientific research, international planning for conservation and economic mechanisms for compensation and 'protection'. Some see these two discourses as a form of bioimperialism, and advocate instead two discourses arguing (bio)diversity is cultural as well as biophysical, that identity is linked to territories and the associated diversity: biodemocracy from progressive southern NGOs and cultural autonomy, a social movements perspective. These discourses call for collective rights instead of (individualistic) intellectual property and for a halt to capitalist activities that are the cause of destruction.

In another example, Adger et al. (2001) explore cases of four global environmental challenges, deforestation, desertification, biodiversity use and climate change, and find that in each case there are broadly two global discourses explaining the so-called problem. On the one hand, a global environmental management discourse cites the local smallholders or peasants as the cause due to their over-exploitation of resources. On the other hand, a populist discourse cites the smallholders and peasants as victims of multi-national companies and international consumer demand that drives the local

actors to take destructive and extractive action. In all cases, the situation on the ground revealed more complex political ecology that did not fit either global discourse.

Environmental management solutions are built from the policies and the underlying science that created the discourse. For example, the global environmental management or globalocentric discourse holds that only global agreements, with international programs often in association with external interventions and strict regulations controlling resource use can combat desertification, deforestation and climate change. But, following the idea that for the globalocentric discourse the science, policies and solutions are narrowly constructed, intentionally or not, from ideas external to the site of the 'problem' (and often Western ideas), they tend to benefit selected proponents and are thus interwoven with power relations. As many case studies in forestry (Jewitt 1995; Peluso 1992), soil conservation (Guthman 1997; Rocheleau et al. 1995; Tiffen et al. 1994) and biodiversity use and conservation (Campbell 2007; Neumann 1992; Neumann 1997) show, the solutions benefit the state and other powerful actors more than the local people affected by changes in the resource use (more on this in Section 1.7.3. *Use of Knowledge*).

#### *1.7.2.2 What is the 'evidence' and the associated story?*

Taking a step back, what are the 'facts' supporting these discourses and how were they created? Four points are picked out here. Firstly, directly or indirectly, a researcher's discipline affects what insights are revealed (and which are not). Second, this means that those commissioning knowledge production influence the outcome with their choice of who does the research. Thirdly, 'scientific' knowledge is not the only 'evidence' out there. Finally, there is always an element of uncertainty in data, but if the story is compelling, this can be forgotten.

One's discipline and the prevailing concepts at the time influence which questions are asked, which methodology to explore them, which indicators are used, and which factors are considered important (Forsyth 2003; Little 2003). These are implicitly



guided by one's epistemology, with different "understandings of causality and explanation, what constitutes evidence, the value of quantitative and qualitative research methods, and other paradigmatic issues that can be difficult to reconcile (Evely et al. 2008; Mollinga 2010a). Likewise, the choice of temporal, spatial, or quantitative dimensions used focus and bound the research (Ahlborg and Nightingale 2012). These choices, subconscious or not, affect what conclusions are drawn by scientists – and what remains undiscovered. For example, revised thinking and research in rangeland ecology drawing on the new dynamic equilibrium concepts suggested that earlier studies could not have known what 'over-grazed' and 'desertified' was as they used the wrong vegetation indicators and did not take into account climate variability and long-term vegetation changes (Little 2003). As a result, rangelands were deemed 'fragile' whereas in fact the extensive, mobile livestock management of pastoralism was later found to be inherently resilient, having evolved to deal with the climate variability (Behnke and Scoones 1992; Little 2003; Scoones 1999). Similarly, in modelling for environmental management, it has been found that there is often a mismatch in perception of what the modellers think is useful and important to measure, model and present as results compared to what the users want (Dewulf et al. 2005; Mollinga 2010a). As Forsyth (2003) argues, the implications are that *"many environmental policies will not address underlying biophysical causes of environmental problems; second, many environmental policies will impose unnecessary and unfair restrictions on livelihoods of marginalised people"* (Forsyth 2003, p.11).

In a more practical sense, the creation of knowledge, including research, is an inherently 'political and institutionalised process' due to the choices made in setting agendas for funding, the framing of problems and research questions to fit in with the support provided for research and the political or strategic motivations in choosing how to implement research or selecting what research results to share to inform policies (Clay and Schaffer 1984; Kerkhoff and Lebel 2006; Vogel et al. 2007).

Knowledge governance seeks to understand what is considered 'valid' knowledge (credible, salient, legitimate) in different social-political contexts, and understand what

rules, norms and values influence how knowledge is produced, shared, accessed and used (Clark, Kerkhoff, et al. 2016; Kerkhoff 2014; Kerkhoff and Lebel 2006; Vogel et al. 2007). Types of knowledge have been characterised in several ways. Very common is the separation between scientific knowledge created from research, assumed to be generalizable with universal significance, and indigenous knowledge which is tested by the need to survive and therefore more meaningful in an everyday context (Briggs 2005). Another way to look at it is academia, teachable and abstract knowledge (episteme, 'know-why') compared to practical knowledge which is a combination of knowing how to do the job, to implement the abstract knowledge (techne, 'know how'), and "ethical and political-practical knowledge (phronesis), which relates to the ability to know what makes a good end and a viable, morally defensible path toward that end" (Fazey et al. 2018 citing Aristotle; Reed 2008). There are also critiques of the way knowledge is considered a product in technical, positivist traditions, arguing instead that knowledge is socially constructed, information that comes to life when interpreted through individuals' and groups' experiences and worldviews, similar to how traditional knowledge is closely tied to culture and history (Opstal and Hugé 2013; Berkes 2012).

One can also question the certainty of evidence, scientific or otherwise, that was used to legitimise environmental policies. For example, biophysical science is often used unquestioningly without taking account of uncertainties and limitations in what variables were taken into account (Forsyth 2003; Guthman 1997; Stott and Sullivan 2000). This is particularly important when the conclusions provide compelling storylines that support particular claims (Kenworthy 1997; Leach and Mearns 1996). Scientific evidence is usually a simplification of any given situation, providing a selected representation of reality, endorsed by and supporting certain power relations (Escobar 1995).

For example, an early work by Erik Eckholm in Nepal explained that deforestation for fuelwood destabilised the slopes in the Himalayas causing more soil erosion and silting of the rivers and therefore more flooding – despite being rooted in very little data

(Eckholm 1976; cited in Guthman 1997; and Ives and Messerli 1989). Yet, the storyline had a logic that resonated with international aid programs and other scholars and was used to support several eras of development interventions (Guthman 1997). The scholars realised the insufficiency of the storyline, but found that further scientific evidence was ignored or re-interpreted to support the development discourses; “the facts about environmental deterioration have become subordinate to the broader debates on the politics of resource use and sustainable development” (Guthman 1997).

Similar examples abound in rangeland science. Rangeland research in the 1970's, inspired by Garret Hardin's *Tragedy of the Commons* (1968), espoused that the large herds of local animals, managed by mobile grazing of open access, communally managed rangelands was causing overgrazing to the extent of being severe environmental degradation (Bollig and Schulte 1999; Homewood 2014). The storyline of desertification goes back further, to the original colonists perceiving the advance of the Sahara southwards due to increasing population, reinforced by Lamprey's vegetation comparison (Adger et al. 2001). This evidence provides support for the social theory that local people, including pastoralists, could not manage their land, and instead enclosure and external management that excluded pastoralists was required to protect the natural savanna environment which became idealised in Western minds (Blaikie 2006, p.1948; Bollig and Schulte 1999). This research was subsequently countered by ecologists in the 1980s and 1990s, who argued that the drylands are a variable system, and that fluctuations can be equally, or more, attributed to climatic variability than to human influence; and that the concept of carrying capacity had been poorly used (Adger et al. 2001; Behnke et al. 1993; Bollig and Schulte 1999). Ecologists pointed to the flaws in Lamprey's studies – he compared the state of the Sahel at the end of a very wet period (1950s) with the state at the end of a very dry period (1970s) (Adger et al. 2001). Anthropologists showed that the dynamic and flexible lifestyle, herd management and social institutions were adapted to the variable ecology of the drylands and based on a wealth of indigenous knowledge of the local environmental processes (cited in Bollig and Schulte 1999; e.g. Homewood and Rodgers 1989). With

the new, dynamic ecology, it was shown that the drylands where Africa's livestock are typically located are actually in a dynamic, non-equilibrium driven mainly by drought, and that livestock numbers adjust to the dry periods (Scoones 1995). As such, livestock grazing was shown to have less effect on long-term grass production than the fluctuations in rainfall. Secondly, as a dynamic system, the rangelands are patchy in space and time, meaning that the flexible movement of pastoralists – who 'follow the grass' – is critical (Behnke et al. 1993; Sandford 1995). This also means that the enclosures of the 1970s were flawed, because they limit the flexibility needed to make the most of heterogeneous production of the rangeland. Yet a study of rangeland management in Botswana showed that despite the evidence against such simple storylines, in this case the tragedy of the commons, policy change is not always automatic, if following the initial discourse and its supporting evidence suits the purposes of the policymakers (Blaikie 2006, p.1947).

#### 1.7.2.3 *Who supports the story and makes it 'the truth'?*

*"The facts, then, are not the issue, but rather, who has the power to claim they are facts." (Guthman 1997; citing Escobar 1995)*

Acknowledging that knowledge is shaped by the epistemology of those creating it means recognising that it is subject to cultural politics influencing what is knowledge and how it is produced (Bollig and Schulte 1999; Flynn 2007; Hajer and Versteeg 2005). While '*whose knowledge counts?*' is an obvious question, Ingalls and Stedman (2016) raise three further questions. First, '*who gets to decide whose knowledge counts?*' which links to representation in decision-making and control over knowledge. Second, '*who wins and who loses from the decision?*' which links to the sociology of human-environment interactions. And finally, '*what are the political implications of the decision?*' which prompts analysis of whether there are other power structures that may erode the success of a proposed solution. As Rocheleau found, "[t]he history of crisis construction and resolution by outsiders, juxtaposed with the diverse experience

of people within the region suggests that simple solutions to single problems may actually create new crisis, [locally] and elsewhere.” (Rocheleau et al. 1995)

Interdisciplinarity and integrating knowledge is commonly proposed in order to address the narrowness of previous forms of knowledge production, but comes with challenges of bringing together the assumptions of different epistemologies not only between natural and social science but within each; researchers will have different views on what information is acceptable as data and how much data is needed to produce an understanding, but will also collect data that illuminates different questions, making it difficult to combine. Positivists seek observations to create an approximation of the real world whereas subjectivists seek to understand the process by which the observed ‘real world’ was created by the collection of individuals acting or reacting to their lived experience and interaction with others (Bardhan and Ray 2006; Evely et al. 2008; Mollinga 2010a; Raymond et al. 2010). Then there are the challenges of bringing together the generalizable, abstract scientific knowledge with the local, experiential and sometimes fragmented indigenous knowledge – particularly for those who do not trust the knowledge that comes from a different epistemology to their own (Berkes 2009; Berkes 2012; Reid et al. 2006). Goldman (2007) proposed ‘building dialogue’ rather than ‘building bridges’ between different knowledges – by mapping “the ‘situated knowledge’ or ‘knowledge spaces’ embodied by Maasai and conservation scientists” (emphasis in the original) to see where the two meet. In this way, one can identify the strengths and weaknesses in each knowledge type.

But also, following the idea that everyone has their own worldview, and interprets the experience of others through their own worldview, therefore it implies that the researcher is always re-interpreting others’ worldviews through the researchers’ worldviews (Opstal and Hugé 2013). As such, it is important to do research with the subjects, for example in a collaboration, to avoid the danger of past positivists and colonialists who implicitly subdued the voice of the subject by interpreting their findings and writing up their research experiences through the researcher’s world view.

Boundary work, boundary organisations and bridging organisations emerged to address the challenge of bringing knowledge together across diverse worldviews, epistemologies and knowledge systems (Berkes 2009; Mollinga 2010a). Boundary work explicitly recognises that knowledge is translated and transformed when it passes from one actor's domain to another (Berkes 2009; Clark, Tomich, et al. 2016; Oswick and Robertson 2009). It is also aware of the importance of politics of expertise and context in the process – for example, handling different agendas that might clash, or deciding what knowledge is credible. Similarly, there is power involved in choosing which information to share or not (Oswick and Robertson 2009).

### 1.7.3 Use of knowledge

*“Knowledge is not power, it is only potential. Applying that knowledge is power. Understanding why and when to apply that knowledge is wisdom!” Takeda Shingen*

Or, in other words, power is not just knowledge, power is the ability to use one's knowledge – this speaks to the person recognising the value of his/her knowledge, but also about others recognising his/her knowledge as valid and letting them take part and contribute. As mentioned earlier, studies of postcolonial resource management show the historical (colonial) influences in the discourses of environmental problems, with an interest in providing resources to international or imperial market. The desertification and deforestation discourses have roots in research done during colonial times that took hold because the solution was enclosure and privatisation (Adger et al. 2001) – benefiting state enterprises such as forestry (Bryant 1997; Guha 1989; Peluso 1992) and ranching (Blaikie 2006; Peters 1994). For example, the colonial system of 'scientific forestry' in South-East Asia 'protected' forests by turning to commercial forestry, keeping species preferred by international markets and weeding out other, locally relevant species, also closing off the forest to other local uses of

forests. This was a driven transformation in the social and ecological conditions, building a discourse of 'progressive modern forestry' in which local activities were designated as 'ecologically bad' and 'illegal' – in all ways stamping out the rights of the local residents to use the forest resource (Bryant 1996). The result was to legitimise the new concept and de-legitimising the old knowledge and practices. As Bryant (1998) reviews, the discourses have been maintained in postcolonial times, and indeed, resource extraction in third world countries may even be said to have intensified as demand for resources for 'modernisation' and individual and group wealth grows.

Leach & Mearns' (1996) and other collections of case studies provided evidence that challenged the 'received wisdom' of simplified storylines and discourses, including that desertification in the tropics was caused by overgrazing and related anti-pastoralist views (e.g. Behnke et al. 1993; Swift 1996; Thomas and Middleton 1994), that deforestation of woodlands for woodfuel was a key challenge in forestry (see Doherty 1990; Fairhead and Leach 1996; Jewitt 1995; Leach and Mearns 1988; Munslow 1988; e.g. Peluso 1992), that population growth exacerbates soil erosion and conservation measures are needed to rehabilitate the land before further use (Guthman 1997; Rocheleau et al. 1995; Scoones 1997; Stocking 1995; e.g. Tiffen et al. 1994; Zimmerer 1996), and the discourses around biodiversity use and conservation (Campbell 2007; Neumann 1992; Neumann 1997). The cases highlight how such simplifications do not explain the diversity and variability of local situations, provide unhelpful solutions or ones that have not taken into account feedback loops and typically that have not taken into account the social framing of the problem. They may not take into account the history that shaped the landscape or the impact on the people on the ground, and miss the opportunity to engage local indigenous knowledge for locally-relevant understandings and solutions (Escobar 1998; Forsyth 2003; Leach and Mearns 1996; Stott and Sullivan 2000). Mollinga (2010b) describes this as the 'clamours and silences' in the debates about natural resource management, illustrating with the case of agricultural water management in India. The simplified storylines or 'strategic essentialism' are easily reproduced by media and debates and therefore easily

sustained, creating a 'clamour' – and in some cases, holding to the storyline is required to support one's claims despite evidence to the contrary. For example, the 'traditional' water control systems in India that have been glorified as the answer to the imposition of destructive technocratic modernisation (also an essentialism) despite "extended, detailed and devastating academic critiques" (Mollinga 2010b; citing Mosse 2003). On the other side of the coin are the analytical reductions, the "one-dimensional abstractions from complex realities" that create the simplifications, which in doing so create silences that hide all the aspects that are not selected – in the Indian case, the focus on the function of local, community institutions leaves the functioning of the national state unquestioned and therefore unaffected by the debate and able to continue with business as usual (Mollinga 2010b). In doing so, using popular, entrenched narratives discourages plurality of vision in exploring contexts (Kenworthy 1997; Leach and Mearns 1996). The outcome is that where old paradigms are used to create policy, for whatever reason and even in face of new evidence, it can perpetuate rather than solve the (perceived) problem. For example, rangeland management policies are still based on equilibrium models, for which the answer is enclosure, rather than acknowledging the dynamic and variable nature of the system (Blaikie 2006; Little 2003; Boles et al. 2019). A similar example in Burkina Faso shows how sedentarisation is the preferred policy which is supposedly in the better interest of the pastoral people, yet by not taking into account changes in land use in rural areas, the policy cuts pastoralists off from more productive and sustainable pastures (Gonin and Gautier 2015). Another example critically analyses how labels, as interpretations of a set of symptoms and indicators that are context and narrative specific, have been used to support policy agendas (e.g. Bergius et al. 2020). Overgrazing and degradation are labels that have long been (contentiously) applied to pastoralists. Bergius et al. (2020) describe how, when used in conjunction with a narrative of ecosystem conversation, the degradation label could be used to justify removing pastoralists from an area, despite the underlying agenda being to make way for cropping.



To those studying knowledge systems, the analytical reduction is typical for the scientific system with the epistemological assumption that phenomena can be rigorously observed, and facts can be abstracted to broad generalizable concepts - and thence to the popular discourses which are assumed to be equally relevant in other locations. While 'scientific' knowledge is often conflated with a 'Western' knowledge system that is set in contrast to indigenous knowledge systems, we should not forget that all are in fact a type of local knowledge, each embedded in their own cultural tradition and history that influence how individuals view and interpret their environment (Sillitoe 1998). Removing the presumed primacy of (Western) scientific knowledge over other types of local knowledge, opens the door to recognising that other knowledge systems may have solutions, for adaptive management or governance of natural resources for example (Berkes et al. 2000; Berkes 2012). If farmers can 'pick and choose' from both Western and indigenous knowledge according to what suits their needs (Briggs 2005; Millar and Curtis 1999; Vanclay 2004), why not researchers, practitioners and decision-makers?

Indigenous knowledges are often more overtly "a social product closely linked to a cultural and environmental context" (Briggs 2005; citing Homann and Rischkowsky 2001), and therefore understanding or applying indigenous knowledge explicitly requires the researcher to understand the socio-economic, cultural, political context in which it is embedded, because that is the frame of reference (Briggs 2005). Yet this should be assumed to be true for any 'research findings' or opinions or perspectives raised, regardless of the knowledge system, that to understand any observed or perceived changes one needs "[a] good understanding of the dynamics of social and environmental systems and their interactions" (Mahanty et al. 2007). Opstal and Hugé (2013) go further and propose that any knowledge that has been taken out of the social and cultural context in which it was produced, such as the knowledge collected or produced by modern, positivist tradition, should be considered as 'dead'; it has been decontextualised, removed from its context and therefore unlinked from its meaning. Such knowledge is just information in a database that is there for someone else to pick

up – and when they do so, they will interpret it using their values, understanding and worldview, relating it to their experience and therefore giving it life again – but probably a different life to when it was collected (Opstal and Hugé 2013).

However, there are also caveats to be aware of. Simply because an indigenous knowledge exists does not mean that it is necessarily correct or unproblematic at the local level (Watts and Peet 2004). For example, whose knowledge counts when indigenous knowledge is variable across a location, with gender, age, occupational and other stratifications “and the interpretation that people put on shared knowledge may differ, depending on how it affects their interests” (Kapoor 2002; citing Scoones and Thompson 1994; Sillitoe 1998, p.216). As mentioned before, trying to extract rigorous knowledge that can be transferred (for academics) misses the point that indigenous knowledge is meant to be tailored to the local context, which is not transferrable (Briggs 2005). Reed et al’s (2008) study of land management knowledge showed that “local knowledge cannot be accepted unquestioningly” – although most indigenous knowledge indicators were validated, “they were not always sufficiently accurate or reliable for objective degradation assessment”. A third challenge is that ‘indigenous’ is not a helpful label, as it implies folk-lore, subjective - and most farmers do not necessarily have a pure ‘indigenous’ knowledge but rather a “hybridized, mediated and local” because they are pragmatic and use what information makes economic sense to use, and will continuously adapt it with new technical input from outside combined with practical experience of how it works when applied in their local context (Briggs 2005; Millar and Curtis 1999; Vanclay 2004). Yet, local indigenous knowledge remains a valid contribution. Goldman (2003) suggests that we should move on from trying to identify differences between indigenous and scientific knowledge and start working on how to make the two work together.

Escobar, Nightingale and others have encouraged using a plurality of vision and discourses in research as a way to do integrative research (Escobar 2011; Nightingale 2015; Miller et al. 2008; Healy 2003). For example, this would include considering social-politics of knowledge as a starting point, rather than the biophysical parameters,

emphasising that neither starting point is better, just different. Starting with socio-politics may reveal that a slightly different set of biophysical dimensions are important than if biophysical change was assessed first. The two starting points are equally valid, and each contribute complementary insights - just “situated and partial viewpoints” (Nightingale 2003a; Nightingale 2015). Nightingale (2003a) translated Donna Haraway’s influential concept of ‘situated knowledge’ (Haraway 1988; Haraway 1991) for geographers, as a methodological approach to understanding the partiality of knowledge to hold in view the epistemological and ontological tensions between different ways of conceptualising a research problem (Nightingale 2003a).

Finally, a cautionary reflection from pastoralism studies is to be aware of how others will make use of the knowledge we produce, in Turner’s study of resource conflict in the Sahel (Turner 2004). Unpicking the motivations of the actors involved in the conflict, he found several layers of motivations. It was not often a ‘simple’ conflict over resources, but the outcome of social tensions and “orchestrated actions for higher political purpose”; and an example of research findings may be re-packaged and used for different purposes. Although political ecologists have a more nuanced understanding of what they research, once material is published it can be selectively used and re-framed by others.

#### **1.7.4 Scale**

Understanding *scalar processes*, and implications for distribution of knowledge, power, influence and impacts is important for tracing unexpected linkages and interactions in the ‘causal chain’, and for realising that impacts are not uniform. Neumann (2009) summarises how scale has been theorised in political ecology and draws three themes from the collected work “(1) the interactions of power, agency, and scale; (2) socioecological processes and scaling; and (3) scaled networks.” (Neumann 2009, p.403). Yet, he acknowledges that there is still widespread conflation of terminology when talking about scale, especially as the work on scale is only a narrow sub-set in

such a broad field as political ecology. Key works have advanced the consideration of scale in political ecology by borrowing from ecological concepts (Sayre 2005), biocomplexity studies (Manson 2008), environmental movements (McCarthy 2005) and the co-production of nature and society (Swyngedouw and Heynen 2003).

Manson (2008) proposes that there can be no one definition of what scale is or how it is used in human-environment systems, because the systems are complex, but more because there are several epistemological approaches to scale. Manson (2008) describes the continuum “from the realist contention that there are natural scales independent of observers through to the constructionist view that scale is subjective and socially mediated” (Manson 2008, p.776). At one end, the realist approach focuses on: i) resolution and extent; ii) the scale of observation and scale of explanation and which are the best scales for data collection or building theory respectively; iii) scale dependence and iv) scale variance/ invariance. In the middle, the hierarchical approach allows for more complex cross-scale interaction than realists, considering: i) inclusive and exclusive hierarchies; ii) upscaling and downscaling, looking at how things are linked to higher or lower levels, such as problems of aggregation, and the problem that fixed scalar levels (e.g. watershed) do not map onto all important processes. The realist approach draws solutions from hierarchy theory in considering constraints for bounding and defining levels of scale, so the levels are defined by the observer. This is not to say the levels are subjective, because anyone should come to the same definition, but highlighting the role of the observer. Levels do not naturally manifest but are an interpretation by the observer. In setting levels, there is an important distinction between absolute scale (levels are independent) and relative scale (levels are interdependent, have a common measure). At the other end, constructionist perspectives hold that the observers define scale using language and actions and this can affect the real human-environment system. By comparison, in hierarchy and realist approaches, the real world and the environment is immutable. Constructionist perspectives include social construction and re-construction of scale recognising the influence of social and political process on human-environment systems and how

language and scale are used to political purposes to affect how environmental processes are seen, governed and used to legitimise actions. Similarly, they recognise the concept of networks and positionality, saying that a thing can be many scales at once. The variety of approaches to scale allows multiple entry-points to complex human-environment systems, so as well as selecting the most useful or valid scales of observation and explanation, researchers can consider which epistemological approach, or point of entry, will be most useful for exploring their particular issue. As Manson (2008) points out, issues with less influence of human decision-making, such as remote physical systems or cell-level research, are more amenable to realist or hierarchical perspectives. However, issues involving natural resource management are intrinsically tied to social and political processes and should at least be aware of and account for or at best include social constructionist approaches (Sayre 2005).

*Scale is constructed – or at least chosen*

Acknowledging that scale is socially and environmentally constructed addressed concerns about the dangers of localism and the 'local trap', whereby political ecologists assume that decisions made locally, or with input from local stakeholders, will have outcomes that are more socially and environmentally just (Bebbington 1996; Mohan and Stokke 2000; Herring 2001; Zimmerer 1994). Based on theorising in political economy and geography (e.g. Swyngedouw 1997), Brown & Purcell (2005) encourage a more constructionist approach, to consider scale as the object of enquiry rather than just a methodological lens. Simply using scale as a lens, as a realist approach might do, renders scale apolitical (Rangan and Kull 2009). This means investigating which scale is important and why, asking how scale is produced: what are the social processes at play that negotiated a scalar arrangement, which political interests are pursuing which scalar arrangements, what is their agenda, and which actors or concepts are keeping that scale 'fixed', for the time being (McCarthy 2005; Brown and Purcell 2005). Similarly, how scale is articulated, and how it is used to interpret the outcomes of ecological change and spatiotemporal difference in socialized landscapes, has implications on actions taken to address the outcomes (Rangan and Kull 2009).

Although, if it is socially constructed it is always open to be reconstructed and is therefore malleable (Brenner 2001). For example, environmental NGOs have played an important role in constructing the scale at which environmental problems should be analysed and governed – according to their claims of what is right and relevant (McCarthy 2005). The concept of ‘scale-jumping’ illustrates how actors regularly use constructions of scale to their advantage, by shifting the level at which some process occurs in order to secure a desired outcome (Sayre 2005, p.285). For example, where indigenous groups have skipped national levels to align with global organisations where they have more traction to influence actions (McCarthy 2005) or cases of multi-national companies claiming global positioning and freedom from national responsibility but using national and local regulations to take advantage of lower labour or environmental safety standards (Manson 2008). Similarly, community-based forestry management actors in Tanzania manoeuvred to re-organise the scalar arrangements in the political struggles of devolving power to reinforce their role in resource management (Green 2016). These are the ‘scalar practices of social actors’ (Neumann 2009).

Sayre (2005) proposes a way to bridge the more broadly realist approaches to scale in ecology with the more broadly constructivist approaches to scale in (critical) geography to complement both. Critical human geography has explored the socio-spatial categories that are evident when viewing scale as a socially constructed concept, such as local, global or international, that in turn are politically contested and affect social processes such as cultural identities. Yet, critical geographers struggle to find a rigorous methodology to theorise and use scale. Ecology has developed methods and rules for using scale to help analyse complex ecological processes that cross multiple scales but recognises the mismatch between the scales at which human responsibility and natural phenomena work. Based on ecological concepts, Sayre proposes dividing uses of scale into two categories or ‘moments’. First, a more technical category, the epistemological moment, concerned with methods – what is the scale to observe? Scale here is “an attribute of how one observes something rather than of the thing observed” (Sayre

2005, p.280), and is the choice made by researchers of which grain and extent to use, bearing in mind what is not visible with that choice of focus (Turner et al. 1989; Turner 1999). Grain refers to the finest level of spatial or temporal resolution available within a given data set. Extent refers to the size of the study area or the duration of the study (Turner et al. 1989). Second, the ontological moment is about understanding that scale is relational, “as a characteristic of objective relations among processes or among observable levels of organization produced by processes” (Sayre 2005).

Rangan and Kull (2009) build on Sayre’s work, suggesting that “scale is central to the production and representation of spatiotemporal *difference*, and the means by which *change* – be it ecological, social, or economic – is made ‘political’” (Rangan and Kull 2009, p.35). The authors therefore propose that scale is produced by three moments of action: operation (Sayre’s ontological moment), observation (Sayre’s epistemological moment), and interpretation (the moment of translation) (Rangan and Kull 2009). The moment of translation is the point at which researchers create a link between their epistemology and ontology to produce scale. By explicitly considering the choice of operational scale, observational scale and interpretive scale, one can explore the implication of these on how scale is used to frame what is studied and how it is interpreted. Furthermore, exploring ‘knowledge scales’ which describe the “temporal and spatial extent and character of knowledge held by individuals and collectives” can reveal mismatches between actors in the scales of observation chosen or prioritised and the resulting conclusions (Ahlborg and Nightingale 2012; Cash et al. 2006).

#### *Ecological and socio-political processes at different time and spatial scales*

Scales can also be seen as embedded within each other, and that political, economic, cultural and ecological processes operate simultaneously at a range of scales (Brown and Purcell 2005). Engel-Di Mauro (2009) adds from a World Systems perspective, while agreeing that scale is socially and environmentally produced, that political ecology work on scale could benefit from consideration of long-term internal dynamics of systemic processes crossing scales. Also, recognising different time and spatial scales

of social and ecological processes and spatial variability and heterogeneity is important as the scale of observation affects one's conclusions; the dominant processes change as you move across scales, so the choice of scale is a choice of what processes you are interested in (Sayre 2005). For example, Turner (1999, cited in Sayre 2005) showed grasslands in the Sahel were more affected by historical land use than current grazing practices.

As political ecology broadened from a structural, Marxist approach to include post-structural, feminist and critical realist ideas (Khan 2013), so too did ecology evolve from an equilibrium approach (assuming that nature tends to equilibrium and steady states) to a new dynamic ecological thinking that considers history, spatial and temporal variability, dynamics, complexity, and uncertainty (Scoones 1999; Grabbatin and Rossi 2012). Scoones (1999) reviewed three ways in which the new dynamic ecology could enhance social science thinking. The first is in acknowledging the role of environmental change over time in understanding contemporary social-ecological processes in a historical context. The non-equilibrium perspective sees that landscapes and ecological systems are only temporarily stable, particularly if one extends the temporal scale of observation. Incorporating historical environmental change one can see how human processes may have influenced environmental change but were in turn responding to and conditioned by environmental change. Cultural symbols can be traced back to historical environmental changes, reflecting how local society was affected by such change and how they interpreted it (Scoones 1999, p.491).

Furthermore, case studies reveal how landscape change has been patchy with a diversity and complexity in patterns of spatial and temporal change. Secondly, the local environment is both the product of local human actions over time (agency) which may be influenced by national or global structures (or incidents of agency), while at the same time shaping human action over time, to explain how landscapes emerge (Scoones 1999, p.493). Finally, dynamic ecology explores how environmental knowledge is framed and produced when local and scientific knowledge interact in instances such as adaptive management where there is scientific uncertainty (Scoones



1999, p.495). When seeking to understand the context, it is important to consider how institutions and organisations often have an informal and cultural basis. As such, trust within organisations is built on social relations and networks (Scoones 1999, p.495).

### **1.7.5 History and context**

In several of the examples above, the explanation of current institutions or practices lay at least partly in historical decisions and influences. For example, the colonial system of 'scientific forestry' in South-East Asia which turned to commercial forestry, keeping species preferred by international markets, and even in Nepal, a non-colonised country, the advice of British forestry experts was driven by an interest in the commercial value of the Nepalese timber, rather than in preserving and managing the forest ecosystem (Guthman 1997). Similarly, there is widespread agreement that inviting a range of stakeholders to engage in planning and implementing NRM interventions is not sufficient, instead one needs to have an understanding of the context to address the underlying process that will affect how the intervention plays out, including the social, cultural, political, historical, economic and ecological context (Scholz et al. 2014; Stringer et al. 2006).

There are many examples illustrating the unintended and unexpected consequences of having too narrow a focus in implementing 'solutions' – of fixing one thing and causing one or more problems elsewhere, where climatic suitability was not considered, the climatic unsuitability, dismissing the local system without understanding its value, the costs of higher inputs for the higher-yielding species, access to labour, water, and extension networks, the interaction of the intervention with the rest of their livelihood. (e.g. Robbins 2012, pp.50–51; Taylor and Bhasme 2018). These raise questions related to the system that allowed the project to go ahead, who benefited from running the project, what global and national processes influenced the choices made in the project, what happened to the farmers who lost their livelihoods and their land, and who claimed the land.

Many examples arose in rangeland science following the shift from equilibrium to disequilibrium thinking, showing how the shift within a research paradigm broadened the perspective to take in other dynamics and reach new conclusions. In contrast to the initial concept of rangelands as 'fragile' and 'marginal' because they have low and erratic rainfall, they are now seen as inherently resilient because they have to deal with such climatic variability – but can be made fragile by imposing land use on it that is not suitable (Little 2003; Behnke et al. 1993; Behnke and Scoones 1992). In another example, the imposition of conservation rules disrupted and weakened the local regimes of controlling livestock management and causing more environmental degradation (Turner 1999).

#### **1.7.6 Conclusion**

There has been a lot of work on pastoralism, forestry and conservation, but less on using the toolbox of political ecology enquiry to explore the role of livestock in the agricultural sector, and more particularly on the role of livestock in a sustainable agriculture. Given the political pressures to meet conflicting targets of increased food production while reducing environmental impacts, considerations of what knowledge is being produced and used, by who and to support which discourses of livestock and agricultural production is an interesting, and large, question. Even more so when considering the question of scale – the targets of the Sustainable Development Goals and national development policies are at national level. How will that be translated to action on the ground? Several research and development programs are stepping up to offer answers to that – the SAIRLA programme included. There has been a lot of progress on making projects more aware of the context and the diverse knowledges, perspectives and priorities to consider, suggesting a more collaborative and less of a blueprint approach. This thesis explores how social learning facilitates inclusive knowledge production and use, supporting researchers with their narrow academic, theoretical knowledge to interface with the broader, experiential and practical knowledge of local stakeholders to find out what is 'better' or 'more sustainable'.

## **2 Research design, Methodology and Case Studies**

### **2.1 Overview of the study**

The purpose of this research is to critically explore how a social learning process supports inclusive production and use of knowledge. Bridging the knowledges of diverse stakeholders is relevant in a decision support context which needs to produce advice that is locally situated, practically relevant and still able to scale up and speak to policymakers at a regional or national level. The research used a comparative case study of a social learning process carried out in three sites as multiple sequential cases, in order to explore the complex interaction of the many factors affecting design and facilitation of learning processes across three different settings (Ragin and Becker 1992). Given the constraints of following three cases in three countries, this research is not an ethnography. Rather it involved contributing to the design of the two workshops per country that comprised the learning process, participant observation during the workshops, collating the workshop outputs including unstructured reflection on the workshop with group facilitators and conducting semi-structured interviews with a selection of participants following the second workshop in each country. The observations, records of workshop activities and interviews were analysed using thematic analysis according to Braun & Clarke (2006).

As chapters four and five are prepared as manuscripts that can be submitted as journal articles, they each contain their own methods section with details specific to the analysis and data used in each chapter.

## **2.2 Research design**

### **2.2.1 Qualitative approach**

This research uses a case study approach, which offers an analysis of the complexity that is involved in real-life situations (Simons 2009; Ragin and Becker 1992). Case studies allow the researcher to interrogate the interaction and interdependence of multiple, unpredictable variables in a single situation rather than a narrower analysis of a select few variables over many more cases such as is required for predictive, statistical analyses. Particularly in situations involving complex dynamics, a narrower analysis may miss out on what is in fact the key driver in that situation but could not have been anticipated by the researcher due to mismatched world views and asking the wrong question. A case study has two parts, a subject and an object (Thomas 2011). This research studies a series of workshops in Burkina Faso, Ethiopia and Tanzania. This is the subject, a *“practical, historical unity”*, (Thomas 2011, p.513). The workshops are studied as a case of enabling conditions for facilitating learning processes. This is the object, the *“class of phenomena that provides an analytical frame...which the case illuminates and explicates.”* (Thomas 2011, p.513).

The cases are sequential because later workshops were tweaked to respond to learning from earlier workshops (Ragin and Becker 1992).

### **2.2.2 Research philosophy**

The philosophical stance taken in this research is critical realism, which integrates a realist ontology with a constructivist epistemology. That is to say, that I understand the world as a real thing that can be sampled and learnt about but is independent of our interpretation of it, and that we create our understanding of the world using our perceptions, theories and constructions (Maxwell and Mittapalli 2010; Sayer 2000). As such any knowledge is therefore not reality, but a representation of the world that is filtered by our past experiences and the discourses through which we understand the world. Furthermore, the research is informed by the actor-oriented perspective (Long

and Long 1992; Long 2001) which offers an alternative to the top-down structuralist approach to analysing systems such as the agricultural system. The actor-oriented approach takes the perspective of the people (actors) creating, maintaining and perpetuating, modifying or resisting the system through their daily actions, rather than assuming that the system is somehow objectively created and imposed by outside forces such as the national government in an agricultural policy or strategy (Scott 1985; Scott 1990). Such an approach recognises the diversity and complexity of the system, such that the same conditions and interventions produce different responses from one place to another, due to the web of “intended and unintended consequences of human action” (Long 1992, p.272), driven by diverging or converging interests, projects of individual actors and their representations of the world.

An actor-oriented perspective is rooted in ethnography, which this research was not able to do. However, there are a few examples in the literature which support a simpler use of it, from a wide range of fields including development studies (Vennet et al. 2016; Aubert et al. 2018; Chigudu et al. 2018), adaptation studies, disaster risk reduction (Schaer et al. 2017) and Technological Innovation Systems (Jansma et al. 2018). An actor-oriented approach informs the theoretical framework (to focus on actors, agency, social relations) without doing a full actor-oriented analysis of the case that would require using an ethnographic research method and months of fieldwork. Typically, these studies use a mixture of semi-structured interviews of the spectrum of actors, secondary data to provide context and history, and in some cases surveys or focus groups (Vennet et al. 2016; Aubert et al. 2018; Jansma et al. 2018; Schaer et al. 2017; Chigudu et al. 2018).

## **2.3 Methods**

### **2.3.1 Case selection**

This thesis uses the ReSLeSS project as a case, and therefore adopts the same case sites. The ResLeSS project had sites in three countries across West and East Africa –

Burkina Faso, Ethiopia and Tanzania – representing different livestock systems and different climates. They also have different histories of CGIAR value chain development programme intervention. Sites in Tanzania and Ethiopia were selected by the project team to coincide with ongoing CGIAR value chain programme activities. In Ethiopia, given ongoing civil unrest, safety of the project staff was an extra consideration that ultimately determined the site as it was the only one of the nine CGIAR sites that was in a region that was considered high risk by the university travel insurance company. In Tanzania, the site where a prototype CLEANED-R tool had already been developed was chosen. In Burkina Faso, the CGIAR value chain programme was stagnant, and so site selection was based on the advice of the local research partner, INERA, and where they had existing experience and research capacity. Descriptions of the study site locations are in Section 2.5.

### **2.3.2 Data collection**

Data for this thesis was collected during and after the six workshops that comprised the learning processes in the three study countries. Quantitative methods give a tangible measure, but qualitative stories or narratives are also important to capture less tangible outcomes, for example in feedback on what has changed for individuals as a result of the event. If enough qualitative stories of change are gathered, they can accumulate sufficiently to be considered ‘systematic anecdotal evidence’ (Wenger 1999). In a review of methods used to assess learning, in relation to learning by using serious games, den Haan & van der Voort (2018) find that the five most common methods for collecting data are questionnaires, observations, debriefings, interviews, and data logging. In-depth methods include analyzing “*observations during game sessions complemented with analyses of the debriefings and interviews with participants after game sessions*” (Den Haan and Van der Voort 2018; citing Lawrence and Haasnoot 2017). With a constructionist epistemology, the findings from these methods and conclusions drawn are not assumed to be ‘true’, but rather represent the author’s logical interpretation of the accumulated snippets of data, which could change

with the addition of new information or ways of interpreting it (Kincheloe 2005). These situated and partial interpretations are not meant to be extrapolated generically, rather the reader can decide how the findings relate to their own experience and draw their own conclusions on the relevance of the findings to another situation (Arnold et al. 2012).

With this support, the data sources chosen for this thesis were participant observation of the workshops, review of the workshop proceedings, debriefings with workshop facilitators and reflective discussions between workshops with team members, and semi-structured interviews with selected workshop participants after the workshops. The workshops, reporting and interviews took place during six two-week periods between 2017 and 2019.

Participant observations of the workshop discussions and debriefs (unstructured reflective discussions) with the group facilitators and other research team members following each workshop provided an overview of the tone and key points of discussions. Notes from informal reflections with researchers and group facilitators gave insights to the design decisions and revisions made to the structure and facilitation of the learning process. This was an element of participant observation too, as I was part of designing the learning process.

In lieu of transcripts of each discussion, reports by each group's note-taker were compiled at the end of the workshop into workshop proceedings, supplying the detail of what was discussed in each activity. In addition to documenting the outputs of each workshop session, such as the scenario choices, results and evaluations of the socio-economic and environmental implications of those results, we asked the facilitators to observe and reflect on the discussions and activities during the workshop with a critical eye. We asked them to take particular note of similar and diverging opinions, relationships between stakeholders (who is present, who speaks, who does not) and examples of changes in understanding of different perspectives taking place during discussions (through tracing the language used over time).

After the second workshop, semi-structured interviews were conducted with eight to ten participants in each country to have a more in-depth discussion about their experience of the workshop. Interviewees were selected by a local team member to represent one or two individuals from each stakeholder group (e.g. producers, traders, processors, local administrators, local researchers or livestock ministry officials).

### **2.3.3 Participant selection**

Purposive sampling was used throughout to select participants for the workshops and for the semi-structured interviews, with the primary objective to have representation from each type of stakeholder connected with the value chain, and as a secondary objective, to aim for gender balance. Participants were identified by local fieldwork coordinators in each country. In Tanzania, participants were identified based on participation with a prior project which produced a prototype of the CLEANED-R tool, and mostly knew each other from engagement in the Maziwa Zaidi programme (Omore 2017).

For the workshop activities, participants were split into four roughly equal-sized groups in Workshop 1, and these groups were maintained for the first section of Workshop 2. These four groups were homogeneous with respect to stakeholder type, so that members within a group were more similar to each other, in terms of experiences and perspective on the value-chain, than to the members of other groups. Beyond stakeholder type, local coordinators sought to invite females in each category to capture intra-household dynamics, tasks and priorities. Overall, there were more male participants than female and a fair mix of age groups to contribute perceptions on changing culture over time. We did not ask about class and ethnicity. The distribution of stakeholders into stakeholder groups in each country is shown in Table 1.



Table 1: Characteristics of the three study sites of the ResLeSS learning process and distribution of stakeholders into four homogeneous stakeholder groups for the workshop activities.

	<b>Burkina Faso</b>	<b>Ethiopia</b>	<b>Tanzania</b>
<b>Study location</b>	Bama commune, Hauts-Bassin region, Burkina Faso	Atsbi woreda, Tigray region, Ethiopia	Lushoto District, Tanga region, Tanzania
<b>Focus value chain</b>	Cattle	Cattle and sheep	Smallholder dairy cattle
<b>Participants by stakeholder group (# in Workshop 1/# in Workshop 2)</b>	<i>Pastoralists (7/8)</i> transhumant production of livestock NGOs involved with transhumant livestock production <i>Settled farmers (6/6)</i> sedentary production of livestock <i>Processors (7/8)</i> milk processors, cattle fattening, butchers <i>Government officials (9/10)</i> local administration and agricultural extension agents (Chef-ZAT) provincial and regional government representatives Total participants: 29/32	<i>Farmers (8/8)</i> livestock producers, including a community leader and model farmers <i>Traders (11/11)</i> feed supplier, vet, meat and milk processors, hotel manager <i>Local leaders and administrators (4/7)</i> local administration and agricultural extension agents, women's representative, disabled group representative <i>Experts, researchers (7/7)</i> provincial and regional government representatives, regional researchers <i>National level stakeholders (0/7)</i> national level officials from Addis Total participants: 30/40	<i>Farmers (17/17)</i> two groups, representatives of village livestock farmer groups <i>Traders (11/12)</i> feed supply, milk collection and processing, butcher, hotel manager <i>Administration (7/5)</i> local and regional administration agricultural extension agents Total participants: 35/34

### 2.3.4 Analysis

Workshop proceedings, notes from participant observations, debriefs and reflective discussions, and transcripts of the semi-structured discussions were analysed in NVivo, using thematic coding (Braun and Clarke 2006). Most coding was emergent – letting the codes and themes emerge from the data, because the data was mostly unstructured. Although there was a common template used by the facilitators for reporting the workshop proceedings, the questions and topics were not necessarily answered in great detail. The themes and codes depended on the chapter for which

data was being analysed. Analysis for chapter three looked for references to livestock, its role, value and function. Analysis for chapter four looked for references to collaboration, knowledge sharing and learning during workshop activities. Analysis for chapter five looked for references to conflict and diverging opinions and how they were handled.

## **2.4 Considerations**

This is not an ethnographic study, and therefore only a limited snapshot of life in the study sites, validated and cross-referenced as far as possible with other literature. However, as such it may reflect biases of exclusion (aspects of daily life not covered, questions not asked) or perception (drawing conclusions from limited information that is filtered by my assumptions and interpretations and may not reflect participants' and residents' perspectives or interpretations). As far possible, the principles of ethical research were followed. Ethics approval was received for the ResLeSS project as a whole, including the semi-structured interviews. Workshop participants were given written information about the workshops and their participation in them and asked to give signed and informed consent when registering. Verbal consent was received for the interviews, and for the interviews to be recorded for note-taking purposes. The local fieldwork coordinator was entrusted with selecting participants and interviewees in such a way that protected the interest of participants. All information presented in this thesis is referenced to indicate where it came from, such as workshop discussions, interviews or reflections with facilitators, while ensuring the anonymity of the participants. Data has been stored on a secure server and not shared openly unless in anonymised form and only within the research team.

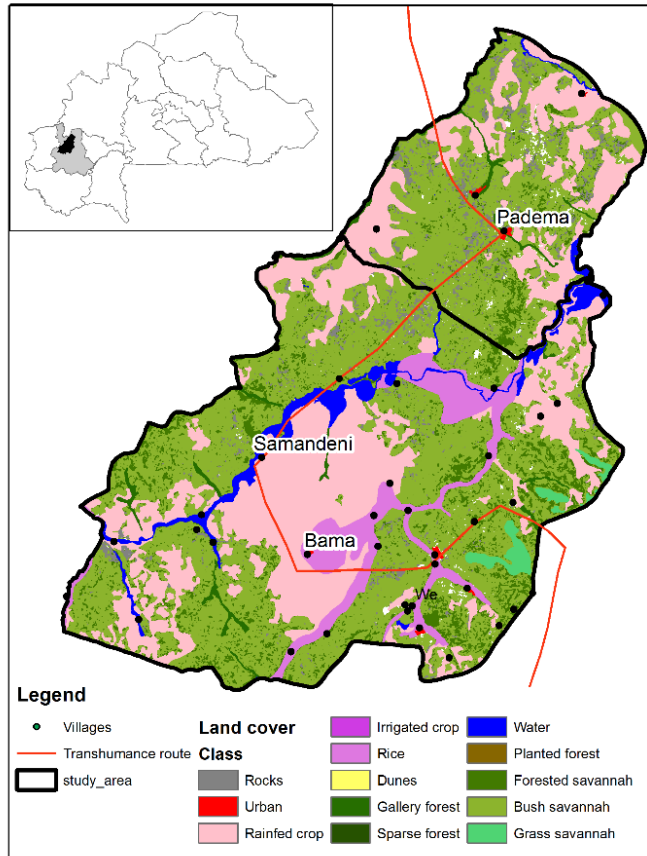
## 2.5 Case study site descriptions

### 2.5.1 Burkina Faso

In Burkina Faso, the focus is cattle production in the zone of Bama Departement, Houet province, in the Hauts-Bassins region of Burkina Faso. Bama is 20km north-west of Bobo-Dioulasso, the second largest city in Burkina Faso. The commune receives over 900mm rainfall per year, and is classified as a tropical wet and dry Köppen-Geiger climate (Aw).

From the first ResLeSS workshop and consultation with local experts, five categories were identified to represent cattle production in Bama: agro-pastoral transhumance herds (with short and long transhumance), agro-pastoral dairy herds, specialised dairy animals, fattening animals and draft animals. There are three types of transhumance within the two agro-pastoral categories. A small portion of the transhumant animals go on a long transhumance, joining the cross-border transhumant animals travelling between Mali and Ghana and/ or Côte d'Ivoire (around 10% of the cattle in Bama). The majority of the transhumant animals go on a small transhumance route to the hills in the southern part of Padema and the fringes of neighbouring communes (around 23% of the cattle in Bama). The final portion are the lactating cows that stay in Bama all year round, the agro-pastoral dairy herd (around 3% of the cattle in Bama). The agro-pastoral dairy herd is becoming more popular as a risk mitigation strategy, to allow part of the family, mainly women and children, to have a sedentary life and live from the sale of milk. Then, there are the cattle that do not move - the draft animals and an emerging semi-intensive specialisation in dairy and meat production. The specialised dairy cattle are kept at home, sourcing feed from natural grass within a day's walk from home but supplemented by concentrates and planted fodder. They may also be improved breeds. Those specialising in fattening nowadays generally buy animals (often from the pastoral system), often weaker or undernourished, and feed them well for two to six months before selling them for a profit (also called 'finishing'). In future this category might include male animals from the improved dairy herd.

To capture the area providing the majority of feed for the Bama cattle, the southern part of Padema commune was included in the study area, as this area is utilised by the majority of the transhumant herds who only go on a small transhumance route that extends to the southern part of Padema and the fringes of other communes neighbouring Bama (Figure 1). This description comes from Workshop 1, enhanced and verified by a visit with a pastoral elder and the CLEANED-R modeler. Those animals that join the long transhumance route to Ghana and Cote d'Ivoire are considered in CLEANED-R to leave the study area for the seven months of the year that they are away (December to June), and the impact of their feeding during this time is considered to be external. As described in Workshop 1, the feedbasket in Bama is predominantly natural vegetation and crop residues, with some supplementation of planted fodder and agro-industrial by-products such as cotton-seed cake. The composition varies in the wet and dry season, so each production category has a wet and a dry season feedbasket.



*Figure 1: Study area boundaries for the cattle population of Bama Commune, Houet Province, including southern part of Padema Commune to the north (Pfeifer, Morris, Ouedraogo and Ensor 2018)*

Bama is on two main transhumance routes from Mali to Ghana and from Niger to Cote d'Ivoire (Gonin et al. 2019) and, as elsewhere across Africa, there is a history of conflict between pastoralists taking cattle on transhumance and settled/crop farmers (Gonin et al. 2019; Gonin and Gautier 2016; Turner 1999; Turner 2004; Bollig and Österle 2013). The government is now officially supporting pastoralism - Burkina Faso, together with the UEMOA, are committed to supporting the livestock (beef) sector, including by protecting transhumance, for example by building new transfrontier livestock markets, and, with more limited success, protecting livestock transhumance routes. However, implementation has been slow or paused in places such as Bama (Pfeifer et al. 2020) which means that people have been reluctant to invest in fattening if no visible

market<sup>6</sup> and there is still criticism that the underlying discourse is still rooted in intensification and settlement thinking rather than considering territories and landscape-scale movement of livestock (Gonin and Gautier 2015). There is a historical interdependence between pastoralists/herders and croppers in Burkina Faso (Styring et al. 2019), whereby pastoralists were allowed to graze their cattle in the crop fields after harvest, in return fertilising the farmers' fields with the cattle manure<sup>7</sup>. This relationship is strained as more crop farmers keep livestock at home and keep their crop residue for their own cattle (workshop discussions), but there is also increasing blurriness between pastoralists and croppers in terms of who owns the cattle that pastoralists are keeping and seeking feed for, as croppers and urban dwellers entrust cattle to pastoralists as form of investment or savings (Pfeifer et al. 2020). For example, a butcher in our workshop has slowly been expanding his business and now invests extra profit in animals placed in care of pastoralists<sup>8</sup>. Locally, livestock and cropping are in two separate ministries, so when there are conflicts between farmers and herders, the outcome is influenced by which ministry representative arrives to deal with the disagreement<sup>9</sup>.

## **2.5.2 Ethiopia**

In Ethiopia, the focus is on cattle and sheep production in the plateau part of Atsbi Wonberta Woreda (above 2,200 m above sea-level), in the eastern zone of Tigray region, about 65 km north of Mekelle regional city. The woreda receives a mean annual rainfall of about 670 mm/year which is known for being erratic, intense and short duration, and is classified as a hot semi-arid Köppen-Geiger climate (BSh), with an average temperature of 18°C. Atsbi woreda includes two livelihood zones: the plateau which has significant wheat, barley, teff and pulses production and is suitable for dairy

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<sup>6</sup> Interviews with butcher and fattener in Bama, Burkina Faso on 20 November 2017.

<sup>7</sup> Interview with pastoral elder in Bama, Burkina Faso on 21 November 2017.

<sup>8</sup> Interview with butcher in Bama, Burkina Faso on 20 November 2017.

<sup>9</sup> Interview with local agricultural official in Bama, Burkina Faso on 21 November 2017.

production; and a transition zone that is mainly forested area with bee keeping, where mainly goats are kept. The livestock sector is a traditional mixed crop-livestock system in which local cattle are kept for meat, milk and draft power along with sheep. The animals are mainly fed on natural grass and crop residue. Traditionally, keeping a large number of livestock was considered as an expression of status in the rural farming community. But the productivity of these livestock is very low. Key reasons are feed shortage both in quality and quantity, poor vet service, poor management and awareness of the farmers. This description comes from the facilitators' reports after Workshop 1.

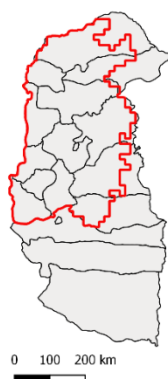
The Ethiopian livestock master plan (Shapiro et al. 2015), a five year plan adopted by the government in 2015 to support the Growth and Transformation Plan II (2015-2020) (NPC 2016), foresees for water deficient highlands such as Atsbi a shift to more intensive dairy production to supply a dairy agro-industrial park in Tigray. Livestock consumption lower than in other countries, in part because of religious fasting for two-thirds of the year (D'Haene et al. 2019), rather than poor value chain development. However, the government recognises and emphasises the role of agriculture and livestock in contributing to national income and food security in the Growth and Transformation Plan II (GTPII, 2015-2020). Four agro-industrial parks have already been set up across Ethiopia to encourage investment in processing, and therefore agricultural development. At the same time, the Climate Resilient Green Economy Strategy (CRGE, 2011-2025) sets out supplementary plans for how to achieve the GTPII while minimising the increase in greenhouse gas emissions and remaining within natural resource constraints to limit reliance on imports. The CRGE's measures for the livestock sector aim to restrict the increase in GHG emissions from the livestock sector to 20% higher than 2010 levels, compared to a business-as-usual forecast of close to 100% increase from 2010 levels (CRGE n.d., p.117). Measures include higher yielding breeds, diversification to lower-emitting types of livestock such as poultry, improving value chain efficiency, partial mechanisation and rangeland management. The adoption of the Livestock Master Plan to implement the above strategies requires an

increased focus by Atsbi woreda officials on livestock production, where their focus has historically been on cereal production and irrigation. Two planned activities are to promote specialisation by kebele (district) into either sheep or improved dairy production using Holstein-Friesian crossbreeds according to agro-ecological zones, and to increase irrigated areas used for growing protein-rich fodder grasses<sup>10</sup>. Therefore, the government is bringing in improved crossbreed dairy animals, and those farmers who keep them feed them with concentrates such as bran, oil seed cake or *atela* (by-product from local beer production) and are trialling subsidised alfalfa for planted fodder (workshop 1). Also, the government is trialling mechanisation, bringing tractors to replace the draft animals at least in the flatter area of the plateau. At the same time, the Atsbi sheep is a well-known product with a regional reputation, which the CGIAR Value Chain programme had been promoting with a community-based breeding programme in Atsbi woreda (scoping tour). Sheep are easier to keep with a quicker reproduction cycle than cattle and therefore is also an activity that more vulnerable groups such as landless youth and poor households can perform (workshop discussions). In order to be able to capture these dynamics, the CLEANED-R tool defined five livestock categories based on Workshop 1 discussions, namely dual-purpose local breed dairy cows, local breed dual-purpose cattle kept for fattening and rearing, local breed draft cattle, specialized crossbreed dairy cows and sheep. The choice to restrict the study area to the Atsbi plateau (Figure 2) was made to limit the number of categories for CLEANED-R to five, as sheep are replaced by goats in the transition zone, reducing complexity to a level that the Transformation game was simple enough to learn about the essential environmental dynamics.

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<sup>10</sup> Interview with local agricultural officer in Atsbi, Ethiopia, 9 March 2018





*Figure 2: Atsbi woreda boundary in black, in red selected boundaries for CLEANED (area above 2200m) (Pfeifer, Morris, Mulatu, Wakeyo, et al. 2018)*

There is a long history of NGO development projects providing support for technological advancement, including pumps and training for irrigation and distributing cross-breed cows to overcome initial capital outlay<sup>11</sup>. The government is currently encouraging individuals and groups to invest in specialised dairy production, offering support to form cooperatives, providing infrastructure (barns, feed storage, water taps) and loans<sup>12</sup>.

There is also a history of droughts and famine in Tigray, but interviewees believe there has been adaptation to famine, and an increase in resilience to drought, because of better distribution of relief between districts, but also managing dry season stores of food to buffer against droughts<sup>13</sup>. In addition, the plan is to increase irrigation and designate 10% irrigated land to fodder, which is intended to boost dry season reserves to counter increased feed demand of cross-breeds<sup>14</sup>.

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<sup>11</sup> Interviews with elderly model farmer and elderly priest farmer in Atsbi, Ethiopia on 12<sup>th</sup> and 8<sup>th</sup> March 2018 respectively.

<sup>12</sup> Interviews with older model farmer in Wukro, Ethiopia on 8<sup>th</sup> and 19<sup>th</sup> March 2018; Interview with livestock researcher in Mekelle, Ethiopia on 7<sup>th</sup> March 2018.

<sup>13</sup> Most interviewees had a similar response.

<sup>14</sup> Interview with local agricultural officer in Atsbi, Ethiopia on 9 March 2018.

### **2.5.3 Tanzania**

In Tanzania, the area of interest is Lushoto District, on the border with Kenya, containing the Usambara mountains as well as the southern portion of Mkomazi National Park. Lushoto is one of eight districts in Tanga region, Tanzania. Lushoto is a high potential area, supplying vegetables to Dar es Salaam. The focus is on the small-scale dairy cattle livestock population of Lushoto District. Lushoto District has a range of climates, from hot semi-arid in the lowland to warm dry and warm humid in upland, receiving over 1000mm/year mean annual rainfall in the upland, with an elevation ranging from 300-600 m above sea-level in the lowland (25% of area) to 1000-2100 m above sea-level in the upland (75% of area) (facilitators' reports after Workshop 1).

Livestock is recognised as an important sector in Tanzania, economically and for rural livelihoods, and its growth has been supported by the National Livestock Policy (2006), the Tanzania Livestock Modernization Initiative (TLMI 2015) and the Tanzania Livestock Master Plan (TLMP, Michael et al. 2018). The emphasis on rangeland management and resilient pastoral livelihoods in the TLMI shift to a focus on commercialising production in the TLMP. The CGIAR Value Chain programme 'Maziwa Zaidi' has been running projects since 2012 to promote small-scale dairy, organised around village-level dairy hubs, with Lushoto district as one of the programme sites (Omore 2017). The initial development of the CLEANED tool used Lushoto as a case study site. This project returned to and continued that case study. There is a long history of research in the area, including previous programmes promoting REDD+, a long history of soil conservation measures, and biodiversity studies (workshop discussions).

Based on the activities in the first workshop, the research team characterised the livestock production in Lushoto into three categories, extensive lowland, semi-intensive highland and intensive highland. Yet, discussion about future developments in the first ResLess workshop have pointed out that in all three systems smallholders are trying to improve the breeds and the management systems. These breeds would be similar across all systems. The geography is not a key driver in the up-coming changes, it had only emerged in the first workshop because of the participatory mapping

exercise. For this reason, the CLEANED-R tool for Tanzania was parametrized with breeds, namely preliminary local breeds, cross breeds (with 65-85% exotic genes), almost pure breed (more than 85% exotic breed). This classification is in line with ILRI results (AgriTT 2017).

According to discussions from Workshop 1, local breeds are mainly found in the lowlands and are mainly fed on natural grasses and some crop residue. The crossbreeds are found in the highlands and are mainly fed on a mix of natural grass, crop residues and a bit of concentrate. In this system the main issue is the feed shortage in the dry season, which can be addressed with the production of hay and silage. Planted feed, which has higher nutritional value than crop residues could be used to improve milk productivity per cow. The almost pure breed is a category which is only marginally existent in Lushoto in the current situation. These animals need much more care, eating mainly planted fodder and concentrates and hardly any natural grasses and crop residues. The choice of boundaries was based on an ongoing value chain program at ILRI funded by the livestock CRP, boundaries that were confirmed to be relevant at the first workshop and the consultation with local experts following the first workshop. Because CLEANED-R computes the resource available for the livestock sector, the protected area, namely the national park was cut out of the boundary (red line in map Figure 3).

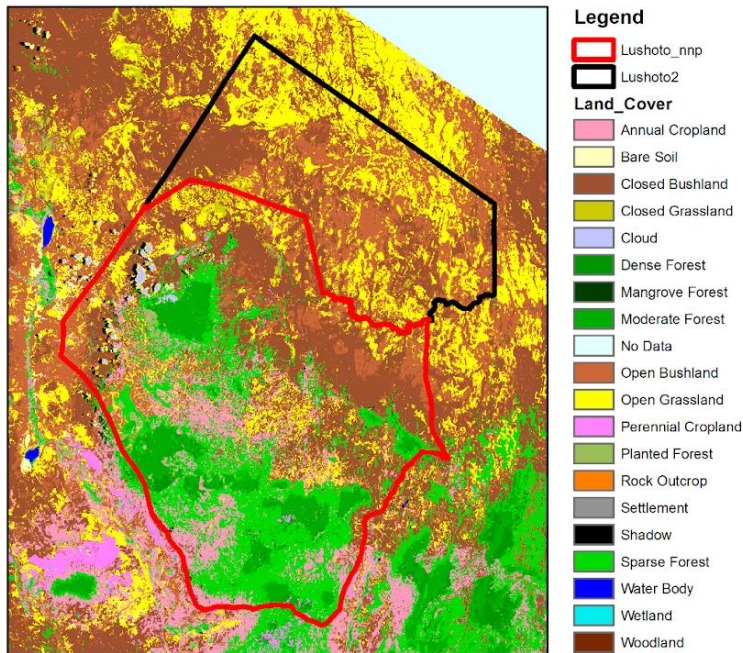


Figure 3: Study area boundaries for the dairy cattle population of Lushoto District, Tanga Region, Tanzania (Pfeifer, Morris, Soka, Moses, et al. 2018).

## 2.6 Social learning process description

A detailed description of the social learning process, including the multistakeholder workshops, can be found in the facilitation guide that I produced for practitioners who wish to repeat the process (Morris et al. 2019). Figure 4 summarises the flow of activities in the ResLeSS learning process which aimed to support decision-makers in using a rapid ex-ante environmental impact assessment tool (CLEANED-R) and a participatory economics approach together with input from local stakeholders, to produce decisions that have taken into account three pillars of sustainability – the environment, economics and equity. An extract giving an overview of the environmental assessment approach and participatory economics approach is given in Appendix 1.

The social learning process comprised two workshops in each country (B and D, Figure 4), supported by a reconnaissance tour (A, Figure 4) and ongoing outreach that is

designed to enable stakeholders to consolidate their own understanding and priorities before acknowledging the perspective of others.

Workshop 1 gathered data from stakeholders connected to livestock livelihoods in relation to the environment and socio-economics in a series of group activities using participatory GIS to map present and future livelihoods and storytelling to identify socio-economic priorities. This work set the stage for the second workshop in two ways. First, the environmental data gathered enabled the parameterisation of the computer-based environmental impact assessment tool (CLEANED-R), so that it can be used to explore the impacts of alternative livestock futures in the study area in Ethiopia. Second, engaging with participants around desirable socio-economic futures started a process of capturing an understanding of value that is wider than that offered by a financial assessment alone.

In Workshop 2, participants refined their socio-economic priorities from Workshop 1 into indicators, and then played the Transformation Game. Participants first played the game within their stakeholder groups to acclimate to it, then again in mixed stakeholder groups. Workshop 2 builds on Workshop 1 through:

- Use of the CLEANED-R tool to generate environmental impact data for different livestock scenarios, parameterised for the case study site in each country using the data gathered in Workshop 1
- The assessment of livelihood impacts of alternative livestock scenarios, using the socio-economic indicators developed during Workshop 1.

Taken together, the two workshops offer a systematic process that works towards the development of more equitable relationships between stakeholders through improved mutual understanding and shared learning.

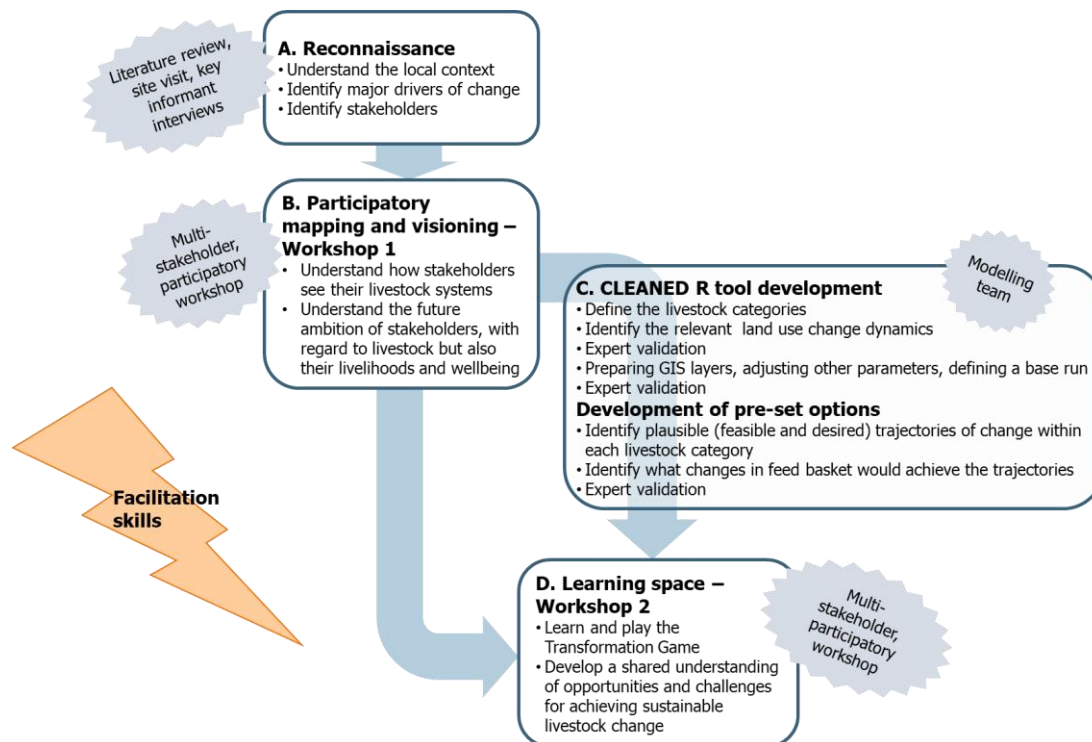


Figure 4: Diagrammatic overview of the ResLeSS social learning process.

The social learning process incorporates five central tools and concepts. More detail on these, framing them as boundary objects for Chapter four, can be found in Appendix 2.

First, the workshop makes use of a computer-based environmental simulation tool, called **CLEANED-R**. The tool is an application of the CLEANED framework (Notenbaert et al. 2014) and calculates environmental impacts (water use, greenhouse gas emission, biodiversity loss and nitrogen balance) for a given area based on the livestock production that is being undertaken in that area. This production is expressed in terms of parameters that can be defined via a user interface (developed during the project). The underlying code consists of 5 modules: livestock productivity, water, greenhouse gas, biodiversity and nitrogen balance.

Second, the report refers to **livestock production practices** to describe ways of keeping livestock (a combination of livestock species - cows or sheep, traditional or improved breeds - feed requirements, and management). In CLEANED-R, each livestock

production practice is parameterised by approximately 17 parameters (differences in land use for feed production, feed basket, animal productivity, manure management etc.).

Third, a **vignette** is a pre-defined narrative description of a particular livestock production practice (e.g. traditional cattle extensively grazed, or improved cattle tethered and fed with locally grown grasses). A combination of vignettes can be used to quickly formulate a plausible livestock future for the landscape – referred to as a **scenario**. For each vignette all CLEANED-R parameters are fixed, and by only selecting which vignettes to include and the number of animals assigned to each vignette, the participants can define a scenario (e.g. 5,000 animals in vignette A, 500 in B, 7,000 in C).

Thus (and fourthly), a **scenario** refers to one possible mix of different livestock production practices in a defined landscape. This encompasses the types of livestock production practices assumed to be present and the proportion (or scale) of each practice. For a particular scenario, CLEANED-R calculates the environmental impact from the mix of livestock production practices in a landscape.

Finally, the workshop culminates in participants playing the **Transformation Game**. The Transformation Game enables groups of participants to define a livestock scenario using the vignettes, and then explore the socio-economic consequences of that scenario (via indicators developed in Workshop 1 and refined at the outset of Workshop 2) and environmental consequences (using computers running the CLEANED-R simulation).

Through discussion of how these results might be interpreted and valued, the Transformation Game enables learning to develop between stakeholders with different viewpoints on livestock livelihoods. Together, the group can then revise their scenario, and test this new scenario using the socio-economic indicators and CLEANED-R. In this way, the game allows participants to explore livestock futures and develop a better

sense of the trade-offs that are embedded in different choices and how these trade-offs are experienced by different stakeholder groups.

This thesis is particularly interested in the flow of information in the workshop, visualised in Figure 5. Solid outline shapes represent workshop activities or outputs: in workshop 1, participants created a 'story of the future' (A1) describing one day in the life of a successful fictitious individual of their choosing, from which they extracted indicators of success (A2). These were part of the socio-economic approach and are described in more detail in Appendix 1. Then, participants played the transformation game and created scenarios first in homogeneous stakeholder groups (B2) and then mixed stakeholder groups (B3). The CLEANED-R tool calculated the results of the scenario producing results in the form of environmental and productivity indicators (B1) which were defined by the research team. Participants were then asked to evaluate the scenarios, based on B1 and bearing in mind A2. The flow of knowledge between A1 and A2 is clear, as is the flow of information between B2 and B3. However, while the researchers hoped that the stories of the future and indicators (A1+A2) would inform the scenarios (B2+B3), there was no explicit process to facilitate this. Shapes in dotted outlines indicate outside knowledge informing the activities – the design of the workshops and CLEANED-R tool by the researchers was informed by background detail from reconnaissance interviews, secondary data and literature. Livestock, water, soil and climate change science informed the researchers' choice of indicators used in the CLEANED-R tool (B1). Group participants' experiential and professional knowledge informed their input to the workshop activities (A1+A2 and B2+B3). The facilitators' informed opinion influenced their executive decision on how to summarise the four homogeneous stakeholder groups' scenarios into 2-3 summary scenarios for the mixed groups to start discussing.



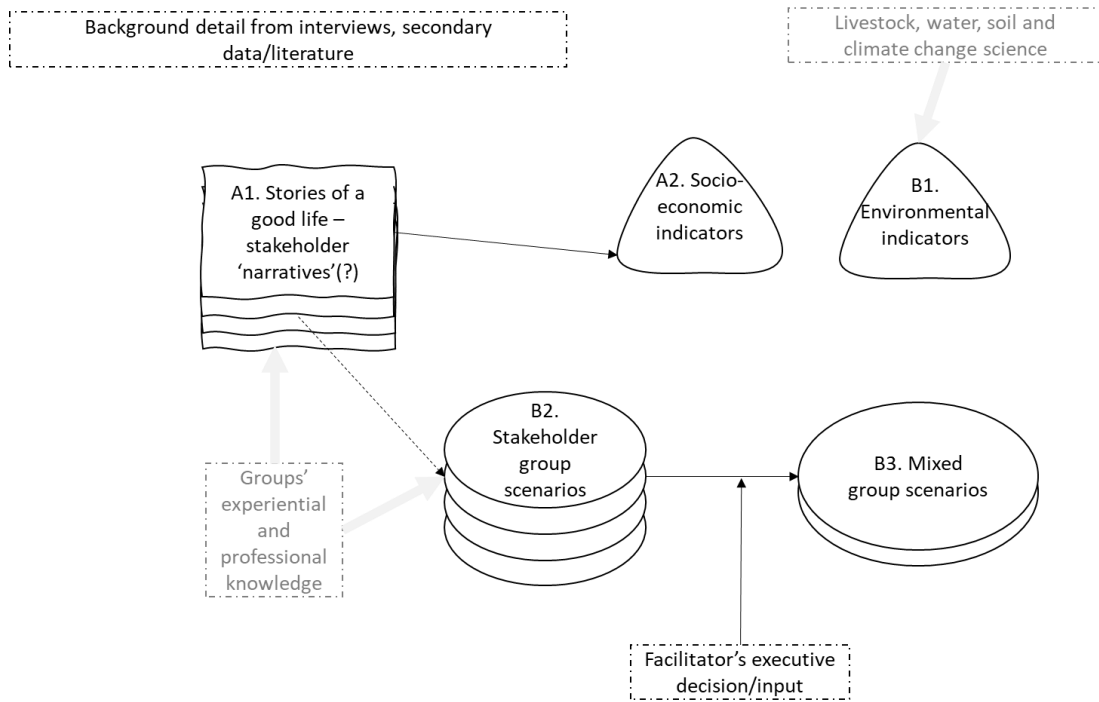


Figure 5: Flow of knowledge through the ResLeSS workshop activities and learning process.

# 3 Stakeholder perspectives on livestock now and in the future

## 3.1 Introduction

The objective of this chapter is to present knowledge production from the three cases, asking the question: “what are the narratives or visions for sustainable livestock production in each country?” and laying ground for asking how social learning process supported the exploration of these visions. This chapter provides the foundation for the main analytical chapters by providing the reader with a picture of what happened in each workshop – key themes raised in discussion in homogeneous and mixed stakeholder groups and what those revealed about the perspectives held by the stakeholders. It focuses on what stakeholders said about the role, function, value and importance of livestock for the actors in their case study area, and how they perceive that livestock production should be now and going forward.

These perspectives emerged most directly from the ‘stories of success’ created by the homogeneous stakeholder groups in the first workshop, describing one day in the life of a fictitious successful individual of their choice in 2030. In these stories, livestock was described in the context of the individual’s daily life, and the indicators of success that the groups drew from the stories highlighted which aspects of the successful life that they had envisioned were most important to them. Where the fictitious individual was from the same stakeholder group as themselves, these stories and indicators were interpreted as representing the stakeholder group’s perspective on livestock. However, some groups chose fictitious individuals from a different stakeholder group, for example the policymakers’ group in Tanzania telling the story of a farmer. In those cases, the story and indicators were interpreted as the stakeholder’s perspective of what livestock means to others, and more broadly, the role of livestock in the area.

In the second workshop, groups were discussing scenarios of livestock production referring to all the livestock in the study area, and therefore broader than the direct

interaction with livestock that any one individual would have for themselves. References to the role and value of livestock in these discussions was interpreted as the stakeholders' perspectives on the role of livestock for the area. Instances where groups did not discuss a livestock category suggest that the category is not relevant to them, or less important than the category of main concern to them.

The next sections present, for each country, an overview of the key story emerging from the learning process and any themes that cut across groups followed by brief descriptions of the perspective(s) raised by each group and how other groups interacted with them. Data comes from workshop discussions in groups and plenary. As the workshops were held in the local language (Djula, Tigrigna and Swahili), the facilitators wrote reports in English afterwards capturing main discussion points. While this meant that the workshop discussions themselves were comfortable for participants, the data reported here has been translated and interpreted by the facilitators and by me, losing something of the participants' voice each time (see Ch 2). As such, the following is my interpretation of the perspectives of the stakeholders, assuming that the points that made it into the facilitators' reports were the important ones.

### **3.2 Perspectives from Burkina Faso**

Two clear types of scenarios emerged from the homogeneous stakeholder groups, reflecting an intensive narrative and an extensive one. The settled farmers, processors and government officials' scenarios featured a shift from agro-pastoral, transhumant animals to stationary, specialised dairy and beef production with an overall reduction in the number of animals. This reflects the common push in national policy for intensifying and sedentarising livestock production to increase yield. In contrast, the pastoralist group doubled the number of agro-pastoral, transhumant animals while keeping the management the same as today, and only slightly increasing the number and management of specialised animals.

To transition from the four homogeneous groups' scenarios to two mixed groups, the workshop facilitators created two new scenarios reflecting the two narratives, one inspired by the three groups and the other inspired by the pastoralists. Given the opposite nature of the two scenarios and having proponents of each narrative in each mixed group, there was immediately conflict and very unhappy members in each group. The extensive scenario favoured by the pastoralists elicited intense objections from other stakeholders - it represents a business-as-usual approach that environmentally concerned stakeholders including government officials are keen to change, because of the severe challenge of resourcing that pathway and the inevitable land-based conflicts that will arise. Yet all stakeholders were pleased with the economic output of a significant increase in meat and milk. It stimulated a heated debate about land use and management of resources for sourcing feed and water for additional animals, exploring who uses natural resources and who is more 'responsible' for environmental degradation. For example, crop farmers or urban expansion clearing swathes of trees might do more deforestation than pastoralists collecting tree branches for fodder as they pass through. It was noted in the debate that perhaps the competition between types of livestock was intensified because all parties currently use the same feed types. The conclusion was that a strategy that supports both intensive and extensive livestock keeping would be feasible if land use were regulated – if pastoral areas are protected from encroachment – and if the intensive livestock shift to concentrates and planted fodder, leaving the pasture to the pastoralists. If the pasture was improved, then both could make use of it; in short, suggesting better allocation and management of feed. This broader debate brought into question the assumptions that more intensive livestock keeping is necessarily better than extensive livestock keeping.

The intensive scenario raised concerns from both livestock producers and environmentally concerned stakeholders. Pastoralists objected to losing animals and all livestock producers were concerned with the lower-than-expected meat and milk output, while environmentally concerned stakeholders raised concerns that already

today there is competition for water, feed and land so increasing demand for these will be difficult.

All groups raised a concern about current resource availability in one way or another. The government officials referenced ongoing conflicts occurring over access to water and biomass. They also proposed that crop farmers will not want more pastoral animals, as more animals leads to more conflict. Government officials also spoke of their perception that there are already traders concerned about price of feed increasing, leading to settled farmers using crop residues for their own animals instead of leaving them for pastoral animals or selling them. Processors perceive that grazing land is a constraint, with not enough pasture so transhumant animals will need to decline, in part due to encroachment by crop farming. As one processor described in an interview<sup>15</sup>, looking out from where we were sitting in Bama, it used to be farmland and grazing land, now it is buildings or urban area, so the land for grazing has shrunk and will continue to shrink, increasing the competition between grazing and crop land. Settled farmers and pastoralists arguing in the mixed stakeholder discussions over access to drinking water for livestock and using forests for feed highlighted the ongoing conflicts over water and land access. Pastoralists also raised their perspective on their inability to plan for the future due to competition for land, saying there is no point in investing in the pastures to be more productive as they have no guarantee that the land will still be there when they return, taken over by cropping.

Promising evidence of starting to build relationships and trust to share perspectives in Burkina Faso is that two parties who are historically in conflict (pastoralists and officials promoting intensification) had a reasoned discussion and came to an accepted compromise (despite a rocky start). A couple of participants remarked that they were surprised how enlightening and open the debate was, and a pastoralist leader made a comment about being 'listened to' for the first time. Realising that rational debate is

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<sup>15</sup> Interview with processor in Bama, Burkina Faso, 20 November 2017

possible could be the start of building relationships and trust between stakeholders. A couple of others responded that the most important thing they had learned had been meeting new people, the beginning of building relationships.

### 3.2.1 Pastoralists

The objective of the pastoralists emphasised in their story of the future and subsequent indicators was to have security of resources to provide for their priorities: trip to Mecca, supporting family and friends in need, providing for their families (home, education, food). For them, having enough cattle on the hoof is the secure way to do that, and two *troupeaux*<sup>16</sup> was the calculated safe target. This perspective sees cattle as capital, yet as explained in an interview with a pastoralist elder, cattle have more than economic value – money slips through your fingers, but having cattle also feeds the soul<sup>17</sup>. Pastoralists are aware of need to adapt to changing times, mentioning in interviews<sup>18</sup> the need to advocate for benefits pastoralists can offer such as manure and clearing crop residues, and growing the entrepreneurial side of milk production - increasing milk sales and soap production beyond home consumption in response to increasing prices. However, they also argued in the mixed group discussions for the right to maintain transhumance as it is, citing that it makes no sense to provide extra feed which will be walked off, or change to breeds that are less heat and disease resistant. While agreeing that investing in the finishing stage makes sense, it is only feasible if there is a demand, if they can sell the fattened cows, and if concentrates are not too expensive, both of which were cause for concern at the time of the workshop<sup>19</sup>.

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<sup>16</sup> Troupeaux is loosely translated as ‘herd’ but represents a complex structure of sub-herds, so the original was used in the workshop and is used here. More detail is given in Morris et al. (2017)

<sup>17</sup> Interview with pastoralist elder, Bama, Burkina Faso, 20 November 2017.

<sup>18</sup> Interview with pastoralist elder, Bama, Burkina Faso, 20 November 2017; interview with milk processor, Bama, Burkina Faso, 20 November 2017.

<sup>19</sup> Interview with pastoralist fatteners, Bama, Burkina Faso, 20 November 2017.

Other groups interacted with the pastoralists' perspectives explicitly and implicitly. All other groups explicitly rejected the pastoralists' target to have two *troupeaux*, on the assumption that this represents an increase in the number of animals and therefore runs counter to the other groups' perspectives to reduce the number of animals. Two implicit interactions highlight the complexity of the place of pastoral livestock keeping in Bama. In the government officials' group discussions, while arguing against allowing 'two *troupeaux*' as something to aspire to, one group member reminded the others that not everyone has the same objective, that in the villages it is seen as prestigious to have several animals, and so one cannot prevent them from having several animals. Secondly, an interview with a processor revealed that excess earnings from their growing business are invested by buying cattle and entrusting them to pastoral livestock keepers, so the animals in a pastoralist's *troupeau* may not all belong to him, rather he may be being paid to keep them for someone else.

### **3.2.2 Farmers (settled, non-pastoralist)**

The main objective of the settled farmers was income, and if they can get more milk from fewer animals, then the group was in favour of specialised dairy production. Their story of the future presented a perspective of intensive livestock production providing for a wealthy life and supporting hired labour to look after the livestock and investment in other businesses such as rental properties which in turn provide other income streams. This is similar to the government official's vision of a 'modernised farm' (their phrase). The settled farmers referenced an ongoing programme to introduce 3,000 crossbreed dairy cows to Bama as additional support for the area to invest in specialised dairy. In favour of improving milk output with improved feeds, the group wanted agro-pastoral dairy to improve, although they raised concerns that there are already problems with accessing agro-industrial by-products such as cotton-seed cake, prior to any further increase in demand.

Consistent with their perspective that producing more milk from fewer animals is preferable, the settled farmers had the same reaction as the government officials and processors in objecting to ‘two *troupeaux*’ indicator because it goes counter to the strategy of shifting to specialised breeds and reducing numbers.

### **3.2.3 Processors**

The objective of the processors can be summed up in their indicator of wanting serenity - free from worry, which was agreed to be, for them, about providing for their family. They envision that modernising their trades would provide that – improved equipment for butchery and milk processing. Their perspective of modernising their trade as the way to improving their livelihood, and therefore securing serenity, is similar to the government officials’ vision of a ‘modernised farm’. They did not refer to how livestock would be produced in their story of the future. When discussing livestock production in the scenarios, they raised concerns about the cost of concentrates limiting the level of improvement they could make, particularly for beef where they considered that there is not enough market. This reflects the concerns raised by the pastoralists about fattening. They were, however, cautiously optimistic about improving milk production, that demand for milk would increase enough to offset the costs of feed.

The processors had the same reaction as the government officials and settled farmers in objecting to the pastoralists’ ‘two *troupeaux*’ indicator, their rationale being that they believe there is already insufficient space in Bama commune and surrounding area for cropping, livestock grazing and expanding settlements, and they estimate that having two *troupeaux* of 70 head each would exacerbate the difficulties linked to insufficient space.



#### **3.2.4 Government officials**

The objective of the government officials encapsulated in their story of the future is of improving livestock production by modernising, implying better breeds, with higher productivity, kept stationary in good shelters, monitoring health, providing high protein feeds. This is a high-input, high-output vision; the animals can no longer go out grazing to find their own feed, so the cows need full time care, but with higher output to offset the increased costs. When developing their scenarios, they often referenced their success story to rationalise their management option choices, in conjunction with their expectations of what might realistically be feasible for Bama livestock producers. They acknowledged that change will come slowly and only envision 30% of livestock keepers achieving this by 2030. They also agreed with the pastoralists that there is no benefit to changing the transhumant animals' management but proposed that there could be improvement of the pastoral dairy herd that is kept locally particularly if fodder could be grown. This perspective centres on the meat and milk output, while being aware of the cost of inputs and households' capabilities to invest in improving production.

Similar to the processors and settled farmers, the government officials objected to the pastoralists' '*two troupeaux*' indicator on the basis of not enough water and biomass and grazing land resources to support the increased pastoral animals that this implies - specifically that crop farmers would object to the competition for resources.

### **3.3 Perspectives from Ethiopia**

The scenarios in the homogeneous stakeholder groups varied both between and within groups. Clear perspectives emerged about both the categories of animal to prioritise and how to feed them, although the perspectives were combined in a variety of ways across groups such that there was no clear pattern or distinction between groups, contrary to the case in Burkina Faso. Building on the sharing of perspectives in homogeneous stakeholder groups, the mixed stakeholder groups explored the trade-off between increasing income potential while mitigating GHG emissions, concluding

that beef has lower potential than dairy and sheep. There was discussion around the costs and benefits of dairy, beef and sheep production; both in economic and environmental terms. Compared to beef and sheep, dairy production has higher feeding and maintenance costs, but provides more milk and therefore potentially more income. It also has higher water use and GHG emissions. Beef production is more costly to 'finish' (to fatten) up in Atsbi because of the altitude and cooler temperatures, although the meat is highly sought for its taste, and also has higher water use and GHG emissions. Sheep are a good pro-poor strategy as they require small capital, have a high turn-over and therefore faster return on investment and have relatively lower water use and GHG emissions. Understanding these characteristics of the three types of livestock, the proposition was put forward that the income opportunities offered by dairy and sheep cover the largest portion of the Atsbi population, and that these should therefore be supported. In order to mitigate GHG emissions and water use, it was proposed to reduce beef production.

There was a strong difference in opinions between individuals reflecting different perspectives on how to use land and cash resources for acquiring livestock feed, but as the disagreement occurred during mixed stakeholder discussions the perspectives cannot be attributed to stakeholder groups. One woman resisted the idea of buying concentrates from the market, arguing that the cost of the food for family is less than acquiring the concentrates, and furthermore that the alfalfa which they would produce (planted fodder) is cheaper since it is subsidized by the government. In contrast, one woman was against the complete fodder planting in their land and would rather buy livestock feed from the market. She explained that had she had land, she would use all her land for cereal production, and not for livestock improvement. She would prefer to use it for cereal production to first secure food for the family as she would not want to take the risk of food shortage for the family. Also, since she has no land, it might not be easy for her to get land, much less irrigated land, for planting fodder. This illuminates the influence of financial situation on one's perspective – those with land to spare, and with access to irrigation, can afford to grow planted fodder. The stories of the future

reinforce the value inherently ascribed to supplying one's own fodder, all featuring irrigated fodder alongside fruit and vegetable production (apart from the local researchers' story about dairy and beef cooperatives).

Drawing from interviews across all stakeholders gave an insight into the evolving place of livestock in Tigray. On the one hand, as youth (labour) move away from home to work off-farm and grazing land and feed remain scarce, it makes sense to reduce the number of free-grazing indigenous breed cattle, rather keeping a few specialised dairy cows at home for their high income potential and switching to sheep which are easier to keep. Yet, the sentiment of "livestock is mandatory" (for rural farming households) was a repeated refrain that came through strongly. Despite the feeling that households are reducing their herds, on the whole the perspective was that the indigenous cattle population would remain fairly stable, because a high proportion of the population are still rural and will still need cattle as they play an important support role. They provide draught power and manure for cropping and meat for the household, especially for festivities, as it is cheaper to slaughter your own than to buy it from the butcher. Furthermore, although the youth may have moved off-farm, the parents may still be looking after land and livestock in their children's name, because in Ethiopia if you are not using the land it goes back to the state for redistribution.

### **3.3.1 Farmers**

From the scenario discussions, the perspective of the farmer group was in favour of specialised dairy production as key income activity that would replace at least some of the less productive indigenous cows, keeping some for draught power for the hilly parts that tractors cannot reach and some for maintaining genetic diversity. While the priority is on maintaining (or ideally increasing) economic gains, the interviews and the story of change highlight that specialised dairy would be alongside cropping. The story of the future envisions an improved mixed crop-livestock system, with specialised dairy and beef cows, using manure for the fields and producing their own irrigated forage

and horticulture producing vegetables and fruit for market and home consumption. This is a similar vision to that of the traders and local administrators.

The farmers placed less emphasis on sheep than other groups. After finding out more about the farmers in the interviews, that they were mainly farmers who had adopted specialised dairy, may explain the preference for dairy and even cattle over sheep. Speaking with individuals from the farmers' group after the workshop revealed a wide range of backgrounds, including a model farmer, a farmer who had livestock as support for cropping, and a landless farmer with two specialised dairy cows whose main job was as a conservation officer at the local district office while her parents look after her two cows. The model farmer engaged with a government programme to provide cattle sheds in which a group of farmers could come together to keep specialised dairy cows in addition to his crop farm. Related to this, in the traders' group was a butcher who had invested in specialised dairy as a side interest and found that it was more lucrative than the butchery, prompting them to open a yoghurt shop.

### **3.3.2 Traders**

Similar to the farmers and local administrators, the traders' story of the future envisions an improved mixed crop-livestock system, with specialised dairy and a few beef cows, producing their own irrigated forage and horticulture producing vegetables and fruit for market and home consumption. When designing scenarios, initially the individuals in the traders' group had diverging opinions. Some advocated for specialised dairy, others maintained that for many the indigenous dairy cows are their most valuable asset. Some felt beef production is not so suitable in Atsbi's cooler climate whereas others felt it could still be profitable. After talking through several individuals' scenario configurations, they came to a compromise that supported both specialised dairy and beef production.

In an example of gaining new perspective from hearing the discussions in the workshops, one of the traders spoke in the interview afterwards<sup>20</sup> of how they gained confidence in the appetite of farmers for using concentrates for feed after seeing the trend in the workshop towards dairy cows and more emphasis on feeding concentrates, supporting their decision to buy concentrates in bigger quantities. Perhaps in part as a result of that change in practice, they have seen big changes in the six months following the workshop, so much that they plan to expand to two stores.

### **3.3.3 Local administration**

Similar to the farmers and the traders, the local administrators' story of the future envisions an improved mixed crop-livestock system with specialised dairy and beef cows together with irrigated vegetable and fruit production, with an added stipulation that the family would have substantial savings accumulated. In discussing the scenarios, the group echoed the others in wanting to reduce indigenous cows in favour of specialised dairy, though not too many specialised dairy cows so that the cost will be affordable in acquiring and in feeding them but feed the remaining indigenous cows better to maximise their potential. Of all the groups, local administration chose the lowest number of sheep despite recognising their value as being readily marketable and a good source of income for health and education. For them, the role of livestock, particularly specialised dairy, is to procure money for improved agricultural technologies and access to education.

Aside from their perspective on livestock, one official in Ethiopia reflected that the workshop changed their opinion on participation. Although it is often required in their work, they previously considered participation to be a problem, but since the workshop they can see the value of participation. This could be a reflection on the method used in the workshops. The role of facilitation is key, and the structure of the

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<sup>20</sup> Interview with feed supplier, Wukro, Ethiopia, 18 March 2019

participation, focused around the Transformation Game, provided a mechanism to elicit farmers' – and others' – input to the questions that we wanted answered.

Related to this, several of the local researchers, officials and national level participants, remarked how the second workshop had shown them that farmers have something to contribute, and the value of the indigenous knowledge of the farmers. They seemed surprised to be in a setting where they could discuss directly with farmers, and that the farmers could contribute equally and counter the experts' suggestions. This could indicate a shift in perception of the value of knowledge other than 'scientific' or classic 'expert' knowledge. An example of changing their views about the value of farmers' input was cited by several participants in Ethiopia, of farmers correcting the assumptions of other stakeholders. Farmers rejected scenarios proposed by others that suggested removing draught animals altogether, as they contribute environmental impacts for no monetary benefits, and could therefore be replaced by tractors that do not need to be fed. However, farmers - as the ones who work the land in Atsbi - pointed out that there are steep and hilly areas that tractors cannot plough, and therefore draught power cannot fully be replaced<sup>21</sup>.

### **3.3.4 Livestock experts and local researchers**

The local researchers' story was different in that it envisioned beef and dairy cooperatives with concentrated and specialised livestock production, as opposed to having the animals distributed on family farms. In discussing the scenario discussions, the experts put a lot of emphasis on sheep, selecting the highest number of sheep of all the groups, as sheep are more easily managed. Many smallholder farmers could earn income from sheep as they require little start-up capital and have a short reproductive cycle so one reaps the benefits of investment soon. It is therefore an inclusive, pro-poor business for women, men, landless youths and people with

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<sup>21</sup> A reflection by the project team afterwards is that tractors do need to be 'fed' with diesel or petrol and the GHG emissions of this fuel is not in fact captured by CLEANED-R yet.

disabilities. They propose using concentrates to boost quality sheep meat and reduce GHG emissions, and furthermore, sheep can support environmental rehabilitation as sheep grazing is not as damaging as cattle grazing. Also, sheep production does not need large land areas. Similar to the other groups, they also favour increasing specialised dairy and reducing indigenous cows as they are less productive but keep some to maintain the indigenous genetics – and feed the remaining indigenous cows better to maximise their potential.

This group also was more focused on reducing greenhouse gas emissions in considering the scenario design than the other groups and questioned whether the model behind the CLEANED-R tool was capturing greenhouse gas dynamics correctly. In their perspective, changing the feed type should have more impact than the model portrayed. This was noted by the modelling team. Nonetheless, the scenario that the group arrived at achieved the lowest change in greenhouse gases of all the homogeneous stakeholder groups, though still a small increase, suggesting that their balancing of specialised dairy, beef and sheep to meet the needs of income from milk while providing a low-capital solution for less well-off households was successful from an environmental standpoint.

### **3.3.5 National Learning Alliance**

The presence of representatives from the national level was unique to the Ethiopian case. As they had not been present for the first workshop, they adopted the local administrators' story and indicators as their base, with an introduction to the area by one of the research team and her interpretation of key issues and trends. Building on these, they could discuss a scenario to represent their mandate from national policy level to reduce greenhouse gas emissions while considering what little they knew of the local context from their brief introduction to it. They were particularly in favour of the local administrators' indicator of success of joint decision making, factoring

empowerment of women in their discussions. They also considered surrounding market options in selecting specialised dairy as a profitable option to focus on.

Initially, the project team was concerned about bringing in national level stakeholders to the learning process, worried that the power imbalance between national and local stakeholders would unsettle local participants and mute their voices in the learning process. However, facilitators actively encouraged equal participation and both national and local participants enjoyed the opportunity to meet each other (informal participant feedback). The benefit of having the national perspective present in the workshop, in addition to local researchers, was that farmers in Ethiopia learned that greenhouse gas emissions are an important factor for policymakers and local officials, and therefore why greenhouse gases were a relevant indicator in the environmental assessment. The farmers accepted that, which explained the policymakers' decisions about how to design their scenario. Facilitators commented how farmers embraced the consideration of GHG to the extent of taking it into account when they talked about further revisions to their scenarios. This appreciation of the motivation of policy makers is particularly important in the Ethiopian context, where green growth remains a high national priority. At the same time, policymakers and local officials accepted and acknowledged that for the farmers and traders, income is an important factor, more so than GHGs, which in turn is what drove the farmers' scenario designs.

### **3.4 Perspectives from Tanzania**

The narrow focus of the learning process on small-scale dairy production and excluding beef cattle effectively restricted the relevance of the discussions to the highland parts of Lushoto district by virtue of being close to Lushoto town and access to inputs (feeds and veterinary services) and milk collection centres, as well as being wetter and having more natural feed available than the drier mid and lowland parts of Lushoto district.

Across stakeholder groups there was a common trajectory of upgrading their few stay-at-home cows to crossbreeds to increase milk output. All agree that land is a



constraint, with no space for new grazing land and by-laws in the highlands preventing grazing in common areas. This is conducive to keeping cows in sheds all the time and bringing food to the animals rather than allowing them to graze their own feed out in public or common grazing areas, so intensive, specialised dairy production makes sense - in the highlands at least. In addition, small-scale specialised dairy production had already been promoted by the ongoing CGIAR programme with its network of dairy hubs and other programmes providing heifers on condition that the recipients pay forward the first-born heifer to another recipient. However, there was varying emphasis within groups with regards to how exotic the crossbreed should be (higher proportion of exotic in a crossbreed gives higher milk output, but requires more feed, medicine and care, and at the time of interviewing maintaining genetic integrity using artificial insemination was expensive in Lushoto and not guaranteed a successful pregnancy).

There was a long debate in plenary, so perspectives were not assigned to stakeholder groups, where one side proposed that local breeds should be replaced by crossbreed dairy cows – for increased income leading to improved livelihood of everyone in the district, and this would be possible because a large demand for milk nationally and regionally, and instead of allowing imported milk to fill the gap, they should protect local incomes and livelihoods. The other side argued in turn why local breeds could not be fully replaced, because of their role in cultural ceremonies, for which crossbreed dairy cows could not be used because they are too large (too expensive) and do not taste as good, and because of the hardiness they are a less risky option for those who are less well off. There was an appreciation on both sides of this debate of the validity of the other argument, though no clear resolution was found, except that both points remained valid. The debate provided the opportunity to appreciate the different roles for the different types of livestock, and the different values attached to different types of livestock. The scenarios reflect the value of local breeds, with all groups opting to keep a portion of local breeds for cultural functions, and some also for the better taste of the meat.

Although not directly about the role of livestock, several participants mentioned that the learning process showed them the value of planning for the future, and how they appreciated the opportunity to do so in the workshops. Several reflected that it was new to think about having a plan, and that it is something they would continue to do in the future, now that they had the tools to do so. They found it inspiring to think about what they want and how they would get there instead of just keeping cows without a specific target.

### **3.4.1 Farmers groups 1 and 2**

Both farmers groups' stories of the future presented mixed crop-livestock systems, but alongside non-farm activities which were the primary activity. Farmers group 1's fictitious individual was also a carpenter with a money transactions shop, and in addition to dairy cows, had plots of forestry and cash and food crops, tended by labourers. Farmers group 2's fictitious individual worked during the day at his construction spares shop and tended the farm with his wife in the morning and evening. These diversified livelihood strategies could only be translated partially and implicitly into scenarios due to the constraints of the tool which focus on dairy livestock.

When discussing the scenarios, farmer group 2 was more ambitious than farmer group 1 in upgrading a greater portion of the indigenous breed cows to crossbreeds and almost pure exotic breed cows. Group 1 were cautious about the expense and risk of the most improved crossbreeds and exotic breeds, which require extra feed, care and medical inputs which will be feasible for some but not all households, so crossbreeds are a better compromise if going for improved breeds at all. They questioned whether the expense and risk were worth the higher productivity. The second farmer group was comfortable with the more improved crossbreeds and with the exotic breeds because of the high milk yield, particularly after doing a rough cost-benefit analysis by themselves to support their thinking. They consider that there is land available for

planted fodder and an unfulfilled market for milk in the nearby milk processing plant that support their decision. They recognised that there will be early and late adopters - only a few have the capacity to go for exotic breeds, but still think it is important to cater for those few in the scenario. They also recognised that not everyone wants to or should have to move to specialised dairy, particularly thinking of those in the lowlands who may prefer to keep to indigenous breeds. This shows two contrasting perspectives among farmers, those who consider that the high milk yield can support the costs, and those who consider the costs a little too risky and make a compromise on milk yield to retain some hardiness.

Interviews with some of the farmers expand on this distinction, reiterating that the position of dairy cows in farmers' lives is diverse, but typically dairy cows are additional to crop farming and other livelihood activities, often kept more for their manure than for their milk, and therefore investing in specialised dairy depends on one's other resources. For example, growing one's own fodder is only possible for those with enough land. Interviewees ranged from the woman joining the crossbreed promotion programme to gain an independent activity and still struggling to make it worthwhile to those who invested in crossbreeds using excess resources, for whom crossbreeds are very profitable. The diverse livelihood activities presented in the stories of the future were also apparent. For five of the 11 interviewees, the dairy cattle were supplementary to their crop or horticulture production, although improving the cows to crossbreeds was a strategic, and satisfactory, investment to provide more manure and extra income. Three also have off-farm income from a shop or providing a milk collection service. However, investing in crossbreeds was possible due to having extra resources from the crop farming and off-farm income, or having land to spare to produce fodder crops. Only one farmer had dairy cows as her main source of income, and that only because it was her own endeavour, we did not ask about the rest of the household. Another two of the interviewees have office jobs as their primary activity, but have crossbreed cows, as well as crops, horticulture, some forestry and aquaculture as additional investments. Interviewees were generally positive about

crossbreed dairy production as an additional source of income for improving lives. For example, for two interviewees, the income from milk funded building new houses, and sending children to private school. For others, the costs are still high and the returns are not yet covering costs, but they are still hopeful that the investment will pay off in the long term.

### **3.4.2 Traders**

For the traders' story of the future, they related the story of an existing person, the father of one of the participants. In contrast to the farmers groups' stories of the future, livestock was the main activity, though later in life he established a restaurant as well. In the rest of the workshop discussions, the trader group was ambitious about modernisation and progress, arguing for producing high - and stable - quantities of milk to supply the two nearby milk processing plants, proposing that everyone move to crossbreed and eventually pure-breed dairy cows. Acknowledging that some indigenous breed cows will remain for cultural functions, they also encouraged the others with their perspective of nothing ventured, nothing gained – there are high costs associated with crossbreeds and exotic breeds, but also high rewards.

### **3.4.3 Administration**

Similar to the traders, and in contrast to the farmers, the administrators' group's story of the future also had no off-farm activity. A mixed crop-livestock farm was the main activity, although it is diverse and produces eggs as well as vegetables and milk for sale<sup>22</sup>. When discussing the scenario, this group in particular highlighted how they see the population of Lushoto adopting different livestock keeping practices at different rates, reflecting the different socio-economic status of households and the differing

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<sup>22</sup> Producing eggs for sale is not necessarily unique to this group's story of the future, it just may not be mentioned in other groups that the households keep chickens as well, as it is likely a standard feature of most households.

position of livestock in their lives. They would have distributed the livestock herd across all possible management options to cater for low inputs and high inputs, although the CLEANED-R tool can only handle one management option per category of the 2-3 management options to choose from per category. This is an example of the value of embedding the CLEANED-R tool in a game and playing it as part of a learning process. An end-user using the tool on their own might be frustrated at not being able to represent their more diverse landscape scenario, whereas playing the game allowed participants to elicit and discuss the more diverse scenario and discuss how to simplify it for the tool in a way that would represent it to their satisfaction.

Based on their discussions, the perspective of the administrators was similar to the farmer group 2 – ambitious in encouraging adoption of crossbreed and exotic cows, while recognising that they are not for everyone, and that there are additional risks to consider. While acknowledging the promise of a large demand from processing factories, and wishing to provide for it instead of leaving it for other countries to meet the demand, the group raised the uncertainty in milk prices. At the time of the workshop, the market was stable, despite relatively low prices offered by the cooperatives. However, the stability of the market was unpredictable since introduction of cheaper milk and milk products may interfere and affect the local market. Examples from other products such as rice were given. So, they would want to see an enabling environment with the presence of local market protective policies to control importation of milk and milk products.

Reflecting on the social learning process, the administrators mentioned that although the crossbreeds have been promoted for some time in preceding long-term programmes, of which the participants at the workshop are members, it seemed that the participants got more excited about the potential of crossbreeds after playing the Transformation Game and seeing the implications for the whole district of increasing the number of crossbreeds.

### 3.5 Discussion and conclusion

This chapter shows that stakeholder groups do hold different perspectives towards livestock, and often they are the broad-brush categorisations one might expect – but not always. The government officials, local researchers and administrators (loosely grouped under the label ‘technician’ for this discussion) would like to see modernisation of livestock production and frame livestock production as a primary enterprise, keeping livestock for sole purpose of the meat or milk product rather than any other function, which reflects a technical narrative emphasising need to increase production and particularly the efficiency of production of livestock and animal sourced foods (milk, meat, eggs), by improving the genetics of animals to produce more per animal (Eisler et al. 2014; McDermott et al. 2010; Delgado et al. 2001; Herrero et al. 2010). This is a top-down narrative, by researchers, economists and policymakers, aiming to improve productivity, away from ‘subsistence’ production, also as path out of poverty, and for improved nutrition (in moderate amounts, e.g. Godfray et al. 2018; Dror and Allen 2011; Jackson et al. 2016). The change in genetics tends to be accompanied by higher input requirements – better and more feed and more medication to prevent disease – but the argument is that the higher output offsets the higher inputs required, which was repeated for example in the Tanzania workshops.

Farmers are more cautious in moving towards high-input livestock production particularly when livestock is secondary to crop production and the main functions are to provide manure for the farm and capital reserves for emergencies – as stakeholders in Ethiopia repeated, “*Livestock is mandatory*”, but for the cow or sheep itself, not for the meat or milk. This reflects a livelihood or bottom-up perspective, illustrating the multi-functionality of livestock for households (Udo et al. 2011; Herrero et al. 2013; Rufino et al. 2007). The arguments raised by the pastoralists in Burkina Faso for maintaining the transhumant aspect of their livestock keeping as it is (although agreeing that the sedentary aspect could be improved) reflects the literature that on some land livestock is the most sensible option (Röös et al. 2016; Ran et al. 2017).

However, the results highlight that stakeholders are also individuals who wear many hats, and therefore may have different perspectives to the perspective distilled by the stakeholder group to present in the workshop. The 'farmer' label was shown to be particularly broad – in Africa, people say 'everyone is a farmer', and within the case studies' stakeholder groups many technicians and traders kept livestock. Furthermore, farmer stakeholder groups contained farmers of diverse age, gender and economic situation, which all affect their priorities for, and ability to invest in, livestock. For those who are able, investing in a few specialised dairy cows as part of the crop-livestock system or as an additional income source was agreed to be feasible and desirable. This reflects a moderate technical/agroecology narrative promoting diversity and moderation, highlighting the role for livestock for ecosystem functioning (Rudel et al. 2016; Herrero et al. 2010) but at lower animal numbers.

It was interesting to see 'real life' wishes from participants in Tanzania that translated into scenarios which were too diverse or complex for the CLEANED-R tool to take as input (sections 3.4.1 and 3.4.3). This revealed that the value chain approach used by the CLEANED-R tool and the project overall, and the focus on a limited number of livestock categories is too narrow to be able to replicate participants' livelihoods. It raises the question of the purpose of the tool and the learning process. On the one hand, it bears out the project team's reason for using the learning process – to provide a space in which to use the tool as part of a discussion, to allow the users to bring in information and experience that was not included in the tool when designing scenarios and evaluating the results, as the tool cannot realistically handle everything. This encourages the tool to be only part of a wider discussion and not the sole focus and final answer (Nelson et al. 2002). On the other hand, it is an example of one's discipline and epistemology bounding the research and influencing what knowledge is produced by which questions are asked, which indicators are used, and which factors are considered important (Ahlborg and Nightingale 2012; Forsyth 2003; Little 2003). The project was built around the CLEANED-R tool, and self-reflection by the team and the critical realist analysis in this thesis reveals how the team's expertise and technical,

positivist disciplinary background implicitly overshadowed the implementation of the learning process as well in maintaining the focus on the livestock value chain too much in the activities. More could have been done to guide participants in translating their broad perspective scenarios into the more specific input for the tool, for example using the critical realist and political ecology framing of the thesis to design pluralistic workshop activities and guide the translation between epistemologies. A related point is that the workshop discussions focused on economic and environmental perspectives, with little or no mention of the cultural, political and historical dimensions. Partly this was an issue of time, but a broader framing of the activities such as a multi-functional landscape approach rather than a livestock-only approach may address this.

On a separate note, in each country one or two participants from the advisory and private sectors commented about the participatory methods used in the workshop, which they found to be a promising approach that could be useful to them in the future. This is not a perspective on livestock, but as this thesis is about the value of the learning process, it is worth recording that participants gained this new perspective and felt strongly enough about it to report it after the workshop, appreciating the knowledge they gained about new approaches, methods and processes. Several mentioned that they could foresee continuing to use these methods in their future work, and some participants would like to see other workshops and projects using such methods. Reflecting on the process some months after the workshop, facilitators reinforced this sentiment, confirming that it is something they would use again, and that in some cases that they had had further feedback from participants repeating it. The research team consider this choice to adopt a participatory approach as the beginning of a normative shift, if it is based on a changed sense of what needs to be valued, that is to say needing to value other people's knowledge.



## **4 Games as boundary objects: charting trade-offs in sustainable livestock transformation**

This chapter has been published as a paper with a request for an added focus on managing trade-offs, however the core of the paper is still about how to facilitate crossing boundaries of knowledge in the social learning process and therefore contributes to the aim of the thesis. It is presented here largely as it was published and may therefore have some repetition of information from the introduction and methodology chapters.

### **4.1 Introduction**

Population and income growth in Africa will lead to an increase in demand for food and, in particular, for animal products (Enahoro et al. 2018). Increased crop and livestock production will inevitably compete for land and water with urbanisation, industrial crop production, biofuel production and conservation of land under protected areas (Vlek et al. 2017; Kariuki et al. 2018). Some degree of intensification of production will be required so that sufficient calories and nutrients can be provided for an expanding population. To be sustainable, this intensification will need to maintain ecological integrity, livelihoods and wellbeing. This is a complex challenge and one that has given rise to much debate (e.g. Hagggar et al. 2018; Garnett 2014; Leach et al. 2013) and competing alternative strategies (e.g. sustainable intensification (Pretty et al. 2011), climate smart agriculture (Lipper et al. 2014) and agro-ecology (Gliessman 2016)). Solutions for changing livestock production systems are inevitably contested as each will have a range of better or worse consequences, generating new patterns of winners and losers among actors with unequal power and influence (Eriksen et al. 2015). Stakeholders, including researchers, policy makers, private enterprises, producers, community leaders, non-governmental organisations and civil society

organisations, frequently hold different visions for a sustainable agriculture and livestock system, which can translate into conflicting priorities (e.g. Scown et al. 2019).

Gains in economic growth from increased livestock production compete with 'losses' associated with increased resource use and pollution, and/or losses of cultural, social and livelihood functions (e.g. Vlek et al. 2017; Loos et al. 2014). For example, high yielding livestock cannot replace draught power, or provide lower value animals for cultural rituals (Moll 2005). Prioritisation of gains and losses differ according to social norms, beliefs and perceptions of costs and risks (Salmon et al. 2018; Tittone 2013; Garforth 2015). Apparently sustainable strategies for livestock may result in indirect or "hidden" social and environmental consequences (Tschakert et al. 2017) and will likely distribute socio-economic impacts unevenly across actors, the more so when they are embedded in different social and cultural contexts (Beuchelt 2016). As such, a given socio-economic gain can be realised in terms of environmental costs - or *vice versa* - in many ways.

This complexity suggests that diverse actors must participate in evaluating the relevance and weighting of trade-offs in a particular context and at a given scale (Tschakert et al. 2017; Thomson et al. 2019). While multi-stakeholder processes, such as those informed by social learning, have been proposed as a mechanism for exploring complex problems (Ison et al. 2007; Tschakert and Dietrich 2010), the use of participatory processes comes with opportunities and challenges (Cooke and Kothari 2001; Hickey and Mohan 2004a).

Participatory processes create opportunities for empowerment by including marginalised perspectives into decision-making and challenging dominant assumptions about which trade-offs or synergies are most appropriate (Duncan and Claeys 2018; Capitani et al. 2019). When decision makers increase their awareness of the multiple, legitimate perspectives of an issue, the chance of positive outcomes increases, as does the transparency and legitimacy of decision-making (Cash et al. 2003; Clark, Kerckhoff, et al. 2016). The design and facilitation of participatory events influence whether (or

not) the process of participation opens spaces for innovation and transformation (Gaventa 2006; Cornwall 2004), with factors such as invitees, location and language influencing who is included or excluded from participating. Furthermore, no space for participation is neutral as hierarchy, rules and norms leak into the space with participants' habits and experiences, and the risks of reinforcing existing power relations are considerable (Gaventa 2006; Cornwall 2004). While these power dynamics are not necessarily bad, it can be detrimental when they are ignored (Stirling et al. 2018). A facilitator thus has both the power and the responsibility to guide and intervene in discussions (Kapoor 2002).

Ison (2010) and Rist (2006) therefore call attention to the design of the participatory process, to ensure that it invites equal participation and provides rules for promoting open dialogue and the freedom to express oneself. This encourages negotiation based on rationality rather than influenced by hierarchy or emotion; in other words, creating the conditions for Habermas' (1981) communicative action. But sharing knowledge between stakeholders is not always straightforward (Lamont and Molnár 2002; Oswick and Robertson 2009). There are natural boundaries between stakeholders, reflecting levels of education, types of knowledge, experiences, and observed rules and norms (Lamont and Molnár 2002). These differences can be exacerbated when, as is frequently the case in Africa, technical and scientific terminology does not translate well into local languages and understandings.

As discussed in more detail below, the concept of boundary objects, made popular by Star & Griesemer (1989), has been increasingly used in literature on learning processes and structured multi-stakeholder methodologies to address facilitation of communication between stakeholders (e.g. Jean et al. 2018; Cash 2001). Modelling, visualisations and games are being conceptualised as structured boundary objects that organise knowledge and produce comparable visual outputs that are useful for communication (Pennington 2016). As such, they offer a means of facilitating shared learning and collaboration between stakeholders (Jakku and Thorburn 2010; Forrester, Matin, et al. 2019). In this paper, we assess the benefits and challenges of using

structured boundary objects in stakeholder processes to support meaningful stakeholder engagement. Focusing on the problem of livestock livelihood futures in Africa, we ask: (a) how effective are structured boundary objects in supporting knowledge sharing and learning between stakeholders, and (b) in doing so, how effective are they in supporting the identification of context-specific trade-offs? Our study looks at the deployment of a computer simulation and board game within a participatory process to co-design sustainable pathways for livestock production in three case study areas: Burkina Faso, Ethiopia and Tanzania. In the following sections, we describe the functions of boundary objects and, for our case, how the simulation tool and board game provided these functions. We then discuss how the boundary objects represent stakeholder perspectives and how the findings inform our understanding of the trade-offs implicit in sustainable livestock production.

## **4.2 Boundary objects**

Boundary objects may mean different things to each actor, but are recognisable enough to allow meaningful communication around a common issue (Jakku and Thorburn 2010). In this way, they mediate between the values, interests and knowledges of people from intersecting lifeworlds (Pennington 2016; Long 2001). Importantly, all actors can contribute knowledge to a boundary object, modify it or use it in some way, providing a common point of reference. Boundary objects have, or rely on, some inherent infrastructure or standardisation that allows diverse actors to work together (Star 2010; Trompette and Vinck 2009). Examples are a standard classification template or common computer program, that establish a common vocabulary to define and discuss the issue. Examples of boundary objects from the literature are: design blueprints or scale models for new products (e.g. Carlile 2002; Ewenstein and Whyte 2009; Lee 2007), project management tools (e.g. Sapsed and Salter 2004) or agricultural innovation (e.g. Klerkx et al. 2012); simulation models and serious games for decision support (Cash 2001; Jakku and Thorburn 2010; Jean et al. 2018); documents, research studies and bodies of knowledge (e.g. Wallis et al. 2017; Baka et

al. 2019); or concepts such as 'ecosystem services', 'watershed' or 'stewardship' (Abson et al. 2014; Cohen 2012; Peçanha Enqvist et al. 2018).

Sometimes forgotten in literature using 'boundary objects' as any object on the boundary between actors, is that some form of infrastructure or standardisation is inherent in boundary objects (Trompette and Vinck 2009). It is the infrastructure, be it a standard protocol, classification template or common computer program, which establishes a common vocabulary to define and discuss the issue (e.g. Martin 2015) and allows diverse actors to work together despite knowledge, social or other boundaries (Ewenstein and Whyte 2009; Reed 2007; Roux et al. 2017). This means that a particular set of knowledge conventions, standards and norms is inherently forming the basis of this infrastructure (Trompette and Vinck 2009).

Boundary objects mediate between perspectives by making explicit actors' interpretations of the objects and of the common issue, in turn supporting knowledge sharing (Jakku and Thorburn 2010; Forrester, Matin, et al. 2019; Pennington 2016). Similarly, boundary objects can be props for catalysing discussion that lead to fuller exploration of issues that are understood differently or incompletely by the actors, until a common level of understanding is reached (Lee 2007; Wallis et al. 2017). An example is visual representations of reality, such as conceptual maps, mental models or social network maps, which create a tangible object that can be viewed and discussed (Black and Andersen 2012; Forrester, Matin, et al. 2019; van Bruggen et al. 2019). Revealing and exploring differences through successive drafts of conceptual maps or scenarios, help to build mutual understanding of the different perspectives between actors in defining the issue, knowledge about the issue, and preferences or intentions for acting on the issue (Forrester, Matin, et al. 2019; Jakku and Thorburn 2010; Klerkx et al. 2012). Identifying and reconciling mismatches in the perceptions of a boundary object and its outputs can build relationships and trust between actors and increase confidence in the object and transparency in the collaborative process (Martin 2015; Cash 2001; Jean et al. 2018).

Objects that do not allow collaboration are not boundary objects (Star 2010). In Black & Andersen's (2012) example, when one actor replaced the shared visual representation with his own list, it was no longer a boundary object because none of the other actors could engage with it. This relates to *authorship*: who created and contributed to the boundary object. Narrow authorship, where there are knowledge or power imbalances, can reinforce dominant perspectives. The more powerful may not wish to be confronted with another perspective and others may refrain from contributing out of concern for how their stated positions might be used going forward (Oswick and Robertson 2009).

Whether with narrow or wide authorship, boundary objects are external *representations* of reality that simplify an issue to be more easily communicated (Pennington 2016). Understanding actors' interpretations of the boundary objects is to hold up a "partial mirror" reflecting their lifeworld, their perception of reality (Forrester, Taylor, et al. 2019, p.71). There is a three-way relation between what is being represented (reality), the representation itself (the boundary object) and the intentions, both of the creator and of the audience (Zeitlyn 2010). As such, while boundary objects are created with an intention, once produced they take on a separate identity, and one cannot predict how they might be interpreted and used, or how they might evolve once created (e.g. Klerkx et al. 2012). Critical consideration of how representations are crafted (authorship) and the variety of ways in which they are used offers a gauge of the quality of the collaboration and the outcomes.

### **4.3 The ResLeSS learning process**

The Research and learning for sustainable intensification of smallholder livestock value chains (ResLeSS) learning process was implemented during 2017-2018 in Bama commune in Hauts-Bassins region, Burkina Faso, in Atsbi woreda in Tigray region, Ethiopia and in Lushoto district in Tanga region, Tanzania (Table 2). The objective was to integrate environmental, economic and equity considerations into decision making

around sustainable livestock production. The learning process, designed using social learning principles (Ensor and Harvey 2015), comprised two participatory workshops in each site, supported by a scoping visit before the first workshop and development of the site-specific CLEANED-R tool before the second workshop (Figure 6). Two facilitators led each stakeholders group, experts who spoke the local language and provided an interface between the research team and the local participants. Workshop participants were selected by local project coordinators, principally for their role as a stakeholder in the livestock value chain, looking for an even distribution of stakeholders, and secondarily for a mix of genders as far as possible.

*Table 2: Characteristics of the three study sites of the ResLeSS learning process.*

	<b>Burkina Faso</b>	<b>Ethiopia</b>	<b>Tanzania</b>
<b>Study location</b>	Bama commune, Hauts-Bassin, Burkina Faso	Atsbi woreda, Tigray, Ethiopia	Lushoto District, Tanga Region, Tanzania
<b>Focus value chain</b>	Cattle	Cattle and sheep	Smallholder dairy cattle
<b>Participants</b>	32: <ul style="list-style-type: none"> <li>- livestock producers</li> <li>- processors</li> <li>- local administration and agricultural extension agents (Chef-ZAT)</li> <li>- provincial and regional government representatives</li> <li>- NGOs involved with livestock production</li> </ul>	33 per workshop, total of 51 over both: <ul style="list-style-type: none"> <li>- livestock producers</li> <li>- animal and input traders</li> <li>- meat and milk processors</li> <li>- local administration and agricultural extension agents</li> <li>- provincial and regional government representatives</li> <li>- regional researchers</li> </ul> + 7 in second workshop: <ul style="list-style-type: none"> <li>- national level officials from Addis</li> </ul>	34: <ul style="list-style-type: none"> <li>- livestock producers</li> <li>- traders and milk processors</li> <li>- local administration</li> <li>- agricultural extension agents</li> </ul>

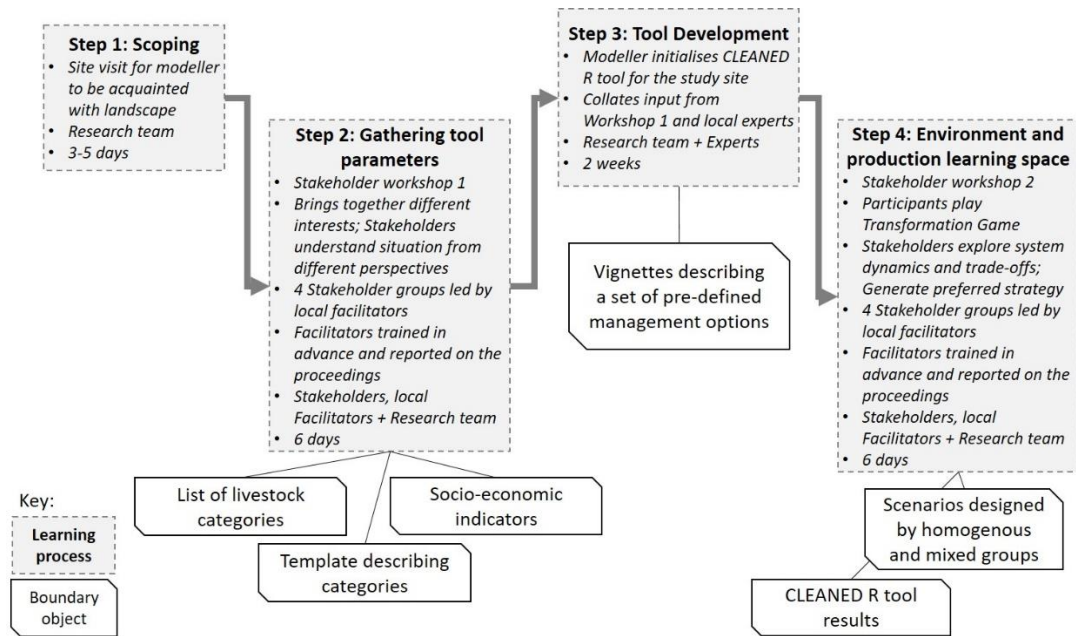


Figure 6: Summary of the stages of the ResLeSS learning process, highlighting the elements of the Transformation Game that functioned as boundary objects.

#### 4.3.1 The Transformation Game as a structured boundary object

In all except the first step in the learning process, participants and researchers created or used certain items that were instrumental in designing or playing the Transformation Game, which are conceptualised in this paper as boundary objects (Figure 6). These boundary objects played complementary roles in facilitating participants' engagement with the Transformation Game over the course of the learning process (Table 3, described in more detail in Appendix 2).



Table 3: Overview of boundary objects in the ResLeSS process, which activities they were used in, correlated with boundary object functions, which lead to identifying trade-offs and social learning outcomes.

	Function of boundary objects	Parts of the ‘Transformation Game’ set of boundary objects performing the function	ResLeSS Process activity
<i>Collaboration</i>	Bringing actors together around a common point of reference	List of livestock categories representing livestock in the study area	Workshop 1: Snowballing exercise
	Establishing a common protocol or infrastructure for engagement	<ul style="list-style-type: none"> <li>- List of livestock categories</li> <li>- Template for describing categories</li> </ul>	Workshop 1: Describing current and future livestock categories;
<i>Knowledge sharing</i>	Providing a focus for attention or a prop for facilitating dialogue	<ul style="list-style-type: none"> <li>- Vignettes describing management options</li> <li>- Socio-economic indicators</li> <li>- Starting scenarios<sup>a</sup></li> <li>- CLEANED-R tool results</li> </ul>	Defining indicators of well-being Workshop 2: Designing scenarios and evaluating tool results
	<ul style="list-style-type: none"> <li>- Eliciting different perspectives</li> <li>- Building mutual understanding between perspectives</li> </ul>	<ul style="list-style-type: none"> <li>- Homogeneous and mixed group Scenarios</li> <li>- Socio-economic indicators</li> </ul>	Workshop 2: Mixed group evaluations and discussions

<sup>a</sup> The starting scenarios were collated by the research team from the homogeneous stakeholder groups’ scenarios, to provide a starting point in the mixed groups

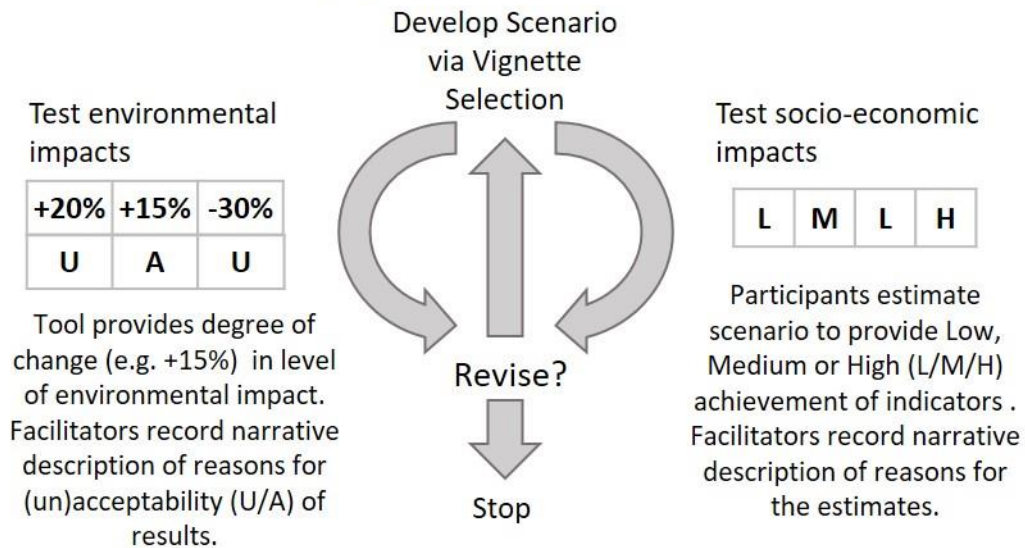
In Step 2, the *list of livestock categories*, created by the participants, and *template for describing the categories*, provided by the researchers, were the first boundary objects that brought people together and provided a common structure with which everyone could engage. The list of livestock categories classify the livestock in the study areas into sufficiently different groups for the CLEANED-R tool to model. Participants used the research team’s template to describe current and future management of livestock in each category, providing comparable feedbasket and manure management data for CLEANED-R (further details in Pfeifer et al. 2020). Participants also identified and defined *socio-economic indicators* reflecting aspects outside livestock that were of significance to them, such as children’s education, and peace of mind.

In Step 3, researchers built the CLEANED-R tool using the list of livestock categories and the category descriptions. To speed up gameplay in the second workshop, the research

team created a selection of pre-defined management options for each livestock category (*vignettes*), although an experienced user could define their own management profile in the CLEANED-R tool user interface.

While playing the Transformation Game in Step 4, participants created the main structured boundary objects in the form of the *scenarios* they designed, first in homogeneous and then mixed stakeholder groups, to negotiate what would be acceptable or not across all stakeholder groups. Players designed scenarios by allocating the number of livestock and selecting their management (which vignette), in each livestock category; iteratively evaluating the scenario using the *CLEANED-R tool results* and their (subjective) assessment of the socio-economic indicators; and revising the scenario as necessary (Figure 7). The scenarios are the external representation, or mirrors, of participants' desired reality that elicit different perspectives in a structured manner to facilitate knowledge sharing. The vignettes, CLEANED-R tool results and socio-economic indicators function as boundary objects that provide information and prompt discussion of certain aspects to support evaluation of the scenarios.

## Playing the Transformation Game



*Figure 7: Playing the Transformation Game: iteratively designing and evaluating scenarios of livestock production.*

### 4.3.2 Data and methods of analysis

Data were collected using participant observation, feedback from the workshops and semi-structured interviews with participants from the two workshops in each of the three countries. Thematic analysis according to Braun & Clarke (2006) was used to analyse the data.

The first and third authors participated in all six workshops, reflecting on the effectiveness of the process, emerging perspectives and participants' engagement. Feedback from the workshops was gathered in workshop reports prepared by eight group facilitators in each workshop team on perspectives discussed by participants, their engagement and interaction with the process, as well as pre-post questionnaires before and after each workshop. Following the second workshop in each country, the first author carried out semi-structured interviews with eight (25%), ten (30%) and ten (29%) workshop participants in Burkina Faso, Ethiopia and Tanzania respectively. Interviewees, selected by a local team member, represented one or two individuals

from each stakeholder group (e.g. producers, traders, processors, local administrators, local researchers or livestock ministry officials). The workshops, reporting and interviews took place during six two-week periods between 2017 and 2019.

The workshop reports and transcripts of interviews were analysed in QSR International's NVivo 12 software (Richards 1999), coding for how the Transformation Game functioned as a boundary object in supporting collaboration, knowledge sharing and learning, while reflecting on how the Transformation Game was created and used, as outlined in Figure 8.

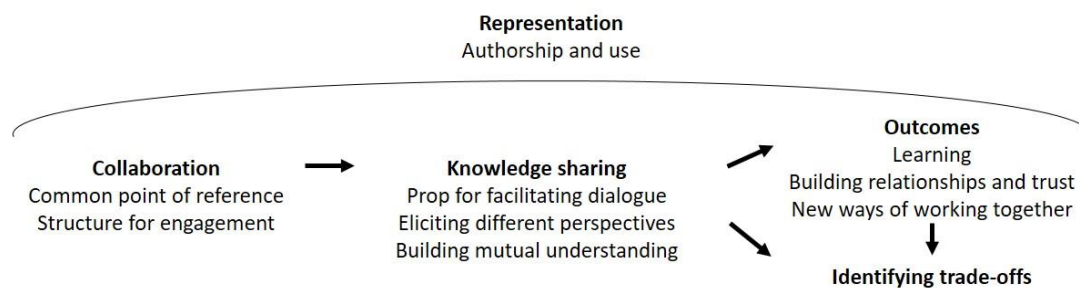


Figure 8: Functions and outcomes of boundary objects (authors' illustration of concepts drawn from the literature).

## 4.4 Results

This section gives examples from each study site of how the Transformation Game provided opportunities to collaborate and props for discussion, how it exposed different perspectives and catalysed negotiations toward an agreed strategy.

### 4.4.1 Enabling collaboration

Once the stakeholders were in the same room, having a meaningful engagement process implies they were able to talk to each other. The list of livestock categories and template for describing their present and future management, as the initial boundary objects, established a common topic to talk about and a common vocabulary with which to talk about it.

The use of, and need for, these initial boundary objects became clear as actors have many different ways of classifying livestock, for example by breed (e.g. Zebu or Friesian), function (e.g. draught power, main herd or fattening), level of inputs, type of output (e.g. milk, meat), or ethnic groups. Particularly in Burkina Faso, no one could agree on how best to split up the livestock herd (cattle) into common livestock 'systems' for the study area – or, as the word 'systems' was too ambiguous or contentious, into *categories*: sufficiently distinct groups of animals that CLEANED-R could model. The groupings finally proposed by the modeller provided a common point of reference, to set common categories and common understandings of what those categories entailed, so that all participants were 'on the same page'. This was as important in Ethiopia and Tanzania, where participants more readily agreed on categories themselves. The template provided a structure for describing the livestock management, to capture in a comparable way participants' qualitative experience into quantitative input for the CLEANED-R tool. As input into the CLEANED-R tool, these boundary objects meant participants could identify with the tool – they also set the scope for what could be manipulated when playing the Transformation Game, providing the vocabulary and structure for designing scenarios of livestock production.

The scenarios also facilitated collaboration - as comparable physical representations serving as a mirror reflecting the reality of the individual or group who designed the scenario, yet separate from the creator(s) (Forrester, Taylor, et al. 2019). As such, they could be viewed, shared and built upon by other participants. In this way, participants could collaborate with each other to explore alternative options for the future.

#### **4.4.2 Supporting knowledge sharing while playing the Transformation Game**

Knowledge sharing happened throughout the ResLeSS process, qualitatively captured in facilitators' reports of points of contention and learning during group discussions and self-reported instances of 'something that surprised me' in participants' post-workshop questionnaires. Negotiating the list of livestock categories revealed different

perspectives on classifying livestock, and the template regulated knowledge sharing between participants and researchers. Most knowledge sharing occurred while playing the Transformation Game, with the elements of the Game serving different boundary object functions. They iteratively provided props for facilitating dialogue, exposing different perspectives that needed to be explored, in turn bringing new knowledge into play, prompting new dialogue, and so on. This iterative process, conducted as a group, played an important role in building shared understanding of the different stakeholder priorities with respect to what they expected to achieve from livestock in the future. In turn, it provided opportunities for learning how to design scenarios that could meet those expectations. The following gives some examples, selected to highlight different aspects of knowledge sharing.

#### *Eliciting different perspectives when designing scenarios*

The vignette descriptions provided new information about higher yielding cows and sheep. For many participants, particularly from farmers and traders groups, the vignettes introduced new animals with higher milk or meat production potential than those currently found in the study area. Similarly, for many participants the vignettes showed that it is possible to increase production within their livestock category by providing good quality feed in sufficient quantities. The vignettes became props for stimulating dialogue: when selecting a vignette for each category, they stimulated discussions about the resource implications of different management strategies; when deciding how many animals to keep in each category, the discussion focused on the value placed on different categories of livestock. Exploring these issues exposed different and competing perspectives.

In all three countries, the choice of vignettes elicited different perspectives on the trade-off between food for the household and feed for the animals. Improving the feedbasket requires more financial resources to buy concentrates or planted fodder, or spare irrigated land to grow planted fodder. Some in Ethiopia and Tanzania would rather grow planted fodder as they consider it cheaper to buy staple food required by

the household than to buy concentrates<sup>23</sup>. In strong opposition to this view, others would not use “*their little land available*” for planted fodder as they would lose the opportunity to secure food for the family. Similarly, sensitive higher-yielding breeds are more labour-intensive to care for and require more financial resources for maintaining their health. Some judged the increased milk yield to be sufficient to pay for higher investment in inputs while providing extra income for the household. However, those with little land or capital preferred to retain land for food production, hedging against emergencies with smaller animals that can easily be sold if required. The Tanzania stakeholder group scenarios reflect these perspectives as a gradient of intensification, with improved management of local and cross breeds for the more cautious and the most improved breeds and management for the more ambitious.

Discussions also revealed different understandings of livestock, not always as the primary source of income. Often it is a secondary support to cropping (where livestock is appropriated for labour and manure for fertiliser) or to off-farm income, and in all three countries there are cultural values and functions performed by local breeds for which high-performing breeds could not be a substitute. For the pastoralists, cattle are a substantive form of wealth and therefore more than a money-earner. Each of these considerations play a different role in the choice made by different actors over which animals to keep, in what numbers, and under what management practice. In the Tanzanian example, groups emphasised that while much of the current dairy herd should intensify, albeit to varying extents, there would remain a portion of the herd kept as it is today to satisfy cultural functions.

#### *Eliciting different perspectives on the outcomes of the scenarios*

Running the scenarios in CLEANED-R, the tool results provided a second round of new information, specifically including environmental measures to prompt exploration of

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<sup>23</sup> This was raised in the mixed stakeholder group, so it is hard to say which stakeholder groups these views came from.

issues the researchers felt might be important. The socio-economic indicators defined by the participants offered a third dimension, prompting discussion of the consequences in terms of ambitions for education for all children, sufficient food, health and peace of mind. The results were sometimes unexpected, usually when scenarios produced less meat and milk, or more greenhouse gas emissions, than anticipated. It should be noted here that the model behind the CLEANED-R tool is static, so it provides a snapshot of annual production and consumption of resources for a given input of number of animals kept in a particular way for a year. Participants were asked to develop scenarios for 2030, and several groups did mention explicitly in their discussions the extent to which they hoped or doubted that current production could feasibly have changed in the next twelve years to back up their arguments.

This exploration exposed different perspectives on what participants had expected their chosen scenarios would achieve, and how they expected the scenarios to link to improving livelihoods and wellbeing. Revealing the differences between officials and experts (who have a mandate or interest to reduce greenhouse gas emissions and water use) and those concerned with how livestock products can support improved livelihoods, was useful. In Ethiopia, for example, both sides of the debate indicated how much they appreciated being confronted with the opposite view, as it prompted the mixed groups to seek a balance between increasing output and minimising environmental impact. Agreeing that specialised dairy production and sheep provide valuable social benefits to unemployed, landless and poorer households, the group agreed to offset increased greenhouse gases from specialised dairy by trading in beef production for mutton production. Yet, in all three countries, regardless of environmental indicators, scenarios that produced less than around 25% more meat or milk compared to today were considered to provide insufficient extra income to meet the socio-economic goals of the community, and therefore were deemed to be inadequate.



### *Mediating between different perspectives*

In some cases, the Transformation Game, as a boundary object, functioned as an impartial voice to mediate in arguments and, in some cases, conflicts. In Ethiopia, the CLEANED-R results suggested that scenarios emphasising sheep produce less greenhouse gas emissions than those emphasising beef cattle. The results added weight to those arguing that sheep are less expensive and more easily managed, and therefore would benefit more households than cattle. In Burkina Faso, the tool results defused a heated discussion that reflects a wider history of dispute between pastoralists and settled farmers. First, the scenarios, which appeared in the Game as external representations of conflicting perspectives, were somewhat detached from the original proponents. Then, as participants came to ascribe a voice to the CLEANED-R tool, “*the computer*”, the tool results were seen as coming from an impartial party. The tool results provided an external, physical object which participants could address, “de-personalising” the scenarios and their implications (e.g. Black and Andersen 2012, p.201). This allowed an objective debate between the conflicting perspectives, in a safe space, which was much appreciated by participants from each side. Explaining their evaluations of the scenarios drew out the rationales behind the opposing perspectives, painting a rich picture of both sides of the argument and offering the opportunity for each side to learn from the other. This was particularly the case for those with limited experience of or empathy with the broader context outside of their own life, such as a relatively wealthy male farmer that does not understand the challenge of a female-headed landless household.

#### **4.5 Representing different perspectives**

Participants’ use of the ResLeSS learning process exemplifies how boundary objects assist groups to “*collectively make their thought and action more coherent*” (van Bruggen et al. 2019, p.824). The scenarios produced in playing the Transformation Game, as physical representations of participants’ subjective realities, were used to

facilitate or mediate the exploration of different perspectives. Reflecting on how these objects represent participants' different perspectives gives an insight to how effectively the Transformation Game provided enabling conditions for meaningful engagement. The following section considers who took part in creating the boundary objects, how they were interpreted by others and what has been learnt about sustainable livestock production.

#### **4.5.1 Authorship and use – who shaped the boundary objects and how were they used?**

The findings offer lessons about how authorship shapes the use of boundary objects. First, users can only contribute to collective thought and action if they can identify with the structure of the boundary objects (Black and Andersen 2012). Giving participants authorship, as input to the Transformation Game, meant that the scenarios could mirror their realities. The Burkina Faso example of very different stakeholder classifications of livestock illustrates the importance of ensuring the boundary object is constructed on common ground, using terminology they had collectively agreed (that is, the list of livestock categories).

The second lesson more broadly relates to the role of the research team's authorship in influencing participation in and scope of the Transformation Game. For example, in Burkina Faso the researchers deliberately kept both the minority storyline (more animals kept in a similar way as today) as well as the majority storyline (intensification, which appeared in three of the four initial group scenarios) in the mixed starting scenarios. Maintaining diversity in the scenarios forced participants to consider both perspectives, thereby providing space for less powerful voices (pastoralists) to enter the debate instead of driving towards consensus too early (Muro and Jeffrey 2008).

Pragmatic choices restricted the scope of discussions. For example, restricting the template to describe only animal management gathered sufficient information, fairly quickly, to populate the CLEANED-R tool. However, participants could not contribute

how livestock fits into the rest of their lives, as in Tanzania where many dairy cattle are complementary to the main activity of horticulture, providing manure for the fields. As such, the scenario ‘mirrors’ filter out activities such as crop production or off-farm livelihoods that complement or compete with livestock production in any of the categories.

Similarly, the researchers embedded the CLEANED-R tool in the Transformation Game to make it more accessible in a participatory setting, which included pre-selecting a set of management options (vignettes) to simplify the scope in designing scenarios. As another simplification, users could only select one vignette per livestock category. One scenario is therefore good at reflecting one actor’s vision, a mirror of their reality – but a “partial mirror” when compared to the diverse visions of other actors, reflected in their scenarios (Forrester, Taylor, et al. 2019, p.71). Learning from the partial mirrors, groups can acknowledge the variety of preferences households have for how to engage with changes in livestock categories. In the Tanzania example, groups would have selected two vignettes in certain categories to show that only some producers will transition to new management. Those preferences are shaped by producers’ ability and resources (Udo et al. 2011) and their perspectives on the role of livestock (van Bruggen et al. 2019), such as ambition to be early adopters of new breeds, caution about the risks involved, interest in conserving cultural functions or focus on other primary income activities. The final scenarios might best be referred to as *composite mirrors* that collate the preferences expressed in the partial mirrors. The CLEANED-R tool intentionally models producers as a collective, representing the animals associated with the landscape in livestock categories that are meaningful to the stakeholders and thereby encapsulating this diversity in preferences by translating the diverse strategies into the common denominator of biophysical feed demand (Lannerstad et al. submitted for review). The simplified Transformation Game guides participants to consciously chart the diversity and combine it into one representative vignette per category, reflecting an average or most common strategy.

At the same time, the physical representation of each composite scenario veils diversity for new viewers by presenting just one vignette per category. As van Bruggen et al. (2019) find in their work and that of others (e.g. Salvini et al. 2016), the most significant learning in participatory modelling or gaming exercises happened when there was deep discussion and reflection within the group about the scenarios or outcomes. The results presented here reflect this – the important learning about the diversity encoded in the composite mirror remains with the group members who agreed which vignette should represent the average, or most common, management within each category. Similarly, the Transformation Game, and the embedded CLEANED-R tool, are useful as a means (as a boundary object within a learning process) but are not an end in themselves for answering complex questions.

The Transformation Game and the scenarios have thus been shaped by the intentions of their creators. The research team intended to support communication and learning between participants in a short space of time, with particular attention to securing a place for minority or less powerful voices. The participants intended to showcase their perspectives. However, once created, the Transformation Game and scenarios became independent objects that were used by others to serve their own purposes (Zeitlyn 2010). Many participants used the Transformation Game to enhance their own knowledge, about new breeds and management practices to increase yield, and about the greenhouse gases that dominate the concerns of higher-level actors. Some used the scenarios to advocate strongly for their perspectives. This was conspicuously the case in Burkina Faso, where the Transformation Game gave pastoralists an opportunity to have their voices heard and to make the case for a viable livestock future that includes pastoralist livelihoods. In turn, the researchers found the actors' interaction with the Transformation Game instructive in identifying how the interface and information provided by the tool could be made most relevant to the actors (Cash 2001).

Overall, the project team held all the influence over the design of the project and learning process, although feedback from and reactions of participants to each

workshop fed into tweaks to forthcoming workshops where relevant, for example refining the way the Transformation Game was presented, giving participants more time to get to know it. Participants had some influence over the design of the model, in terms of setting the categories to use and describing the systems that the model would need to reflect. The modeler held most influence on what the model calculated and what indicators were used in the results, but refined which indicators to present based on feedback from participants and facilitators. The modeler also consulted local livestock experts to validate the parameters of the models. The project team had most influence over the vignettes, though drawing on participant input in the first workshop and scoping reports on livestock production in the case study areas from the literature. After seeing how much influence the vignettes had on the type of scenarios participants could build in the first workshop, the project team refined their approach to the vignettes and how they introduced the Transformation Game to give the participants more flexibility in using the vignettes. Participants delineated what socio-economic aspects to discuss in conjunction with the CLEANED-R tool results in Workshop 1, which was their chance to specify priorities other than environmental.

#### **4.5.2 Understandings of intensification**

Our results reflect existing literature that emphasises how different understandings and prioritisation of trade-offs influence farm level decision making and shape or constrain opportunities for taking steps towards intensification (Salmon et al. 2018; Udo et al. 2011). Literature challenging whether we should be focussing on sustainable intensification suggests that it may be more important to focus on outcomes in order to meet both production and livelihood objectives (Mehrabi et al. 2017). Being open to viewing the situation from different standpoints can identify different methods or pathways, and may ultimately challenge outsiders' views of the most appropriate objectives (Nightingale 2015; Ensor et al. 2019). In Tanzania, intensification in the highland part of Lushoto makes sense as land is severely limited and free grazing is forbidden. However, for pastoralists in Burkina Faso, the discourse around

intensification directly threatens the social, cultural and economic basis of their livelihood (Gonin and Gautier 2015). Recognising this claim to pastoralism opens the space for alternative understandings of livestock futures, which may not surface when discussion is premised on a narrow view of intensification and assumption of meat and milk production as the primary role of livestock. And, indeed, other studies confirm the potential for some locally co-adapted farming and agro-pastoral systems to be more sustainable, in their physical and social context, than an intensified alternative (Jones and Thornton 2009; Ran et al. 2017; Wynants et al. 2019; Scoones 1995).

A meaningful stakeholder engagement process that elicits these different objectives and pathways must then be flexible enough to include them when exploring future alternatives for livestock production. This involves designing the process to encourage different viewpoints, but also to be adaptable if new actors or information needs are identified. The ResLeSS learning process succeeded in drawing out different perspectives by using structured boundary objects around which to focus a discussion that was open to different voices. Yet, by focusing on the livestock value chain rather than the landscape or food system (e.g. Sayer et al. 2013) other actors were not represented, such as crop producers, land planners and urban developers in Burkina Faso, finance institutions in Ethiopia, and forest managers in Tanzania. Widening stakeholder participation would add new perspectives on how intensification or alternative options interact with broader social, economic and land use systems, to further understand hidden trade-offs and how transforming livestock systems can match the specificities of the local context. For example, urban developers in Burkina Faso may challenge the sustainability of maintaining or increasing the demand for land – and would be available to negotiate a compromise in planning livestock or urban expansion. Adapting the process to cater for the additional perspectives means having flexibility in time and resources for engaging new actors and adjusting the structure of the boundary objects to support new actors' engagement. For example, the common point of reference may evolve as stakeholder participation widens, and they may need different information to support discussion. Catering to different information needs

means that boundary objects, such as the ‘tool’ at the centre of the learning process are not fixed. As a prop to catalyse discussion rather than an end in itself, it may be valuable to have a range of tools on hand, or to be flexible to bringing in appropriate tools once the information needs have been defined, after agreeing on common objectives to explore.

#### **4.6 Conclusion**

Our findings suggest that using boundary objects in a learning process offers a structured way of learning and sharing knowledge. Structuring stakeholders’ interaction opens spaces for exploring differing values and priorities. Compiling and using a simulation tool embedded into a learning process, in the form of the Transformation Game, supported stakeholders in local agri-food systems to share perspectives on which strategies for transforming livestock production would be deemed acceptable. Although this study confirmed that meat and milk output are key evaluation criteria, discussions also raised the value of livestock in supporting other livelihood activities and cultural functions. Further, participants came to understand better how and why people make trade-offs when they have to weigh individual needs and priorities against societal needs. In this way, the boundary objects provided space for understanding how intensification and alternative options may be better or worse for different stakeholders and contexts. Clearly increased demand on food systems across the African continent will inevitably compete for land with urbanisation, industrial crop production, biofuel production and conservation; open dialogue using boundary objects offers an approach to navigate through this increasingly complex landscape and ultimately underpin sustainable livestock transformation.

The boundary object lens also offers an entry point to assess the significance of authorship in the learning process. Being aware of who created the boundary objects and how the objects were used gives an insight into the outcomes of the learning process and the extent to which they are representative of the stakeholders involved.

By providing a common point of reference, a structure, and props for catalysing discussion, boundary objects offer ways to raise, manage and reconcile different perspectives, value systems and objectives. Yet they do so in ways that inevitably reflect choices made by those in control of authorship and are capitalised on by participants in unpredictable ways. The experiences of working with the Transformation Game suggest that incorporating boundary objects into collaboration and learning processes offers enabling conditions for meaningful stakeholder engagement on complex issues, but also that similar processes need to be deployed critically and flexibly to capture the emerging priorities of participants as well as users.



# **5 Letting conflict work for us - learning from differing perspectives on sustainable livestock production in Africa**

## **5.1 Introduction**

Learning is integral to sustainable transformations and is seen as a mechanism to resolve the diverging views, values and goals which characterise complex challenges (e.g. Fazey et al. 2007; Tschakert and Dietrich 2010). Challenges such as sustainable agriculture production inevitably give rise to conflicting perspectives among diverse stakeholders on potential pathways towards improved food production, ecological resources, livelihoods and nutrition (Nielsen et al. 2019; Pretty et al. 2018; Pretty 1995; Béné et al. 2019). This chapter uses a lens of constructive conflict to analyse when and how diverging perspectives in multi-stakeholder social learning workshops lead to productive conclusions. Focusing on efforts to develop sustainable strategies in the livestock and agri-food sector in Burkina Faso, Ethiopia and Tanzania, the paper asks i) in what ways does constructive conflict contribute to learning in multi-stakeholder dialogues? and ii) what implications does that have for designing and facilitating learning processes? Conflict in this paper is any moment or sequence of dialogue within discussions in a learning process in which conflict or a divergence or contestation of opinions or perspectives occurs.

The essence of learning-based approaches such as social learning is to elicit a diversity of (potentially conflicting) perspectives by bringing together multiple stakeholders from different parts of a complex system and providing space to interact. In the process they are supported to identify and understand how their assumptions diverge and overlap, to actively engage in adjusting their own mental model to incorporate or acknowledge the place of new perspectives, and from there co-create new, shared understandings of the complexity (Cundill et al. 2014; Cuppen 2012; Jeong and Chi 2007; Kristjanson et al. 2014; Pennington 2016; Reed et al. 2010; SLIM 2004; Van den

Bossche et al. 2011; Van Epp and Garside 2014). This practical approach to workshop design builds on a body of learning theory: significantly, individual learning in a social context, in which revised mental models are produced based on observing others (Bandura 1977) but building on past experiences (Kolb 1984); and the sociology of learning that emphasises the role of social and cultural context in structuring what is learnt (Lave and Wenger 1991). Past experience and the rules, organisation and language of the social and cultural context combine to form a social world within which individuals view and interpret interactions with others (Strauss 1978). Learning, however, is an ongoing process - there may be no agreement by the end of an interaction, but maybe improved appreciation of others and the emergence of new ways to resolve differences (Ensor and Harvey 2015; Steyaert and Jiggins 2007). Even reaching an agreement is not the end point as the new knowledge revealed and relationships that evolve in the process of reaching agreement can change the desired end points and associated rules of the game for reaching them. However, new knowledge and perspectives will not always be assimilated without question (Jeong and Chi 2007) - particularly when a new perspective challenges deeply held values and beliefs or is perceived to have a negative impact on one's own objectives or actions (Putnam and Wondolleck 2003).

In seeking to bring together divergent perspectives, social learning processes explicitly draw out and expose tensions, dissonance and conflicting claims between stakeholders. The aim is to provide space and facilitation to understand that dissonance and how the conflict can be resolved - or how the conflicting claims can coexist in a new understanding of the situation. It has long been recognised that conflict has positive attributes (Mitchell 1980). Hegel described conflict of opinions as fertile ground for knowledge (co-)creation, because discovering two or more opposing views triggers a search for a better explanation that reflects all views (Müller-Merbach 2004). Conflict resulting from expressing ideas that challenge or contradict dominant perspectives offers counter-hegemonic groups the opportunity to consolidate their idea(l)s. In order to take the conflict forward productively, they must articulate and

support their claims (see also Cuppen 2012; Mitchell 1980). Transcending a zero-sum logic of conflict can lead to the enrichment of ideas when groups modify their claims in the face of new information, but this necessitates approaching dialogue with respect and a curiosity to learn from others (Galtung 2010; Mitchell 1980; Wals 2007a). At the personal level, conflict that frustrates one's ability to achieve one's goals may prompt closer reflection and inspection, stimulating creative thinking (Jung and Lee 2015). Yet despite this potential, the social learning literature is mixed on the role of conflict, and how conflict should be handled in learning processes. Conflict has been experienced as a barrier to social learning, in the form of unresolvable disagreements and mistrust between stakeholders; arguments about outside issues that stall discussions; and unequal power relations that limiting the dialogue (Beers et al. 2016; Cundill 2010; Fernandez-Gimenez et al. 2008; van Bommel et al. 2009). However, learning processes can also be seen as a mechanism for conflict resolution (Leys and Vanclay 2011; Schultz et al. 2018). Reconciling these perspectives reveals how disagreements may be fertile ground for learning (Beers et al. 2016; Cuppen 2012; Van den Bossche et al. 2011; Walkerden 2005; Lindley 2015), or how potentially destructive conflict can be constructively transformed to achieve conflict resolution and learning (Barki and Hartwick 2004; Cuppen 2012). A lot of social learning literature focuses on the role of dissonance and contradictions in enabling true and transformative learning (e.g. Wals 2007b; Wals et al. 2009; Engeström 1987). For example finding the edge of people's comfort zone where dissonance is energising and challenging promotes learning, else too much or too little dissonance dampens learning (Wals 2007a).

The following section reviews the types and characteristics of interpersonal conflict and the enabling conditions for constructive conflict that have been documented in the literature (Section 2), to create a framework for analysis which surfaces the elements creating potential for destructive and constructive micro conflicts. Facilitators can use the framework in analysing learning processes retrospectively to understand how conflicts emerged, as illustrated here. Alternatively, the framework can be used by facilitators when designing learning processes to identify potentials for conflict to

inform how they can prepare to mediate and nurture that conflict to be constructive. The framework is applied in the case study learning processes as described in section 3, presenting the analysis of the conflicts in context of the influence of the learning process and the surrounding historical context in Section 4. Section 5 reflects on these results to provide a discussion of how constructive conflict contributed to learning outcomes in the case studies.

## **5.2 Conflict for learning - when is conflict constructive?**

The following combines insights from literature on interpersonal conflict in groups, teams and stakeholder dialogues to give an overview of the characteristics of conflict and individuals' responses within an episode of conflict, recognising that conflict episodes take place within a context that can be sub-divided into an inside and outside context. The boundary between the two realms of context is permeable (Cornwall 2004), and as will be illustrated by this review, both influence the conflict episode. In this thesis, conflict is considered to include any opposing statement, being a catch-all encompassing differences in perspectives, disagreements, debates, arguments and any escalation beyond that. A conflict episode is defined further below. Constructive conflict is conflict that has an outcome that makes progress in understanding or resolving the conflict, also referred to in this paper as a 'positive' outcome, through a process where participants "*confront each other's claims with their own claims, unravel argumentations, make (implicit) assumptions explicit*" (Cuppen 2012, p.26).

Aspects that are beyond the control of the actors facilitating and participating in a learning process, such as culture and history, are conceptualised here as the *outside context*. The discussions that give rise to a conflict episode do not occur in a vacuum - a culture of violence, opposition and competition will likely favour confrontation; a collaborative culture will usually encourage dialogue (Galtung 2000). Similarly, the interactions between stakeholders in discussion fora are influenced by social, cultural and political histories and traditions as well as by the epistemological differences

between them (Collins and Ison 2009; Cornwall 2004; Steyaert and Jiggins 2007). This may pre-dispose groups to agree or disagree regardless of the content (Putnam and Wondolleck 2003), or guide who can and cannot speak when expressing dissenting views (Cornwall 2004). While ongoing or underlying conflict at the national, international or global scales are not the direct focus in this paper, the interpersonal conflict within a workshop setting may be influenced by or reflect contemporary or past conflict, whether between individuals in the room, the organisations they represent or within the wider society (Paletz et al. 2011; Putnam and Wondolleck 2003, p.37).

Aspects that are within the control of one or more of the actors in the conflict, such as a convenor, facilitator or the team itself, are considered here as the *inside context*. The design and facilitation of team discussions or learning processes, including framing discussions, setting rules of engagement, and stakeholder selection, can mitigate the influences from the outside context and provide enabling conditions for constructive conflict and learning (Cuppen 2012; Steyaert and Jiggins 2007; Collins and Ison 2009; Cornwall 2004). Providing space and time for debate within a discussion enables participants to actively engage with other views, for example by having allotted times for voicing opinions to allow space to lay out arguments in support of each view (Beers et al. 2016), and to recognise the legitimacy of other views (Schusler et al. 2003). As Pennington (2016, p.305) suggests, *“Tolerance for seemingly basic questions and tangential discussion is imperative. What is basic to one is new territory for others, and what appears to be tangential may be the beginning of a novel idea.”* Cuppen (2012) suggests providing this space through three stages of engagement: i) selection of stakeholders according to their perspectives to account for variety, balance and disparity; ii) articulation of perspectives in homogenous groups to build *“argumentations for specific claims based on their perspectives”*; then iii) confrontation of claims and ideas, in mixed groups. This echoes the literature cautioning against driving to consensus too early, without allowing space to recognise

and acknowledge alternative views (van de Kerkhof 2006; van den Hove 2006; Collins and Ison 2010).

A positive and supportive space or environment enables creativity and innovation, but creativity is driven by the people interacting in that space, so having a diversity and balanced contribution of knowledge and stakeholders is also key (Cuppen 2012; Chen et al. 2019). Knowledge, perspectives and epistemologies should be different enough to learn from each other by adding new ideas, but not so different that stakeholders cannot comprehend how the other view relates to theirs or see only competing or exclusive ideas (Stirling 1998; Pennington 2016; Chen et al. 2019). If the difference in opinion becomes so wide that the two sides cannot find a way to bridge the gap - or someone to act as mediator to help bridge the gap – it can lead to frustration and affective conflict, which may become destructive (Pennington 2016; Van den Bossche et al. 2011). Balanced contribution is supported by having a variety of participants that are equally represented and facilitation guidelines or rules of engagement that encourage everyone to participate so that each perspective has a chance to be aired.

*A conflict episode* is any moment or sequence of dialogue within discussions in a learning process in which conflict occurs. Conflict episodes may be isolated or appear repeatedly over the course of the learning process and their manifestation and evolution is influenced by interpersonal dynamics as well as the outside and inside context. A conflict is a state of opposition between ideas or interests which manifests in a multitude of forms, from disagreement between individuals (micro-level, Galtung 2004) or groups of people (meso-level, Galtung 2004) to the highest level of violent struggles and warfare between civilisations, religions or nations (mega and macro-level, Galtung 2004). An extended definition is any situation where parties think that a divergence of values, needs, interests, power, opinions, perceptions, goals, or objectives exists (Barki and Hartwick 2004, p.232; Yasmi et al. 2006) - and when one or more of the parties care enough about that divergence to speak up and challenge what has been said (Paletz et al. 2011), typically because they believe that the divergence

will be harmful to them in some way (Barki and Hartwick 2004). While conflict is natural and pervasive, Paletz et al. (2011) use a temporal lens to distinguish forms of conflict at Galtung's micro or meso levels (which can extend to mega and macro levels): a moment of discomfort or dissonance in a conversation, such as one person correcting another's statement, that is quickly forgotten as the conversation moves on (micro-conflicts), or a sticking point that stalls the conversation for the rest of the day (meso-conflicts) or re-appearing each time the conversation is picked up over months or years (macro-conflicts).

Conflict is also dynamic: a process of social interaction following a lifecycle that ebbs and flows, without a specific beginning or end (Galtung 2000). It appears in response to a building attitude of dissent within an individual, rises in tension to a climax and then wanes (Galtung 2000). The characteristics of this cycle manifest and evolve in response to the reactions and behaviour of the diverging individuals (Barki and Hartwick 2004; Van Leeuwen and Van Der Haar 2016). At the interpersonal level, Barki & Hartwick (2004) conceptualise the characteristics of interpersonal conflict as a matrix across which an episode of conflict might evolve in response to how it is managed. They distil three core characteristics of interpersonal conflict from the multitude of categorisations and conceptualisations in earlier literature. First, *cognitive conflict* is associated with disputed facts, drawing on e.g. Jehn's (1995; 1997) and Amason's (1996) concepts of task and process conflict over the content and implementation of tasks. Turner (2016a), drawing on van den Bossche et al. (2011) and Nonaka (1994), extends cognitive conflict to separate out the clash between knowledge structures in which there is a disparity between the mental models of individuals within a team, recognising that agreeing the definition of a problem or issue may not be straightforward because people inhabit unique social worlds in which the same word or concept has different meaning (Fernández-Giménez et al. 2019). Second, *affective conflict* is associated with negative emotions (drawing on e.g. Janssen et al. 1999; and Jehn 1994), either where exchanges (about tasks, processes or knowledge) become coloured by anger, frustration etc. or where exchanges are heated because the

individuals do not like each other (be it due to personality or historical and cultural factors), regardless of what is being argued (Putnam and Wondolleck 2003). Third, *behavioural conflict* is associated with activities or behaviours that interfere with another party's activities, intentionally or not.

Episodes of conflict may present one or more of these characteristics and may be directed at content (knowledge, tasks or processes) or individuals or both. Each combination of characteristic(s) and target(s) will create an episode of conflict that unfolds differently - and in turn episodes of conflict can evolve through the matrix to different combinations in response to how they are managed (Barki and Hartwick 2004; DeChurch and Marks 2001). Predicting whether the outcome will be positive (progressing the creation of shared understanding and contributing to successful learning) or negative (barrier to learning) is complex (de Wit et al. 2012). For example, affective and behavioural conflict that target individuals rather than content will likely be destructive - be that in terms of obstructing relationships and tasks or in the form of physical violence. On the other hand, cognitive conflict that re-focuses any argument onto content rather than individuals will more likely be constructive, leading to recognition of errors or the creation of more robust understandings (Turner 2016a; Barki and Hartwick 2004).

An individual's conflict behaviour will also be significant in whether actors respond to the conflict actively and agreeably (DeChurch and Marks 2001). Activeness and passiveness are the degree to which actors openly discuss the conflict or ignore it, and agreeableness indicates the degree to which actors are prepared to integrate views and compromise - actors behaving disagreeably force their opinion on the others (van de Vliert and Euwema 1994). For example, constructive cognitive conflict can become destructive if it continues so long without resolution that it becomes frustrating or personal, if actors concede and postpone the conflict (allowing it to fester) or if one view suppresses the others. Constructive confrontation of diverging perspectives is an art. When the issues and perspectives in contention have real-life impacts on those



debating, it requires skill to leave emotions at the door. Empathetic, respectful dialogue that explores the conflict is a primary tool for constructive conflict (Galtung 2000).

Distilled from the literature discussed above, the framework presented in Figure 9 brings together insights from interpersonal conflict and learning literature, showing how enabling conditions for learning and constructive conflict overlap. It is intended as an analytical framework that can be used to analyse the potential for constructive conflict in learning dialogues and their contexts. Used in advance when designing a learning process, this framework highlights factors to consider to pre-empt which types of conflicts may arise and how to design the inside context to mitigate destructive conflict and encourage constructive conflict. In this paper, the utility of the framework is illustrated by analysing three cases to understand and contextualise episodes of conflict, to explain the outcome of conflict and how it affected learning.

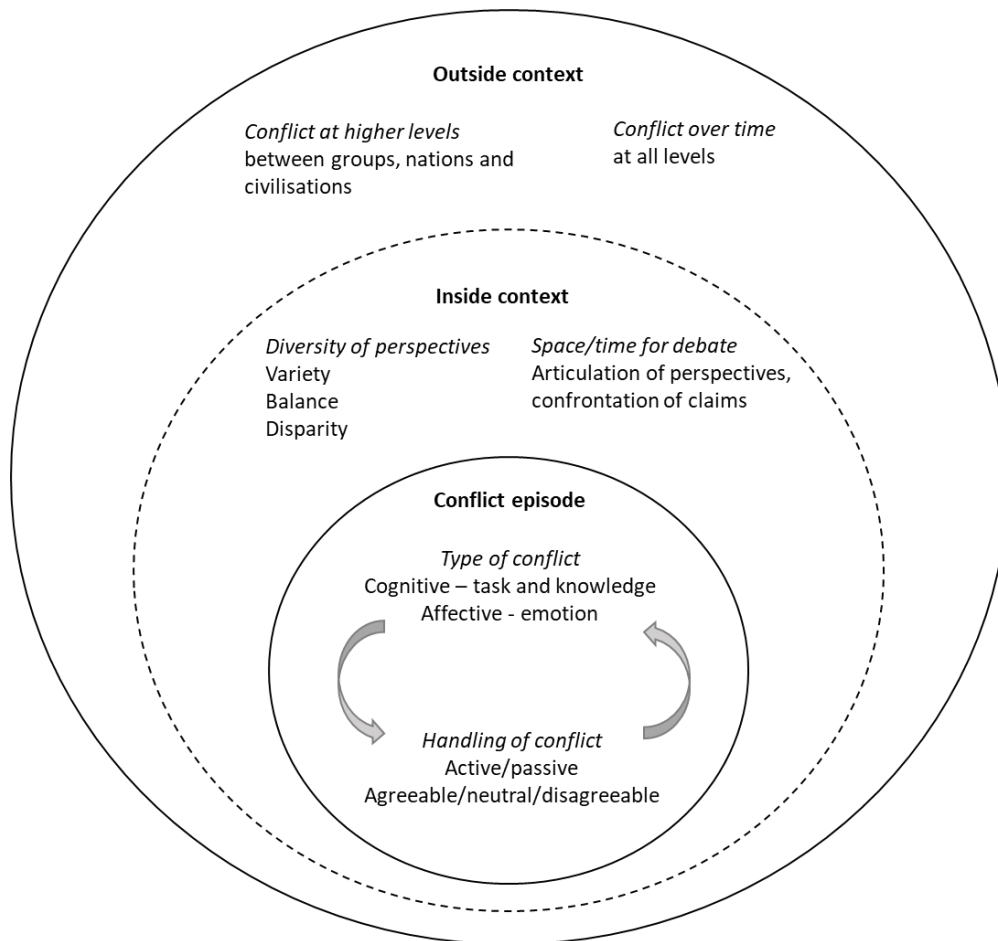


Figure 9: Heuristic representing how factors affecting outcome of conflict episodes map onto the characteristics of conflict affecting the potential for learning within a learning process.

As described above, the *Inside Context* refers to conditions within the control of the convenor of the learning process, which includes the design of the learning process to offer variety, balance and disparity of views, as well as space in which to articulate and contest them, setting enabling conditions for constructive conflict (and learning).

*Outside Context* includes factors out of the control of the convenors, which permeate to some extent through to the inside context depending on measures taken by the convenors to moderate the influence of the outside context (indicated by the broken line between inside and outside context). A *Conflict Episode* occurs within the inside context, as part of a conversation or dialogue occurring for example during a meeting or workshop that is part of the learning process, and is influenced by both the inner

and outer context. Characteristics of a conflict episode are an iteration between type of conflict and the response of individuals to the conflict.

### **5.3 Methods and analytical framework**

Differences in how conflict emerges and evolves were studied using a case study approach with three learning processes as multiple sequential cases, in order to explore the complex interaction of the many factors affecting conflict across three different settings (Ragin and Becker 1992). Each case comprised two workshops, implemented during 2017–2018 within the ‘Research and Learning for Sustainable Intensification of Smallholder Livestock Value Chains’ (ResLeSS) project. Case study sites were i) Bama commune in Hauts-Bassins region, Burkina Faso; ii) Atsbi woreda in Tigray region, Ethiopia; and iii) Lushoto district in Tanga region, Tanzania (Pfeifer et al. 2020). Each case produced unique conflict sequences, yet we can draw comparisons across the cases of the impact of conflict on learning (Thomas 2011).

Data to answer the research question were drawn from observations, reflections and post-workshop feedback from participants. Participant observations of the workshop discussions and unstructured reflective discussions with the group facilitators and other research team members following each workshop provided an overview of the tone and key points of discussions (Den Haan and Van der Voort 2018; citing Lawrence and Haasnoot 2017). In lieu of transcripts of each discussion, reports by each group’s note-taker were compiled at the end of the workshop into workshop proceedings, supplying the detail of what was discussed in each activity. Insights on the influence of the inside context were drawn from the research team’s reflections on designing the workshop, and an understanding of the outside context from follow up interviews with selected participants from each stakeholder group in the workshops, as well as documentary review of the livestock sector in each study site.

Conflict episodes were identified from the observations and reflections, notes and facilitator reports. For each episode, the discussions were assessed to classify the type(s) of conflict displayed and the conflict behaviour of the individuals during the discussion, as well as how the conflict evolved, to map the conflict episode onto Figure 9, including drawing on aspects of the inside and outside context that were relevant in understanding the conflict. The word 'conflict' is used in this paper as shorthand for any disagreement or confrontation between participants, or instances where two differing opinions were put forward which generated further debate and discussion.

The ResLeSS project was one of eight research projects in the Sustainable Agricultural Research and Learning in Africa (SAIRLA) programme, running from 2016-2020 (<https://sairla-africa.org/>). The ResLeSS project implemented the same learning process in three different settings. The learning process provided a facilitated environment in which stakeholders iterated towards environmentally and socially acceptable changes to livestock production (Morris et al. 2020). The design of the learning process was informed by social learning methods, acknowledging that systems are dynamic and that the learning process enters at a moment in time where the system has a certain configuration of context, stakeholding, facilitation needs, types of institutions and policies and epistemological differences (Collins and Ison 2009; Steyaert and Jiggins 2007; Ensor 2011). As a social learning design, the workshop reflected many of the enabling conditions for constructive conflict discussed above.

Stakeholders were selected according to their function in the livestock value chain and divided into four homogeneous stakeholder groups, assuming that their perspectives would be more similar within a group than between groups (Table 1, Section 2.3.3). Activities were initially conducted in the four homogeneous groups to provide a space for articulation of perspectives within each group. The final activity mixed the stakeholders into two or three mixed groups, providing a space to bring perspectives together to be presented, questioned, supported, challenged or contested by other stakeholders.

Two local facilitators, who spoke the language of the participants (Djula in Burkina Faso, Tigrigna in Ethiopia and Swahili in Tanzania), facilitated each group. All stakeholders had some, but different, knowledge and experience of livestock production, to be able to contribute to the discussion, with facilitators able to mediate if the knowledge divide was too great. Facilitators encouraged balanced participation by setting rules of engagement that all views were valid and welcomed and intervening in discussions when individuals spoke too much or too little.

Over the course of the activities in the workshops, groups defined the scope and variables of a simple environmental assessment model of the local livestock production system (CLEANED-R, Lannerstad et al. submitted for review; Pfeifer et al. 2020) and then played the Transformation Game (henceforth ‘the Game’, description in Section 4.3 and Pfeifer (2020)), in which the environmental assessment model is embedded, to explore the implications of changing that system against their social and economic priorities for those living in the area. Participants played the Game first in homogeneous groups to get a feel for the Game and articulate their preferred scenario for changing the system. On the final day, participants played the Game again in mixed groups, negotiating how to adjust the scenario presented to them in order to reach agreed collective preferences. The overall facilitators, from the research team, created starting scenarios to present to the mixed groups based on the scenarios produced by the homogeneous stakeholder groups.

## **5.4 Results**

This section describes the episodes of conflict (instances of disagreement or divergence in perspectives) in each country's learning process<sup>24</sup>, focusing on the character and handling of the conflict or disagreement, summary learning outcomes and reflections

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<sup>24</sup> More details can be found in the workshop reports, (Ensor et al. 2018 - Bama; Pfeifer, Mulatu, Wakeyo, Arbissie, et al. 2018 - Atsbji; Pfeifer, Morris, Soka, Moses, et al. 2018 - Lushoto)

on how the conflict influenced those learning outcomes. Analysing the cases using the lens of the constructive conflict framework illuminates how the tensions elicited in learning dialogues manifest and evolve in response to individual conflict behaviour, but are also influenced by the outside context and moderated by the workshop design and facilitation (inside context).

#### **5.4.1 Burkina Faso**

The learning process in Bama illustrates how macro, mega and long-term conflicts overshadow workshop proceedings, and yet by recognising each other's perspectives a joint conversation is possible (Figure 10). The national level conflict in Burkina Faso between those supporting livestock intensification (that is, sedentary, high-yielding, high-turnover production) and pastoralism has a long history, manifesting in narratives and policies as well as episodes of physical violence. It is a conflict that stretches beyond Burkina Faso to the wider West Africa region and, indeed, across Africa (Gonin et al. 2019; Gonin and Gautier 2015; Bergius et al. 2020). For pastoralists, the conflict is rooted in a perceived threat to their culture as well as their livelihood (Thébaud and Batterbury 2001; Benjaminsen and Ba 2019) which may contribute to the longevity and apparent intractability of the dispute (Putnam and Wondolleck 2003). In Bama, the stakeholders in the learning process had not gathered together before. However, while the learning process was the beginning of a conversation between these individuals, it was a conversation built on a long history and occurred in the presence of strong narratives at national and regional levels. Time was needed throughout the learning process in Burkina Faso to establish that there were two very different epistemological starting points underlying the pastoralist and sedentary understandings of livestock production, and space was needed to articulate these different perspectives and values, and to begin to build bridges between them.

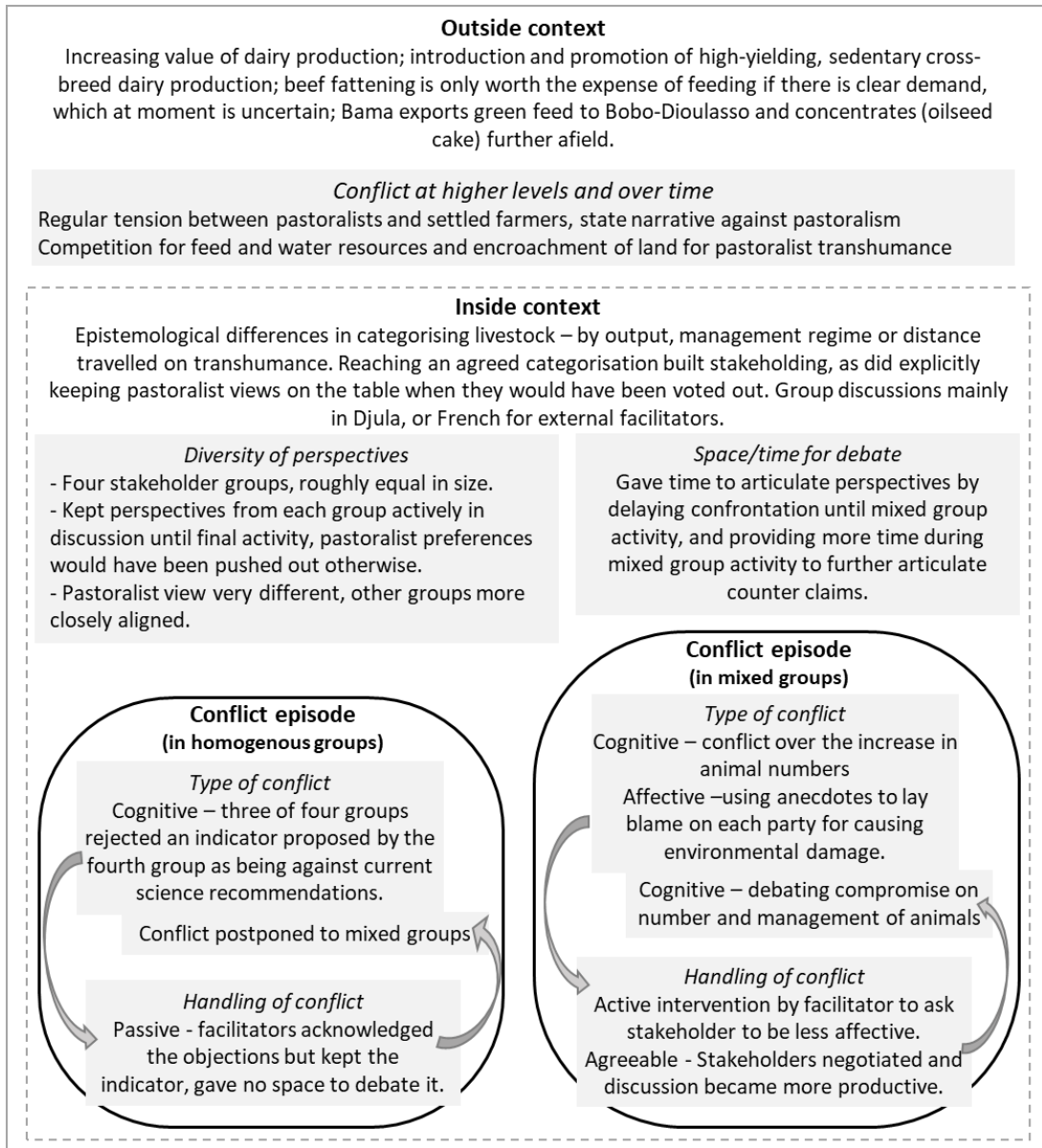


Figure 10: Mapping conflict episodes from the Burkina Faso learning process onto the framework from Figure 9.

This background gave rise to several episodes of cognitive conflict between pastoral stakeholders and others, revolving around animal numbers, which was handled passively by the facilitators during homogenous group activities by postponing any discussion of opposing views until the mixed group activities (see first conflict episode in Figure 10). When arguing about whether to increase pastoral animal numbers or

reduce animal numbers by shifting to specialised breeds and intensifying, facilitators suggested keeping both options as group scenarios. When the other stakeholder groups objected to the pastoralist indicator of having two herds per household to ensure livelihood security, facilitators made an executive decision to keep the indicator as representing a minority view.

Once in mixed groups, the underlying cognitive conflict informed radically different opinions as to the acceptability of the scenario, and quickly turned affective. Neither side was willing to 'be wrong' and drew on personal experiences of conflict outside the workshop to support their claims, offering a clear example of disagreeable conflict behaviour (see second conflict episode in Figure 10). The group facilitator intervened in an effort to shift the tone of the discussion, reminding participants to "bundle up the negative words and emotions and throw them out of the window" (group facilitator). Following this, parties agreed to listen to each other, particularly when the facilitator encouraged participants to reveal to each other the reasoning behind their scenario choices, and therefore behind their views. This move to agreeable conflict behaviour allowed the discussion to become more constructive. Stakeholders learnt that others have a different way of thinking about livestock, and different ways in which they see livestock contributing to their personal objectives and that happiness or success can be measured and achieved in different ways - in some cases being surprised at what they learnt, for example that one can increase production by having fewer cows. Through this process the different stakeholders were able to appreciate the pastoralist perspective and livelihood aims and understand how they had translated this into a scenario. Once this recognition of the validity of the pastoralist perspective had been achieved, the parties began to find common ground, finding land management to be an opening for further conversation, acting as a bridge between their perspectives. Several stakeholders afterwards expressed surprise (and gratitude) that the conversations had been rational, with respect for others, and the pastoral representative gave a speech at the end expressing thanks and gratitude at feeling that they could express themselves and were listened to for a change.



The affective conflict was disruptive because it stalled the process, so one could conclude that learning was slow and limited since working through the conflict took up all the groups' focus and various other aspects, such as resource availability, were not interrogated although they will need to be. However, once the interaction was transformed to constructive conflict, it was more productive than previous encounters between the stakeholders had been - and as a result was greatly appreciated. A year later, stakeholders are still requesting follow-up workshops to continue the conversation.

#### **5.4.2 Ethiopia**

The learning process in Atsbi, Ethiopia is an example of recognising new opportunities for cross-scale dialogue (Figure 11). In Atsbi, some of the stakeholders were meeting for the first time, starting a new conversation in a context in which agricultural governance has historically been strongly top-down. At the time of the workshop, priorities for the woreda (district) were set by national level actors, although woreda officials supplied potential priorities that included input from local community leaders. However, having local and national level stakeholders speaking directly, such as in our workshop, was a new experience for the participants. Participants interacted with people they would not have otherwise, and group facilitators felt that the co-operation and more intimate social relations that developed between stakeholders was a key positive impact.



Figure 11: Mapping conflict episodes from the Ethiopia learning process onto the framework from Figure 9.

There was no affective conflict in the Atsbi learning dialogue, but task and knowledge-based cognitive conflicts within and between groups, summarised in Figure 11.

Facilitators actively encouraged different opinions on which livestock, management options and animal numbers to prioritise (task-based cognitive conflict). Presenting their scenarios and the reasoning behind them to other groups revealed diverging objectives between government administrators aiming to minimise greenhouse gas (GHG) emissions according to Ethiopia's Climate and Green Economy Strategy and the local stakeholders (farmers and traders) aiming to increase income to improve

wellbeing (knowledge-based cognitive conflict). In the mixed group discussions, stakeholders integrated both objectives when discussing how to further refine the scenarios. In this example of constructive conflict, one group found a scenario that increases meat and milk production for marginal GHG change. Realising that choices and decisions of other stakeholders influences their own choices of livestock production, participants tried to align their priorities and choices with that of the wider communities' wellbeing. They agreed to reduce beef production to make way for dairy and sheep production after concluding that these have relatively wider reach in benefits, empowering women and being more accessible to low income households, landless households and youth (Pfeifer et al. 2020).

Although some compromises were easily made, in some cases stakeholders stood by their original choices. There was an unresolved debate with two firm positions on whether planted fodder or concentrates should be used to improve the feed quality. These positions were based on how land, livestock and income are prioritised by households in different circumstances (knowledge-based cognitive conflict), opening up a discussion on using land to plant food for the family and income to buy feed for livestock or vice versa. Providing feed using planted fodder or concentrates are both valid strategies; given the task to produce a group consensus on one scenario to represent the most common action at district level, this unresolved cognitive conflict highlights that individual actions across the district will be heterogeneous, and the importance of catering for both in guidance for livestock development. The intention of the learning process was not to create an average blueprint strategy, but a better grounded composite scenario (chapter 4 - Morris et al. 2020) and personal objectives may not - and should not be expected to - fully align with the common strategy.

The constructive manner in which conflict played out in the workshop produced a more informed compromise scenario, challenging each stakeholder group to see and account for alternative objectives. Given the space to articulate and present claims on an equal footing, local and national decision-makers recognised the value and validity

of other stakeholders' input. Local and national government officials learned from farmers that there is a need to be flexible and adapt generalised policy prescriptions to local conditions (e.g. tractors cannot completely replace draught animals in steep areas), but were also pleased to see that farmers had appreciated the agendas and rationale driving policy priorities, for example in including GHG in their considerations for later scenario revisions.

### **5.4.3 Tanzania**

The learning process in Tanzania was productive yet illustrated that dialogues are never complete and that there is always more to learn (Figure 12). Previous and ongoing programmes and collaboration (Omore 2017) have built prior relationships between stakeholders and knowledge of the topic of the learning process (small-scale dairy), reducing the disparity in views and knowledge between stakeholders and therefore reducing the likelihood of cognitive conflict, as well as the amount of time needed to articulate perspectives. Stakeholders could leverage their prior knowledge when playing the Transformation Game. The Game helped farmers to bridge the information received from extension agents and prior projects on the benefits of more intensive and high-yielding dairy production with their own experience of raising indigenous and exotic dairy cows and their knowledge of the likely opportunities and constraints for others in Lushoto. As such, cognitive distance was smaller, but there was also less likelihood of challenging the conclusion of the ongoing conversation that the future lies in the use of crossbreeds<sup>25</sup> and pure high-yielding dairy cows (as promoted by the ongoing programmes), although there was still some concern that it was not for everyone. In particular, participants appreciated looking ahead and planning for the future, which gave a new perspective for some, leveraging the prior

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<sup>25</sup> Crosses between the indigenous cows and exotic Friesian or Jersey cows, with at least 50% of the exotic genetics, i.e. a first generation cross or subsequent crosses between a hybrid and an exotic.

knowledge gained from the long-term programme occurring outside the learning process to envision what the implications of acting on the extension officers' proposals could be for Lushoto.

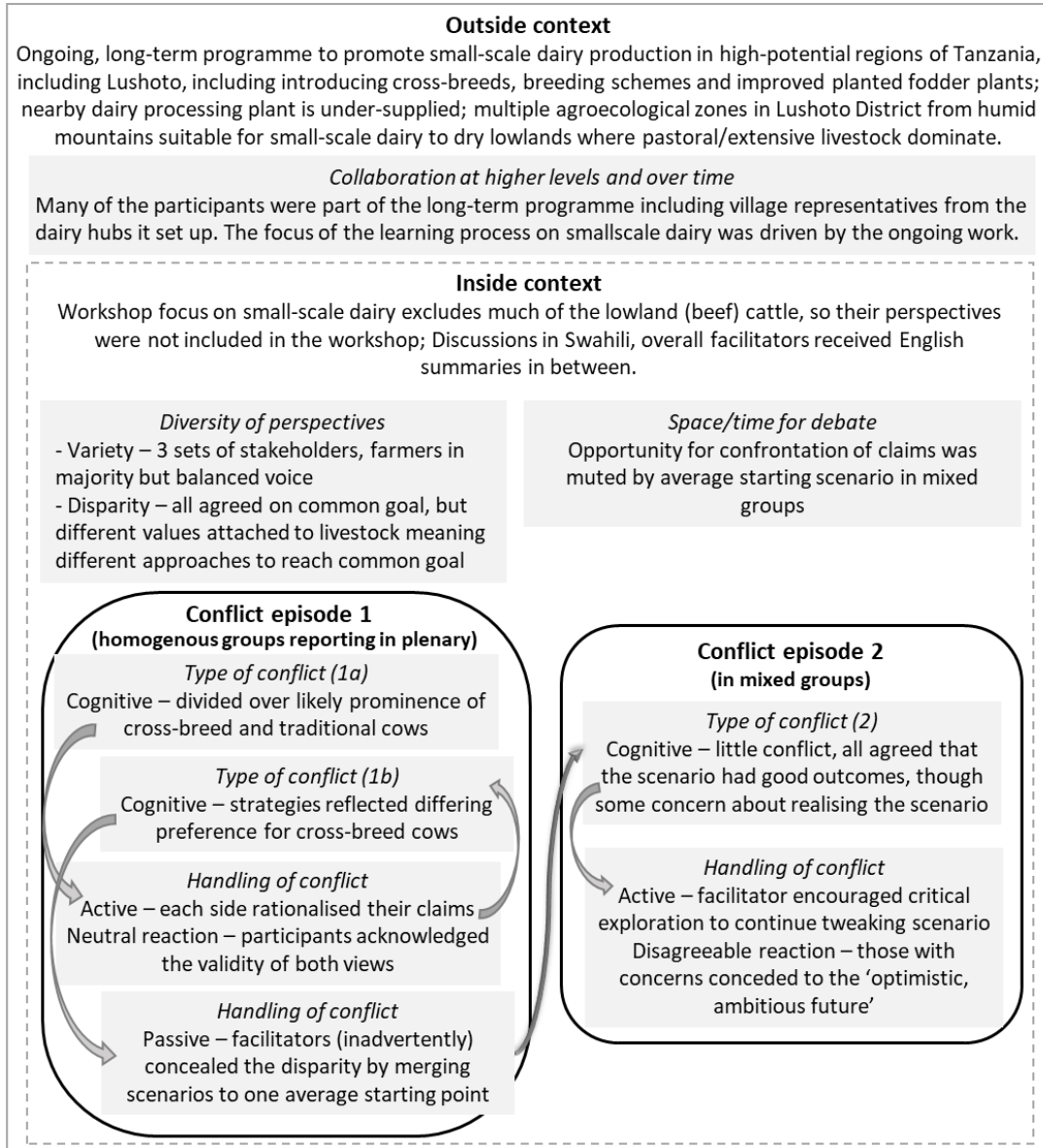


Figure 12: Mapping a set of conflict episodes from the Tanzania learning process onto the framework from Figure 9.

There was broad agreement in the scenarios across homogeneous groups to decrease the number of animals due to increasingly strict rules preventing free grazing of cows,

particularly in the highland part of Lushoto District, where cropping density is high, and to achieve this by shifting from large numbers of indigenous cattle to much small numbers of crossbreed or almost pure exotic (high yielding) breed cows. There were small variations in the ratios of animal numbers, whether to place the emphasis on crossbreed or pure-breed cows, and the degree to which to improve their feeding. In terms of agreeing on numbers and management options to use in their scenario, this is an example of task-based cognitive conflict (part of conflict episode 1a, Figure 4).

Participants created scenarios with more than one management option per category of livestock to show that not everyone will keep their animals in the same way across the district. As the tool can only take one option per livestock category only the option with the most animals was taken, effectively closing down the option to represent diversity within one scenario – an alternative would have been to create multiple variations of their scenario to show the nuances in the routes people might take. This contributed to the passive handling of this conflict, mentioned below (progress from conflict episode 1b to 2 in Figure 12).

In addition, a lively debate occurred in a plenary session, about the different understandings of significance and value of cows, about whether pure-breed high-yielding cows, or even crossbreeds would replace indigenous breeds. One side argued for a progressive increase in improved breed numbers, while the other cautioned that not all have the resources needed to support improved cattle and that indigenous breeds have value and functions beyond dairy production (knowledge-based cognitive conflict). The debate, while vigorous, was not emotional (affective), with both sides accepting the validity of the points made by the other (part of conflict episode 1a in Figure 12).

Although the homogeneous scenario discussions and plenary debate were constructive, two types of disagreeable conflict behaviour muted the opportunity to continue this constructive exploration of a diversity of pathways to increasing small-scale dairy production. First, in an example of mildly disagreeable conflict behaviour is

that the voices arguing for the ambitious and progressive stance to moving to a majority of crossbreed and pure-breed cows were stronger than those raising concerns about the increased costs of production, thereby overriding their concerns. In the second example of passive handling of conflict, the homogenous group scenarios were averaged to a single scenario for the mixed groups to evaluate and refine, having missed the connection between the slight variations between group scenarios and two perspectives revealed in the plenary debate (progress in conflict episodes 1b-2 in Figure 12). Without a clear separation into one commercial dairy focussed scenario emphasising high-yielding cross- and pure-breed cows and one more risk averse scenario retaining more indigenous breed cows and a more cautious increase in crossbreed cows, the starting scenarios muted the opportunity for a confrontation of claims between these two viewpoints. The tool results for the average scenario were deemed good enough that there was less interest in refining them. This closing down avoided confrontation, but it is still clearly an issue that will need to be addressed at some point, as not everyone in the district will be able to take up the most ambitious scenario.

## **5.5 Discussion**

Interrogating the flow of dialogue in the workshops with a constructive conflict lens illuminated the ways in which disagreement (conflict) opened up and closed down opportunities for learning. Using the framework (Figure 9) to understand the context revealed the many factors that influence why disagreements were voiced and how conflict episodes evolved, and the complex and dynamic ways in which these factors interact to produce unique outcomes. The cases show that the framework is a useful analytical tool for understanding the interpersonal dynamics of the workshop discussions and untangling the influence of outside context, workshop design (inside context) and individual behaviour on those dynamics. The first section of this discussion explores some key reflections from the analysis. As such, it is also a useful

framework for informing what to analyse in advance when designing workshops to take into account and mitigate for these influences, as the design is significant in enabling or constraining productive learning through episodes of constructive conflict (e.g. Collins and Ison 2009; Cuppen 2012; Cornwall 2004; Leys and Vanclay 2011). The second section of the discussion sets this out in more detail. The framework builds on existing frameworks for designing learning processes for inclusive and transformative participation (Collins and Ison 2009; Steyaert and Jiggins 2007; Cornwall 2004). While existing frameworks account for institutional, cultural and historical context, stakeholding and facilitation needs and epistemological differences, which address the outside and inside context affecting the potential for conflict, the analytical framework proposed in this paper adds an understanding of the interpersonal dynamics that affect how conflict episodes evolve once manifested. As such, it provides a framework for creating enabling conditions for constructive conflict and learning.

The cases provide examples of disagreement (moments of conflict) emerging and evolving over the course of dialogue within activities, as conceptualised by Barki & Hartwick (2004). Group facilitators invited different opinions on how to design livestock scenarios (cognitive conflict). Explaining why stakeholders chose particular livestock categories, management regimes and numbers revealed different values and objectives attached to livestock, which in turn revealed the different functions of livestock that were being valued - with many cases of farmers highlighting the significance of considerations beyond rapid meat and milk production for maximum profit (cognitive conflict). As long as participants accepted the differing rationales that were present, debating agreeably about the content, and working to integrate perspectives, there was progress towards improved scenarios and learning from each other. In these cases, the conflict can be considered to be constructive, as suggested by Cuppen (2012). When stakeholders tried to exert dominance of one perspective over another, particularly on the basis that another stakeholder's opinion, values or objectives were 'wrong' (disagreeable handling, affective conflict, targeting individuals over content), discussions stalled such that the conflict can be considered to be



destructive until stakeholders were redirected to focus on content and discussing why the views were different (Cuppen 2012; Black and Andersen 2012).

The cases reveal how conflict contributed to opening up and closing down of opportunities for learning in diverse ways. Although affective conflict in Burkina Faso was destructive until transformed, it also opened up new issues to be addressed when drawing on personal experiences of conflict outside the workshop to support their arguments. Although in the end those new issues were not fully addressed in the workshop itself due to time limits of the meeting, they were raised and would be on the agenda for future dialogue. Task and knowledge-based cognitive conflict opened up many new perspectives for learning across all countries, particularly when reacted to agreeably and when stakeholders acknowledged, explored and accepted those new perspectives. The acknowledgement of two valid approaches to adopting improved breeds in Tanzania and obtaining improved feed in Ethiopia are good examples. On the other hand, disagreeable or passive conflict behaviour that dismisses, overrides or avoids new perspectives closes down the opportunity for learning (or postpones it until the conflict re-emerges). A lack of conflict, where existing perceptions are simply reaffirmed, also dissuades exploration of new ideas, as the Tanzania case illustrates. Affective conflict that stalls conversations also closes down opportunities for exploring other relevant topics within the time limits of the meeting; however, working constructively through a conflict has the same effect when it takes up more time than planned.

These two points reinforce firstly that, although emotion may be a useful trigger for challenging points when one might not otherwise speak up, conflict is only constructive once the conversation can move beyond the emotion to a respectful dialogue that can explore alternatives and new configurations that incorporate both views and objectives (Galtung 2000). As concluded in a learning process for Dutch farmers, success came when they were no longer *“dividing up the cake but seeking to bake a new kind of cake together”* (Jiggins et al. 2007). Secondly, it is important to recognise that conflict, like

learning, is ongoing (Putnam and Wondolleck 2003; Paletz et al. 2011). The conflicts addressed in the episodes reported in the case studies did not end so much as evolve, revealing new issues to address or nuances to dig deeper into as the initial issues came close to being resolved. This layering was evident in Burkina Faso where reaching an acceptable compromise to the initial conflict will still require the parties to address water and biomass resource scarcity (an issue raised but not resolved during the affective conflict episode). In Tanzania, the apparent resolution to intensify small-scale dairy opens the next layer of issues to explore around how small-scale dairy interacts with other livelihood activities within the same household.

At the same time, this cyclical nature of conflict rising and falling and moving on to the next rise and fall is similar to the changes in intensity of learning within learning processes (Rist et al. 2006) and the relationship between cognitive distance and learning (Pennington 2016). In a dialogue, it takes time to get to know each other and build a degree of trust, to build a group's voice, and then to build stakeholding, particularly in an unfamiliar group (Rist et al. 2006). At the beginning, the gap between perspectives and epistemologies is large, so the potential for conflict (and learning) is large. As stakeholders learn from each other's perspectives, the disparity or cognitive dissonance between perspectives and epistemologies shrinks (Pennington 2016). Once stakeholders start talking a common language, agreeing a common understanding of the issue and way forward, the potential for conflict, and learning, reduces. Yet, stakeholders still have their own values and objectives that are not - and should not be - fully replaced by the common understanding: *"I can score my goals only if I take account of yours"* (Steyaert and Jiggins 2007, p.576). The commonly agreed strategy may be achieved by several pathways which may come into conflict when discussing other dimensions than those considered initially, and on which the common understanding is based, revealing new issues for the learning dialogue to address.

Our cases show participants at different stages of this learning cycle, reflecting that any project's short-term activities are one episode in broader ongoing conflicts, activities

and strategies at regional, national and international levels (Hickey and Mohan 2004b; Putnam and Wondolleck 2003) and highlighting the influence of both the outside and inside context. In Burkina Faso and Ethiopia, the stakeholders were meeting collectively for the first time, opening new lines or networks of communication and recognising large cognitive distances. In the case of Burkina Faso, relations were fraught with pre-existing tension rooted in the ongoing pastoral-sedentary conflict even if the individuals were new to each other. In Ethiopia, it was a new experience for national government stakeholders to meet local community stakeholders on an equal footing. In Ethiopia, the clash of objectives (e.g. whether to optimise for GHG or for income) was handled with constructive cognitive conflict, whereas in Burkina Faso that clash of objective was rooted in competing epistemologies and manifested in affective conflict. Extra time was needed throughout the learning process in Burkina Faso to establish that there were two very different epistemologies and perspectives underlying the pastoralist and sedentary approaches to livestock production, and then to provide extra space to articulate those perspectives and begin to build bridges between them. At the other end of the scale, in Tanzania where prior relationships were built during previous and ongoing programmes and collaboration, there was a reduced likelihood of cognitive conflict, as well as a reduced amount of time needed to articulate perspectives.

However, there is a lot of responsibility on the facilitators. Particularly for catching subtle sparks of imminent or nascent conflict, facilitators need to pay attention to language, to body language and silent cues, all of which may be culture-specific. In addition, the types of facilitation that participants might expect or respond to may be culture-specific (Leeds 2001). In our case, this put the emphasis on the group facilitators, who could speak the languages of the participants, to follow the discussions and identify flashpoints. The overall facilitators, who held the power to change the workshop activities to respond to incidents, stayed in touch with the proceedings by the atmosphere in the room and small updates from the group facilitators. This degree of separation from the dialogue is a weak point and while the

reminder of the importance of working in a language and culture you know very well is not new (Cooke 2004), it is worth reiterating.

The three cases also demonstrate the influence of the facilitator in guiding the encounter following a flashpoint. Facilitators are all human, and as such have vested interests or simply worldviews which may, however subtly, influence the conducting of their role as facilitators (Arnold et al. 2012). In addition to an objective to run a successful learning process, several of the research team had a background in agriculture or livestock, with ingrained assumptions about what the 'best' livestock production strategies might be. Similarly, for the group facilitators at times the line became blurred between providing a bridge to reduce cognitive distance between stakeholders' knowledge and steering the discussion (unconsciously) according to their experience and assumptions. But the cases also show how dynamic conflict is, evolving and (de-)escalating according to how it is handled, both by the participants and the facilitators.

#### *Implications for better design and facilitation*

As discussed above, the framework can also be used by practitioners as a visual way to map out what they need to analyse in advance when designing a learning process. This includes an assessment of past and ongoing conflict locally and more broadly that are relevant to the issue, in addition to considering the influence of institutions and policies. Analyse the stakeholders to ensure a diversity of perspectives in terms of collecting a balanced representation of perspectives, and a sufficient variety and disparity that the perspectives are understandable by others but not so close as to offer no new ideas. Consider how much time is needed for stakeholders to articulate their perspectives on the issue, particularly if they need to absorb new knowledge or a new language with which to talk about the issue (see Chapter 4), and provide for separate space in the process for confrontation of perspectives. These are the aspects of the outside and inside context which can be prepared for in designing the content

and activities in the learning process. Individual behaviour influences the interpersonal dynamics within conflict episodes. Look for personal conflict relationships between stakeholders that may bias their response to each other's perspectives and prepare both facilitators and participants to be open-minded and respectful, actively listening to others and considering their perspectives before responding. The presence or absence of previous or ongoing conflict affects individuals' perceptions, as well as their reaction to others' perceptions. This includes higher level conflicts, over space and time, that are relevant to the participating stakeholders – in this case, the higher level debate on pastoralism. In addition, the presence of previous or ongoing conflicts between participating individuals that may be unrelated to the issue being discussed will colour their reaction to anything the other says.

The existence of dominant narratives and the possibility of missing voices indicates a need to be open to challenging assumptions. Nonetheless, too much or too emotional conflict is disruptive or destructive and a barrier to learning. However, so is a lack of conflict - as suggested by Beers et al. (2016) and van den Bossche et al. (2011), agreeing and building on each other's common knowledge provided less learning than when participants were encouraged to challenge statements. The aim when designing learning processes or workshops is thus to provide a supporting environment that inspires individuals to positively challenge each other's ideas and therefore stimulate creativity (Chen et al. 2019; Cuppen 2012; Wals 2007a).

Whether or not stakeholders have a dialogue established already increases the chances of some common frames of reference, if they have had time already to start articulating perspectives, thus reducing the cognitive distance. On the other hand, this also raises the chance of an existing dominant narrative having been established that may discourage challenging ideas. To access a variety and disparity of perspectives, consider including related disciplines to expand focus and expose missing voices. Gather an understanding of the culture – for example, if it is considered unacceptable to disagree with someone else publicly, this reduces the chances of constructive

conflict, as it is more likely that everyone will simply agree with what is first said, reinforcing the existing narrative.

As convenors inviting multiple, diverse stakeholders to a learning process or dialogue, there is a role for the facilitators of the learning process to understand the dynamics of interpersonal conflict, to recognise the characteristics of an episode of differences in perspective, perhaps even confrontation, and how to nudge it towards a more productive form. Yet, facilitators must bear in mind that they are also individuals whose views and understanding are partial and be open to and excited about learning about new views, as they hold greater power to restrict learning for others if they allow their (sometimes narrow) perspectives to influence a dialogue that they are facilitating (Arnold et al. 2012; Leeds 2001).

A caveat is that the preceding account and discussion is the researcher's interpretation of events, based on own observations, feedback from the group facilitators and to some extent supplemented by insights from post-workshop interviews. It is not, therefore, 'the truth' of what happened and may differ from the participants' understanding of the events. An example illustrating that there will inevitably be differing understandings comes from one of the post-workshop interviewees who recited how pleased they were during the workshop that they could change the minds of the other participants about the need for intensification, evidenced by how after their group spoke, the other groups all repeated an objection to increasing the number of cattle in the district. However, our understanding as facilitators is that those other groups were already of the same opinion as the interviewees group, as the groups were each reporting the position they had articulated within their groups - it just so happened that the interviewees group presented first.

This contributes to closing the gap in understanding the role of conflict in social learning processes, but there is still work to do on exploring the link between emotion and learning. Although affective conflict and disagreeable conflict behaviour is destructive at the time, looking over a string of conflict episodes suggests that emotion

has an important positive role, for example prompting stakeholders to raise and defend issues that are important to them when they might not otherwise speak out. Furthermore, from personal observation, the emotional conflicts that were successfully transformed were more memorable than the dialogues that went smoothly. An extension of this research would be to follow the stakeholders beyond the learning process to study whether the learning from emotional conflicts is more memorable, as in early research showing that details of emotional encounters are more easily remembered than informative ones (e.g. Heuer and Reisberg 1990). This is not to suggest that we should encourage affective conflict, but that we should not avoid it either.

## **5.6 Conclusion**

Social learning approaches address complex sustainability challenges by eliciting differences in perspectives between diverse stakeholders and seeking to learn from each other to produce new understandings and solutions. Given the high stakes and trade-offs inherent in many sustainability challenges, bringing different competing perspectives together may result in conflict. However, moments of conflict, when one stakeholder challenges another's ideas, are opportunities for learning because they reveal misunderstandings or dissonance - and that those competing understandings are important enough to each party to dispute and defend. This paper expands the literature on designing social learning processes by introducing theory on interpersonal conflict dynamics from organisational literature to offer insight on the types of conflict and how moments of conflict evolve in response to individuals' conflict behaviour. However, conflict within dialogue is also influenced by ongoing processes and context outside the learning process and mitigated by the design of the learning process.

Using a constructive conflict lens to explore the interpersonal conflicts within the dialogues in three learning processes in Burkina Faso, Ethiopia and Tanzania confirmed that conflict is valuable for learning. However, emotional and prolonged conflict stalled

the process, whereas dialogues without conflict affirmed existing, partial views and avoided opportunities to learn. Learning is enabled by constructive conflict, which occurs when the parties can step back from the emotion to unpick the mutual misunderstandings that cause conflict, such as misapprehension of intent and goals, unrecognised value systems, different interpretations of the same words or actions, or competing interests from outside the narrow system or topic that is being discussed. Constructive conflict brought an appreciation for the diversity of needs and priorities among stakeholders and the possibility for a diverse set of pathways to achieving the same goal (improved wellbeing, livelihoods and environment through livestock production) that meets those diverse needs without eclipsing them with an average 'one size fits all' strategy.

The implication for practice is to be more confident about conflict, by preparing for it in order to nurture constructive conflict. This is possible when you design for conflict *for* learning, taking into consideration how to reference and handle ongoing conflict, carefully selecting a balanced variety of perspectives in the stakeholders, understanding how much time stakeholders need to articulate their perspectives and providing separate spaces to articulate and then confront perspectives, and fostering an atmosphere and culture where all participants feel encouraged to be creative. Challenging and confronting ideas and then exploring what is behind the differences between those ideas creates new understandings and brings curiosity into the room. However, this requires leaving defensive emotions at the door.



## 6 Discussion

### 6.1 Introduction

In the previous three chapters I have examined how the structure and facilitation of the social learning process used in the ResLeSS project affected the production and use of knowledge - how a situation is interpreted (for example, how the 'problem' and the 'solution' are defined and presented), what story gets told and acted on, and what opportunities there are for altering it. Structure refers to viewing the decision support tool, scenarios and other workshop outputs as boundary objects that supported collaboration by providing a common frame of reference and making perspectives explicit by capturing them in the physical artefacts of the workshop outputs (chapter 4). Facilitation refers to the facilitation of the dialogues in the learning process, particularly analysing it with a lens of constructive conflict that goes beyond the considerations of participation in invited spaces (Cornwall 2004) and context and stakeholding (Collins and Ison 2009), to include an awareness of interpersonal conflict dynamics and how active and passive handling of cognitive and affective (emotional) conflict or disagreements can foster constructive conflict that supports learning. The structure of activities within the learning process factors into both structure and facilitation of the learning process.

The social learning process produced knowledge in the form of eliciting different perspectives that fed into the creation of scenarios of livestock production and the evaluation of the feasibility of those scenarios in homogeneous stakeholder groups, and the social learning process provided a space to make (initial) use of that knowledge in the final mixed groups' negotiation of scenarios. This discussion chapter draws conclusions from the three results chapters to answer the overall aim of the thesis, which was to understand how a social learning process could support inclusive production and use of knowledge for more situated and relevant use of, in this case, a decision support tool. The answer lies in five insights, reflecting cross-cutting themes of the structure of the learning process (2 workshops in each country), the design of

activities and materials in the learning process and facilitation of the learning process. These are organised and discussed in relation to the political ecology literature in chapter one on knowledge production and use and broader literature where relevant:

- *Knowledge production*
  - Social learning can reveal and support diversity and similarity within and between groups' perspectives (design and facilitation)
  - Consider the history – the starting point matters (structure and design)
  - Tackle complex issues in layers (design and facilitation)
- *Knowledge use*
  - Boundary objects are a catalyst (structure and facilitation)
  - Boundary objects can reveal and diversify authorship

Taken together, they produce an argument that boundary objects in a structured process and a spirit of respectful debate that fosters constructive conflict come together to create the space to articulate and challenge perspectives, and thereby support constructive discussions and learning.

## **6.2 Production of knowledge**

### **6.2.1 Social learning can reveal and support diversity and similarity within and between groups' perspectives**

The first insight is an affirmation that the social learning process drew out different perspectives, which is important and necessary for constructive challenging of, and in turn learning from, other perspectives. Findings in chapters four and five go beyond that to show how the social learning process supported different perspectives, whether they emerged between groups or within groups that were expected to hold similar perspectives. Chapter three shows that stakeholder groups do hold different perspectives towards livestock, and often they are the broad-brush categorisations one might expect, but not always. Government officials, administrators and local researchers were in some cases more conservative than farmers and traders, for

example in Tanzania in advocating for crossbreeds rather than exotic breeds because their oversight of the whole district meant considering households from all levels of capabilities, not just those with the resources to invest in high-input livestock. Chapter three also highlights that stakeholders are also individuals who wear many hats, and therefore may have a different perspective to the perspective distilled by the stakeholder group to present in the workshop. The structured nature of the social learning process invites these different perspectives to emerge, and the structured objects such as the stories of the future and the scenario descriptions allowed multiple perspectives to be recorded and kept in discussion (chapter four). Viewing the scenario descriptions as artefacts representing a snapshot of a particular perspective, either from an individual or the culmination of a group discussion, allows for comparison of perspectives that can reveal similarities and differences. Separating activities into homogeneous groups, before mixing stakeholders, gave space to draw these out and record them, and then in mixed groups addressing the recorded perspectives meant that challenging those perspectives was directed at the objects, rather than individuals, which was more conducive to constructive conflict and learning (chapters four and five). Identifying and reconciling mismatches in stakeholders' perceptions of the scenarios built relationships and trust between actors and increased confidence in the transparency in the collaborative process, reflecting other literature on viewing decision support tools as boundary objects that support learning (Martin 2015; Cash 2001; Jean et al. 2018)

Chapter five shows how a learning process that fosters constructive conflict supports diversity in perspectives, providing space to articulate different opinions on designing livestock strategies (cognitive conflict), and space for others to accept or at least acknowledge new viewpoints while working them into their own understanding to learn how the new knowledge is relevant to them and how they might respond to it (Jeong and Chi 2007; Van den Bossche et al. 2011; Salvini et al. 2016; Van der Wal et al. 2016). A learning process also supports diversity in perspectives by avoiding destructive conflict, that is disagreeable handling of and reactions to the different

opinions offered, for example when stakeholders tried to exert dominance of one perspective over another, particularly on the basis that another stakeholder's opinion, values or objectives were 'wrong' (Cuppen 2012; Black and Andersen 2012).

### **6.2.2 Consider the history – the starting point matters**

The second insight reflects the critical political ecology literature on knowledge production that underlines that the discipline and institution within which an issue is being interrogated influences what answers are revealed and concealed by virtue of selecting which questions to ask, which parameters are considered to be important and the methods of inquiry used (Ahlborg and Nightingale 2012; Evely et al. 2008; Little 2003). Although the social learning process did elicit a diversity of perspectives, it did not elicit all perspectives, and the analysis in chapters four and five reveal how this became apparent. Analysing the dialogue with the lens of constructive conflict that looked for the influence of outside and inside context revealed the importance of previous dialogues on the issue, whether in previous research programmes or national policies (chapter five).

Analysing the outputs of the learning process revealed how structured boundary objects narrow the parameters to be considered, which filters what is discussed, while at the same making the filtering explicit (chapter four). For example, in Tanzania in particular, the livestock categories were restricted to dairy cattle, as this was the emphasis of the previous CGIAR program and the highlands of Lushoto was identified as a suitable location to expand smallscale dairy production. However, a large part of Lushoto district is in the lowlands where beef production from extensive cattle production is predominant. This also accounts for a majority of the livestock herd in Lushoto, but was excluded from the workshop. It was explained to the workshop participants, but it precluded a significant part of the population that is in fact impacted, if they were to be expected to shift from beef to dairy. Incidentally, this raises the point about defining what the 'landscape' is, rather than relying on district

boundaries. Similarly, describing scenarios for the tool precludes any explicit mention of livelihood activities alongside livestock, although they can be part of the discussion surrounding and explaining the scenario, highlighting that not all relevant information is captured in the scenario alone. Documenting and capturing how the filtering was challenged opened the door to other disciplines and worldviews to invite into the process, and thereby expand what knowledge is included in the learning process (chapters four and five).

At the same time, the history of livestock production and historical power relations governing livestock production in each country laid a significant part of the foundation for discussions in the learning process. In Tanzania and Ethiopia, where the CGIAR value chain programmes had already done prior work, the project built on those understandings of the livestock system, which pre-determined to some extent which livestock categories would be addressed in the learning process. This also reflected the national priorities for sustainable transformation of the livestock sector according to the Livestock Master Plans drawn up by ILRI for Ethiopia and Tanzania. In Burkina Faso, the learning process was less influenced by national objectives via CGIAR involvement, but the history of conflict between pastoralists and government officials with an interest in modernising livestock production was reflected in the clashes in perspectives in the Burkina Faso workshops.

The research team learnt most, whether about the case study context or about social learning, when stakeholders challenged the team, often revealing where the team's disciplinary background and experience of and with previous research programmes in the area had imposed pre-judgements and limitations on the research and research materials. The influence of previous programmes in Tanzania restricted the research focus to small-scale dairy, although it is (currently) part of a crop-livestock system. Chapter five explores how this outside context contributed to less disagreement (or constructive conflict) in the learning process due to prior research activities raising awareness on the benefits of crossbreeds and intensifying dairy production (in the highlands at least) and therefore a common agreement, and dominant perspective, on

the way forward. At the same time, this meant less questioning of the stakeholders' goal and how to achieve it, the affirmation of existing perceptions dissuading exploration of new ideas and proposal of alternatives.

In Burkina Faso, when the pastoralists challenged the project's intentions of being open and inclusive due to the implied message in the project name about seeking 'intensification', the team realised how ingrained, taken-for-granted perspectives rooted in the team's research background can affect or channel activities and outcomes, which is tied into the prevailing political narratives of priorities for livestock production and transformation. Even if as individuals, the team may have concerns about the narrow focus on 'intensification', the research agenda was seated in the broad imperative to provide food security while protecting natural resources (SDGs 2 and 11), national strategies to increase food production to meet the demands of the growing population and lift rural smallholders out of poverty, a research programme entitled 'Sustainable Agricultural Intensification', and an implicit understanding of the future direction of livestock in Africa framed by ILRI's influential 'Livestock Revolution' report (Delgado et al. 2001). Within this dominant framing, the researchers' intention with designing the project as a learning process was to open up a space to introduce new framings and alternatives to intensification, in recognition of the strong presence and history of pastoralism in the region and indeed the government's apparent support for pastoralism at the time, but it evidently was not made clear enough at the start. In this case, there was no previous experience of stakeholders working together on the issue and the boundary objects were crucial for making explicit the alternative worldviews on livestock keeping and their associated perspective on livestock production. Interacting with the boundary objects showed how to create a common frame of reference on which to build a CLEANED-R tool that spoke to all stakeholders and could adequately produce scenarios that represented the different stakeholders' perspectives (chapter four).

Critical political ecology literature on knowledge production also explores how socio-political contexts define what knowledge is considered valid and the rules, norms and

values that influence how knowledge is produced, shared, accessed and used (Clark, Kerkhoff, et al. 2016; Vogel et al. 2007). Scientific knowledge is not the only knowledge out there and social learning anticipates the inclusion of indigenous knowledge (Agrawal 1995; Briggs 2005) and vernacular expertise (Lowe et al. 2019) when eliciting diverse perspectives. However, those who do not trust the knowledge that comes from a different epistemology to their own may encounter difficulties combining these types of knowledge (Berkes 2009; Berkes 2012; Reid et al. 2006). Boundary objects in the social learning process created a meeting ground, and example of standardised objects that translate from one's own knowledge into a common form to aid the crossing of such gaps (the categorisation of livestock keeping in chapter four). By creating the space in which stakeholders felt comfortable raising any misunderstandings and thereby exploring the gap between types of knowledge, as in Jakku and Thorburn (2010), the social learning process could, in Goldman's words (2007), 'build dialogue' that acknowledged and identified strengths and weaknesses in each knowledge type.

In a similar vein, the knowledge produced in the workshop is a product of the participants (including the research team), and therefore stakeholder selection has a significant impact. There were missing stakeholders identified, who could have brought important information and perspectives to bear, particularly about issues outside of livestock, such as activities competing with livestock for land use. The difference in perspectives within stakeholder groups, as seen also by Cuppen et al. (2010), is another reason to rethink the stakeholder selection strategy, for example focusing on landscape actors and perspectives rather than value chain categories. However, other dimensions such as gender, class or ethnicity, or livelihood activities are worth considering to capture socio-cultural dynamics.

### **6.2.3 Tackle complex issues in layers**

The influence of history on the social learning process, of the degree to which the learning dialogue was building on previous engagement between stakeholders,

underscores how dialogues are never concluded, and the social learning process that occurred in the case study was just a slice of an ongoing conversation. Building on Rist et al.'s (2006) description of the dynamics of trust-building, transforming attitudes, reshaping perspectives and emergence of common understandings over time, and Pennington's (2016) concept of cognitive distance between stakeholders from different knowledges closing as they learn from each other, chapter five proposes conflict and learning dialogues as somewhat cyclical. When diverse stakeholders first engage on an issue, there is wide cognitive distance, little common vocabulary, higher likelihood of conflicting perspectives and greater chance for constructive conflict and learning. As they work through these to common understanding, conflict and learning on that issue reduce, but as in this case study, the discussions raise other issues that need to be addressed, on which there is again wide cognitive distance, diverse perspectives and so forth. The third insight from across the results chapters is the way in which the social learning process facilitated in addressing topics one at a time while at the same time eliciting adjacent and related topics to be addressed next. This experience underscores why learning processes should be iterative and ongoing to provide the space to tackle complex issues in layers. It also shows how the learning process complemented and enriched the users' experience with the tool, allowing to reveal and address issues, such as the multifunctionality of livestock in the diverse livelihoods of participants, that the tool alone could not tackle.

Boundary objects supported addressing topics one at a time by restricting the scope of conversations, by offering a limited set of topics or parameters – in this case the parameters that the decision-making tool used - and therefore scenarios created for the tool to test are partial (chapter 4). In this case, they represent only livestock activities, filtering out other income activities such as cropping or off-farm activities, that will influence household decision-making on livestock production strategies. Raising these other aspects in the discussion while creating the scenarios laid the way to the next layer of issues to explore and address. A corollary to boundary objects creating partial reflections that support in tackling complex issues in layers is that those



boundary objects are not the final product, only a prop, or catalyst in supporting the dialogue, which is discussed further in section 6.3.1.

Chapter 5 discusses how the conflicts addressed in the case studies did not end so much as evolve, revealing new issues to address or nuances to dig deeper into as the initial issues came close to being resolved. This layering was evident in Burkina Faso where reaching an acceptable compromise to the initial conflict will still require the parties to address water and biomass resource scarcity (an issue raised but not resolved during the affective conflict episode). In Tanzania, the apparent resolution to intensify small-scale dairy opens the next layer of issues to explore around how small-scale dairy interacts with other livelihood activities within the same household.

The ability of the social learning process to elicit adjacent and related topics was in part due to a pluralistic approach in the design of workshop activities (Nightingale 2015), looking from both environmental and economic lenses to explore the topic of livestock production in the form of the stories of the future, which were broader and more open-ended than the CLEANED-R tool, as well as the CLEANED-R tool which brought an environmental focus in addition to the simple economic cost-benefit of weighing inputs (such as feeds, medicine and labour) and outputs (meat, milk and manure).

## **6.3 Use of knowledge**

### **6.3.1 Boundary objects are a catalyst**

Following a post-structural tradition, critical political ecology sees knowledge as a social product (Briggs 2005) – research findings extracted in the positivist tradition may be considered to be ‘scientific’ and therefore highly acceptable, but they are also decontextualised and therefore dead (Opstal and Hugé 2013). Anyone taking and using those findings will be bringing them back to life but they will interpret the knowledge using their values, understanding and worldview, relating it to their experience – probably giving the research findings a different life to when the knowledge was collected (Zeitlyn 2010; Opstal and Hugé 2013). The analysis in chapter four resonates

with this understanding of knowledge. The knowledge produced in the workshops may be represented by the end of the workshops by the set of average composite scenarios recording the stakeholders' perceptions of what livestock production could look like in the future, but the scenarios are superficial information. Encoded in those scenarios is the host of discussion, exploration of diversity and disagreements manifesting in destructive and constructive conflict that occurred within and between groups about the selection of vignettes that comprise the scenarios and the evaluation of the results of the scenarios. As van Bruggen et al. (2019) find in their work and that of others (e.g. Salvini et al. 2016), the most significant learning in participatory modelling or gaming exercises happened when there was deep discussion and reflection within the group about the scenarios or outcomes. The results presented in chapter four reflect this – the important learning about the diversity encoded in the composite mirror remains with the group members who agreed which vignette should represent the average, or most common, management within each category.

As such, the scenarios, once created become dead, or dormant, artefacts that will be imbued with new interpretations, discussions, and learning by the next actors to use them – whether to continue the social learning dialogue beyond the project or for unconnected use. The literature on use of knowledge also cautions about knowledge being selectively used and re-framed by others to support their claims, as in an example by Turner (2004) of research findings being re-packaged to selectively support, and orchestrate, multi-dimensional resource conflict with pastoralists in the Sahel.

However, building on the insight in section 6.2.3, the scenarios are also not the final scenarios, only the ones that were reached at the end of the time available in the workshops, but many topics had not been addressed, and more iterations of creating and evaluating the scenarios would still be needed to continue the conversation. This speaks to the message of chapter five, of inviting constructive conflict to challenge ideas and assumptions, to use boundary objects such as the workshop activities and

decision support tools creatively to test how they can represent new perspectives, and how to revise the boundary objects to incorporate the new perspectives.

### **6.3.2 Boundary objects can reveal and diversify authorship**

Finally, I argue for being aware of, and inclusive with, the authorship of knowledge in terms of recognising who shapes and uses boundary objects that represent different perspectives. Those who are involved in setting the parameters of the boundary objects, and of participation, broadly set the scope of discussions and hold the power to keep, or exclude, perspectives in the room. This reflects Kapoor's (2002) insights on how the supposedly neutral position of the facilitator in a participatory process hides the power, and responsibility, that they have in directing the dialogue. In this case, the choices of the project team, and specifically the CLEANED-R modeler, set several boundaries on the discussions, but group facilitators encouraged participants to raise issues of interest that the project team may not have included, including reflecting on the participant-defined priorities outside of the environmental aspects handled by the CLEANED-R tool. It also reflects Oswick and Robertson's (2009) reflections that the language used in boundary objects and processes can be as much a barrier as a bridge. The cases in chapter four show how the design of the workshop materials, the templates for recording the discussion prompted discussion of certain aspects before others – and where the templates did not match participants' understanding, they hindered discussion, as in the example of (not) discussing environmental impacts because participants did not understand the indicators used to represent environmental impacts. More fundamentally, the focus of the tool on livestock production, and in Tanzania specifically on dairy livestock, set the scope of discussions and excluded explicit reference to crop production for example, hindering open exploration of other aspects that may be relevant to elucidating the role of livestock in the area, and therefore what a sustainable future for livestock might look like.

On the other hand, conceptualising the workshop materials as boundary objects prompts the facilitators to give participants authorship early in the process, in setting up the boundary objects. Including participants as authors, leading to, for example, using terminology they agree on, allows the learning process to produce outputs that mirror their reality in terms that are locally relevant. Furthermore, once created, the Transformation Game and scenarios became independent objects out of the control of the facilitators which could then be used by others to serve their own purposes (Zeitlyn 2010), handing authorship to the stakeholders for the rest of the learning process. Many participants used the Transformation Game to enhance their own knowledge, about new breeds and management practices to increase yield. But also, as in Tanzania, the groups used the Game board as they would want to, rather than how the tool allowed. They selected multiple options of livestock management within a category to show the diversity of objectives held by farmers, although the software tool could not take that complexity as input. Nonetheless, the Game board achieved the objective of stimulating discussion to translate farmers objectives into scenarios<sup>26</sup>.

I argue for open-mindedness and flexibility by all actors because capturing perspectives in physical artefacts passes authorship on to whoever uses those artefacts next, perhaps in unexpected ways, and in this way social learning processes can share power of creating and using the narrative among actors. That said, certain pre-determined constraints and boundaries can be implemented to safeguard the integrity of and respect for each perspective, but also to curate the valid use of the artefacts (at least during the workshops, while they are under the facilitators' and participants' control). Care should also be taken to consider different levels of knowledge among participants, and provide extra support where necessary. Some groups struggled to interpret the CLEANED-R tool results, so they did not discuss environmental impacts much, and facilitators noticed that participants' discussions were more animated as

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<sup>26</sup> Following this experience, the researchers revised their strategy for designing the vignette cards in Ethiopia, to allow more diversity in livestock keeping trajectories.

they gained understanding and confidence in the content of discussions. Where levels of knowledge are too different, it can suppress learning and reduce opportunities for constructive conflict – although misunderstandings and misinterpretations can also spark conflict that may be less easily resolved unless facilitators or participants can unearth the misunderstandings.

#### **6.4 Summary**

Within this chapter, I have drawn together the findings from the analytical chapters and discussed them in relation to the wider political ecology literature on knowledge production and use, discussed in chapter one. In doing so I have argued that the structure and facilitation of social learning processes work together to provide enabling conditions for inclusive collaboration and learning based on five insights. I argue that boundary objects support the eliciting and representation of diverse perspectives as physical artefacts, partial mirrors of a reality, and a constructive conflict approach supports the articulation and respectful challenging of those perspectives. I discuss how boundary objects and disagreements between perspectives in the learning process are, at least in part, a product of previous and ongoing conversations on the issue and the disciplines and institutions within which the learning process is hosted, which can restrict the type of perspectives raised. At the same time, structured boundary objects and a constructive conflict approach reveal the layers in a complex issue; the simplification required to create standardised and structured boundary objects that allow diverse perspectives rooted in differing knowledges, epistemologies and experiences to meet filters the topics that are discussed, while constructive conflict encourages finding diversity in agreement that reveals new layers to explore. I then argue how boundary objects such as decision support tools are catalysts for discussion rather than an end product, based on seeing how the scenarios were revealed as partial representations and that there were topics and perspectives that were raised that could not be explicitly represented by the scenarios but were opened up for future consideration. Taking a constructive conflict approach supports this

argument, in that it encourages participants to use boundary objects such as the scenarios creatively, to test how they can represent new perspectives, and to revise the boundary objects to incorporate the new perspectives. Finally, I argue for being aware of, and inclusive with, the authorship of knowledge in terms of who is involved in setting the parameters of participation and of the boundary objects. I argue for open-mindedness and flexibility by all actors because capturing perspectives in physical artefacts passes authorship on to whoever uses those artefacts next, perhaps in unexpected ways, and in this way social learning processes can share the power of creating and using the narrative among actors.

# 7 Conclusions and recommendations

## 7.1 Introduction

The aim of this thesis is to critically explore how a social learning process supports inclusive production and use of knowledge for more situated and relevant use of decision support tools. It achieved this by answering the following questions:

1. What perspectives are brought to or present in the workshops?
2. How does the structure of the social learning process and use of workshop materials support inclusive knowledge production and use?
3. How does the facilitation of the social learning dialogue support inclusive knowledge production and use?
4. How do the structure and facilitation of learning processes support the exposing and reconciling, or not, of different perspectives in the workshops?

This chapter gives a summary of the thesis chapters and how they contribute to answering the research questions and the overall aim of the thesis. I then reflect on the contributions of this thesis, the research process and its limitations before ending with recommendations for further research.

## 7.2 Summary of chapters

Chapter one lays out the rationale for this thesis, which is to interrogate factors influencing knowledge production and use in social learning processes. The thesis draws on the pros and cons of participation and understanding knowledge as a constructed product. The motivation for the thesis comes from an appreciation of the multiple and diverse knowledges and expertise of stakeholders, the boundaries between them and a desire to understand how social learning processes rise to the challenge of bridging those boundaries. I also introduce the case study of the three social learning processes run by the ResLeSS project, the research aim and questions and key terms used in the thesis. Finally, chapter one concludes with a review of the

academic literature from political ecology which offers theories and concepts on the production and use of knowledge.

Chapter two outlines the research design and methodology of using a comparative case study design, with a critical realist philosophy that recognises that my knowledge is partial and situated and an interpretation of the slice of reality that I observed. It describes the methods of collecting data using participant observation, reflection with the facilitators on the workshop proceedings and semi-structured interviews with selected workshop participants, and the thematic analysis of these data. It also introduces the three case study sites, participant selection and a brief overview of the workshop process.

Chapter three extracts and presents the perspectives on livestock that emerged within and between stakeholder groups during the workshops, with the intention of drawing out situated narratives of current and future livestock production, thereby answering research question one. Stakeholder groups did hold different perspectives towards livestock, and often corresponding to broad-brush categorisations that one might expect – but not always. In Ethiopia and Tanzania, livestock is seen as part of the crop-livestock system, useful for its manure and labour although increasingly the value of milk as an additional stream of income is valued. Although some appreciate the potential of specialised livestock production as a primary activity, their perspective is that a majority of rural households will still see livestock for its many other functions beside commercial meat and milk production, particularly if specialised breeds carry higher risk. In Burkina Faso, stakeholders recognised the value and place of both transhumant and specialised livestock production and exploring the two perspectives revealed how livestock is understood differently in each.

In chapter four, I used the lens of boundary objects to conceptualise how the workshop contents and materials can be explicitly used to foster collaboration and representation of perspectives to enable exploring ideas and building new understanding. This chapter therefore contributed to research question two. I show



that a robust structure and design to learning processes, including boundary objects such as decision support tools, but also structured workshop materials that the participants create together assist groups to “*collectively make their thought and action more coherent*” (van Bruggen et al. 2019, p.824). Beyond that, I argue that how these objects represent participants’ different perspectives gives an insight to how the social learning process provided enabling conditions for meaningful engagement. The workshop materials enabled collaboration by establishing a common topic to talk about and a common vocabulary with which to talk about it (Roux et al. 2017). Capturing participants’ input in text, for example in the scenarios, also facilitated collaboration - as comparable physical representations serving as a mirror reflecting the reality of the individual or group who designed the scenario, yet separate from the creator(s) (Forrester, Taylor, et al. 2019). As such, they could be viewed, shared and built upon by other participants. In this way, to answer research question three, the objects supported knowledge sharing, eliciting different perspectives and mediating between different perspectives. Using structured boundary objects elicited trade-offs between household food and animal feed, and between livestock for income, labour, and/ or cultural functions, reflecting the context-specific and subjective evaluations actors make when attempting to plan livelihood changes. Key themes emerging that contributed to research question four include the role of authorship in representing different perspectives, recognising who shapes and uses boundary objects. Giving participants authorship, using terminology they agree on, allows the learning process to produce outputs that mirror their reality in terms that are locally relevant, while acknowledging that once created, others may use created outputs to support their own arguments. Finally, the majority of learning was encapsulated in the discussions, only a summary is represented in the boundary objects (workshop outputs). The findings suggest to policy and decision-makers that learning processes can contribute to building transition plans that are more inclusive, and therefore perhaps more sustainable, by providing stakeholders in local agri-food systems with an approach to

sharing understandings of the diversity and trade-offs inherent to sustainable agriculture.

In chapter five, I used the lens of constructive conflict to add an awareness of interpersonal conflict dynamics to the design of learning processes, and to provide a framework for analysing the potential for constructive conflict to open up and close down opportunities for learning. This chapter therefore contributed to research question three, finding that both constructive and destructive conflict episodes contributed to opening up and closing down opportunities for learning. Furthermore, it illuminated how conflict evolves in cycles of divergence-learning-raising new issues that may underscore how learning is an ongoing process, offering an approach to tackle complex issues in layers. The framework offers a visual guide of what to analyse when designing workshops, to understand what potential conflict may arise and prepare the invited space (inside context) appropriately. This includes considering:

- the presence or absence of previous or ongoing high-level conflicts, over space and time that are relevant to the participating stakeholders,
- the presence of previous or ongoing conflicts between participating individuals that may be unrelated to the issue being discussed but that will colour their reaction to anything the other says,
- whether or not stakeholders have a dialogue established already which increases the chances of some common frames of reference,
- inviting a variety and disparity of perspectives in stakeholders, for example drawing on related disciplines and experience that encourages new ideas but are not so different as to be unrecognisable
- whether extra work is needed to bring participants to similar level of understanding of key issues to be discussed
- understanding the culture – for example, whether or not it is considered unacceptable to disagree with someone else publicly.

In chapter six, I draw together insights from chapters three, four and five to answer the research questions and aim of the thesis. By drawing on key themes from the three chapters, I found that both structure and facilitation of learning processes work together to provide an enabling space for constructive and inclusive knowledge production and learning. I argue that a robust structure and design to learning processes together with a facilitation approach that welcomes constructive conflict create the space for stakeholders to articulate and, separately, confront their perspectives. Separating out activities in time provides time to articulate perspectives, using boundary objects to record partial representations of perspectives that can then be approached neutrally by all stakeholders when it is time to confront perspectives. Fostering an open-minded and respectful ethos in both facilitators and participants encourages constructive challenging of ideas rather than emotional, reactive and potentially destructive conflict that hinders learning.

### **7.3 Contribution of thesis**

This thesis is structured so that the three analysis chapters (three, four and five) make individual academic contributions, as well as combining to enable the thesis to make overall contributions and fulfil the aim of exploring how social learning supports inclusive knowledge production and use. Individually, chapter three makes an empirical contribution about each study site, giving an understanding of how livestock is viewed and valued in the three case study sites by the stakeholders themselves and what future(s) are seen as feasible.

Chapter four offers a new analytical framework for assessing how the workshop contents and materials can be explicitly used to foster collaboration and representation of perspectives to enable exploring ideas and building new understanding, by identifying which are the key elements of the structure of the learning process and conceptualising them, and treating them, as boundary objects. It then illustrates the use and value of the framework with the case study learning

process, revealing how the decision support tool, the CLEANED-R tool and associated Transformation Game, provided catalysts for learning and building shared understanding.

Chapter five offers builds on Cuppen's (2012) framework of constructive conflict for social learning, expanding it to include concepts from interpersonal conflict dynamics literature. The added value of this is to reveal how individual behaviour and handling of conflict influences the outcome, in addition to how Cuppen's (2012) framework sets the stage for mediating the influence of the outside and inside context. Understanding the interplay of outside context, inside context and individual conflict episode dynamics contributes to understanding how conflict can be constructive or destructive depending on how those aspects manifest and are handled. This, in turn, will be useful for practitioners, informing what they need to analyse when designing learning processes. This paper expands the literature on designing social learning processes by introducing theory on interpersonal conflict dynamics from organisational literature to offer insight on the types of conflict and how moments of conflict evolve in response to individuals' conflict behaviour.

As a whole, the thesis provides a rigorous and structured approach, using the lenses of boundary objects and a constructive conflict, to understanding how the structure and facilitation design elements of a social learning process work together that provide enabling conditions for bridging knowledge boundaries and facilitating learning.

#### **7.4 Reflections and limitations**

I learned so much from doing this research – beyond the expected skill building of doing PhD research, I learned a lot from being part of the social learning process because the research team are also stakeholders and participants in the learning process. We all learned things and had our own perspectives and assumptions challenged by the other stakeholders, especially underlining the partial nature of our disciplinary knowledge – even if we knew this theoretically. One team member has

often mentioned since how they are taking the learning approach forward in their next projects, recognising the value of collaborating and building knowledge with the end-users of the decision support their research provides. It also drove home the importance of knowing the context, knowing the area, the people or at least the livelihoods, the cultural context, the political and institutional landscape and history. As a researcher from another country, visiting the case study site for the two weeks of the workshops, even copious time reading background literature is no replacement for local knowledge, emphasising the importance of local group facilitators for the learning process who know the topic and the stakeholders. This reflection is also nothing new, and is gaining new traction in decolonisation debates. However, there is a role for neutral outsiders to support the mechanics of the social learning process, working in close collaboration with local facilitators with input from an advisory group of stakeholders to tailor the stakeholder diversity and process of articulating perspectives, and to design any boundary objects that may be used, because local facilitators will inherently have their own perspectives and assumptions too.

*Lost in translation?* My interpretation of the facilitator's summary, which is a translation from the local language (Djula, Tigrigna or Swahili) into English, or in Burkina Faso into French and then by a translator into English, and the facilitator's summary is in turn their interpretation of the stakeholders' discussion. This is not only a translation between spoken languages but an interpretation across disciplines, fields of work and experience. As such I did not attempt to do the in-depth analysis that would be possible with transcripts of the whole conversations. I drew on the semi-structured interviews to triangulate my interpretations of stakeholder perspectives – although those interviews also hold translation concerns in that they were conducted in the local language using an interpreter and in some cases I was concerned that the interpreter did not understand the question I was trying to ask, and therefore may not have conveyed the question to the interviewee as I intended.

*Social learning?* While the case study implemented a learning process which I studied, the more I read about social learning, the more I hesitated to truly offer this study as a

contribution to the field of social learning. It was a relatively short term project, with relatively minimal engagement, compared to other social learning studies that I regard as being high quality (Cockburn et al. 2018; Cundill 2010; Pahl-Wostl and Hare 2004; Rist et al. 2006; Akpo et al. 2015). The project involved essentially two substantial opportunities to engage with the stakeholders over a three year period, whereas a true social learning process is ongoing and long-term, nurtured continuously by a community of connected and interested stakeholders, of which social learning researchers are just one (Roux et al. 2017; Shackleton et al. 2009; Wals 2007a). This may be enough time for individual learning (Mudombi et al. 2017), which was observed in both rounds of workshops, which is why I am confident in speaking of a successful learning process, but several definitions of social learning go one step further, expecting that individual learning to trickle out to individuals' organisations or communities, something like social change. The project cannot expect to achieve learning beyond the individual – or if by chance some participants have spread what they learnt, we did not do any follow up engagement afterwards, although we recognised that it was important. Furthermore, although there were instances of learning, trust and relationships that support deep shared learning take longer than two interactions to build, particularly where groups are cognitively distant – their levels of knowledge are too far apart – or where pre-existing destructive conflict is colouring their interactions. At most, this project started a conversation and showcased the multistakeholder learning approach to workshops, which could develop into a true learning process. On the other hand, Lindley (2015) discusses how crucial it is to see social learning as the process and not the outcome, and in that respect this thesis does make a valid contribution, as it has been studying the process of implementing a social learning process.

## **7.5 Recommendations for future research**

The analysis and reflections on this research raised several new questions to explore, often in the form of elements that did not receive enough attention during the learning

process raising questions of how to improve the design of the learning process to address them.

The first point is there was not enough (time for) discussion on distribution – the CLEANED-R tool and Transformation Game asked players to consider the whole herd of livestock in the study area, but left discussion of how the livestock should be distributed across the space and population to the players to be implicitly encoded in the choices of vignettes and animal numbers. In the experience of the ResLeSS workshops, detailed discussion of such distribution did not happen, and would be the next important step as it would prompt discussion on the distribution of costs and benefits and considerations of equity and justice (e.g. McDermott et al. 2013), particularly if considering benefits to more than humans by including the environment (Dyke et al. 2018). An example of how to strengthen this in the method is by making much clearer links between the story of the future and designing the scenarios to explore the question of who should be part of or responsible for agricultural development, and how to translate the detailed stories of the future that reflect different narratives and perspectives into aggregate scenarios (e.g. Etienne et al. 2011). More broadly, shifting the focus from the livestock or milk value chain to understanding the place of livestock in a multi-functional landscape would draw out issues of distribution. This would also address some of the epistemological tension between the narrower, technical and positivist approach of the project which is appropriate for designing the CLEANED-R tool and the critical realist, political ecology framing of the thesis which would be appropriate for designing the workshop activities, particularly for informing a multi-functional landscape approach. The CLEANED-R modeler also pointed out that an agent-based model would also better capture the interaction of actors with the landscape to provide better scenarios locating and linking individuals to animals in the landscape.

A related point that would be addressed by facilitating a more explicit path from the stories of the future to the scenarios, is to gain a better understanding of how participants understand and incorporate scale in their perspectives and discussions of

the scenarios. Individuals could easily represent and act on the part of the system that interested them, but sometimes found it difficult to extrapolate that to the landscape scale of CLEANED-R. Furthermore, interactions outside the study area were explicitly excluded from discussions but would be a next step to assess. For example, to capture interlinkages in the feed system, for example what happens to feed resources outside Lushoto if they are 'successful' in doubling or tripling their milk production while reducing greenhouse gases because they are using agro-industrial by-products from outside the district and effectively exporting their environmental impact. Similarly, an awareness of scale would bring in current discussions in the literature of medium-scale farms, urban 'telephone farmers' who own the land and hire local managers to farm it or invest in livestock that they entrust to transhumant pastoralists for a fee (Jayne et al. 2016; Pfeifer et al. 2020).

Finally, despite the CLEANED-R tool being an environmental assessment tool to stimulate discussion of environmental impact, environment was not the central debate, whether due to social issues being addressed first or insufficient time spent building up stakeholders' ability to engage with the environmental assessment language. Yet, environment was not the only topic to get less attention. Many important land users were not part of the discussion, because they do not have a link to the livestock value chain explicitly - yet in using the land, and competing for land with the livestock value chain, they are implicitly actors in the value chain, and it would be valuable to bring them into the learning space too. This would entail moving towards a land or food systems view of livestock, such as in Meyfroidt et al (2019) and Cockburn et al (2018). It also reflects the need to broaden the focus of the researcher's enquiry beyond just production and the value chain (Ensor et al. 2019). Agriculture is just one part of the wider socio-economic and political context, and in some places, a decreasing part (e.g. Ensor et al. 2019; Stringer et al. 2020; Catley et al. 2016). Building on the story in Ethiopia that emerged in the interviews of the diverse futures of youth, either being educated and leaving agriculture for better things, or then coming back in with enhanced capacity, reflects the literature on there being multiple pathways in and



out of agriculture and livestock (Catley et al. 2016). At the same time, while not everyone will stay in agriculture and livestock, experience from the case studies and examples from the literature speak of the rural homestead as a source of security for the family, maintained by the older generation as a fall back for the younger generation who are employed outside agriculture in perhaps higher earning but more precarious jobs (Rigg et al. 2016; Rigg et al. 2020). Learning processes like this therefore need to be open to broadening the focus, not assuming that agriculture will remain a major part of people's lives for everyone.

# 1 Appendix 1: Extract from facilitation guide for the ResLeSS social learning process

## 1.1 The participatory environmental assessment approach

The environmental assessment approach involves embedding the CLEANED-R tool, a rapid ex-ante environmental assessment simulation tool, into the social learning approach, using the mechanism of the Transformation Game to support engagement. As such, the tool provides a support to discussions, and it is not an end in itself.

The Transformation Game aims at engaging decision makers in a social learning process through which they learn about synergies and trade-offs in their particular context, with a view to developing an inclusive future vision for the livestock sector in their area. Decision makers are defined as those agents who take decisions related to the livestock sector. Therefore, this definition includes policymakers, as well as all players along the livestock value chain, including retailers, middlemen, and farmers.

A key reason for embedding the CLEANED-R tool in the Transformation Game is that the CLEANED-R tool does not provide answers. It provides information about potential changes in key environmental variables (water use, soil nitrogen balance, greenhouse gas emission, loss of habitat and land use) and meat and milk production. **It does not make the judgement about whether these changes are acceptable or not** because there are countless factors related to the socio-economic and biophysical context that influence what impact these changes might have. Therefore, the Transformation Game defers assessment and judgement of the information to a collection of interested and invested experts (the actors, local or other, who will be affected by or make decisions on the impacts).

The CLEANED-R tool is a quick and spatially explicit simulation tool that computes environmental impacts from livestock production (Pfeifer 2019; Pfeifer et al. 2019). This means that it is quick to set up for a new area and uses spatially disaggregated data as the input to the calculations so that the results, while relatively coarse, are

better than when using average values for the study area. As such, it aims at balancing context specificity and speed of implementation. On the one hand, generic models are often available for any part of the globe after the first investment of time in developing the tool but may be too general to support decision-making on the ground because they are not sufficiently context specific. This is particularly true for the African continent, which often is not comparable to the Western contexts for which these generic models were developed and parameterised. On the other hand, studies that collect their own context-specific data for one site give much more accurate results, but often need years to acquire and analyse the data, defying the need of policy makers to take immediate decisions. The principle of the CLEANED-R tools is that they are designed to be developed for a new area within weeks and yet give results that are good enough to support policymakers in a context-specific manner. To achieve this, the tools make use of readily available data only, refining that secondary data with expert knowledge. The tools combine globally available medium and high-resolution geographical data, i.e. data that are spatially disaggregated and therefore context specific, with expert information derived from key informant interviews and/or a participatory stakeholder workshop.

## **1.2 The participatory socio-economic approach**

Our approach to economics looks to integrate considerations of social justice, democratic participation and environmental sustainability into the foundations of the economic model. Conventional approaches to economics are restricted in that they consider value in terms of money: profit, loss, cost of production, labour costs, gross domestic product ... and so on, all are terms that are familiar. Here, we are interested in taking a wider view of 'value' to include those things that different people consider to be important in relation to livelihoods: this usually includes money (or cash income) only as part of a life vision made of less easily quantifiable aspects such as quality of life, wellbeing, plans for their children and family, respect of others, family security,

mastery and social recognition, the ability to influence policy and decision making, identity and long term impact on the environment or their community.

In this socio-economic approach, we are looking to capture this overall vision and these wider components of 'value' to construct a collective local economic vision from different stakeholders, in a set of participatory engagements. This can then be used to help evaluate the desirability of different future livestock livelihood scenarios.

The process involves capturing the diversity of stakeholder priorities that are present in the workshop and clustering them into a manageable number of common themes. Key Performance Indicators are derived to support stakeholders in evaluating the achievement of the priorities identified in the themes. These common indicators should still in some way represent the diversity of perspectives, while recognising the significance of outliers to some groups and capturing variation.

The socio-economic approach is structured in two phases within the broader social learning process (Figure 13). In the first phase, in Workshop 1, we look to generate a 'narrative of success' which integrates different perspectives into a collective future vision. This narrative allows stakeholders to co-define indicators of success that value their interests. To define the narrative of success, homogeneous stakeholder groups describe a day in the life of a family or individual in 10 years' time who, in their eyes, has been successful (A5, Figure 13). From these narratives, each group identifies key aspects that could become indicators (A6, Figure 13) and then select their top 5 indicators by individual, secret voting (A7, Figure 13), producing a large set of indicators that should capture the interests of every stakeholder in the room.

Workshop 1 ends with a plenary reflection on the variety of indicators, identifying where they overlap (commonalities) and where they do not (differences) (A8). Phase 2 is undertaken during Workshop 2, and focuses on refining the top 5 indicators (or 3 if time is short) to make them measurable and specific (A1, Figure 13). Collectively, the stakeholders iteratively suggest draft clustering and revise it (A2). The objective of Phase 2 is to produce a short list of common or 'combined indicators' (also considered

to be Key Performance Indicators, KPIs) that reflect in some way the broader-than-money interests of the variety of stakeholders. This short list is then used in the Transformation Game to evaluate the proposed livestock scenarios, to consider to what extent that livestock scenario would contribute to achieving the stakeholders' socio-economic priorities. This therefore offers the stakeholders a measure by which to evaluate the socio-economic sustainability of the proposed scenario.

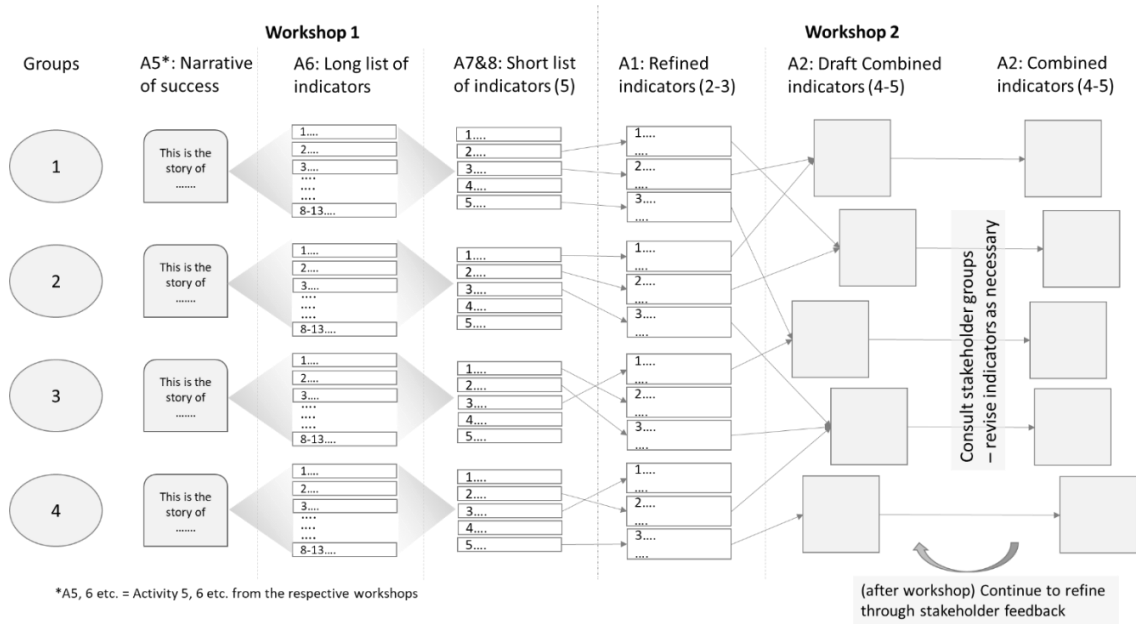


Figure 13: Overview of the socio-economic process, of eliciting and extracting a few Key Performance Indicators

## 2 Appendix 2: Boundary objects in the ResLeSS learning process

The learning process comprised four stages: a reconnaissance tour to become familiar with the area; a first multi-stakeholder participatory workshop that gathered parameters for the Transformation Game with the stakeholders; followed by setting up the computer model; and finally, a second multi-stakeholder participatory workshop where stakeholders played the Transformation Game. Boundary objects were created and used at all stages (Table 4). The following sections describe the boundary objects, how they were created and used.

### 2.1 List of livestock ‘systems’ to be defined

A *List of livestock ‘systems’ to be defined* was the first boundary object, produced in a snowballing activity, a brainstorming that quickly gathered individuals’ ideas of how livestock was kept, most commonly, in the area, first in pairs, then agreeing a common set in bigger groups until all came together. The final agreed list was negotiated to four categories by the modeller, and these four categories were described in detail in the next activity of the workshop. The following tables show the evolution from the four agreed categories in the workshop to the livestock categories represented in the CLEANED-R tools (Table 4-Table 6).

#### *Burkina Faso*

*Table 4: Linkage between Workshop 1 livestock categories to CLEANED-R categories in Burkina Faso.*

Categories discussed in the groups in Workshop 1	Categories retained for CLEANED-R
Transhumance Dairy production Animal fattening	Long transhumance herds (‘troupeaux’) Short transhumance herds (‘troupeaux’) Pastoral dairy herds (‘troupeaux’) Specialized dairy animals Fattening animals Draft animals

The snowballing negotiation showed that there was no common vocabulary about the different livestock practices and systems. Some groups classified different practices depending on how far animals go from home, others by product line (meat or milk), and others along ethnic group divisions. Many of the participants did not contribute to the negotiation, so agreeing on some common groups became a lengthy and frustrating expert debate. The facilitator picked some of the often-repeated words and proposed that the groups work with three topics, rather than systems or practices:

1. Transhumance
2. Dairy production
3. Animal fattening

Because milk had raised so many debates, two groups were assigned to the topic of milk, to see how different the discussion in the two groups might be.

Based on the activities in the first workshop, the research team characterised the livestock production in Bama into five categories, seeking to provide a representation that all stakeholders can recognise and work with, rather than describing the full complexity of reality. As such, these five categories describe common ways of keeping cattle, acknowledging that farmers may keep cattle in several categories at once, for example, having some on transhumance, a few kept at home for dairy, one or two draft animals, and perhaps some for fattening. The categories draw on two different ways of classifying livestock: i) in terms of practices, according to the product (milk, meat or draft power); and ii) in terms of production systems that describe the nutrition and herd management of the livestock. Nutrition management ranges from an 'extensive' type of feedbasket that is almost entirely free grazing through a 'semi-intensive' type of feedbasket that contains concentrate feed with free grazing, but not a cross breed to an 'intensive' type of management that refers to improved breeds with mainly concentrate feed and very limited free grazing. Note in particular the presence of both pastoralist and settled farming in the study area, and that the two are not mutually exclusive. For this reason, the categories focus on the animals as moving

(pastoral/ transhumant) or not moving (draft, specialised dairy and specialised fattening) and do not specify who keeps them.

### *Ethiopia*

*Table 5 : Linkage between Workshop 1 livestock categories to CLEANED-R categories in Ethiopia.*

<b>Categories in the snowballing in workshop 1</b>	<b>Categories discussed in the groups in Workshop 1</b>	<b>Categories retained for CLEANED-R</b>
Specialized dairy Dairy	Dairy	Specialized dairy Dual purpose – milk (lactating cows)
Cattle rearing	Dual purpose including draft animals	Dual purpose – rearing and fattening
Cattle fattening		
Draft animal		Draft animals
Sheep rearing	Sheep and goat rearing	Sheep – rearing and fattening
Sheep fattening		
Goat rearing		
Goat fattening	Sheep and goat fattening	

The first snowballing exercises in Workshop 1 came up with 9 categories. Within the workshop these nine categories were collapsed into four groups to be described in further detail (Table 5).

For Workshop 1, the study area was the whole of the Atsbi woreda, including the transition zone to the lowlands (lower than 2200m). In order to limit the number of categories in CLEANED-R, the study area boundary was set to the plateau, which, based on the maps developed in Workshop 1, excludes the goats. The four groups from Workshop 1 were transformed into the five categories used in the CLEANED-R tool to fulfil the following requirements (Table 5):

- Animals in a category should have consistent energy requirement - lactating animals have different requirement than fattening animals;
- The categories should allow users to test out some of the wished interventions, which in Atsbi means:



- Removing draft animals to test impact of mechanisation
- Switch to improved cattle breeds

### Tanzania

Table 6: Linkage between Workshop 1 livestock categories to CLEANED-R categories in Tanzania.

Categories discussed in the groups in Workshop 1	Categories retained for CLEANED-R
Extensive lowland Dairy semi-intensive lowland Dairy semi-intensive upland Dairy intensive upland	Local breed dairy cows (L) Cross-breed dairy cows (Cb) (mostly) Exotic breed dairy cows (E)

Based on the activities in the first workshop, the research team characterised the livestock production in Lushoto into three categories, extensive lowland, semi-intensive highland and intensive highland. Yet, discussion about future developments in the first ResLeSS workshop have pointed out that in all three systems smallholders are trying to improve the breeds and the management systems. These breeds would be similar across all systems. The geography is not a key driver in the up-coming changes, it had only emerged in the first workshop because of the participatory mapping exercise. This is why the CLEANED-R Tanzania was parametrized with breeds, namely preliminary local breeds, cross breeds (with 65-85% exotic genes), almost pure breed (more than 85% exotic breed). This classification is in line with ILRI results.

## 2.2 Template

The agreed livestock categories were described using a pre-prepared *Template*, including number of animals in that category, what they are fed, in which proportions and where the feed comes from, housing and manure management and other services, both for the current situation and how they might change in the future.

Information required by the template:

- Type of animal
- Number of animals in the study area (or number of households keeping them in the study area and minimum, mode and maximum number of animals per household)
- Feedbasket – items in the feedbasket, proportion of the feed basket, and where each feed item is sourced; and if there is significant variation in the feedbasket over the year, then do a wet season and dry season feedbasket
- Manure management – what is the manure used for, and in what proportions
- Equipment and infrastructure required or used for keeping animals in this category
- Input and output markets

### **2.3 Transformation Game – game boards**

*The Transformation Game (board game with bricks and vignettes + CLEANED-R tool)* was built by the modeller based on the agreed livestock categories and the current and future descriptions of those categories and verified by local livestock experts. The board game is a replica of the user interface for the CLEANED-R tool, to aid groups to visually build a scenario to enter into CLEANED-R.

The vignettes and numbers of animals initialise the Transformation Game on the game board. Important elements of the game board are:

- the name of each production category – translated into the appropriate language,
- two rows of spaces to place vignettes – the starting situation (bottom row) and the scenario to be designed (top row) (see Table 7-Table 9 describing the vignettes for each production category),
- a definition of what 1 brick represents – how many animals – leading to a corresponding number of bricks in the current scenario.

During the game, vignettes are laid in the squares (along the top row) and bricks piled on each vignette commensurate with the number of animals to be represented.

An example of the game board used in Burkina Faso is presented in Figure 14.

	1 brick = 10 troupeaux	1 brick = 10 troupeaux	1 brick = 1,00 animals	1 brick = 1,000 animals	1 brick = 1,000 animals
<b>Your Scenario</b>					
<b>Present Situation</b>					
	85 + 135 troupeaux <b>Ap</b> Transhumant animals (long + short transhumance)	125 troupeaux <b>L</b> Dairy animals (Agropastoral)	1,600 animals <b>D</b> Specialised Dairy animals	70,000 animals <b>F</b> Fattening animals	12,500 animals <b>T</b> Draught animals

Figure 14 : Game board for selecting vignettes to build a scenario for Bama, Burkina Faso

## 2.4 Transformation Game - vignettes

The *Vignette cards* used in the board game are pre-defined descriptions of viable profiles of management within one livestock category, i.e. a feedbasket to produce a particular volume of output and relevant manure management (Table 7-Table 9). The choice of vignettes was inspired by future system descriptions in Workshop 1 and local livestock literature, but designed by the modellers and local livestock experts. Figure 15 gives an example of one of the vignettes as a playing card to be used in the Transformation Game.

**DDO:**  
ክልተኣዊ/ድርብ ዕላማ ፀባን ውፅኢት ፀባን- ኣብዙይ



ናይ ፀባ እንሰሳ ክልታኣዊ ዕላማ /ረብሓ ጉጅለ ንምቕፃል እዮ። እዝኣም ድማ ከባብደዊ ዓሌት እንሰሳ እዮም። ቀለብ ወይ ድማ ምግብ እንሰሳ ብዋናነት ካብናይ ተፈጥሮ ሰዕሪን ተረፍመረፍ ምህርቲ ኮይኑ እዚ ዉህሉል ብጣዕሚ ትሑት ዝኾነ ናይ ፀባ ዉፅኢት ይህብ።

**DDO: ክልተኣዊ/ድርብ ዕላማ ፀባን ውፅኢት ፀባን**

Alive weight (kg)	lwes	150
Milk production (kg/cow/year)	myes	1100
Dressing percentage	des	0.3
<b>Feed basket dry season</b>		
Natural grass	efng1	40
Cereal crop residue	efrc1	5
Rice crop residue	efrr1	0
Legume crop residue	efrl1	0
Planted fodder	efpf1	0
Concentrate – bran	efconc1	10
Concentrate – oil seed cake	efconos1	5
Hay	efhay1	40
Silage	efsil1	0
<b>Feed basket wet season</b>		
Natural grass	efng2	95
Cereal crop residue	efrc2	5
Rice crop residue	efrr2	0
Legume crop residue	efrl2	0
Planted fodder	efpf2	0
Concentrate – bran	efconc2	0
Concentrate – oil seed cake	efconos2	0
Hay	efhay2	0
Silage	efsil2	0
<b>Manure management</b>		
% in lagoon	es_lagoon_perc	0
% as liquid slurry	es_liquidslurry_perc	0
% as solid storage	es_solidstorage_perc	45
% as drylot	es_drylot_perc	0
% left on pasture	es_pasture_perc	0
% daily spread	es_dailyspread_perc	0
% in digester	es_digester_perc	0
% used as fuel	es_fuel_perc	55
% other management	es_other_perc	0

Figure 15: Example of a vignette card for the baseline dual purpose dairy category used in Ethiopia. The left panel has a short description (as in Table 7-Table 9) in the local language (Tigrigna in Atsbi). The right panel shows the parameters represented by this vignette.

Table 7: Vignettes for Burkina Faso and their descriptions. A total of 13 vignettes, including the current version of each production category (five vignettes) and one or two alternative futures for each category (eight vignettes).

	Code	Description
Trans-humant herds (A)	ABR: Baseline (current state)	Current way of keeping pastoral non-dairy animals relying mainly on grass and crop residues
	A1: somewhat improved	Pastoral animals get little supplements (oil seed cake and bran) during the dry season
Pastoral dairy herds (L)	LBR: Baseline (current state)	Current way of keeping pastoral dairy animals relying mainly on grass and crop residues
	L1: somewhat improved	Dairy pastoral animals get little supplements (oil seed cake and bran) during the dry season
	L2: much improved	Dairy pastoral animals get fed the optimum amount of supplements (oil seed cake and bran in both seasons)
Specialized dairy (improved breeds) (D)	DBR: Baseline (current state)	Current specialized dairy production with improved breed and little supplements (bran and oil seed cake)
	D1: somewhat improved	Specialized dairy production with improved breed and some supplements (bran and oil seed cake) and little use of planted fodder
	D2: much improved	Specialized dairy production with improved breed and optimum supplements (bran and oil seed cake) in combination of planted fodder (no crop residues)
Fattening animals (Fa)	FBR: Baseline (current state)	Current fattening with little use of supplements (bran and oil seed cake)
	F1: somewhat improved	Fattening with medium use of supplements (bran and oil seed cake) more relying on crop residues than grass
	F2: much improved	Fattening with important use of supplements (bran and oil seed cake) more relying on crop residues and planted fodder
Draft animals (Tr)	TBR: Baseline (current state)	Current draft animal keeping relying on grass and crop residue only
	T1: somewhat improved	Draft animal keeping with supplements (bran and oil seed cake) during the wet season

Table 8: Vignettes for Ethiopia and their descriptions. A total of 13 vignettes, including the current version of each production category (5 vignettes), one alternative future for draft animals and specialized dairy (2 vignettes) and 2 alternative futures for all other categories (6 vignettes)

	Code	Description
Dual purpose dairy cattle (DD) – local breed	DD0 : baseline (current state)	The current way to keep lactating dual purpose animals, mainly fed on natural grass, crop residue and very slight amount of concentrate
	DD1 : improved farm produced feed basket	Improved feed basket for lactating dual-purpose animal, with more concentrates, natural grass is mainly replaced by planted fodder.
	DD2 : improved commercial feed basket	Improved feed basket for lactating dual-purpose animal, with more concentrates the DD1, natural grass and hay.
Dual purpose fattening and rearing cattle (DF) – local breed	DF0 : baseline (current state)	The current way to keep non- lactating dual-purpose animals, mainly fed on natural grass, crop residue and very slight amount of concentrate
	DF1 : improved farm produced feed basket	Improved feed basket for non- lactating dual-purpose animal, with more concentrates, natural grass is mainly replaced by planted fodder.
	DF2 : improved commercial feed basket	Improved feed basket for non- lactating dual-purpose animal, with more concentrates the DF1, natural grass and hay.
Draft animal (DA) – local breed	DA0 : baseline (current state)	The current way to keep draft animals, mainly fed on natural grass, crop residue and very slight amount of concentrate
	DA1 : improved feed basket	Improved feed basket for draft animal, with more concentrates, but remains mainly fed on natural grass
Improved dairy cattle (SD) – cross breed	SD0 : baseline (current state)	The current way to keep cross-breed animals, with already a good proportion of concentrates
	SD1 : improved feed basket	Improved feed basket for cross-breed animals, with slightly more concentrate but replacing partly natural grass and crop residues with planted fodder
Sheep rearing and fattening (SH)	SH0 : baseline (current state)	The current way to keep sheep, mainly fed on natural grass, crop residue and very slight amount of concentrate
	SH1 : improved farm produced feed basket	Improved feed basket for sheep, with more concentrates, natural grass is partially replaced by planted fodder.

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SH2: improved  
commercial feed  
basket

Improved feed basket for lactating dual-purpose  
animal, with more concentrates the SH1, natural grass  
and hay.

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Table 9: Vignettes for Tanzania and their descriptions. A total of 11 vignettes, including the current version of each production category (three vignettes), two alternative futures for each category (six vignettes) and two vignettes representing options to increase available biomass by increasing crop yield and by invoking a land use change from grazing land to cropland.

	Code	Description
<b>Local Breed (L)</b>	LBR: Baseline (current state)	Current way of keeping local breed dairy animals, relying on grass and crop residues only
	L1: somewhat improved	Local breed dairy animals, kept extensively, fed little planted fodder and little concentrates (bran and oil seed cake), with hay and silage in dry season
	L2: much improved	Good quality local breed dairy animals, fed some planted fodder and little concentrates (bran and oil seed cake), with silage in the dry season
<b>Cross Breed (Cb)</b>	CBR: Baseline (current state)	Current cross-breed dairy animal, fed little planted fodder and little concentrates (bran and oil seed cake), with little hay in dry season
	C1: somewhat improved	Cross-breed dairy animals, fed some planted fodder and some concentrates (bran and oil seed cake), with hay and silage in dry season
	C2: much improved	High-quality cross-breeds, are fed an optimum amount of planted fodder and concentrates (bran and oil seed cake) with hay and silage in the dry season
<b>Mostly Exotic Breed (E)</b>	EBR: Baseline (current state)	Current specialised dairy production with 'mostly exotic' breeds, fed on some planted fodder and little concentrates (bran and oil seed cake), with hay and silage in the dry season
	E1: somewhat improved	Intensive dairy production with 'mostly exotic' breeds, fed mainly on planted fodder and some concentrates (bran and oil seed cake), with hay and silage in the dry season
	E2: much improved	Intensive dairy production with 'mostly exotic' breeds, are fed an optimum of planted fodder and some concentrates (bran and oil seed cake) and hay and silage in the dry season
<b>Land use change (x%)</b>		Choose how much feed biomass you need (in terms of % of existing cropland), for which you want to convert to crop land. Cropland will be converted from any land use (except protected forests) based on proximity of already existing cropland and suitability for crop.
<b>Crop productivity (+20%)</b>		Increase crop and fodder yields by 20%. More manure and chemical fertiliser is applied to croplands.



## 2.5 Scenarios

A scenario is designed by selecting a vignette and a number of animals for each livestock category. All the scenarios produced during the workshops are listed in Table 10-Table 12.

The base run is a simplified virtual landscape that tries to represent the reality on the ground as far as possible at the time of initialising the model for each country, i.e. by using the most accurate and realistic dataset possible for the user. But it is not possible (or necessary) to reproduce all the complexity of reality, and the base run remains a “virtual landscape” with features that are inspired by the information obtained from literature, the reconnaissance tour, key informants and Workshop 1, which in turn (preferably) represent the features that are seen to be important and relevant by the stakeholders.

The *group scenarios* were created and evaluated by homogeneous stakeholder groups during Workshop 2 as their introduction to playing the Game.

*Starting scenarios* were provided to each mixed group in the final stage of Workshop 2, to avoid them spending time designing a first scenario. The intention was to focus on revising that starting point. The *starting scenarios* were created by the research team at the end of Day 1, as a combination of the 4 homogeneous group scenarios, either showing two clear trends (in Burkina Faso), or one average for both groups (in Tanzania) or three variations inspired by patterns across the groups as no clear trends emerged (in Ethiopia).

The *mixed group scenarios* are revisions of the starting scenario given to each mixed group, negotiated by the mixed groups during their final discussions.

*Table 10: Design of homogeneous group scenarios, starting scenarios and mixed group scenarios in Burkina Faso, described by a vignette and number of animals for each livestock category. The agro-pastoral animals are counted in troupeaux (Troup., sub-herds) that go on long transhumance beyond the district (LT) or on short transhumance within the district boundary (ST). A Transhumance herd troupeaux was assumed to have 120 animals on average, while a dairy herd troupeaux was assumed to have 20 animals on average. Animals in the other livestock categories are counted in individual animals.*

	A Transhumant herds (tr.)			L Dairy herds (tr.)		D Specialized dairy		F Fattening animals		T Draft animals		Total cattle
	Vignette	# tr. LT	# tr. ST	Vignette	Troup.	Vignette	Animals	Vignette	Number	Vignette	Number	
Baseline	ABR	100	238	LBR	200	DBR	1,400	FBR	55,000	TBR	22,500	123,460
Other farmers	A1	50	78	L2	50	D2	2,800	F2	65,000	T1	23,000	107,160
Pastoralists	ABR	200	300	LBR	300	D1	2,400	FBR	110,000	T1	23,000	201,400
Processors	A1	50	100	L2	100	D2	1,400	F2	110,000	T1	12,000	143,400
Technicians	A1	230 (LT+ST)	Part of 230	L2	150	D2	1,800	F2	83,000	T1	13,000	128,000
Starting A	A1	85	135	L2	125	D2	1,600	F2	70,000	T1	12,500	113,000
Mixed A	A1	130	310	L2	260	D2	1,750	F2	70,000	T1	12,500	142,250
Starting B	ABR	200	300	LBR	300	D1	2,400	FBR	110,000	T1	23,000	201,400
Mixed B	ABR	200	300	L1	300	D2	1,400	F1	110,000	T1	17,000	194,400

Table 11: Design of homogeneous group scenarios, starting scenarios and mixed group scenarios in Ethiopia, described by a vignette and number of animals for each livestock category.

	DD Dual purpose dairy (animals)		DF fattening and rearing (animals)		DA Draught animals (animals)		SD Specialized dairy system (animals)		SH Sheep (animals)		Total cattle	Total sheep
	Vignette	Animals	Vignette	Animals	Vignette	Animals	Vignette	Animals	Vignette	Animals		
Baseline	DD0	22,000	DF0	19,000	DA0	10,000	SD0	500	SH0	100,000	51,500	100,000
Producers	DD2	5,000	DF2	10,000	DA1	3,000	SD1	10,500	SH2	70,000	28,500	70,000
Traders	DD1	12,000	DF2	34,000	DA1	5,000	SD1	12,500	SH1	100,000	63,500	100,000
Local admin	DD2	8,000	DF2	19,000	DA1	5,000	SD1	3,000	SH1	50,000	35,000	50,000
Technicians	DD2	10,000	DF2	10,000	DA1	6,000	SD1	13,000	SH2	140,000	39,000	140,000
National	DD1	8,000	DF1	6,000	DA1	5,000	SD1	5,000	SH1	95,000	24,000	95,000
StartingW	DD1	10,000	DF1	6,000	DA1	5,000	SD1	10,000	SH1	100,000	31,000	100,000
Mixed W (1st)	DD1	10,000	DF1	9,000	DA0	5,000	SD0	15,000	SH1	150,000	39,000	150,000
Starting B	DD2	8,000	DF2	10,000	DA1	5,000	SD1	12,000	SH2	70,000	35,000	70,000
Mixed B (2nd)	DD2	8,000	DF2	5,000	DA1	5,000	SD1	12,000	SH2	95,000	30,000	95,000
Starting R	DD1	10,000	DF2	25,000	DA1	5,000	SD1	5,000	SH1	100,000	45,000	140,000
Mixed R (1st)	DD1	5,000	DF2	25,000	DA1	5,000	SD1	10,000	SH1	140,000	45,000	140,000

Table 12: Design of homogeneous group scenarios, starting scenarios and mixed group scenarios in Tanzania, described by a vignette and number of animals for each livestock category.

	L Local breeds (animals)		Cb Cross breeds (animals)		E (mostly) Exotic breeds (animals)		Yield +20%	Total cattle
	Vignette	Animals	Vignette	Animals	Vignette	Animals		
Baseline	LBR	25,000	CBR	15,000	EBR	0	-	40,000
Producers 1	L2	8,000	C1	14,000	E1	3,000	-	25,000 <sup>b</sup>
Producers 2	LBR	10,000	C2	20,000	E2	10,000	-	40,000
Processors	L2	10,000	C2	15,000	E1	10,000	-	35,000
Technicians	L2	12,000	C2	12,000	E1	5,000	-	29,000
Start <sup>a</sup>	L2	10,000	C2	15,000	E1	6,000	-	31,000
Mixed A 1	L2	5,000	C2	15,000	E1	21,000	-	41,000
Mixed A 2	L2	5,000	C2	15,000	E1	21,000	yes	41,000
Mixed B 1	L2	10,000	C2	8,000	E2	17,000	-	35,000
Mixed B 2	L1	10,000	C2	15,000	E2	10,000	-	35,000

<sup>a</sup> The starting scenario was the same for both mixed groups

<sup>b</sup> When designing the scenarios, the group allocated animals to two vignettes in the local breed animal category (8,000 in L2 and 5,000 in LBR). As the tool can only take one vignette, that with more animals was taken (L2). However, the number of animals was not adjusted to incorporate the 5,000 in LBR, so this group 'lost' 5,000 animals in their scenario results.

## 2.6 Tool results

The *tool results* from the CLEANED-R tool give percentage change for a scenario compared to the current situation (baseline) for a variety of production (meat and milk yield, crop area used etc.) and environmental indicators (volume of water used for growing feed, greenhouse gases emitted, soil nitrogen balance and biodiversity). Tool results for Burkina Faso, Ethiopia and Tanzania are given in Table 13-Table 15, for the indicators presented to stakeholders in respective workshops.

Note that these tool results should not be taken as accurate ‘truth’. Further refinements to the tool could still be made. These results give likely changes in magnitude and direction compared to the baseline, but the main purpose was to catalyse discussion.

*Table 13: Percentage change in production and environmental indicator results, compared to the baseline, for homogeneous group scenarios, starting scenarios and mixed group scenarios in Burkina Faso. Units are the units in which the indicator is calculated, but numbers in the table are % change.*

Scenario name	Milk (tons)	Meat (tons)	Crop area (ha)	Grazing land (ha)	Rice area (ha)	Total water used (l)	Water/ animal (l)	Total GHG emitted	kg CO <sub>2</sub> eq/ animal	N balance
Other farmers	592	115	1622	-41	100	14	29	43	61	-27
Pastoralists	108	83	106	47	100	49	-7	65	3	27
Processors	315	256	2037	-39	167	30	9	111	76	-26
Technicians	454	181	1710	-38	133	20	14	74	65	-25
Starting A	385	140	1450	-44	100	5	15	49	62	-29
Mixed A	544	163	1528	-23	133	29	12	69	47	-17

Starting B	246	83	168	48	100	53	-5	63	1	27
Mixed B	362	100	917	22	133	51	-3	67	8	10

Table 14: Percentage change in production and environmental indicator results, compared to the baseline, for homogeneous group scenarios, starting scenarios and mixed group scenarios in Ethiopia. Units are the units in which the indicator is calculated, but numbers in the table are % change.

	Milk (litres )	Beef (tons)	Mutton (tons)	Tons cereal	Planted fodder (ha)	Concentrates (kg)	Total Water used (l)	Water/ cow (l)	Water/ sheep (l)	Total GHG emitted	kg CO <sub>2</sub> eq/ cow	kg CO <sub>2</sub> eq/ sheep	N balance	Manure (tons)
Producers	39	-53	5	-5	4,600	202	-6	66	45	-14	56	18	-53	-29
Traders	100	39	50	-11	11,000	350	-6	-21	-15	71	78	21	63	47
Local admin	-13	-15	-25	-3	3,200	125	-5	42	81	-13	33	23	-26	-25
Technicians	100	-38	110	-6	6,300	320	-6	11	-9	24	57	17	-41	-4
National	6	-56	43	-7	7,000	75	-6	75	56	-22	58	7	-37	-45
W1	70	-53	50	-9	9,500	172	-7	44	22	3	67	17	-17	-26
W2(1st)	102	-44	125	-10	10,200	196	-11	9	-0.4	23	53	17	19	-1
B1	75	-44	5	-5	5400	260	-7	41	22	4	57	20	-47	-17
B2 (2nd)	75	-60	43	-5	5330	250	-7	50	24	-3	64	17	-54	-26
R1	21	8	110	-9	8,500	188	-5	-6	4	27	39	20	13	5
R2 (1st)	34	-1	110	-8	8,500	241	-5	-6	6	29	42	20	22	12

Table 15: Percentage change in production and environmental indicator results, compared to the baseline, for homogeneous group scenarios, starting scenarios and mixed group scenarios in Tanzania. Units are the units in which the indicator is calculated, but numbers in the table are % change.

	Milk (litres)	Maize (tons)	Crop area (ha)	Grazing land (ha)	Total water use (l)	Water use/cow (l)	Water/litre milk (l)	Total GHG emitted	kg CO <sub>2</sub> eq/animal	kg CO <sub>2</sub> eq/kg milk	N balance	Manure (tons)
Farmers 1	19	-51	-50	-50	-56	-27	-61	-24	+23	-35	-28	-29
Farmers 2	100	-45.5	-29	-51	-42	-41	-70	23	24	-38	-7	16
Processors	56	-46	-46	-45	-51	-27	-61	-17	23	-34	-28	-25
Technicians	18	-515	-50	-51	-55	-27	-62	-23	23	-36	-29	-30
Start A	154	-55	-16	-64	-34	-36	-74	38	35	-46	-9	24
Mixed A	154	-55	-29	-64	-46	-48	-79	38	35	-46	21	24
Start B	122	-68	-50	-0.05	-64	-59	-84	23	41	-44	-49	0
Mixed B	106	-60	-42	-52	-35	-55	-78	23	41	-45	-41	0
Mixed B (+20% cy)	106	-60	-51	-52	-64	-59	-82	19	36	-42	-21	0

## 2.7 List of socio-economic indicators of wellbeing

The *list of socio-economic indicators* of well-being was created by the participants, first in homogeneous groups, and then consolidated to a set of common socio-economic indicators that were agreed in plenary (Table 16). These are indicators representing what a successful life would look like in 2030, reflecting the socio-economic and wellbeing priorities of the participants.

*Table 16: Common socio-economic indicators agreed in each country.*

<b>Burkina Faso</b>	<b>Ethiopia</b>	<b>Tanzania</b>
Improved infrastructure, processing services, selection and breeds Generous and able to offer help Children go to school and no child goes hungry Land rights and housing Diversification of livelihoods Two "troupeaux" at any one time	Access to Education and Health Infrastructure Agricultural technology Joint decision-making	Education Fertile land Improved livestock Modern house Food security



# Abbreviations

<b>Acronym</b>	<b>Full name</b>
CCSL	Climate Change and Social Learning
CCAFS	Climate Change, Agriculture and Food Security
CGIAR	Consultative Group on International Agricultural Research
CLEANED	Comprehensive Livestock Environmental Assessment for improved Nutrition, a secured Environment and sustainable Development
CRP	CGIAR Research Program
ECRC/EDRI	Environment and Climate Research Center (ECRC) at Ethiopian Development Research Institute (EDRI)
GHG	Greenhouse Gas
GIS	Geographic Information System
ICARDA	International Center for Agricultural Research in the Dry Areas
ILRI	International Livestock Research Institute
INERA	Institut de l'Environnement et de la Recherche Agricole
kg	kilogram
km	kilometre
mm	millimetre
NGO	Non-governmental organisation
NRM	Natural Resource Management
ResLeSS	Research and Learning for Sustainable Intensification of Smallholder Livestock Value Chains
SAI	Sustainable Agricultural Intensification
SAIRLA	Sustainable Agricultural Intensification Research and Learning in Africa
SEI	Stockholm Environment Institute
SUA	Sokoine University of Agriculture
UK	United Kingdom
UNDP	United Nations Development Program

# References

- Abson, D. J., von Wehrden, H., Baumgärtner, S., Fischer, J., Hanspach, J., et al. (2014). Ecosystem services as a boundary object for sustainability. *Ecological Economics*, 103(Supplement C). 29–37. DOI: 10.1016/j.ecolecon.2014.04.012
- Adger, W. N., Benjaminsen, T. A., Brown, K. and Svarstad, H. (2001). Advancing a Political Ecology of Global Environmental Discourses. *Development and Change*, 32(4). 681–715. DOI: 10.1111/1467-7660.00222
- Adriansen, H. K. (2008). Understanding pastoral mobility: the case of Senegalese Fulani. *The Geographical Journal*, 174(3). 207–22. DOI: 10.1111/j.1475-4959.2008.00278.x
- Agrawal, A. (1995). Dismantling the Divide Between Indigenous and Scientific Knowledge. *Development and Change*, 26(3). 413–39. DOI: 10.1111/j.1467-7660.1995.tb00560.x
- AgriTT (2017). *Improving Tanzania's Dairy Cattle*. Landell Mills. <https://www.landell-mills.com/agriculture-fisheries-food-security-and-nutrition/2017/8/23/improving-tanzanias-dairy-cattle>
- Ahlborg, H. and Nightingale, A. J. (2012). Mismatch Between Scales of Knowledge in Nepalese Forestry: Epistemology, Power, and Policy Implications. *Ecology and Society*, 17(4). <https://www.jstor.org/stable/26269208>
- Akpo, E., Crane, T. A., Vissoh, P. V. and Tossou, R. C. (2015). Co-production of Knowledge in Multi-stakeholder Processes: Analyzing Joint Experimentation as Social Learning. *The Journal of Agricultural Education and Extension*, 21(4). 369–88. DOI: 10.1080/1389224X.2014.939201
- Alston, M., Clarke, J. and Whittenbury, K. (2017). Gender Relations, Livelihood Strategies, Water Policies and Structural Adjustment in the Australian Dairy Industry. *Sociologia Ruralis*, 57(S1). 752–68. DOI: 10.1111/soru.12164
- Amason, A. C. (1996). Distinguishing the Effects of Functional and Dysfunctional Conflict on Strategic Decision Making: Resolving a Paradox for Top Management Teams. *The Academy of Management Journal*, 39(1). 123–48. DOI: 10.2307/256633
- Arnold, J., Koro-Ljungberg, M. and Bartels, W.-L. (2012). Power and Conflict in Adaptive Management: Analyzing the Discourse of Riparian Management on Public Lands. *Ecology and Society*, 17(1). DOI: 10.5751/ES-04636-170119
- Aubert, P.-M., Brun, M., Agamile, P. and Treyer, S. (2018). From aid negotiation to aid effectiveness: the case of food and nutrition security in Ethiopia. *Third World Quarterly*, 39(1). 104–21. DOI: 10.1080/01436597.2017.1368379
- Baka, J., Hesse, A., Weinthal, E. and Bakker, K. (2019). Environmental Knowledge Cartographies: Evaluating Competing Discourses in U.S. Hydraulic Fracturing Rule-Making. *Annals of the American Association of Geographers*, 0(0). 1–20. DOI: 10.1080/24694452.2019.1574549
- Bandura, A. (1977). *Social Learning Theory*. Prentice Hall, Toronto, Canada
- Bardhan, P. and Ray, I. (2006). Methodological Approaches to the Question of the Commons. *Economic Development and Cultural Change*, 54(3). 655–76. DOI: 10.1086/500032
- Barki, H. and Hartwick, J. (2004). CONCEPTUALIZING THE CONSTRUCT OF INTERPERSONAL CONFLICT. *International Journal of Conflict Management*, 15(3). 216–44. DOI: 10.1108/eb022913
- Basco-Carrera, L., Warren, A., van Beek, E., Jonoski, A. and Giardino, A. (2017). Collaborative modelling or participatory modelling? A framework for water resources management. *Environmental Modelling & Software*, 91(Supplement C). 95–110. DOI: 10.1016/j.envsoft.2017.01.014

- Bebbington, A. (1996). Movements, Modernizations, and Markets: Indigenous organizations and agrarian strategies in Ecuador. In *Liberation Ecologies: Environment, Development, Social Movements*. Peet, R. and Watts, M. (eds). Routledge, London & New York
- Beers, P. J., Mierlo, B. and Hoes, A.-C. (2016). Toward an Integrative Perspective on Social Learning in System Innovation Initiatives. *Ecology and Society*, 21(1). DOI: 10.5751/ES-08148-210133
- Behnke, R. H. and Scoones, I. (1992). *Rethinking Range Ecology: Implications for Rangeland Management in Africa*. Drylands Issue Paper, 33. IIED and ODI, London. <http://pubs.iied.org/7282IIED/>
- Behnke, R. H., Scoones, I. and Kerven, C., eds. (1993). *Range Ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannas*. Overseas Development Institute, London
- Béné, C., Oosterveer, P., Lamotte, L., Brouwer, I. D., de Haan, S., Prager, S. D., Talsma, E. F. and Khoury, C. K. (2019). When food systems meet sustainability – Current narratives and implications for actions. *World Development*, 113. 116–30. DOI: 10.1016/j.worlddev.2018.08.011
- Benjaminsen, T. A. and Ba, B. (2019). Why do pastoralists in Mali join jihadist groups? A political ecological explanation. *The Journal of Peasant Studies*, 46(1). 1–20. DOI: 10.1080/03066150.2018.1474457
- Bergius, M., Benjaminsen, T. A., Maganga, F. and Buhaug, H. (2020). Green economy, degradation narratives, and land-use conflicts in Tanzania. *World Development*, 129. 104850. DOI: 10.1016/j.worlddev.2019.104850
- Berkes, F. (2009). Evolution of co-management: Role of knowledge generation, bridging organizations and social learning. *Journal of Environmental Management*, 90(5). 1692–1702. DOI: 10.1016/j.jenvman.2008.12.001
- Berkes, F. (2012). *Sacred Ecology*. Routledge. DOI: 10.4324/9780203123843
- Berkes, F., Colding, J. and Folke, C. (2000). Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications*, 10(5). 1251–62. DOI: 10.1890/1051-0761(2000)010[1251:ROTEKA]2.0.CO;2
- Beuchelt, T. D. (2016). Gender, Social Equity and Innovations in Smallholder Farming Systems: Pitfalls and Pathways. In *Technological and Institutional Innovations for Marginalized Smallholders in Agricultural Development*. Gatzweiler, F. W. and von Braun, J. (eds). Springer International Publishing, Cham. 181–98. DOI: 10.1007/978-3-319-25718-1\_11
- Birkenholtz, T. (2012). Network political ecology: Method and theory in climate change vulnerability and adaptation research. *Progress in Human Geography*, 36(3). 295–315. DOI: 10.1177/0309132511421532
- Black, D. C., Wallbrink, P. J. and Jordan, P. W. (2014). Towards best practice implementation and application of models for analysis of water resources management scenarios. *Environmental Modelling & Software*, 52(Supplement C). 136–48. DOI: 10.1016/j.envsoft.2013.10.023
- Black, L. J. and Andersen, D. F. (2012). Using Visual Representations as Boundary Objects to Resolve Conflict in Collaborative Model-Building Approaches. *Systems Research and Behavioral Science*, 29(2). 194–208. DOI: 10.1002/sres.2106
- Blackmore, C. (2006). Where do participatory approaches meet social learning systems in the context of environmental decision making? *Changing European Farming Systems for a Better Future - New Visions for Rural Areas*, Langeveld, H. and Röling, N. (eds). 29–35. Proceedings of the 7th European IFSA symposium, Wageningen, the Netherlands. Wageningen Academic Publishers.

- [http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/2156/Where\\_do\\_participatory..\\_Blackmore.pdf?sequence=1&isAllowed=y](http://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/2156/Where_do_participatory.._Blackmore.pdf?sequence=1&isAllowed=y)
- Blackmore, C. (2007). What kinds of knowledge, knowing and learning are required for addressing resource dilemmas?: a theoretical overview. *Environmental Science & Policy*, 10(6). 512–25. DOI: 10.1016/j.envsci.2007.02.007
- Blaikie, P. (2006). Is Small Really Beautiful? Community-based Natural Resource Management in Malawi and Botswana. *World Development*, 34(11). 1942–57. DOI: 10.1016/j.worlddev.2005.11.023
- Blaikie, P. M. (1985). *The Political Economy of Soil Erosion in Developing Countries*. Longman, London & New York
- Blaikie, P. M. and Brookfield, H. (1987). *Land Degradation and Society*. Methuen, London & New York
- Boles, O. J. C., Shoemaker, A., Courtney Mustaphi, C. J., Petek, N., Ekblom, A. and Lane, P. J. (2019). Historical Ecologies of Pastoralist Overgrazing in Kenya: Long-Term Perspectives on Cause and Effect. *Human Ecology*, 47(3). 419–34. DOI: 10.1007/s10745-019-0072-9
- Bollig, M. and Österle, M. (2013). The Political Ecology of Specialisation and Diversification: Long-term Dynamics of Pastoralism in East Pokot District, Kenya. In *Pastoralism in Africa: Past, Present and Future*. Bollig, M., Schnegg, M. and Wotzka, H.-P. Berghahn Books, New York and Oxford
- Bollig, M. and Schulte, A. (1999). Environmental Change and Pastoral Perceptions: Degradation and Indigenous Knowledge in Two African Pastoral Communities. *Human Ecology*, 27(3). 493–514. DOI: 10.1023/A:1018783725398
- Boyd, E., Ensor, J., Broto, V. C. and Juhola, S. (2014). Environmentalities of urban climate governance in Maputo, Mozambique. *Global Environmental Change*, 26. 140–51. DOI: 10.1016/j.gloenvcha.2014.03.012
- Braun, B. and Castree, N., eds. (1998). *Remaking Reality: Nature at the Millenium*. Routledge, New York
- Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2). 77–101. DOI: 10.1191/1478088706qp063oa
- Brenner, N. (2001). The limits to scale? Methodological reflections on scalar structuration. *Progress in Human Geography*, 25(4). 591–614. DOI: 10.1191/030913201682688959
- Briggs, J. (2005). The use of indigenous knowledge in development: problems and challenges. *Progress in Development Studies*, 5(2). 99–114. DOI: 10.1191/1464993405ps105oa
- Brown, J. C. and Purcell, M. (2005). There's nothing inherent about scale: political ecology, the local trap, and the politics of development in the Brazilian Amazon. *Geoforum*, 36(5). 607–24. DOI: 10.1016/j.geoforum.2004.09.001
- Bryant, R. L. (1996). Romancing colonial forestry: the discourse of 'forestry as progress' in British Burma. *Geographical Journal*, 162. 169–78.
- Bryant, R. L. (1997). *The Political Ecology of Forestry in Burma, 1824-1994*. C. Hurst & Co. Publishers, London
- Bryant, R. L. (1998). Power, knowledge and political ecology in the third world: a review. *Progress in Physical Geography: Earth and Environment*, 22(1). 79–94. DOI: 10.1177/030913339802200104
- Campbell, L. M. (2007). Local Conservation Practice and Global Discourse: A Political Ecology of Sea Turtle Conservation. *Annals of the Association of American Geographers*, 97(2). 313–34. DOI: 10.1111/j.1467-8306.2007.00538.x
- Capitani, C., Garedew, W., Mitiku, A., Berecha, G., Hailu, B. T., et al. (2019). Views from two mountains: exploring climate change impacts on traditional farming communities

- of Eastern Africa highlands through participatory scenarios. *Sustainability Science*, 14(1). 191–203. DOI: 10.1007/s11625-018-0622-x
- Carlile, P. R. (2002). A Pragmatic View of Knowledge and Boundaries: Boundary Objects in New Product Development. *Organization Science*, 13(4). 442–55. DOI: 10.1287/orsc.13.4.442.2953
- Cash, D. W. (2001). “In Order to Aid in Diffusing Useful and Practical Information”: Agricultural Extension and Boundary Organizations. *Science, Technology, & Human Values*, 26(4). 431–53. DOI: 10.1177/016224390102600403
- Cash, D. W., Adger, W. N., Berkes, F., Garden, P., Lebel, L., Olsson, P., Pritchard, L. and Young, O. (2006). Scale and Cross-Scale Dynamics: Governance and Information in a Multilevel World. *Ecology and Society*, 11(2).  
<https://www.jstor.org/stable/26265993>
- Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., Jäger, J. and Mitchell, R. B. (2003). Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences*, 100(14). 8086–91. DOI: 10.1073/pnas.1231332100
- Castree, N. and Braun, B., eds. (2001). *Social Nature: Theory, Practice and Politics*. Wiley-Blackwell, Oxford, U.K., Malden, Massachusetts
- Catley, A., Lind, J. and Scoones, I. (2016). The futures of pastoralism in the Horn of Africa: pathways of growth and change. *Revue Scientifique et Technique*, 35(2). 389–403. DOI: <http://dx.doi.org/10.20506/rst.35.2.2524>
- Chambers, R. (1994). Participatory Rural Appraisal (PRA): analysis of experience. *World Development*, 22(9). 1253–68.
- Chen, X., Liu, J., Zhang, H. and Kwan, H. K. (2019). Cognitive diversity and innovative work behaviour: The mediating roles of task reflexivity and relationship conflict and the moderating role of perceived support. *Journal of Occupational and Organizational Psychology*, 92(3). 671–94. DOI: <https://doi.org/10.1111/joop.12259>
- Chigudu, S., Jasseh, M., d’Alessandro, U., Corrah, T., Demba, A. and Balen, J. (2018). The role of leadership in people-centred health systems: a sub-national study in The Gambia. *Health Policy and Planning*, 33(1). e14–25. DOI: 10.1093/heapol/czu078
- Clark, W. C., Kerkhoff, L. van, Lebel, L. and Gallopin, G. C. (2016). Crafting usable knowledge for sustainable development. *Proceedings of the National Academy of Sciences*, 113(17). 4570–78. DOI: 10.1073/pnas.1601266113
- Clark, W. C., Tomich, T. P., Noordwijk, M. van, Guston, D., Catacutan, D., Dickson, N. M. and McNie, E. (2016). Boundary work for sustainable development: Natural resource management at the Consultative Group on International Agricultural Research (CGIAR). *Proceedings of the National Academy of Sciences*, 113(17). 4615–22. DOI: 10.1073/pnas.0900231108
- Clay, E. J. and Schaffer, B. B. (1984). *Room for Manoeuvre: An Exploration of Public Policy in Agricultural and Rural Development*. Heinemann Educational Books, London
- Clay, N. and Yurco, K. (2020). Political ecology of milk: Contested futures of a lively food. *Geography Compass*, 14(8). e12497. DOI: <https://doi.org/10.1111/gec3.12497>
- Cockburn, J., Cundill, G., Shackleton, S. and Rouget, M. (2018). Towards Place-Based Research to Support Social–Ecological Stewardship. *Sustainability*, 10(5). 1434. DOI: 10.3390/su10051434
- Coe, R., Sinclair, F. and Barrios, E. (2014). Scaling up agroforestry requires research ‘in’ rather than ‘for’ development. *Current Opinion in Environmental Sustainability*, 6. 73–77. DOI: 10.1016/j.cosust.2013.10.013
- Cohen, A. (2012). Rescaling Environmental Governance: Watersheds as Boundary Objects at the Intersection of Science, Neoliberalism, and Participation. *Environment and Planning A: Economy and Space*, 44(9). 2207–24. DOI: 10.1068/a44265

- Collins, K. B. and Ison, R. L. (2010). Trusting Emergence: Some Experiences of Learning about Integrated Catchment Science with the Environment Agency of England and Wales. *Water Resources Management*, 24(4). 669–88. DOI: 10.1007/s11269-009-9464-8
- Collins, K. and Ison, R. (2009). Jumping off Arnstein’s ladder: social learning as a new policy paradigm for climate change adaptation. *Environmental Policy and Governance*, 19(6). 358–73. DOI: 10.1002/eet.523
- Cooke, B. (2004). Rules of thumb for participatory change agents. In *Participation--From Tyranny to Transformation?: Exploring New Approaches to Participation in Development*. Hickey, S. and Mohan, G. (eds). Zed Books, London & New York
- Cooke, B. and Kothari, U. (2001). *Participation: The New Tyranny?* Zed Books, London & New York
- Cornwall, A. (2004). Spaces for transformation? reflections on issues of power and difference in participation in development. In *Participation--From Tyranny to Transformation?: Exploring New Approaches to Participation in Development*. Hickey, S. and Mohan, G. (eds). Zed Books, London & New York. 75–91
- Cote, M. and Nightingale, A. J. (2012). Resilience thinking meets social theory: Situating social change in socio-ecological systems (SES) research. *Progress in Human Geography*, 36(4). 475–89. DOI: 10.1177/0309132511425708
- CRGE (n.d.). *Ethiopia’s Climate-Resilient Green Economy: Green Economy Strategy*. Federal Democratic Republic of Ethiopia, Addis Ababa, Ethiopia
- Cundill, G. (2010). Monitoring Social Learning Processes in Adaptive Comanagement: Three Case Studies from South Africa. *Ecology and Society*, 15(3). <http://www.ecologyandsociety.org/vol15/iss3/art28/>
- Cundill, G. and Rodela, R. (2012). A review of assertions about the processes and outcomes of social learning in natural resource management. *Journal of Environmental Management*, 113. 7–14. DOI: 10.1016/j.jenvman.2012.08.021
- Cundill, G., Shackleton, S., Sisitka, L., Ntshudu, M., Lotz-Sisitka, H., Kulundu, I. and Hamer, N. (2014). *Social Learning for Adaptation: A Descriptive Handbook for Practitioners and Action Researchers*. Rhodes University, Grahamstown, South Africa. <http://hdl.handle.net/10625/52509>
- Cuppen, E. (2012). Diversity and constructive conflict in stakeholder dialogue: considerations for design and methods. *Policy Sciences*, 45(1). 23–46. DOI: 10.1007/s11077-011-9141-7
- Cuppen, E., Breukers, S., Hisschemöller, M. and Bergsma, E. (2010). Q methodology to select participants for a stakeholder dialogue on energy options from biomass in the Netherlands. *Ecological Economics*, 69(3). 579–91. DOI: 10.1016/j.ecolecon.2009.09.005
- de Vente, J., Reed, M., Stringer, L., Valente, S. and Newig, J. (2016). How does the context and design of participatory decision making processes affect their outcomes? Evidence from sustainable land management in global drylands. *Ecology and Society*, 21(2). DOI: 10.5751/ES-08053-210224
- de Wit, F. R. C., Greer, L. L. and Jehn, K. A. (2012). The paradox of intragroup conflict: a meta-analysis. *The Journal of Applied Psychology*, 97(2). 360–90. DOI: 10.1037/a0024844
- DeChurch, L. A. and Marks, M. A. (2001). Maximizing the Benefits of Task Conflict: The Role of Conflict Management. *International Journal of Conflict Management*, 12(1). 4. DOI: 10.1108/eb022847
- Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S. and Courbois, C. (2001). Livestock to 2020: The Next Food Revolution. *Outlook on Agriculture*, 30(1). 27–29. DOI: 10.5367/000000001101293427

- Den Haan, R.-J. and Van der Voort, M. C. (2018). On Evaluating Social Learning Outcomes of Serious Games to Collaboratively Address Sustainability Problems: A Literature Review. *Sustainability*, 10(12). 4529. DOI: 10.3390/su10124529
- Dewulf, A., Craps, M., Bouwen, R., Abril, F. and Zhingri, M. (2005). How indigenous farmers and university engineers create actionable knowledge for sustainable irrigation. *Action Research*, 3(2). 175–92. DOI: 10.1177/1476750305052141
- D’Haene, E., Desiere, S., D’Haese, M., Verbeke, W. and Schoors, K. (2019). Religion, Food Choices, and Demand Seasonality: Evidence from the Ethiopian Milk Market. *Foods (Basel, Switzerland)*, 8(5). DOI: 10.3390/foods8050167
- Doherty, J. (1990). Review of Beyond the Fuelwood Crisis: People, Land and Trees in Africa, ; The Fuelwood Trap: A Study of the SADCC Region. *Africa: Journal of the International African Institute*, 60(2). 300–302. DOI: 10.2307/1160338
- Dror, D. K. and Allen, L. H. (2011). The Importance of Milk and other Animal-Source Foods for Children in Low-Income Countries. *Food and Nutrition Bulletin*, 32(3). 227–43. DOI: 10.1177/156482651103200307
- Dryzek, J. S. (1997). *The Politics of the Earth: Environmental Discourses*. Oxford University Press, Cambridge, UK
- Dryzek, J. S. and Niemeyer, S. (2008). Discursive Representation. *The American Political Science Review*, 102(4). 481–93.
- Duncan, J. and Claeys, P. (2018). Politicizing food security governance through participation: opportunities and opposition. *Food Security*, 10(6). 1411–24. DOI: 10.1007/s12571-018-0852-x
- Dyke, A., Geoghegan, H. and de Bruin, A. (2018). Towards a More-Than-Human Approach to Tree Health. In *The Human Dimensions of Forest and Tree Health: Global Perspectives*. Urquhart, J., Marzano, M., and Potter, C. (eds). Springer International Publishing, Cham. 445–70. DOI: 10.1007/978-3-319-76956-1\_17
- Eckholm, E. P. (1976). *Losing Ground: Environmental Stress and World Food Prospects*. W. W. Norton, New York
- Eisler, M. C., Lee, M. R. F., Tarlton, J. F., Martin, G. B., Beddington, J., et al. (2014). Agriculture: Steps to sustainable livestock. *Nature News*, 507(7490). 32. DOI: 10.1038/507032a
- Enahoro, D., Lannerstad, M., Pfeifer, C. and Dominguez-Salas, P. (2018). Contributions of livestock-derived foods to nutrient supply under changing demand in low- and middle-income countries. *Global Food Security*, 19. 1–10. DOI: 10.1016/j.gfs.2018.08.002
- Engel-Di Mauro, S. (2009). Seeing the local in the global: Political ecologies, world-systems, and the question of scale. *Geoforum*, 40(1). 116–25. DOI: 10.1016/j.geoforum.2008.09.004
- Engeström, Y. (1987). *Learning by Expanding: An Activity-Theoretical Approach to Developmental Research*. Orienta-Konsultit Oy, Helsinki
- Ensor, J. (2011). *Uncertain Futures: Adapting Development to a Changing Climate*. Practical Action Publishing, Rugby
- Ensor, J. E., Wennström, P., Bhattarai, A., Nightingale, A. J., Eriksen, S. and Sillmann, J. (2019). Asking the right questions in adaptation research and practice: Seeing beyond climate impacts in rural Nepal. *Environmental Science & Policy*, 94. 227–36. DOI: 10.1016/j.envsci.2019.01.013
- Ensor, J. and Harvey, B. (2015). Social learning and climate change adaptation: evidence for international development practice. *Wiley Interdisciplinary Reviews: Climate Change*, 6(5). 509–22. DOI: 10.1002/wcc.348
- Ensor, J., Pfeifer, C., Morris, J. and Ouedraogo, S. (2018). *Exploring Alternatives for Livestock Production in Bama, Burkina Faso: Playing the Transformation Game*. Report of

- ResLeSS Workshop 2*. Stockholm Environment Institute, York.  
<https://cgspace.cgiar.org/handle/10568/93069>
- Erb, K.-H., Lauk, C., Kastner, T., Mayer, A., Theurl, M. C. and Haberl, H. (2016). Exploring the biophysical option space for feeding the world without deforestation. *Nature Communications*, 7. 11382. DOI: 10.1038/ncomms11382
- Eriksen, S. H., Nightingale, A. J. and Eakin, H. (2015). Reframing adaptation: The political nature of climate change adaptation. *Global Environmental Change*, 35. 523–33. DOI: 10.1016/j.gloenvcha.2015.09.014
- Escobar, A. (1995). *Encountering Development: The Making and Unmaking of the Third World*. Princeton University Press, Princeton, New Jersey
- Escobar, A. (1996a). Constructing Nature: Elements for a Post-Structuralist Political Ecology. In *Liberating Ecologies: Environment, Development, Social Movements*. Peet, R. and Watts, M. (eds). Routledge, London, UK. 46–68
- Escobar, A. (1996b). Construction nature: Elements for a post-structuralist political ecology. *Futures*, 28(4). 325–43. DOI: 10.1016/0016-3287(96)00011-0
- Escobar, A. (1998). Whose Knowledge, Whose nature? Biodiversity, Conservation, and the Political Ecology of Social Movements. *Journal of Political Ecology*, 5(1). 53–82. DOI: 10.2458/v5i1.21397
- Escobar, A. (2011). Sustainability: Design for the pluriverse. *Development*, 54(2). 137–40. DOI: 10.1057/dev.2011.28
- Etienne, M., Du Toit, D. and Pollard, S. (2011). ARDI: A Co-construction Method for Participatory Modeling in Natural Resources Management. *Ecology and Society*, 16(1). DOI: 10.5751/ES-03748-160144
- Evely, A. C., Fazey, I., Pinard, M. and Lambin, X. (2008). The Influence of Philosophical Perspectives in Integrative Research: a Conservation Case Study in the Cairngorms National Park. *Ecology and Society*, 13(2). <http://www.jstor.org/stable/26268007>
- Ewenstein, B. and Whyte, J. (2009). Knowledge Practices in Design: The Role of Visual Representations as 'Epistemic Objects'. *Organization Studies*, 30(1). 07–30. DOI: 10.1177/0170840608083014
- Fairhead, J. and Leach, M. (1996). *Misreading the African Landscape: Society and Ecology in a Forest-Savanna Mosaic*. Cambridge University Press, Cambridge
- Fazey, I., Fazey, J. A., Fischer, J., Sherren, K., Warren, J., Noss, R. F. and Dovers, S. R. (2007). Adaptive capacity and learning to learn as leverage for social–ecological resilience. *Frontiers in Ecology and the Environment*, 5(7). 375–80. DOI: 10.1890/1540-9295(2007)5[375:ACALTL]2.0.CO;2
- Fazey, I., Schöpke, N., Caniglia, G., Patterson, J., Hultman, J., et al. (2018). Ten essentials for action-oriented and second order energy transitions, transformations and climate change research. *Energy Research & Social Science*, 40. 54–70. DOI: 10.1016/j.erss.2017.11.026
- Fernández-Giménez, M., Augustine, D., Porensky, L., Wilmer, H., Derner, J., Briske, D. and Stewart, M. (2019). Complexity fosters learning in collaborative adaptive management. *Ecology and Society*, 24(2). DOI: 10.5751/ES-10963-240229
- Fernandez-Gimenez, M., Ballard, H. and Sturtevant, V. (2008). Adaptive Management and Social Learning in Collaborative and Community-Based Monitoring: a Study of Five Community-Based Forestry Organizations in the western USA. *Ecology and Society*, 13(2). DOI: 10.5751/ES-02400-130204
- Flynn, T. (2007). Foucault among the geographers. In *Space, Knowledge and Power: Foucault and Geography*. Crampton, J. W. and Elden, S. (eds). Ashgate Publishing, Ltd., Aldershot & Burlington. 59–66
- Forrester, J., Matin, N., Taylor, R., Pedoth, L., Davis, B. and Deeming, H. (2019). Managing Complex Systems: The Need to Structure Qualitative Data. In *Framing Community*



- Disaster Resilience: Resources, Capacities, Learning, and Action*. Deeming, H., Fordham, M., Kuhlicke, C., Pedoth, L., Schneiderbauer, S., and Shreve, C. (eds). John Wiley & Sons, Hoboken, New Jersey and Chichester, West Sussex. 125–38. <https://www.wiley.com/en-gb/Framing+Community+Disaster+Resilience-p-9781119165965>
- Forrester, J., Taylor, R., Pedoth, L. and Matin, N. (2019). Wicked Problems: Resilience, Adaptation, and Complexity. In *Framing Community Disaster Resilience: Resources, Capacities, Learning, and Action*. Deeming, H., Fordham, M., Kuhlicke, C., Pedoth, L., Schneiderbauer, S., and Shreve, C. (eds). John Wiley & Sons, Hoboken, New Jersey and Chichester, West Sussex. 61–75. <https://www.wiley.com/en-gb/Framing+Community+Disaster+Resilience-p-9781119165965>
- Forsyth, T. (2003). *Critical Political Ecology: The Politics of Environmental Science*. Routledge, Abingdon. [https://www.google.co.uk/books/edition/\\_/1oYmfX72IFsC?hl=en](https://www.google.co.uk/books/edition/_/1oYmfX72IFsC?hl=en)
- Forsyth, T. and Walker, A. (2008). *Forest Guardians, Forest Destroyers: The Politics of Environmental Knowledge in Northern Thailand*. University of Washington Press, Seattle, WA
- Foucault, M. (1980a). *Power/Knowledge: Selected Interviews and Other Writings, 1972-1977*. Gordon, C. (ed.). Pantheon Books, New York
- Foucault, M. (1980b). Truth and Power. In *Power/Knowledge: Selected Interviews and Other Writings, 1972-1977*. Gordon, C. (ed.). Pantheon Books, New York. 109–33
- Galtung, J. (2000). *Conflict Transformation by Peaceful Means (The Transcend Method), Participants' and Trainers' Manual*. United Nations Disaster Management Training Programme, Geneva, Switzerland. <https://gsdrc.org/document-library/conflict-transformation-by-peaceful-means-the-transcend-method/>
- Galtung, J. (2004). *Transcend and Transform: An Introduction to Conflict Work*. Pluto Press, London
- Galtung, J. (2010). Peace Studies and Conflict Resolution: The Need for Transdisciplinarity. *Transcultural Psychiatry*, 47(1). 20–32. DOI: 10.1177/1363461510362041
- Garforth, C. (2015). Livestock Keepers' Reasons for Doing and Not Doing Things Which Governments, Vets and Scientists Would Like Them to Do. *Zoonoses and Public Health*, 62(s1). 29–38. DOI: 10.1111/zph.12189
- Garnett, T. (2014). Three perspectives on sustainable food security: efficiency, demand restraint, food system transformation. What role for life cycle assessment? *Journal of Cleaner Production*, 73. 10–18. DOI: 10.1016/j.jclepro.2013.07.045
- Garnett, T., Godde, C., Muller, A., Rööös, E., Smith, P., et al. (2017). *Grazed and Confused?* Food Climate Research Network, Oxford. [https://www.fcrn.org.uk/sites/default/files/project-files/fcrn\\_gnc\\_report.pdf](https://www.fcrn.org.uk/sites/default/files/project-files/fcrn_gnc_report.pdf)
- Gaventa, J. (2006). Finding the Spaces for Change: A Power Analysis. *IDS Bulletin*, 37(6). 23–33. DOI: 10.1111/j.1759-5436.2006.tb00320.x
- Giller, K. E., Tittonell, P., Rufino, M. C., van Wijk, M. T., Zingore, S., et al. (2011). Communicating complexity: Integrated assessment of trade-offs concerning soil fertility management within African farming systems to support innovation and development. *Agricultural Systems*, 104(2). 191–203. DOI: 10.1016/j.agsy.2010.07.002
- Glatzle, A. (2014). Questioning key conclusions of FAO publications 'Livestock's Long Shadow' (2006) appearing again in 'Tackling Climate Change Through Livestock' (2013). *Pastoralism*, 4(1). 1. DOI: 10.1186/2041-7136-4-1
- Gliessman, S. (2016). Transforming food systems with agroecology. *Agroecology and Sustainable Food Systems*, 40(3). 187–89. DOI: 10.1080/21683565.2015.1130765

- Godfray, H. C. J., Aveyard, P., Garnett, T., Hall, J. W., Key, T. J., et al. (2018). Meat consumption, health, and the environment. *Science*, 361(6399). DOI: 10.1126/science.aam5324
- Goldman, M. (2003). Partitioned Nature, Privileged Knowledge: Community-based Conservation in Tanzania. *Development and Change*, 34(5). 833–62. DOI: 10.1111/j.1467-7660.2003.00331.x
- Goldman, M. (2007). Tracking Wildebeest, Locating Knowledge: Maasai and Conservation Biology Understandings of Wildebeest Behavior in Northern Tanzania. *Environment and Planning D: Society and Space*, 25(2). 307–31. DOI: 10.1068/d0505
- Goldman, M. J., Nadasdy, P. and Turner, M. D., eds. (2011). *Knowing Nature: Conversations at the Intersection of Political Ecology and Science Studies*. The University of Chicago Press, Chicago and London.  
<https://www.press.uchicago.edu/ucp/books/book/chicago/K/bo10348588.html>
- Gonin, A., Filoche, G. and Delville, P. L. (2019). Dynamics of Access to Pastoral Resources in a Farming Area (Western Burkina Faso): Unveiling Rights in Open Access Regimes. *International Journal of the Commons*, 13(2). 1049–1061. DOI: 10.5334/ijc.950
- Gonin, A. and Gautier, D. (2015). Shift in herders' territorialities from regional to local scale: the political ecology of pastoral herding in western Burkina Faso. *Pastoralism*, 5. 7. DOI: 10.1186/s13570-015-0023-z
- Gonin, A. and Gautier, D. (2016). Herders' Territorialities and Social Differentiation in Western Burkina Faso. *Nomadic Peoples*, 20(1). 62–87. DOI: 10.3197/np.2016.200105
- Gorddard, R., Colloff, M. J., Wise, R. M., Ware, D. and Dunlop, M. (2016). Values, rules and knowledge: Adaptation as change in the decision context. *Environmental Science & Policy*, 57. 60–69. DOI: 10.1016/j.envsci.2015.12.004
- Grabbatin, B. and Rossi, J. (2012). Political Ecology: Nonequilibrium Science and Nature-Society Research. *Geography Compass*, 6(5). 275–89. DOI: 10.1111/j.1749-8198.2012.00491.x
- Green, K. E. (2016). A political ecology of scaling: Struggles over power, land and authority. *Geoforum*, 74. 88–97. DOI: 10.1016/j.geoforum.2016.05.007
- Guha, R. (1989). *The Unquiet Woods: Ecological Change and Peasant Resistance in the Himalaya*. Oxford University Press, Delhi
- Guthman, J. (1997). Representing Crisis: The Theory of Himalayan Environmental Degradation and the Project of Development in Post-Rana Nepal. *Development and Change*, 28(1). 45–69. DOI: 10.1111/1467-7660.00034
- Habermas, J. (1981). *The Theory of Communicative Action - Volume 1 (Translated by T. McCarthy, 1984)*. Beacon Press, Boston, MA
- Haggar, J., Lamboll, R. and Nelson, V. (2018). *Understanding Different Perspectives on Sustainable Agricultural Intensification and How It Can Be Achieved*. 1. National Resources Institute, Chatham
- Hajer, M. and Versteeg, W. (2005). A decade of discourse analysis of environmental politics: Achievements, challenges, perspectives. *Journal of Environmental Policy & Planning*, 7(3). 175–84. DOI: 10.1080/15239080500339646
- Haraway, D. (1988). Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective. *Feminist Studies*, 14(3). 575–99. DOI: 10.2307/3178066
- Haraway, D. (1991). *Simians, Cyborgs, and Women : The Reinvention of Nature*. Routledge, New York. DOI: 10.4324/9780203873106
- Hardin, G. (1968). The Tragedy of the Commons. *Science*, 162(3859). 1243–48. DOI: 10.1126/science.162.3859.1243

- Havlík, P., Valin, H., Herrero, M., Obersteiner, M., Schmid, E., et al. (2014). Climate change mitigation through livestock system transitions. *Proceedings of the National Academy of Sciences*, 111(10). 3709–14. DOI: 10.1073/pnas.1308044111
- Healy, S. (2003). Epistemological pluralism and the ‘politics of choice’. *Futures*, 35(7). 689–701. DOI: 10.1016/S0016-3287(03)00022-3
- Herrero, M., Grace, D., Njuki, J., Johnson, N., Enahoro, D., Silvestri, S. and Rufino, M. C. (2013). The roles of livestock in developing countries. *Animal*, 7(s1). 3–18. DOI: 10.1017/S1751731112001954
- Herrero, M., Thornton, P. K., Notenbaert, A. M., Wood, S., Msangi, S., et al. (2010). Smart Investments in Sustainable Food Production: Revisiting Mixed Crop-Livestock Systems. *Science*, 327(5967). 822–25. DOI: 10.1126/science.1183725
- Herring, R. J. (2001). Authority and scale in political ecology: some cautions on localism. In *Biological Diversity: Balancing Interests Through Adaptive Collaborative Management*. Buck, L. E., Geisler, C. C., Schelhas, J., and Wollenberg, E. (eds). CRC Press, Boca Raton, FL. 187–204
- Heuer, F. and Reisberg, D. (1990). Vivid memories of emotional events: The accuracy of remembered minutiae. *Memory & Cognition*, 18(5). 496–506. DOI: 10.3758/BF03198482
- Hickey, S. and Mohan, G. (2004a). *Participation--From Tyranny to Transformation?: Exploring New Approaches to Participation in Development*. Zed Books, London & New York
- Hickey, S. and Mohan, G. (2004b). Towards participation as transformation: critical themes and challenges. In *Participation--From Tyranny to Transformation?: Exploring New Approaches to Participation in Development*. Hickey, S. and Mohan, G. Zed Books, London & New York. 3–24
- Homann, S. and Rischkowsky, B. (2001). Integration of indigenous knowledge into land-use planning for the communal rangelands of Namibia. *Indigenous Knowledge and Development Monitor*, 9(3).
- Homewood, K. (2014). Review of Pastoralism in Africa. Past, Present, and Future. *Anthropos*, 109(2). 667–68.
- Homewood, K. and Rodgers, W. A. (1989). Pastoralism, conservation and the overgrazing controversy. In *Conservation in Africa: Peoples, Policies and Practice*. Anderson, D. and Grove, R. H. (eds). Cambridge University Press, Cambridge [England]; New York; Melbourne. 111–28
- Ingalls, M. L. and Stedman, R. C. (2016). The power problematic: exploring the uncertain terrains of political ecology and the resilience framework. *Ecology and Society*, 21(1). <https://www.jstor.org/stable/26270347>
- Ison, R. (2010). Traditions of Understanding: Language, Dialogue and Experience. In *Social Learning Systems and Communities of Practice*. Blackmore, C. (ed.). Springer London, London. 73–87. DOI: 10.1007/978-1-84996-133-2\_5
- Ison, R., Blackmore, C. and Iaquinto, B. L. (2013). Towards systemic and adaptive governance: Exploring the revealing and concealing aspects of contemporary social-learning metaphors. *Ecological Economics*, 87. 34–42. DOI: 10.1016/j.ecolecon.2012.12.016
- Ison, R., Röling, N. and Watson, D. (2007). Challenges to science and society in the sustainable management and use of water: investigating the role of social learning. *Environmental Science & Policy*, 10(6). 499–511. DOI: 10.1016/j.envsci.2007.02.008
- Ives, J. and Messerli, B. (1989). *The Himalayan Dilemma: Reconciling Development and Conservation*. Routledge, New York
- Jackson, J., Williams, R., McEvoy, M., MacDonald-Wicks, L. and Patterson, A. (2016). Is Higher Consumption of Animal Flesh Foods Associated with Better Iron Status

- among Adults in Developed Countries? A Systematic Review. *Nutrients*, 8(2). 89. DOI: 10.3390/nu8020089
- Jakeman, A. J., Letcher, R. A. and Norton, J. P. (2006). Ten iterative steps in development and evaluation of environmental models. *Environmental Modelling & Software*, 21(5). 602–14. DOI: 10.1016/j.envsoft.2006.01.004
- Jakku, E. and Thorburn, P. J. (2010). A conceptual framework for guiding the participatory development of agricultural decision support systems. *Agricultural Systems*, 103(9). 675–82. DOI: 10.1016/j.agsy.2010.08.007
- Jansma, S. R., Gosselt, J. F. and Jong, M. D. T. de (2018). Technological start-ups in the innovation system: an actor-oriented perspective. *Technology Analysis & Strategic Management*, 30(3). 282–94. DOI: 10.1080/09537325.2017.1308480
- Janssen, O., Van De Vliert, E. and Veenstra, C. (1999). How task and person conflict shape the role of positive interdependence in management teams. *Journal of Management*, 25(2). 117–41. DOI: 10.1016/S0149-2063(99)80006-3
- Janssen, R. (1992). *Multiobjective Decision Support for Environmental Management*. Kluwer Academic Publishers
- Jayne, T. S., Chamberlin, J., Traub, L., Sitko, N., Muyanga, M., et al. (2016). Africa's changing farm size distribution patterns: the rise of medium-scale farms. *Agricultural Economics*, 47(S1). 197–214. DOI: 10.1111/agec.12308
- Jean, S., Medema, W., Adamowski, J., Chew, C., Delaney, P. and Wals, A. (2018). Serious games as a catalyst for boundary crossing, collaboration and knowledge co-creation in a watershed governance context. *Journal of Environmental Management*, 223. 1010–22. DOI: 10.1016/j.jenvman.2018.05.021
- Jehn, K. A. (1994). ENHANCING EFFECTIVENESS: AN INVESTIGATION OF ADVANTAGES AND DISADVANTAGES OF VALUE-BASED INTRAGROUP CONFLICT. *International Journal of Conflict Management*, 5(3). 223–38. DOI: 10.1108/eb022744
- Jehn, K. A. (1995). A Multimethod Examination of the Benefits and Detriments of Intragroup Conflict. *Administrative Science Quarterly*, 40(2). 256–82. DOI: 10.2307/2393638
- Jehn, K. A. (1997). A Qualitative Analysis of Conflict Types and Dimensions in Organizational Groups. *Administrative Science Quarterly*, 42(3). 530–57. DOI: 10.2307/2393737
- Jeong, H. and Chi, M. T. H. (2007). Knowledge convergence and collaborative learning. *Instructional Science*, 35(4). 287–315. DOI: 10.1007/s11251-006-9008-z
- Jewitt, S. (1995). Europe's 'Others'? Forestry Policy and Practices in Colonial and Postcolonial India. *Environment and Planning D: Society and Space*, 13(1). 67–90. DOI: 10.1068/d130067
- Jiggins, J., van Slobbe, E. and Röling, N. (2007). The organisation of social learning in response to perceptions of crisis in the water sector of The Netherlands. *Environmental Science & Policy*, 10(6). 526–36. DOI: 10.1016/j.envsci.2006.12.006
- Johannes, R. E., Freeman, M. M. R. and Hamilton, R. J. (2000). Ignore fishers' knowledge and miss the boat. *Fish and Fisheries*, 1(3). 257–71. DOI: 10.1111/j.1467-2979.2000.00019.x
- Jones, P. G. and Thornton, P. K. (2009). Croppers to livestock keepers: livelihood transitions to 2050 in Africa due to climate change. *Environmental Science & Policy*, 12(4). 427–37. DOI: 10.1016/j.envsci.2008.08.006
- Jones, R. (2009). Categories, borders and boundaries. *Progress in Human Geography*, 33(2). 174–89. DOI: 10.1177/0309132508089828
- Jung, E. J. and Lee, S. (2015). The combined effects of relationship conflict and the relational self on creativity. *Organizational Behavior and Human Decision Processes*, 130. 44–57. DOI: 10.1016/j.obhdp.2015.06.006

- Kapoor, I. (2002). The Devil's in the Theory: A Critical Assessment of Robert Chambers' Work on Participatory Development. *Third World Quarterly*, 23(1). 101–17. DOI: 10.1080/01436590220108199
- Kariuki, R., Willcock, S. and Marchant, R. (2018). Rangeland Livelihood Strategies under Varying Climate Regimes: Model Insights from Southern Kenya. *Land*, 7(2). 47. DOI: 10.3390/land7020047
- Keen, M., Brown, V. A. and Dyball, R. (2005). *Social Learning in Environmental Management: Towards a Sustainable Future*. Earthscan, London
- Kenworthy, J. M. (1997). The Lie of the Land: Challenging received wisdom on the African environment. *African Affairs*, 96(385). 629–30. DOI: 10.1093/oxfordjournals.afraf.a007896
- Kerkhoff, L. van (2014). Knowledge Governance for Sustainable Development: A Review. *Challenges in Sustainability*, 1(2). 82–93. DOI: 10.12924/cis2013.01020082
- Kerkhoff, L. van and Lebel, L. (2006). Linking Knowledge and Action for Sustainable Development. *Annual Review of Environment and Resources*, 31(1). 445–77. DOI: 10.1146/annurev.energy.31.102405.170850
- Kerkvliet, B. J. T. (2009). Everyday politics in peasant societies (and ours). *The Journal of Peasant Studies*, 36(1). 227–43. DOI: 10.1080/03066150902820487
- Khan, M. T. (2013). Theoretical frameworks in political ecology and participatory nature/forest conservation: the necessity for a heterodox approach and the critical moment. *Journal of Political Ecology*, 20(1). 460–72.
- Kincheloe, J. L. (2005). *Critical Constructivism Primer*. Peter Lang, New York, USA
- Klerkx, L., van Bommel, S., Bos, B., Holster, H., Zwartkruis, J. V. and Aarts, N. (2012). Design process outputs as boundary objects in agricultural innovation projects: Functions and limitations. *Agricultural Systems*, 113. 39–49. DOI: 10.1016/j.agsy.2012.07.006
- Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Prentice Hall, Englewood Cliffs, NJ, USA
- Kristjanson, P., Harvey, B., Van Epp, M. and Thornton, P. K. (2014). Social learning and sustainable development. *Nature Climate Change*, 4. 5–7. DOI: doi:10.1038/nclimate2080
- Kull, C. A. (2004). *Isle of Fire: The Political Ecology of Landscape Burning in Madagascar*. University of Chicago Press, Chicago
- Lamont, M. and Molnár, V. (2002). The Study of Boundaries in the Social Sciences. *Annual Review of Sociology*, 28(1). 167–95. DOI: 10.1146/annurev.soc.28.110601.141107
- Lannerstad, M., Ran, Y., Notenbaert, A. M. O., Fraval, S., Morris, J., Pfeifer, C. and Paul, B. K. (submitted for review). CLEANED: A rapid ex-ante environmental livestock production assessment framework applied in three low income countries. *Ecological Indicators*.
- Lave, J. and Wenger, E. (1991). *Situated Learning*. Cambridge University Press, Cambridge, UK
- Lawhon, M. and Murphy, J. T. (2012). Socio-technical regimes and sustainability transitions: Insights from political ecology. *Progress in Human Geography*, 36(3). 354–78. DOI: 10.1177/0309132511427960
- Lawrence, J. and Haasnoot, M. (2017). What it took to catalyse uptake of dynamic adaptive pathways planning to address climate change uncertainty. *Environmental Science & Policy*, 68. 47–57. DOI: 10.1016/j.envsci.2016.12.003
- Leach, G. and Mearns, R. (1988). *Beyond the Woodfuel Crisis: People, Land and Trees in Africa*. Earthscan, London
- Leach, M. and Mearns, R. (1996). *The Lie of the Land: Challenging Received Wisdom on the African Environment*. James Curry, London. <https://www.ids.ac.uk/publication/the-lie-of-the-land-challenging-received-wisdom-on-the-african-environment>

- Leach, M., Raworth, K. and Rockström, J. (2013). Between social and planetary boundaries: Navigating pathways in the safe and just space for humanity. In *World Social Science Report 2013, Changing Global Environments*. OECD Publishing and UNESCO Publishing, Paris. 84–89. <http://www.worldsocialscience.org/documents/wss-report-2013-part-1.pdf#page=21>
- Lee, C. P. (2007). Boundary Negotiating Artifacts: Unbinding the Routine of Boundary Objects and Embracing Chaos in Collaborative Work. *Computer Supported Cooperative Work (CSCW)*, 16(3). 307–39. DOI: 10.1007/s10606-007-9044-5
- Leeds, C. A. (2001). Culture, conflict resolution, peacekeeper training and the D mediator. *International Peacekeeping*, 8(4). 92–110. DOI: 10.1080/13533310108413922
- Leys, A. J. and Vanclay, J. K. (2011). Social learning: A knowledge and capacity building approach for adaptive co-management of contested landscapes. *Land Use Policy*, 28(3). 574–84. DOI: 10.1016/j.landusepol.2010.11.006
- Lindley, D. (2015). Elements of Social Learning Supporting Transformative Change. *Southern African Journal of Environmental Education*, 31. 50–64. DOI: 10.4314/sajee.v31i1.137671
- Lipper, L., Thornton, P., Campbell, B. M., Baedeker, T., Braimoh, A., et al. (2014). Climate-smart agriculture for food security. *Nature Climate Change*, 4(12). 1068–72. DOI: 10.1038/nclimate2437
- Little, P. D. (2003). Rethinking interdisciplinary paradigms & the political ecology of pastoralism in East Africa. In *African Savannas: Global Narratives & Local Knowledge of Environmental Change*. Bassett, T. J. and Crummey, D. (eds). James Currey Publishers and Heinemann Books, Oxford UK and Portsmouth NH. 161–77. [https://s3.amazonaws.com/academia.edu.documents/42554003/RETHINKING\\_INTERDISCIPLINARY\\_PARADIGMS\\_A20160210-5585-sbflg4.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1530187870&Signature=ykOqJ7fyyrIIQIIMYWcdAOLN2sY%3D&response-content-disposition=inline%3B%20filename%3DRethinking\\_Interdisciplinary\\_Paradigms\\_a.pdf](https://s3.amazonaws.com/academia.edu.documents/42554003/RETHINKING_INTERDISCIPLINARY_PARADIGMS_A20160210-5585-sbflg4.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1530187870&Signature=ykOqJ7fyyrIIQIIMYWcdAOLN2sY%3D&response-content-disposition=inline%3B%20filename%3DRethinking_Interdisciplinary_Paradigms_a.pdf)
- Liu, J., Mooney, H., Hull, V., Davis, S. J., Gaskell, J., et al. (2015). Systems integration for global sustainability. *Science*, 347(6225). 1258832. DOI: 10.1126/science.1258832
- Long, N. (1992). Conclusion. In *Battlefields Of Knowledge*. Long, N. and Long, A. (eds). Routledge, London, UK
- Long, N. (2001). *Development Sociology: Actor Perspectives*. Routledge
- Long, N. and Long, A., eds. (1992). *Battlefields Of Knowledge*. Routledge, London, UK
- Loos, J., Abson, D. J., Chappell, M. J., Hanspach, J., Mikulcak, F., Tichit, M. and Fischer, J. (2014). Putting meaning back into “sustainable intensification”. *Frontiers in Ecology and the Environment*, 12(6). 356–61. DOI: 10.1890/130157
- Lowe, P., Phillipson, J., Proctor, A. and Gkartzios, M. (2019). Expertise in rural development: A conceptual and empirical analysis. *World Development*, 116. 28–37. DOI: 10.1016/j.worlddev.2018.12.005
- Maarleveld, M. and Dangbégnon, C. (1999). Managing natural resources: A social learning perspective. *Agriculture and Human Values*, 16(3). 267–80. DOI: 10.1023/A:1007559903438
- Mahanty, S., Stacey, N., Holland, P., Wright, A. and Menzies, S. (2007). Learning to learn: Designing monitoring plans in the Pacific Islands International Waters Project. *Ocean & Coastal Management*, 50(5–6). 392–410. DOI: 10.1016/j.ocecoaman.2006.09.004
- Manson, S. M. (2008). Does scale exist? An epistemological scale continuum for complex human–environment systems. *Geoforum*, 39(2). 776–88. DOI: 10.1016/j.geoforum.2006.09.010

- Martin, G. (2015). A conceptual framework to support adaptation of farming systems – Development and application with Forage Rummy. *Agricultural Systems*, 132. 52–61. DOI: 10.1016/j.agsy.2014.08.013
- Maxwell, J. A. and Mittapalli, K. (2010). Realism as a Stance for Mixed Methods Research. In *SAGE Handbook of Mixed Methods in Social & Behavioral Research*. Tashakkori, A. and Teddlie, C. SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States. 145–68. DOI: 10.4135/9781506335193.n6
- McCarthy, J. (2005). Scale, Sovereignty, and Strategy in Environmental Governance. *Antipode*, 37(4). 731–53. DOI: 10.1111/j.0066-4812.2005.00523.x
- McDermott, J. J., Staal, S. J., Freeman, H. A., Herrero, M. and Van de Steeg, J. A. (2010). Sustaining intensification of smallholder livestock systems in the tropics. *Livestock Science*, 130(1). 95–109. DOI: 10.1016/j.livsci.2010.02.014
- McDermott, M., Mahanty, S. and Schreckenber, K. (2013). Examining equity: A multidimensional framework for assessing equity in payments for ecosystem services. *Environmental Science & Policy*, 33(Supplement C). 416–27. DOI: 10.1016/j.envsci.2012.10.006
- McIntosh, B. S., Ascough, J. C., Twery, M., Chew, J., Elmahdi, A., et al. (2011). Environmental decision support systems (EDSS) development – Challenges and best practices. *Environmental Modelling & Software*, 26(12). 1389–1402. DOI: 10.1016/j.envsoft.2011.09.009
- Mehrabi, Z., Seufert, V. and Ramankutty, N. (2017). The Conventional Versus Alternative Agricultural Divide: A Response to Garibaldi et al. *Trends in Ecology & Evolution*, 32(10). 720–21. DOI: 10.1016/j.tree.2017.07.011
- Meyfroidt, P. (2018). Trade-offs between environment and livelihoods: Bridging the global land use and food security discussions. *Global Food Security*, 16. 9–16. DOI: 10.1016/j.gfs.2017.08.001
- Meyfroidt, P., Abeygunawardane, D., Ramankutty, N., Thomson, A. and Zeleke, G. (2019). Interactions between land systems and food systems. *Current Opinion in Environmental Sustainability*, 38. 60–67. DOI: 10.1016/j.cosust.2019.04.010
- Michael, S., Mbwambo, N., Mruttu, H., Dotto, M., Ndomba, C., et al. (2018). *Tanzania Livestock Master Plan*. ILRI, Nairobi, Kenya. <https://cgispace.cgiar.org/handle/10568/92405>
- Millar, J. and Curtis, A. (1999). Challenging the boundaries of local and scientific knowledge in Australia: Opportunities for social learning in managing temperate upland pastures. *Agriculture and Human Values*, 16(4). 389–99. DOI: 10.1023/A:1007695516492
- Miller, T., Baird, T., Littlefield, C., Kofinas, G., Iii, C., Stuart, F. and Redman, C. (2008). Epistemological Pluralism: Reorganizing Interdisciplinary Research. *Ecology and Society*, 13(2). DOI: 10.5751/ES-02671-130246
- Mirza, N. M. and Perret-Clermont, A.-N. (2016). “Are you really ready to change?” An actor-oriented perspective on a farmers training setting in Madagascar. *European Journal of Psychology of Education*, 31(1). 79–93. DOI: 10.1007/s10212-014-0238-1
- Mitchell, C. R. (1980). Evaluating Conflict. *Journal of Peace Research*, 17(1). 61–75. DOI: 10.1177/002234338001700105
- Mohan, G. and Stokke, K. (2000). Participatory Development and Empowerment: The Dangers of Localism. *Third World Quarterly*, 21(2). 247–68.
- Moll, H. A. J. (2005). Costs and benefits of livestock systems and the role of market and nonmarket relationships. *Agricultural Economics*, 32. 181–93.
- Mollinga, P. P. (2010a). Boundary Work and the Complexity of Natural Resources Management. *Crop Science*, 50(Supplement\_1). S-1-S-9. DOI: 10.2135/cropsci2009.10.0570

- Mollinga, P. P. (2010b). The Material Conditions of a Polarized Discourse: Clamours and Silences in Critical Analysis of Agricultural Water Use in India. *Journal of Agrarian Change*, 10(3). 414–36. DOI: 10.1111/j.1471-0366.2010.00277.x
- Morris, J., Ensor, J. E., Pfeifer, C., Marchant, R., Mulatu, D. W., Soka, G., Ouédraogo-Koné, S., Wakeyo, M. B. and Topi, C. (2020). Games as boundary objects: charting trade-offs in sustainable livestock transformation. *International Journal of Agricultural Sustainability*, 0(0). 1–24. DOI: 10.1080/14735903.2020.1738769
- Morris, J., Ensor, J. E., Topi, C. and Pfeifer, C. (2019). *Facilitating the ResLeSS Process: A Learning Process for Inclusive, Context Specific Planning in the Livestock Sector*. Stockholm Environment Institute, York.  
<https://cgspace.cgiar.org/handle/10568/106156>
- Morris, J., Pfeifer, C., Ouedraogo, S. and Ensor, J. (2017). *Research and Learning for Sustainable Intensification of Smallholder Livestock Value Chains (ResLeSS) Report of Workshop I, Bama, Burkina Faso 26 – 27 July 2017*. Stockholm Environment Institute, York
- Mosse, D. (2003). *The Rule of Water. Statecraft, Ecology, and Collective Action in South India*. Oxford University Press, New Delhi
- Mudombi, S., Fabricius, C., van Zyl-Bulitta, V. and Patt, A. (2017). The use of and obstacles to social learning in climate change adaptation initiatives in South Africa. *Jàmbá: Journal of Disaster Risk Studies*, 9(1). 1–8. DOI: 10.4102/jamba.v9i1.292
- Müller-Hansen, F., Heitzig, J., Donges, J. F., Cardoso, M. F., Dalla-Nora, E. L., Andrade, P., Kurths, J. and Thonicke, K. (2019). Can Intensification of Cattle Ranching Reduce Deforestation in the Amazon? Insights From an Agent-based Social-Ecological Model. *Ecological Economics*, 159. 198–211. DOI: 10.1016/j.ecolecon.2018.12.025
- Müller-Merbach, H. (2004). Creative conflict. *Knowledge Management Research & Practice*, 2(2). 129–30. DOI: 10.1057/palgrave.kmrp.8500029
- Munslow, B. (1988). *The Fuelwood Trap: A Study of the SADCC Region*. Earthscan Pub. Limited
- Muro, M. and Jeffrey, P. (2008). A critical review of the theory and application of social learning in participatory natural resource management processes. *Journal of Environmental Planning and Management*, 51(3). 325–44. DOI: 10.1080/09640560801977190
- Nelson, R. A., Holzworth, D. P., Hammer, G. L. and Hayman, P. T. (2002). Infusing the use of seasonal climate forecasting into crop management practice in North East Australia using discussion support software. *Agricultural Systems*, 74(3). 393–414. DOI: 10.1016/S0308-521X(02)00047-1
- Neumann, R. P. (1992). Political ecology of wildlife conservation in the Mt. Meru area of Northeast Tanzania. *Land Degradation & Development*, 3(2). 85–98. DOI: 10.1002/ldr.3400030203
- Neumann, R. P. (1997). Primitive Ideas: Protected Area Buffer Zones and the Politics of Land in Africa. *Development and Change*, 28(3). 559–82. DOI: 10.1111/1467-7660.00054
- Neumann, R. P. (2009). Political ecology: theorizing scale. *Progress in Human Geography*, 33(3). 398–406. DOI: 10.1177/0309132508096353
- Nielsen, J. Ø., de Bremond, A., Roy Chowdhury, R., Friis, C., Metternicht, G., Meyfroidt, P., Munroe, D., Pascual, U. and Thomson, A. (2019). Toward a normative land systems science. *Current Opinion in Environmental Sustainability*, 38. 1–6. DOI: 10.1016/j.cosust.2019.02.003
- Nightingale, A. J. (2003a). A feminist in the forest: Situated knowledges and mixing methods in natural resource management. *ACME*, 2(1). 77–90.



- Nightingale, A. J. (2003b). Nature–society and development: social, cultural and ecological change in Nepal. *Geoforum*, 34(4). 525–40. DOI: 10.1016/S0016-7185(03)00026-5
- Nightingale, A. J. (2015). Adaptive scholarship and situated knowledges? Hybrid methodologies and plural epistemologies in climate change adaptation research. *Area*, 48(1). 41–47. DOI: 10.1111/area.12195
- Nijdam, D., Rood, T. and Westhoek, H. (2012). The price of protein: Review of land use and carbon footprints from life cycle assessments of animal food products and their substitutes. *Food Policy*, 37(6). 760–70. DOI: 10.1016/j.foodpol.2012.08.002
- Nonaka, I. (1994). A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, 5(1). 14–37. DOI: 10.1287/orsc.5.1.14
- Notenbaert, A., Lannerstad, M., Barron, J., Paul, B. K., Ran, Y., Morris, J., Fraval, S., Mugatha, S. and Herrero, M. (2016). *Using the CLEANED Approach to Assess the Environmental Impacts of Livestock Production*. 17. International Livestock Research Institute, ILRI, Nairobi, Kenya
- Notenbaert, A., Lannerstad, M., Herrero, M., Fraval, S., Ran, Y., Paul, B. K., Mugatha, S., Barron, J. and Morris, J. (2014). A framework for environmental ex-ante impact assessment of livestock value chains. Presented at the 6th All Africa Conference of Animal Agriculture, Nairobi, Kenya. International Center for Tropical Agriculture (CIAT).
- NPC (2016). *Growth and Transformation Plan II (GTP II) (2015/16-2019/20)*. National Planning Commission of the Federal Democratic Republic of Ethiopia, Addis Ababa, Ethiopia. [https://europa.eu/capacity4dev/resilience\\_ethiopia/documents/growth-and-transformation-plan-ii-gtp-ii-201516-201920](https://europa.eu/capacity4dev/resilience_ethiopia/documents/growth-and-transformation-plan-ii-gtp-ii-201516-201920)
- Nygren, A. (1999). Local Knowledge in the Environment–Development Discourse: From dichotomies to situated knowledges. *Critique of Anthropology*, 19(3). 267–88. DOI: 10.1177/0308275X9901900304
- Oba, G. and Kotile, D. G. (2001). Assessments of landscape level degradation in southern Ethiopia: pastoralists versus ecologists. *Land Degradation & Development*, 12(5). 461–75. DOI: 10.1002/ldr.463
- Omoro, A. (2017). Maziwa Zaidi past, present and future: reflecting on an inclusive dairy development initiative in Tanzania. *CGIAR Research Program on Livestock*, 26 June 2017. <https://livestock.cgiar.org/2017/06/26/maziwa-zaidi-past-present-future/>
- Opstal, M. V. and Hugé, J. (2013). Knowledge for sustainable development: a worldviews perspective. *Environment, Development and Sustainability*, 15(3). 687–709. DOI: 10.1007/s10668-012-9401-5
- Oswick, C. and Robertson, M. (2009). Boundary Objects Reconsidered: from Bridges and Anchors to Barricades and Mazes. *Journal of Change Management*, 9(2). 179–93. DOI: 10.1080/14697010902879137
- Pahl-Wostl, C. and Hare, M. (2004). Processes of social learning in integrated resources management. *Journal of Community & Applied Social Psychology*, 14(3). 193–206. DOI: 10.1002/casp.774
- Paletz, S. B. F., Schunn, C. D. and Kim, K. H. (2011). Intragroup Conflict Under the Microscope: Micro-Conflicts in Naturalistic Team Discussions. *Negotiation and Conflict Management Research*, 4(4). 314–51. DOI: 10.1111/j.1750-4716.2011.00085.x
- Parson, E. A. and Clark, W. C. (1995). Sustainable development as social learning: Theoretical perspectives and practical challenges for the design of a research program. In *Barriers and Bridges to the Renewal of Ecosystems and Institutions*. Gunderson, L. H., Holling, C. S., and Light, S. S. (eds). Columbia University Press, New York. 428–59

- Peçanha Enqvist, J., West, S., Masterson, V. A., Haider, L. J., Svedin, U. and Tengö, M. (2018). Stewardship as a boundary object for sustainability research: Linking care, knowledge and agency. *Landscape and Urban Planning*, 179. 17–37. DOI: 10.1016/j.landurbplan.2018.07.005
- Peet, R. and Watts, M. (1996). *Liberation Ecologies: Environment, Development, Social Movements*. 1st ed. Routledge, London & New York
- Peet, R. and Watts, M. (2004). *Liberation Ecologies: Environment, Development, Social Movements*. 2nd ed. Routledge, London, UK
- Peluso, N. L. (1992). *Rich Forests, Poor People: Resource Control and Resistance in Java*. University of California Press, Berkeley, CA
- Pennington, D. (2016). A conceptual model for knowledge integration in interdisciplinary teams: orchestrating individual learning and group processes. *Journal of Environmental Studies and Sciences*, 6(2). 300–312. DOI: 10.1007/s13412-015-0354-5
- Perreault, T., Bridge, G. and McCarthy, J. (2015). *The Routledge Handbook of Political Ecology*. Routledge, Abingdon
- Peters, P. E. (1994). *Dividing the Commons: Politics, Policy, and Culture in Botswana*. University Press of Virginia, Charlottesville, VA
- Pfeifer, C. (2019). *CLEANED R - an Ex-Ante, Landscape Level Environmental Impact Assessment Tool Assessing Changes from Transforming Livestock Value Chains*. Stockholm Environment Institute and International Livestock Research Institute, Nairobi, Kenya. <https://github.com/ilri/CLEANED-R>
- Pfeifer, C., Morris, J. and Ensor, J. E. (2019). *The CLEANED R Tool: Generic Manual*. Stockholm Environment Institute, York
- Pfeifer, C., Morris, J., Ensor, J., Ouédraogo-Koné, S., Mulatu, D. W. and Wakeyo, M. (2020). Designing sustainable pathways for the livestock sector: the example of Atsbi, Ethiopia and Bama, Burkina Faso. *International Journal of Agricultural Sustainability*, 0(0). 1–16. DOI: 10.1080/14735903.2020.1824419
- Pfeifer, C., Morris, J., Mulatu, D. W., Wakeyo, M., Hruy, G. and Ensor, J. (2018). *CLEANED-R Documentation: Conceptual Overview of CLEANED and Parameterisation of a CLEANED-R Tool for Atsbi, Ethiopia*. Stockholm Environment Institute, York. <https://cgspace.cgiar.org/handle/10568/106324>
- Pfeifer, C., Morris, J., Ouedraogo, S. and Ensor, J. (2018). *CLEANED Documentation: Conceptual Overview of CLEANED and Parameterisation of a CLEANED Tool for Bama, Burkina Faso*. Stockholm Environment Institute, York. <https://cgspace.cgiar.org/handle/10568/93076>
- Pfeifer, C., Morris, J., Soka, G., Moses, E. A. and Ensor, J. (2018). *CLEANED-R Documentation: Conceptual Overview of CLEANED and Parameterisation of a CLEANED-R Tool for Lushoto, Tanzania*. Stockholm Environment Institute, York. <https://cgspace.cgiar.org/handle/10568/98349>
- Pfeifer, C., Morris, J., Soka, G., Moses, E. A., Mkiramweni, N. P., et al. (2018). *Exploring Alternatives for Livestock Production in Lushoto, Tanzania: Playing the Transformation Game. Report of ResLeSS Workshop 2*. Stockholm Environment Institute, York. <https://cgspace.cgiar.org/handle/10568/98356>
- Pfeifer, C., Mulatu, D. W., Wakeyo, M., Arbissie, B., Berhe, M., et al. (2018). *Exploring Alternatives for Livestock Production in Atsbi, Ethiopia: Playing the Transformation Game. Report of ResLeSS Workshop 2*. Stockholm Environment Institute, York. <https://cgspace.cgiar.org/handle/10568/106159>
- Phalan, B., Green, R. E., Dicks, L. V., Dotta, G., Feniuk, C., et al. (2016). How can higher-yield farming help to spare nature? *Science*, 351(6272). 450–51. DOI: 10.1126/science.aad0055

- Poppy, G. M., Chiotha, S., Eigenbrod, F., Harvey, C. A., Honzák, M., et al. (2014). Food security in a perfect storm: using the ecosystem services framework to increase understanding. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 369(1639). 20120288. DOI: 10.1098/rstb.2012.0288
- Pretty, J., Benton, T. G., Bharucha, Z. P., Dicks, L. V., Flora, C. B., et al. (2018). Global assessment of agricultural system redesign for sustainable intensification. *Nature Sustainability*, 1(8). 441. DOI: 10.1038/s41893-018-0114-0
- Pretty, J. N. (1995). Participatory learning for sustainable agriculture. *World Development*, 23(8). 1247–63. DOI: 10.1016/0305-750X(95)00046-F
- Pretty, J., Toulmin, C. and Williams, S. (2011). Sustainable intensification in African agriculture. *International Journal of Agricultural Sustainability*, 9(1). 5–24. DOI: 10.3763/ijas.2010.0583
- Putnam, L. L. and Wondolleck, J. M. (2003). Intractability: definitions, dimensions and distinctions. In *Making Sense of Intractable Environmental Conflicts: Concepts and Cases*. Lewicki, R., Gray, B., Gray, P. and S. E. P. F. F. B., and Elliott, M. (eds). Island Press, Washington, D.C., U.S.A. 35–62
- Ragin, C. C. and Becker, H. S., eds. (1992). *What Is a Case?: Exploring the Foundations of Social Inquiry*. Cambridge University Press, New York, NY
- Ramírez, R. and Fernández, M. (2005). Facilitation of Collaborative Management: Reflections From Practice. *Systemic Practice and Action Research*, 18(1). 5–20. DOI: 10.1007/s11213-005-2456-6
- Ran, Y., van Middelaar, C. E., Lannerstad, M., Herrero, M. and de Boer, I. J. M. (2017). Freshwater use in livestock production—To be used for food crops or livestock feed? *Agricultural Systems*, 155. 1–8. DOI: 10.1016/j.agsy.2017.03.008
- Rangan, H. and Kull, C. A. (2009). What makes ecology ‘political’?: rethinking ‘scale’ in political ecology. *Progress in Human Geography*, 33(1). 28–45. DOI: 10.1177/0309132508090215
- Raymond, C. M., Fazey, I., Reed, M. S., Stringer, L. C., Robinson, G. M. and Evely, A. C. (2010). Integrating local and scientific knowledge for environmental management. *Journal of Environmental Management*, 91(8). 1766–77. DOI: 10.1016/j.jenvman.2010.03.023
- Reed, M. G. (2007). Seeking red herrings in the wood: tending the shared spaces of environmental and feminist geographies. *The Canadian Geographer / Le Géographe Canadien*, 51(1). 1–21. DOI: 10.1111/j.1541-0064.2007.00162.x
- Reed, M. S. (2008). Stakeholder participation for environmental management: A literature review. *Biological Conservation*, 141(10). 2417–31. DOI: 10.1016/j.biocon.2008.07.014
- Reed, M. S., Dougill, A. J. and Baker, T. R. (2008). Participatory Indicator Development: What Can Ecologists and Local Communities Learn from Each Other. *Ecological Applications*, 18(5). 1253–69. DOI: 10.1890/07-0519.1
- Reed, M. S., Evely, A. C., Cundill, G., Fazey, I., Glass, J., et al. (2010). What is social learning. *Ecology and Society*, 15(4). r1.
- Reid, W. V., Berkes, F., Wilbanks, T. J. and Capistrano, D., eds. (2006). *Bridging Scales and Knowledge Systems: Linking Global Science and Local Knowledge in Assessments*. Millenium Ecosystem Assessment and Island Press, Washington, D.C.
- Richards, L. (1999). *Using NVIVO in Qualitative Research*. SAGE, London & Los Angeles
- Rigg, J., Phongsiri, M., Promphakping, B., Salamanca, A. and Sripun, M. (2020). Who will tend the farm? Interrogating the ageing Asian farmer. *The Journal of Peasant Studies*, 47(2). 306–25. DOI: 10.1080/03066150.2019.1572605

- Rigg, J., Salamanca, A. and Thompson, E. C. (2016). The puzzle of East and Southeast Asia's persistent smallholder. *Journal of Rural Studies*, 43. 118–33. DOI: 10.1016/j.jrurstud.2015.11.003
- Ripple, W. J., Smith, P., Haberl, H., Montzka, S. A., McAlpine, C. and Boucher, D. H. (2013). Ruminants, climate change and climate policy. *Nature Climate Change*, 4. 2–5. DOI: 10.1038/nclimate2081
- Rist, S., Chiddambaranathan, M., Escobar, C. and Wiesmann, U. (2006). "It was Hard to Come to Mutual Understanding ..."—The Multidimensionality of Social Learning Processes Concerned with Sustainable Natural Resource Use in India, Africa and Latin America. *Systemic Practice and Action Research*, 19(3). 219–37. DOI: 10.1007/s11213-006-9014-8
- Robbins, P. (2007). *Lawn People: How Grasses, Weeds, and Chemicals Make Us Who We Are*. Temple University Press, Philadelphia
- Robbins, P. (2012). *Political Ecology: A Critical Introduction*. 2nd ed. John Wiley & Sons, Chichester, West Sussex and Malden, Massachusetts
- Robbins, P. and Monroe Bishop, K. (2008). There and back again: Epiphany, disillusionment, and rediscovery in political ecology. *Geoforum*, 39(2). 747–55. DOI: 10.1016/j.geoforum.2006.12.013
- Rocheleau, D. E., Steinberg, P. E. and Benjamin, P. A. (1995). Environment, development, crisis, and crusade: Ukambani, Kenya, 1890–1990. *World Development*, 23(6). 1037–51. DOI: 10.1016/0305-750X(95)00016-6
- Rockström, J., Williams, J., Daily, G., Noble, A., Matthews, N., et al. (2017). Sustainable intensification of agriculture for human prosperity and global sustainability. *Ambio*, 46(1). 4–17. DOI: 10.1007/s13280-016-0793-6
- Röling, N. G. and Wagemakers, M. A. E. (1998). *Facilitating Sustainable Agriculture: Participatory Learning and Adaptive Management in Times of Environmental Uncertainty*. Cambridge University Press, Cambridge, UK
- Röös, E., Patel, M., Spångberg, J., Carlsson, G. and Rydhmer, L. (2016). Limiting livestock production to pasture and by-products in a search for sustainable diets. *Food Policy*, 58. 1–13. DOI: 10.1016/j.foodpol.2015.10.008
- Roux, D. J., Nel, J. L., Cundill, G., O'Farrell, P. and Fabricius, C. (2017). Transdisciplinary research for systemic change: who to learn with, what to learn about and how to learn. *Sustainability Science*, 12(5). 711–26. DOI: 10.1007/s11625-017-0446-0
- Rudel, T. K., Kwon, O.-J., Paul, B. K., Boval, M., Rao, I. M., et al. (2016). Do Smallholder, Mixed Crop-Livestock Livelihoods Encourage Sustainable Agricultural Practices? A Meta-Analysis. *Land*, 5(1). 6. DOI: 10.3390/land5010006
- Rufino, M. C., Tittonell, P., van Wijk, M. T., Castellanos-Navarrete, A., Delve, R. J., de Ridder, N. and Giller, K. E. (2007). Manure as a key resource within smallholder farming systems: Analysing farm-scale nutrient cycling efficiencies with the NUANCES framework. *Livestock Science*, 112(3). 273–87. DOI: 10.1016/j.livsci.2007.09.011
- Salmon, G., Teufel, N., Baltenweck, I., van Wijk, M., Claessens, L. and Marshall, K. (2018). Trade-offs in livestock development at farm level: Different actors with different objectives. *Global Food Security*, 17. 103–12. DOI: 10.1016/j.gfs.2018.04.002
- Salvini, G., van Paassen, A., Ligtenberg, A., Carrero, G. C. and Bregt, A. K. (2016). A role-playing game as a tool to facilitate social learning and collective action towards Climate Smart Agriculture: Lessons learned from Apuí, Brazil. *Environmental Science & Policy*, 63. 113–21. DOI: 10.1016/j.envsci.2016.05.016
- Sandford, S. (1995). Improving the efficiency of opportunism: new directions for pastoral development. In *Living with Uncertainty: New Directions in Pastoral Development in Africa*. Scoones, I. (ed.). Intermediate Technology Publications, London. 174–82

- Sapsed, J. and Salter, A. (2004). Postcards from the Edge: Local Communities, Global Programs and Boundary Objects. *Organization Studies*, 25(9). 1515–34. DOI: 10.1177/0170840604047998
- Sayer, J., Sunderland, T., Ghazoul, J., Pfund, J.-L., Sheil, D., et al. (2013). Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land uses. *Proceedings of the National Academy of Sciences*, 110(21). 8349–56. DOI: 10.1073/pnas.1210595110
- Sayer, R. A. (2000). *Realism and Social Science*. Thousand Oaks, California. SAGE, London
- Sayre, N. F. (2005). Ecological and geographical scale: parallels and potential for integration. *Progress in Human Geography*, 29(3). 276–90. DOI: 10.1191/0309132505ph546oa
- Schader, C., Muller, A., Scialabba, N. E.-H., Hecht, J., Isensee, A., et al. (2015). Impacts of feeding less food-competing feedstuffs to livestock on global food system sustainability. *Journal of The Royal Society Interface*, 12(113). 20150891. DOI: 10.1098/rsif.2015.0891
- Schaer, C., Thiam, M. D. and Nygaard, I. (2017). Flood management in urban Senegal: an actor-oriented perspective on national and transnational adaptation interventions. *Climate and Development*, 0(0). 1–16. DOI: 10.1080/17565529.2017.1291405
- Scholz, G., Dewulf, A. and Pahl-Wostl, C. (2014). An Analytical Framework of Social Learning Facilitated by Participatory Methods. *Systemic Practice and Action Research*, 27(6). 575–91. DOI: 10.1007/s11213-013-9310-z
- Schultz, M., Hahn, T., Ituarte-Lima, C. and Hällström, N. (2018). Deliberative multi-actor dialogues as opportunities for transformative social learning and conflict resolution in international environmental negotiations. *International Environmental Agreements: Politics, Law and Economics*, 18(5). 671–88. DOI: 10.1007/s10784-018-9410-4
- Schusler, T. M., Decker, D. J. and Pfeffer, M. J. (2003). Social Learning for Collaborative Natural Resource Management. *Society & Natural Resources*, 16(4). 309–26. DOI: 10.1080/08941920390178874
- Schwilch, G., Bachmann, F., Valente, S., Coelho, C., Moreira, J., et al. (2012). A structured multi-stakeholder learning process for Sustainable Land Management. *Journal of Environmental Management*, 107. 52–63. DOI: 10.1016/j.jenvman.2012.04.023
- Scoones, I., ed. (1995). *Living with Uncertainty: New Directions in Pastoral Development in Africa*. Intermediate Technology Publications, London
- Scoones, I. (1997). The Dynamics of Soil Fertility Change: Historical Perspectives on Environmental Transformation from Zimbabwe. *The Geographical Journal*, 163(2). 161–69. DOI: 10.2307/3060179
- Scoones, I. (1999). New Ecology and the Social Sciences: What Prospects for a Fruitful Engagement? *Annual Review of Anthropology*, 28(1). 479–507. DOI: 10.1146/annurev.anthro.28.1.479
- Scoones, I. (2018). Care or control? Four challenges for transformations to sustainability. *STEPS Centre*, 7 February 2018. <https://steps-centre.org/blog/care-or-control-four-challenges-for-transformations-to-sustainability/>
- Scoones, I. and Thompson, J., eds. (1994). *Beyond Farmer First: Rural People's Knowledge, Agricultural Research and Extension Practice*. Intermediate Technology Publications, London
- Scott, J. C. (1985). *Weapons of the Weak: Everyday Forms of Peasant Resistance*. Yale University Press, London
- Scott, J. C. (1990). *Domination and the Arts of Resistance: Hidden Transcripts*. Yale University Press, New Haven, CT. <http://www.jstor.org/stable/j.ctt1np6zz>

- Scown, M. W., Winkler, K. J. and Nicholas, K. A. (2019). Aligning research with policy and practice for sustainable agricultural land systems in Europe. *Proceedings of the National Academy of Sciences*, 116(11). 4911–16. DOI: 10.1073/pnas.1812100116
- Sen, A. K. (1981). *Poverty and Famines: An Essay on Entitlement and Deprivation*. Clarendon Press, Oxford, U.K.
- Shackleton, C. M., Cundill, G. and Knight, A. T. (2009). Beyond Just Research: Experiences from Southern Africa in Developing Social Learning Partnerships for Resource Conservation Initiatives. *Biotropica*, 41(5). 563–70.
- Shapiro, B. I., Gebru, G., Desta, S., Negassa, A., Nigussie, K., Aboset, G. and Mechal, H. (2015). *Ethiopia Livestock Master Plan*. International Livestock Research Institute, ILRI, Nairobi, Kenya.  
[https://cgspace.cgiar.org/bitstream/handle/10568/68037/Imp\\_roadmaps.pdf?sequence=1](https://cgspace.cgiar.org/bitstream/handle/10568/68037/Imp_roadmaps.pdf?sequence=1)
- Shove, E. (2010). Beyond the ABC: Climate Change Policy and Theories of Social Change. *Environment and Planning A: Economy and Space*, 42(6). 1273–85. DOI: 10.1068/a42282
- Sillitoe, P. (1998). What, know natives? Local knowledge in development. *Social Anthropology*, 6(2). 203–20. DOI: 10.1111/j.1469-8676.1998.tb00356.x
- Simons, H. (2009). *Case Study Research in Practice*. SAGE Publications, London
- SLIM (2004). *SLIM Framework: Social Learning as a Policy Approach for Sustainable Use of Water*. Social Learning for the Integrated Management and Sustainable Use of Water at Catchment Scale (SLIM), Milton Keynes, UK
- Soussana, J.-F. and Lemaire, G. (2014). Coupling carbon and nitrogen cycles for environmentally sustainable intensification of grasslands and crop-livestock systems. *Agriculture, Ecosystems & Environment*, 190. 9–17. DOI: 10.1016/j.agee.2013.10.012
- Star, S. L. (2010). This is Not a Boundary Object: Reflections on the Origin of a Concept. *Science, Technology, & Human Values*, 35(5). 601–17. DOI: 10.1177/0162243910377624
- Star, S. L. and Griesemer, J. R. (1989). Institutional Ecology, ‘Translations’ and Boundary Objects: Amateurs and Professionals in Berkeley’s Museum of Vertebrate Zoology, 1907–39. *Social Studies of Science*, 19(3). 387–420. DOI: 10.1177/030631289019003001
- Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. and de Haan, C. (2006). *Livestock’s Long Shadow: Environmental Issues and Options*. FAO, Rome.  
<http://www.fao.org/docrep/010/a0701e/a0701e00.HTM>
- Steyaert, P. and Jiggins, J. (2007). Governance of complex environmental situations through social learning: a synthesis of SLIM’s lessons for research, policy and practice. *Environmental Science & Policy*, 10(6). 575–86. DOI: 10.1016/j.envsci.2007.01.011
- Stirling, A. (1998). *On the Economics and Analysis of Diversity*. Science Policy Research Unit, University of Sussex, Brighton. <http://sro.sussex.ac.uk/id/eprint/28823/>
- Stirling, A., Ely, A. and Marshal, F. (2018). How do we ‘co-produce’ transformative knowledge? *STEPS Centre*, 7 February 2018. <https://steps-centre.org/blog/how-do-we-co-produce-transformative-knowledge/>
- Stocking, M. (1995). Soil erosion in developing countries: where geomorphology fears to tread! *CATENA*, 25(1). 253–67. DOI: 10.1016/0341-8162(95)00013-I
- Stott, P. A. and Sullivan, S. (2000). *Political Ecology: Science, Myth and Power*. Arnold, London
- Strauss, A. (1978). A social world perspective. *Studies in Symbolic Interaction*, 1. 119–28.
- Stringer, L. C., Dougill, A. J., Fraser, E., Hubacek, K., Prell, C. and Reed, M. S. (2006). Unpacking “Participation” in the Adaptive Management of Social–ecological

- Systems: a Critical Review. *Ecology and Society*, 11(2).  
<http://www.ecologyandsociety.org/vol11/iss2/art39/>
- Stringer, L. C., Fraser, E. D. G., Harris, D., Lyon, C., Pereira, L., Ward, C. F. M. and Simelton, E. (2020). Adaptation and development pathways for different types of farmers. *Environmental Science & Policy*, 104. 174–89. DOI: 10.1016/j.envsci.2019.10.007
- Styring, A. K., Höhn, A., Linseele, V. and Neumann, K. (2019). Direct evidence for agricultural intensification during the first two millennia AD in northeast Burkina Faso. *Journal of Archaeological Science*, 108. 104976. DOI: 10.1016/j.jas.2019.104976
- Swain, M., Blomqvist, L., McNamara, J. and Ripple, W. J. (2018). Reducing the environmental impact of global diets. *Science of The Total Environment*, 610–611. 1207–9. DOI: 10.1016/j.scitotenv.2017.08.125
- Swift, J. (1996). Desertification: narratives, winners and losers. In *The Lie of the Land: Challenging Received Wisdom on the African Environment*. Leach, M. and Mearns, R. (eds). James Curry, London. <https://www.ids.ac.uk/publication/the-lie-of-the-land-challenging-received-wisdom-on-the-african-environment>
- Swyngedouw, E. (1997). Neither global nor local: glocalization and the politics of scale. In *Spaces of Globalization: Reasserting the Power of the Local*. Cox, K. R. Guildford/Longman, New York and London. 137–66
- Swyngedouw, E. and Heynen, N. C. (2003). Urban Political Ecology, Justice and the Politics of Scale. *Antipode*, 35(5). 898–918. DOI: 10.1111/j.1467-8330.2003.00364.x
- Tavener, K. and Crane, T. A. (2018). Gender power in Kenyan dairy: cows, commodities, and commercialization. *Agriculture and Human Values*, 35(3). 701–15. DOI: 10.1007/s10460-018-9867-3
- Taylor, M. and Bhasme, S. (2018). The political ecology of rice intensification in south India: Putting SRI in its places. *Journal of Agrarian Change*, 0(0). 1–18. DOI: 10.1111/joac.12268
- Thébaud, B. and Batterbury, S. (2001). Sahel pastoralists: opportunism, struggle, conflict and negotiation. A case study from eastern Niger. *Global Environmental Change*, 11(1). 69–78. DOI: 10.1016/S0959-3780(00)00046-7
- Thomas, D. and Middleton, N. (1994). *Desertification : Exploding the Myth*. Wiley, Chichester
- Thomas, G. (2011). A Typology for the Case Study in Social Science Following a Review of Definition, Discourse, and Structure. *Qualitative Inquiry*, 17(6). 511–21. DOI: 10.1177/1077800411409884
- Thomson, A. M., Ellis, E. C., Grau, Hé. R., Kuemmerle, T., Meyfroidt, P., Ramankutty, N. and Zeleke, G. (2019). Sustainable intensification in land systems: trade-offs, scales, and contexts. *Current Opinion in Environmental Sustainability*, 38. 37–43. DOI: 10.1016/j.cosust.2019.04.011
- Tiffen, M., Mortimore, M. and Gichuki, F. (1994). *More People, Less Erosion: Environmental Recovery in Kenya*. John Wiley & Sons, Chichester
- Tittonell, P. (2013). Towards ecologically intensive smallholder farming systems: design, scales and trade-offs evaluation. In *Agro-Ecological Intensification of Agricultural Systems in the African Highlands*. Vanlauwe, B., Asten, P. van, and Blomme, G. (eds). Routledge, London. 132–44
- TLMI (2015). *Tanzania Livestock Modernisation Initiative*. United Republic of Tanzania and Ministry of Livestock and Fisheries Development, Dar es Salaam.  
[https://livestocklivelihoodsandhealth.org/wp-content/uploads/2015/07/Tanzania\\_Livestock\\_Modernization\\_Initiative\\_July\\_2015.pdf](https://livestocklivelihoodsandhealth.org/wp-content/uploads/2015/07/Tanzania_Livestock_Modernization_Initiative_July_2015.pdf)

- Trompette, P. and Vinck, D. (2009). Revisiting the notion of Boundary Object. *Revue d'anthropologie des connaissances*, Vol. 3, n° 1(1). 3–25. DOI: <https://doi.org/10.3917/rac.006.0003>
- Tschakert, P., Barnett, J., Ellis, N., Lawrence, C., Tuana, N., New, M., Elrick-Barr, C., Pandit, R. and Pannell, D. (2017). Climate change and loss, as if people mattered: values, places, and experiences. *Wiley Interdisciplinary Reviews: Climate Change*, 8(5). n/a-n/a. DOI: 10.1002/wcc.476
- Tschakert, P., Das, P. J., Shrestha Pradhan, N., Machado, M., Lamadrid, A., Buragohain, M. and Hazarika, M. A. (2016). Micropolitics in collective learning spaces for adaptive decision making. *Global Environmental Change*, 40(Supplement C). 182–94. DOI: 10.1016/j.gloenvcha.2016.07.004
- Tschakert, P. and Dietrich, K. (2010). Anticipatory Learning for Climate Change Adaptation and Resilience. *Ecology and Society*, 15(2). 11. DOI: 10.5751/ES-03335-150211
- Turner, J. R. (2016a). Team Cognition Conflict: A Conceptual Review Identifying Cognition Conflict as a New Team Conflict Construct. *Performance Improvement Quarterly*, 29(2). 145–67. DOI: 10.1002/piq.21219
- Turner, M. D. (1999). No space for participation: pastoralist narratives and the etiology of park-herder conflict in southeastern Niger. *Land Degradation & Development*, 10(4). 345–63. DOI: 10.1002/(SICI)1099-145X(199907/08)10:4<345::AID-LDR358>3.0.CO;2-8
- Turner, M. D. (2004). Political ecology and the moral dimensions of “resource conflicts”: the case of farmer–herder conflicts in the Sahel. *Political Geography*, 23(7). 863–89. DOI: 10.1016/j.polgeo.2004.05.009
- Turner, M. D. (2014). Political ecology I: An alliance with resilience? *Progress in Human Geography*, 38(4). 616–23. DOI: 10.1177/0309132513502770
- Turner, M. D. (2016b). Political ecology II: Engagements with ecology. *Progress in Human Geography*, 40(3). 413–21. DOI: 10.1177/0309132515577025
- Turner, M. G., Dale, V. H. and Gardner, R. H. (1989). Predicting across scales: Theory development and testing. *Landscape Ecology*, 3(3). 245–52. DOI: 10.1007/BF00131542
- Turner, S. (2012). Making a Living the Hmong Way: An Actor-Oriented Livelihoods Approach to Everyday Politics and Resistance in Upland Vietnam. *Annals of the Association of American Geographers*, 102(2). 403–22. DOI: 10.1080/00045608.2011.596392
- Udo, H. M. J., Aklilu, H. A., Phong, L. T., Bosma, R. H., Budisatria, I. G. S., Patil, B. R., Samdup, T. and Bebe, B. O. (2011). Impact of intensification of different types of livestock production in smallholder crop-livestock systems. *Livestock Science*, 139(1). 22–29. DOI: 10.1016/j.livsci.2011.03.020
- UNDP (n.d.). Goal 2: Zero hunger. Sustainable Development Goals. <http://www.undp.org/content/undp/en/home/sustainable-development-goals/goal-2-zero-hunger.html> [Accessed 27 February, 2018.]
- Uran, O. and Janssen, R. (2003). Why are spatial decision support systems not used? Some experiences from the Netherlands. *Computers, Environment and Urban Systems*, 27(5). 511–26. DOI: 10.1016/S0198-9715(02)00064-9
- van Bommel, S., Röling, N. G., Aarts, N. and Turnhout, E. (2009). Social learning for solving complex problems: a promising solution or wishful thinking? A case study of multi-actor negotiation for the integrated management and sustainable use of the Drentsche Aa area in the Netherlands. *Environmental Policy and Governance*, 19(6). 400–412. DOI: 10.1002/eet.526
- van Bruggen, A., Nikolic, I. and Kwakkel, J. (2019). Modeling with Stakeholders for Transformative Change. *Sustainability*, 11(3). 825. DOI: 10.3390/su11030825



- van de Kerkhof, M. (2006). Making a difference: On the constraints of consensus building and the relevance of deliberation in stakeholder dialogues. *Policy Sciences*, 39(3). 279–99. DOI: 10.1007/s11077-006-9024-5
- van de Vliert, E. and Euwema, M. C. (1994). Agreeableness and activeness as components of conflict behaviors. *Journal of Personality and Social Psychology*, 66(4). 674–87. DOI: 10.1037//0022-3514.66.4.674
- Van den Bossche, P., Gijsselaers, W., Segers, M., Woltjer, G. and Kirschner, P. (2011). Team learning: building shared mental models. *Instructional Science*, 39(3). 283–301. DOI: 10.1007/s11251-010-9128-3
- van den Hove, S. (2006). Between consensus and compromise: acknowledging the negotiation dimension in participatory approaches. *Land Use Policy*, 23(1). 10–17. DOI: 10.1016/j.landusepol.2004.09.001
- Van der Wal, M. M., de Kraker, J., Kroeze, C., Kirschner, P. A. and Valkering, P. (2016). Can computer models be used for social learning? A serious game in water management. *Environmental Modelling & Software*, 75. 119–32. DOI: 10.1016/j.envsoft.2015.10.008
- Van Epp, M. and Garside, B. (2014). *Monitoring and Evaluating Social Learning: A Framework for Cross-Initiative Application*. 98. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark. [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)
- van Hulst, M. and Yanow, D. (2016). From Policy “Frames” to “Framing”: Theorizing a More Dynamic, Political Approach. *The American Review of Public Administration*, 46(1). 92–112. DOI: 10.1177/0275074014533142
- Van Leeuwen, M. and Van Der Haar, G. (2016). Theorizing the Land–Violent Conflict Nexus. *World Development*, 78. 94–104. DOI: 10.1016/j.worlddev.2015.10.011
- van Mierlo, B., Leeuwis, C., Smits, R. and Woolthuis, R. K. (2010). Learning towards system innovation: Evaluating a systemic instrument. *Technological Forecasting and Social Change*, 77(2). 318–34. DOI: 10.1016/j.techfore.2009.08.004
- Vanclay, F. (2004). Social Principles for Agricultural Extension to Assist in the Promotion of Natural Resource Management. *Australian Journal of Experimental Agriculture*, 44. 213–22. DOI: 10.1071/EA02139
- Vayda, A. P. and Walters, B. B. (1999). Against political ecology. *Human Ecology*, 27(1). 167–79.
- Vennet, B. V., Schneider, S. and Dessen, J. (2016). Different farming styles behind the homogenous soy production in southern Brazil. *The Journal of Peasant Studies*, 43(2). 396–418. DOI: 10.1080/03066150.2014.993319
- Vlek, P. L. G., Khamzina, A., Azadi, H., Bhaduri, A., Bharati, L., Braimoh, A., Martius, C., Sunderland, T. and Taheri, F. (2017). Trade-Offs in Multi-Purpose Land Use under Land Degradation. *Sustainability*, 9(12). 2196. DOI: 10.3390/su9122196
- Vogel, C., Moser, S. C., Kaspersen, R. E. and Dabelko, G. D. (2007). Linking vulnerability, adaptation, and resilience science to practice: Pathways, players, and partnerships. *Global Environmental Change*, 17(3). 349–64. DOI: 10.1016/j.gloenvcha.2007.05.002
- Voß, J.-P., Newig, J., Kastens, B., Monstadt, J. and Nölting, B. (2007). Steering for Sustainable Development: a Typology of Problems and Strategies with respect to Ambivalence, Uncertainty and Distributed Power. *Journal of Environmental Policy & Planning*, 9(3–4). 193–212. DOI: 10.1080/15239080701622881
- Walker, P. A. (2005). Political ecology: where is the ecology? *Progress in Human Geography*, 29(1). 73–82. DOI: 10.1191/0309132505ph530pr
- Walker, P. A. (2007). Political ecology: where is the politics? *Progress in Human Geography*, 31(3). 363–69. DOI: 10.1177/0309132507077086

- Walkerden, G. (2005). Adaptive Management Planning Projects as Conflict Resolution Processes. *Ecology and Society*, 11(1). DOI: 10.5751/ES-01510-110148
- Wallis, P. J., Bosomworth, K., Harwood, A. and Leith, P. (2017). Charting the emergence of a 'knowing system' for climate change adaptation in Australian regional natural resource management. *Geoforum*, 84. 42–50. DOI: 10.1016/j.geoforum.2017.06.002
- Wals, A. E. J. (2007a). Think Piece. Learning in a Changing World and Changing in a Learning World: Reflexively fumbling towards sustainability. *Southern African Journal of Environmental Education*, 24. 35–45. DOI: 10.4314/sajee.v24i0.122738
- Wals, A. E. J., ed. (2007b). *Social Learning towards a Sustainable World*. Wageningen Academic Publishers, Wageningen. DOI: 10.3920/978-90-8686-594-9
- Wals, A. E. J. and Rodela, R. (2014). Social learning towards sustainability: Problematic, perspectives and promise. *NJAS - Wageningen Journal of Life Sciences*, 69. 1–3. DOI: 10.1016/j.njas.2014.04.001
- Wals, A. E. J., van der Hoeven, N. and Blanken, H. (2009). *The Acoustics of Social Learning: Designing Learning Processes That Contribute to a Sustainable World*. Wageningen Academic Publishers, Wageningen. <http://edepot.wur.nl/108487>
- Watts, M. and Peet, R. (2004). Liberating political ecology. In *Liberating Ecologies: Environment, Development, Social Movements*. Peet, R. and Watts, M. (eds). Routledge, London, UK
- Wenger, E. (1999). *Communities of Practice: Learning, Meaning, And Identity*. Cambridge University Press, Cambridge, UK
- Wynants, M., Kelly, C., Mtei, K., Munishi, L., Patrick, A., et al. (2019). Drivers of increased soil erosion in East Africa's agro-pastoral systems: changing interactions between the social, economic and natural domains. *Regional Environmental Change*. DOI: 10.1007/s10113-019-01520-9
- Yasmi, Y., Schanz, H. and Salim, A. (2006). Manifestation of conflict escalation in natural resource management. *Environmental Science & Policy*, 9(6). 538–46. DOI: 10.1016/j.envsci.2006.04.003
- Yurco, K. (2018). Beyond the boma: A gendered approach to conceptualizing resource access in pastoral households. *Geoforum*, 97. 343–51. DOI: 10.1016/j.geoforum.2018.08.001
- Zeitlyn, D. (2010). Representation/Self-representation: A Tale of Two Portraits; or, Portraits and Social Science Representations. *Visual Anthropology*, 23(5). 398–426. DOI: 10.1080/08949460903472978
- Zimmerer, K. S. (1994). Human Geography and the 'New Ecology': The Prospect and Promise of Integration. *Annals of the Association of American Geographers*, 84(1). 108–25.
- Zimmerer, K. S. (1996). Discourses on soil loss in Bolivia: sustainability and the search for socioenvironmental 'middle ground. In *Liberating Ecologies: Environment, Development, Social Movements*. Peet, R. and Watts, M. (eds). Routledge, London & New York. 110–24
- Zulkafli, Z., Perez, K., Vitolo, C., Buytaert, W., Karpouzoglou, T., et al. (2017). User-driven design of decision support systems for polycentric environmental resources management. *Environmental Modelling & Software*, 88. 58–73. DOI: 10.1016/j.envsoft.2016.10.012

