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A social-ecological approach to local forest conflict analysis and shaping

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ABSTRACT

Against the backdrop of the climate crisis, forest conflicts are intensifying in Germany. For this reason, it is time to reopen the scientific debate on how we research and manage forest conflicts. In this commentary, we argue that a social-ecological approach takes into account the interactions and interdependencies between social and physical structures and processes of forest conflicts. Consequently, the approach helps to analyse and shape these conflicts.

A social-ecological approach facilitates the consideration of the physical, social, cultural, political and economic aspects of the forest conflicts as well as the dynamics and contexts of different conflicts. It contributes to analysing the site-specific conditions, parameters and dynamics of local forest conflicts. Four shaping dimensions (*knowledge*, *practices*, *technologies*, *institutions*) can help to relate the conflicts more precisely to the social-ecological system. Against this background, in particular the social context of the conflicts can be analysed in detail.

In turn, a social-ecological approach to conflict management opens up the possibility of initiating change in social and physical interactions and interdependencies. The concept of *conflict transformation* can complement the social-ecological approach in an action-oriented way, both by contributing to social learning among the conflict actors and by generating ways of dealing with the particular forest that are adapted to new challenges.

1. Introduction

Adaptation plans to climate change have been in place in the German forestry sector for some time (Schramm, 2013; Winkel et al., 2011). However, the accelerating climate change requires further action if forests are to be preserved and managed sustainably (Augustin et al., 2023; Knutzen et al., 2025; Rosenkranz et al., 2023). In Germany, the debate about forests is therefore becoming increasingly heated (Mack et al., 2023; Popkin, 2021). This is evident not only in the technical discourse between forestry experts (Brunette et al., 2020; Hengst-Ehrhart, 2019; Nikinmaa et al., 2024; Weinbrenner et al., 2021), but also in the opinions expressed by politicians and journalists (Fischer et al., 2024; Garms et al., 2023; Hazarika et al., 2021; Mack et al., 2023).

The issue of forest restoration, for example, is not only controversial in the professional debate, but can also lead to disputes with civil society about local forests and their future. One contentious issue is the extent to which forestry practices such as the removal of dying trees are considered adequate. Another issue concerns how to deal with existing treeless forest damage areas. Those discussions revolve around whether these areas should be reforested and, if so, how and with which tree species and provenances. Additionally, the role of hunting for the success of forest restoration and the extent to which wildlife populations should be regulated by hunting is being debated. The contributions to the discussions by many different actors highlight the heterogeneous interests and demands of individual groups when it comes to forests. In many cases, the debate is intensifying and is being accompanied by the increasing polarisation of opinions (Mack et al., 2023), partly exacerbated by digital media (Halla and Laine, 2022).

Preliminary analyses from Germany show that many concerned citizens lack confidence in foresters and the administration and/or politics behind them (Bethmann et al., 2018; Hebermehl and Kohler, 2022; Juerges et al., 2017). In many places, constructive communication and

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mutual understanding between conflicting parties are no longer possible; instead, the conflict appears to be hardening (Hebermehl and Kohler, 2022). Despite these diverse challenges, there are ways of recognising emerging conflicts in individual forests and counteracting them at an early stage. Dialogue events, participation processes or joint on-site meetings can provide a foundation for successful communication (e.g., Bethmann et al., 2018; Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg, 2020; Hebermehl et al., 2024).

In a conflict, the interaction between actors (individuals, groups or institutions) is characterised by the existence of differences in the perceptions, emotions or interests and at least one party feels impaired or restricted by the behaviour of another actor (García-Frapolli et al., 2018; Glasl, 1999). Nevertheless, what also complicates the understanding of forest conflicts is that they arise not only from interests and claims, but always in specific relation to the particular forest, its management and its socio-economic and physical condition. Exclusion of the biological and ecological state of the forest and its dynamic development in the conflict analysis entails the risk that the materiality of the conflicts will not be recognised and then cannot be specifically addressed in the conflict reduction measures. Consequently, at least the material (physical and anthropogenic) causes of the conflict will remain and may initiate further conflicts. Moreover, symbolic aspects such as different values, meanings, aesthetic ideas and culturally specific traditions and practices must be taken into account. In hunting, for example, trophies can greatly influence hunting practices. They can lead to large animal populations, which in turn are often associated with heavy tree browsing and thus damage to timber yields (Schramm et al., 2020a).

In the face of pressing challenges, our aim is to reopen the scientific discussion concerning how to research and deal with forest conflicts (Buijs and Lawrence, 2013; Eckerberg and Sandström, 2013; Niemelä et al., 2005; Sandström et al., 2013). We argue that a social-ecological approach (section 2) is helpful in order to understand the conflicts in such a way that the social and physical structures and processes can be understood (section 3) and incorporated into an adequate shaping of the conflict (section 4). In this commentary, we explicitly point out that in order to take into account the complexity of forest conflicts, it is helpful 1) to consider the site-specific conditions, parameters and dynamics of the conflict, 2) to focus more strongly on the social-ecological sphere, and 3) against this background, to analyse the social context of the conflict in detail. We argue that the concept of conflict transformation can complement the social-ecological approach in an action-oriented way, both by contributing to social learning of the conflict actors and by creating a way of dealing with the forest that is adapted to new challenges. To illustrate our argument, we will return to the aforementioned topic of forest restoration throughout the text. Based on our own research and many years of experience, we have chosen the German context as an example.

2. Adopting a social-ecological approach to conflict analysis

Forests are managed ecosystems. Even woods that are not (or no longer) in use are always anthropogenically shaped and thus can be understood and analysed as social-ecological systems (Schramm et al., 2020b). This allows their physical, social, cultural, political and economic aspects to be taken into account. A social-ecological approach takes into account the complex interactions and interdependencies between social and physical structures and processes (Liehr et al., 2017; Mehring et al., 2017) in the emergence of the forest conflict and its dynamics.

One way of making those interactions accessible for empirical research dealing with forest conflicts is to investigate them as social-ecological systems (SES). SES are complex and adaptive and very often delimited by spatial or functional boundaries surrounding particular ecosystems and problem contexts. SES can consist of a biogeophysical unit, such as a forest, and the actors and institutions that use or manage it (Glaser et al., 2012). However, there are also other ways of defining SES (Biggs et al., 2021), so that even a communal forest separated from neighbouring forests by arbitrary boundaries, such as narrow forest roads, and its associated actors and institutions can be understood as an SES.

Additionally, some SES concepts allow a focus on the social-ecological dynamics that are characterised by strong interactions and interdependencies between social and physical structures and processes (Liehr et al., 2017; Mehring et al., 2017). For example, forests and their ecosystem functions are deliberately influenced by management activities and utilisation such as reforestation measures or the designation of protected areas, but also by (un)intended side effects. At the same time, forests and forest-related human practices are now being increasingly affected by drought events due to climate change or browsing damage caused by hoofed game. A core part of the SES concept are four dimensions that interact with each other, can be intertwined, and shape the social-ecological structures and processes: *knowledge* includes scientific and practical knowledge; *practices* represent patterns of behaviour in the use of resources and ecosystem functions in their material and symbolic relevance; *technologies* are human-made, tool-like structures that make this use possible; and *institutions* comprise formal and informal rules of action in economy, politics, culture and legislation (Liehr et al., 2017; Mehring et al., 2017). These four dimensions are hybrid, because they each contain social and physical elements and structures (Liehr et al., 2017).

If we take Germany as an example, we can see that numerous actors have interests in and relations to a social-ecological forest system. The particular institutional framework conditions can lead not only to a variety of demands and utilisation of the SES, but also to different conflicts. Forests in Germany have different owners: in addition to state forests, there are communal forests and private forests. Rights of use (e.g. to collect timber or for hunting) are clearly regulated. In systems taken out of forestry operations, utilisation is often restricted and the nature conservation authority determines access. For more than 50 years, the management of social-ecological forest systems has been subject to nature conservation regulations and to negotiation processes with nature conservation authorities. Usually, foresters responsible for the district develop forestry strategy and management plans based on the owner's specifications, which are then implemented by forestry workers (Eisele et al., 2021; Juerges et al., 2021; Schusser et al., 2016). Other actors who can influence not just the use of social-ecological forest systems, but also the development of conflicts about them, are their immediate residents, buyers of timber and other products, hunters, members of nature conservation associations, and actors who visit the forest for recreation and tourism (Berman and Johnson-Cramer, 2019; Eisele et al., 2021; Sheppard and Meitner, 2005). According to the findings of Reif et al. (2010), the focus of nature conservation associations is differing increasingly from that of state conservation authorities.

Actors not only act as individuals in the sense of methodological individualism (Weber, 1968), but are generally part of institutions or groups and subject to their constraints. This must be taken into account in attempts to avoid or reduce conflicts (cf. Fernández-Manjarrés et al., 2021). Consequently, the SES that form the material basis of forests are subject to different values, demands and interests from different groups of actors. This often also relates to the fact that the respective actors use or would like to use different ecological services. It should be noted that in addition to the ecosystem services that forests provide (e.g. climate regulation, aesthetics, water supplies, timber and firewood), they also provide disservices that can negatively impact society (e.g. plant diseases transferred by forest insects for example).

Especially in the context of conflicts, forests can be conceptualised as SES. Depending on their biogeographical characteristics, location and specific interaction of dimensions, forest conflicts often involve interactions between different actors and their valuations of different ecosystem functions and related practices. Any change to, and therefore improvement in, forest management depends on how a (sometimes large) number of various actors interact and (in part) even collaborate.

Conflicts inevitably arise due to the actors' different interests, heterogeneous understanding of the systemic dynamics and, in the event of a negotiation, divergent expectations of the negotiation process and its results. One key to conflict resolution is a better understanding of the relevant ecosystem functions, and which actor (group) makes use of which ecosystem services and might thus experience disadvantages and impairments, for example in relation to economic demands or social values (Fernández-Manjarrés et al., 2021; Schramm et al., 2020a; Schramm et al., 2020b). Using the shaping dimensions described above – knowledge, practices, technologies and institutions – the social-ecological approach allows greater understanding of the complexity of both social and physical structures and processes. This provides a basis for identifying entry points for dealing with conflicts, which, in addition to the communicative dimension, also take the material side into account.

As "'real-world' problems" (Pohl et al., 2021, p. 19) such as forest conflicts frequently transcend disciplinary boundaries (Becker and Jahn, 2006), the application of disciplinary and sectoral perspectives alone is not necessarily sufficient to capture the underlying problems and to provide an adequate analytical interpretation (Bergmann et al., 2012). Therefore, a social-ecological conflict analysis cannot be carried out by a single scientific discipline. Rather, interdisciplinary cooperation between natural and social sciences is required in order to explore individual components of the SES and put them in relation to one another.

The presented SES concept facilitates a comprehensive and social-ecological approach to forest conflicts. It takes into account not only the ecosystem services and the actors, but also their institutions and knowledge as well as techniques and practices applied in the forest, whereby the respective uses, interests and perceptions of all involved parties can also be captured (cf. Fickel and Hummel, 2019; Frick-Trzebitzky et al., 2021; Liehr et al., 2017).

3. Understanding the complexity of forest conflicts

We have already emphasised the important contribution of considering forests as SES. In this section, we outline what the social-ecological approach implies for an analysis of forest conflicts. To this end, we emphasise three aspects that from our point of view are of central importance for forest conflict analysis: 1) considering the site-specific conditions, parameters and dynamics of the conflict, 2) focussing more strongly on the social-ecological sphere, and 3) against this background, analysing the social context in detail. The importance of these key aspects is outlined below.

(1) It is clear to forest practitioners as well as other actors that forest sites vary considerably. Consequently, management strategies cannot and should not be applied universally everywhere. If the differences between the social-ecological constellations in different regions and localities are to be recognised, there is a need for local, possibly even tailored, approaches to forest management strategies (Aggestam et al., 2020). The same could apply to addressing conflicts related to forests (Niemelä et al., 2005): The local specifics of the SES must be taken into account if, firstly, a local forest conflict is to be understood and, secondly, the outcomes of dealing with the conflict are to be socially and ecologically viable. Therefore, we argue that research on forest conflicts needs to focus more on specific forest sites, enabling the forest to be regarded as an SES. This is an important precondition for acknowledging the diversity inherent within forests, including soil characteristics, species composition, historicity, and weather and climate conditions, all of which require solutions to be tailored to them. Furthermore, factors such as forest ownership structures, existing legislation and regulatory frameworks further underscore the need for context-specific approaches. Societal demands and forest management objectives are also recognised to diverge from forest to forest. Social constellations, the localised practical and experiential knowledge of the different actors, and the interplay of interests that make up the conflict vary in every forest. In addition, the various actors involved have certain place attachments to the respective forest that need to be taken into account (Buijs and Lawrence, 2013). Ultimately, the impacts of climate change exhibit significant regional and local disparities (Millar et al., 2007) and are embedded in local social-ecological constellations. An understanding of local forests as SES can contribute to include these components in conflict analysis.

(2) When analysing the conflict, it may be worthwhile to take a closer look at the conditions and the characteristics of the SES and its development dynamics: To what extent is the conflict determined by the history of the forest and its utilisation for forestry and other purposes (e.g. by birdwatchers, hikers or mushroom pickers)? What is the general state of the forest and what changes are taking place? And finally: How are those aspects interwoven? With regard to the ecosystem, it could for example be important to analyse the ecological conditions not only of the trees, but also of its soil, mycorrhiza, undergrowth and animals. Particularly in the context of conflicts, it could also be analysed which ecosystem functions and services play a role (e.g. wildlife habitat, timber production, recreation, among presumably many others) and which changes in physical structures and processes can be observed (e.g. shorter periods of frost, dieback of trees) (Frick-Trzebitzky et al., 2021). In order to establish further coherences, it is possible to analyse which influencing factors (e.g. drought, forest fires) and which species and biotic interactions (e.g. deer, juvenile oaks) are involved and in which way. The social-ecological approach is useful to integrate these aspects. In our understanding, however, the SES is not a simple, additive combination of a social and a natural sphere, but rather "an additional hybrid social-ecological sphere" that exists at the core of the SES (Liehr et al., 2017, p. 6). The analysis of this hybrid social-ecological sphere can be guided by the following questions developed on the basis of the shaping dimensions: a) Which forms of *knowledge* structure the actors' interactions and uses? b) Which *practices* characterise the relationship to the forest and its uses by the actors? c) Which *technologies* are relevant for interactions with the forest and the actors' uses? d) How are interactions with the forest and actors' uses regulated by *institutions*? (following Fickel and Hummel, 2019). These questions can be used, for example, to take a closer look at knowledge of moss species (*knowledge*), mushroom picking (*practices*), deer fences (*technologies*) or hunting contracts (*institutions*).

(3) At the same time, analysing conflict settings requires an explicit closer look at the social context. In order to find out which actors are involved, how they relate to each other and what different interests they have, actor or network analyses can for example be employed (Brodrechtova, 2024; Creutzburg and Lieberherr, 2021; Marques et al., 2020; Pelyukh et al., 2021). To understand arguments and positions of different actors, it is helpful to identify their underlying layers (Fickel and Hummel, 2019): Relationships, values and social hierarchies are usually not immediately apparent (Harrison and Loring, 2020), but in conflicts these matter just as much as identities, personal experiences and emotionality (Satterfield, 2007). They determine how the actors articulate their needs and perspectives situationally and concretely (Fickel and Hummel, 2019). In that respect, power relations should by no means be ignored (cf. Ingalls, 2017; Juerges et al., 2021). In the analysis of the conflict, it is valuable to examine how power is expressed in discourses, actions, institutions and structures (Shackleton et al., 2023). For example, it is not only relevant which actors have the power to make or influence decisions, but also which actors shape dominant narratives and in what way (Sandström et al., 2013). It should also be

examined which actors, forms of knowledge, perspectives and values are delegitimised or excluded, as well as the extent to which these mechanisms are challenged. Beyond this, Buijs and Lawrence (2013) have pointed out that emotions in particular are usually given far too little attention in forest conflict analyses and should be made more explicit. In this context, it is also relevant to analyse the different forms of relating to the forest. The extent to which human-forest relationships influence the emergence and escalation of conflicts in a variety of ways is for example indicated by Halla et al. (2023). The authors developed the concept of the human-forest relationship to place social relationships to forests at the centre of analytical attention (Halla et al., 2023). For research practice, this means that methods are needed that help us understand the forest-related practices of the different actors and how they relate to the conflict and the forest in question. For example, participant observation is a well-established method in qualitative social science that allows actors to be accompanied for a longer period in their daily actions and interactions (Bethmann et al., 2018). In addition, specific conflict perspectives can be explored through narrative interviews, as Bethmann et al. (2018) also suggest and describe in more detail. This gives the researcher insights into very different conceptions of human-forest relationships and thus into key aspects of the forest conflicts being analysed, especially when they are related back to the entire SES.

4. Shaping forest conflicts

As well as analysing forest conflicts and understanding how certain conflicts arise and develop, it is possible to design potential interventions to manage them (Eckerberg and Sandström, 2013). A social-ecological approach raises the question of whether and how the relationships between society and nature should and can be changed and (at least partly) shaped (Becker and Jahn, 2006). If possible, conflicts should be addressed not only through conventional and sectoral means and measures of the different actors (which are often based on a limited perspective of the problem), but in a more comprehensive and holistic way. Depending on the type and nature of the conflict being analysed, ways and measures should be found in order to contribute to a transition and reduction of the conflict – or even to its solutions. In particular, the concept of conflict transformation as presented in this section may complement the social-ecological approach in an action-oriented way.

The objective of handling the conflict depends on how the conflict is categorised: In some situations, a conflict can lead to positive creativity and improvement, in which case it may make sense to consciously encourage conflict. Frequently, however, conflicts are destructive and should be defused as quickly as possible or even be resolved as they emerge. Often, everything should be done to prevent them from arising. It is therefore a matter of shaping conflicts. With Jahn et al. (2020, p. 6) we understand shaping as "a collective, cooperative, and experimental activity" that creates "concrete utopias, namely those that rely on the capabilities, concepts, practices, and techniques that already exist" in a given context.

Activities that "seek to discover, identify and resolve the underlying root causes of the conflict" allow perfect conflict resolution (Diamond, 1994, p. 3). However, managing or shaping conflicts is not only, or not in all cases, about conflict resolution. In conflict research, it has been noted that conflicts very often "require more than the reframing of positions and the identification of win-win outcomes" (Miall, 2004, p. 70) or conflict negotiation approaches that typically frame conflict resolution and management approaches (Miall, 2004). Therefore, what is known as *conflict transformation* emphasises a fundamental shift in the relationships between the parties involved in a conflict. This can only be achieved if the context and historical aspects underlying the conflict are taken into account, and if all parties involved in the conflict recognise their role in dealing with the conflict (Lederach, 2015; Miall, 2004; Väyrynen, 1991). While the content-centred approach of *conflict resolution* focuses on the question of how undesirable states or dynamics can be ended, the relationship-centred approach of *conflict transformation* highlights the question of how desirable states and dynamics can be created. According to Lederach, the aim of *conflict resolution* is to de-escalate conflict processes and reach an agreement or solution to the conflict (or its causes) at the earliest opportunity. The time horizon is therefore rather short-term, as the focus is on minimising difficulties and fears. *Conflict transformation*, in turn, understands conflict as a dynamic relational environment in which conflict de-escalation and conflict escalation alternate in order to seek constructive change. In the medium to long term, the conflict will be transformed if the problem at hand is seen as an opportunity to respond to symptoms and address relationships, i.e. to react consciously to crises. These change processes are not limited to immediate solutions, but may include them nonetheless (Lederach, 2015).

Conflict resolution and *conflict transformation* can thus be contrasted in an idealised way. However, in reality, intermediate and connecting forms are often possible and even desirable (Lederach, 2015). The possible entry points for processing depend on the form of the conflict and its degree of escalation. It can therefore be helpful to work out the different levels of conflict escalation in order to make the needs of the actors visible and establish the extent to which these are specifically named. These different levels of conflict escalation then allow the conflict to be managed in a targeted way. Depending on the type and level of escalation, different interventions are used (Fickel and Hummel, 2019).

At this point, we return to our argument of focussing more strongly on forest conflicts at the local level. This also applies to *conflict transformation*, as we explain below. Local shaping enables the development and implementation of concrete location-specific strategies for dealing with the forest. However, the actors will always reach the limits of their scope for action (e.g. legislation at the macro-level), which they can identify and address elsewhere if necessary. Nevertheless, in the ideal case, conflicts result in positive changes for a specific SES and can therefore be understood as starting points for social-ecological change. The aim, however, is not just to find a solution. If the participating actors engage in reflection, they can regard their joint dealing with the conflict as a learning process. They learn from each other about the forest, they learn to understand and trust each other (Sotirov et al., 2017), and they learn to communicate (better) with each other. In the best-case scenario, the forms of communication learnt will also be applicable in other cases, meaning that the actors equip themselves to deal with future situations. Through the experience of shared dialogue, the actors are able to communicate and cooperate independently, strengthening their bottom-up power to act. This communication is a preventative measure against potentially escalating conflicts in future, but it also enables local shaping to remain dynamic and makes it easier to adapt to new circumstances so that it will be possible to react more quickly and flexibly in the future. After all, due to the numerous uncertainties regarding the future, measures must be constantly reconsidered and adapted (Detten and Hanewinkel, 2017; Lawrence, 2017; Millar et al., 2007). Even ways of dealing with uncertainties can be learnt (Sarkki, 2008), preferably together.

Thus, dealing with conflicts on a local level is essential in order to account for the complexities and uncertainties inherent in forest management. It seems plausible that the more heterogeneous the actors managing or using a social-ecological forest system are, the greater the possibility that conflicts will arise between them. However, the diversity of actors and "the complementarity of actors' management capabilities" can also lead to a greater resilience of the SES (Grêt-Regamey et al., 2019, p. 290). This calls for increased support and flexibility in regulations to accommodate locally specific solutions (see also Konczal et al., 2023). Moreover, if there are sufficient opportunities to negotiate forest conflicts locally, numerous different ways of dealing with forests will emerge. This diversity of pathways ensures heterogeneity and structural diversity and can also enable forests as a whole to become more resilient to upcoming and as yet unknown phenomena (Mina et al., 2022).

In addition to the flexibility of management options, this also includes the endorsement of open dialogue formats to enable forms of knowledge co-production. In this regard, it is advisable to involve all the affected actors in the process at an early stage (Norström et al., 2020). In the management of forests, little attention has been paid to civil society actors in Germany to date. As a result, participatory processes, such as those possible in forest management planning (Sheppard and Meitner, 2005) and already observed in other countries (Brodrechtova et al., 2023; Paletto et al., 2015; Robson and Rosenthal, 2014) are generally neglected. This applies not only to private forests, but surprisingly also to some municipal and especially state-owned forests, where decisions in some German federal states can still be quite sovereign (cf. Borrass et al., 2017). Round tables, mediation processes and joint planning workshops are formats for participation (Hebermehl et al., 2024) that can also be applied as methods for conflict transformation. In this context, the potential of on-site dialogues is of particular significance as joint observation and discussion in the forest can significantly alleviate tensions (Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg, 2020).

In our experience, it is easier to implement this type of conflict shaping in forests where the values, demands and interests of other actors are of concern to the actor responsible for their management (i.e. their owner). This is often easier in communal forests (e.g. the owner is a municipality), but can also be achieved in forests with other ownerships. In private forests, it is usually a matter of convincing the owner. In state forests, a recommendation from the responsible ministry could lead to attempts being made at this kind of conflict shaping.

As we have shown, adopting a social-ecological approach involves using the productive power of conflicts to initiate conflict transformations. A successful conflict transformation can both contribute to social learning among the conflict actors (e.g. strengthening social relationships and improving forms of communication) and bring about a way of dealing with the forest (and its SES) that is adapted to new challenges. Despite this, it is also important to recognise the limits of controllability (Becker and Jahn, 2006). The extent to which conflicts can actually be controlled is very limited and every relationship, every regulation, every new strategy is embedded in complex structures and processes. However, rather than attempting to control conflicts, conflict transformation emphasises the numerous possibilities for change that arise from the inherent complexity of conflicts (Lederach, 2015). Nevertheless, due to the interconnections of micro- and macro-level structures that conflicts involve (Sandström et al., 2013), the actors may reach the limits of their scope for action, for example with regard to regulations or dynamics at regional, national or global levels. Moreover, conflict transformation can also fail or only partially achieve its goal. In this section, we have described many of the advantages that conflict transformation can bring in favourable cases. However, due to the complexity involved, not all of them necessarily materialise successfully.

5. Conclusions

In Germany, the causes and dynamics of forest conflicts are complex and multifaceted, with heterogeneous actors often holding conflicting values, demands and interests. To address these conflicts successfully, it can be helpful to consider forests as SES. In this commentary, we have argued that a social-ecological approach facilitates the consideration of the interactions and interdependencies between social and physical structures and processes of forest conflicts and thus helps to analyse and shape forest conflicts.

In conflict analysis, a social-ecological approach allows the complex interrelationships of forest conflicts to be considered by analysing the site-specific conditions, parameters and dynamics of the conflict in an *interdisciplinary manner*. We elaborated on why it is therefore helpful to focus more on local forest conflicts when analysing them. In addition, four shaping dimensions (*knowledge*, *practices*, *technologies*, *institutions*) can help to focus analytically on the social-ecological sphere. Against this background, we explained why and how in particular the social context of the conflicts can be taken into account in detail: Identities, emotions and human-forest relationships, for example, must be taken into account and at the same time represent important starting points for understanding the complex forest conflicts.

In order to promote sufficient and long-lasting conflict transformation collaborative learning processes can be pursued with the involvement of all relevant actors where possible. A learning process with effective and long-lasting results should include the following points as far as possible: 1) it relates to locally specific issues and incorporates the social-ecological conditions, parameters and dynamics, 2) it addresses not only the content, but also the social, ecological and social-ecological relationships interwoven in the conflict, and 3) the different actors recognise their role in dealing with the conflict, their scope for action and the limits of controllability.

The productive power of conflicts can be used to initiate conflict transformation. This creates a diversity of pathways which can both contribute to social learning among conflict actors and bring about a way of dealing with the forest (and its SES) that is adapted to new challenges. More support and flexibility in regulations from decision-makers is needed to facilitate locally specific solutions, and sufficient opportunities must be created to negotiate forest conflicts locally.

While in this paper we depart from forest conflicts in Germany to introduce a social-ecological approach, the principles and arguments for analysing and shaping conflicts may be applied to various areas and contexts, with consideration of local specifics. Since conflicts over nature and natural resources often arise along lines of use, utilisation claims, values, demands and interests, but may also be shaped by changes in societal relations to nature, the principles outlined in this commentary provide an approach for comprehensive analysing and constructive shaping of forest conflicts at the local level.

CRediT authorship contribution statement

Anna S. Brietzke: Writing – review & editing, Writing – original draft, Conceptualization. **Engelbert Schramm:** Writing – review & editing, Writing – original draft, Funding acquisition, Conceptualization. **Katharina Heß:** Writing – original draft. **Diana Hummel:** Writing – review & editing, Writing – original draft, Funding acquisition, Conceptualization. **Michael Kreß-Ludwig:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization. **Deike U. Lüdtke:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing interests neither financial interests nor personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

References

Aggestam, F., Konczal, A., Sotirov, M., Wallin, I., Paillet, Y., Spinelli, R., Lindner, M., Derks, J., Hanewinkel, M., Winkel, G., 2020. Can nature conservation and wood production be reconciled in managed forests? A review of driving factors for integrated forest management in Europe. J. Environ. Manage. 268, 110670. https://doi.org/10.1016/j.jenvman.2020.110670.

Augustin, N., Puhlmann, H., Trust, S., 2023. Understanding forest damage in Germany: finding key drivers to help with future forest conversion of climate sensitive stands. In: Book of the Short Papers SEAS IN 2023, pp. 157–162.

Becker, E., Jahn, T., 2006. Soziale Ökologie: Grundzüge einer Wissenschaft von den gesellschaftlichen Naturverhältnissen. Campus-Verlag, Frankfurt am Main.

Bergmann, M., Jahn, T., Knobloch, T., Krohn, W., Pohl, C., Schramm, E., 2012. Methods for Transdisciplinary Research: A Primer for Practice. Campus-Verlag, Frankfurt am Main.
Berman, S.L., Johnson-Cramer, M.E., 2019. Stakeholder theory: seeing the field through the Forest. Bus. Soc. 58, 1358–1375. https://doi.org/10.1177/0007650316680039.
Bethmann, S., Simminger, E., Baldy, J., Schraml, U., 2018. Forestry in interaction. Shedding light on dynamics of public opinion with a praxeological methodology. Forest Policy Econ. 96, 93–101. https://doi.org/10.1016/j.forpol.2018.08.005.
Biggs, R., Preiser, R., Vos, A. de, Schlüter, M., Maciejewski, K., Clements, H., 2021. The Routledge Handbook of Research Methods for Social-Ecological Systems. Routledge, London.
Borrass, L., Kleinschmit, D., Winkel, G., 2017. The "German model" of integrative multifunctional forest management – Analysing the emergence and political evolution of a forest management concept. Forest Policy Econ. 77, 16–23. https://doi.org/10.1016/j.forpol.2016.06.028.
Brodrechtova, Y., 2024. Assessing actor power in the trade-offs between ecosystem services affecting forest management – a case study from Central Slovakia. Forest Policy Econ. 163, 103187. https://doi.org/10.1016/j.forpol.2024.103187.
Brodrechtova, Y., Sedmák, R., Dobšinská, Z., 2023. An approach for integrating stakeholders' participation in forest management planning in Slovakia. In: Deal for Green? Published Scientific Conference Contribution. Ljubljana, pp. 202–210.
Brunette, M., Hanewinkel, M., Yousefpour, R., 2020. Risk aversion hinders forestry professionals to adapt to climate change. Clim. Change 162, 2157–2180. https://doi.org/10.1007/s10584-020-02751-0.
Buijs, A., Lawrence, A., 2013. Emotional conflicts in rational forestry: towards a research agenda for understanding emotions in environmental conflicts. Forest Policy Econ. 33, 104–111. https://doi.org/10.1016/j.forpol.2012.09.002.
Creutzburg, L., Lieberherr, E., 2021. To log or not to log? Actor preferences and networks in Swiss forest policy. Forest Policy Econ. 125, 102395. https://doi.org/10.1016/j.forpol.2021.102395.
Detten, R., Hanewinkel, M., 2017. Strategies of handling risk and uncertainty in forest management in Central Europe. Curr. For. Rep. 3, 60–73. https://doi.org/10.1007/s40725-017-0050-7.
Diamond, L., 1994. The global imperative. Current History 93, 1–7. https://doi.org/10.1525/curh.1994.93.579.1.
Eckerberg, K., Sandström, C., 2013. Forest conflicts: a growing research field. Forest Policy Econ. 33, 3–7. https://doi.org/10.1016/j.forpol.2013.05.001.
Eisele, H., Schreiber, R., Stöger, A., 2021. Oberammergau pilot action region: Mountain Forest initiative (BWO). In: Beguš, J., Berger, F., Kleemayr, K. (Eds.), Best Practice Examples of Implementing Ecosystem-Based Natural Hazard Risk Management in the GreenRisk4ALPs Pilot Action Regions. IntechOpen.
Fernández-Manjarrés, J.F., MacHunter, J., Zavala, M.A., 2021. Forest management, conflict and social-ecological systems in a changing world. Forests 12, 1459. https://doi.org/10.3390/f12111459.
Fickel, T., Hummel, D., 2019. Sozial-ökologische Analyse von Biodiversitätskonflikten: Ein Forschungskonzept. ISOE - Materialien Soziale Ökologie 55. Main. ISOE - Institut für sozial-ökologische Forschung. Frankfurt am.
Fischer, A.P., Shah, M.A.R., Segnon, A.C., Matavel, C., Antwi-Agyei, P., Shang, Y., Muir, M., Kaufmann, R., 2024. Human adaptation to climate change in the context of forests: a systematic review. Clim. Risk Manag. 43, 100573. https://doi.org/10.1016/j.crm.2023.100573.
Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg, 2020. Der Streit um den Wald: Umgang mit waldbezogenen Konflikten. Freiburg im Breisgau.
Frick-Trzebitzky, F., Brinkmann, K., Koböck, K., Liehr, S., Fickel, T., 2021. Sozial-ökologische Konfliktanalyse zur Deichsanierung entlang der Weschnitz zwischen Biblis und Einhausen. ISOE - Institut für sozial-ökologische Forschung, Frankfurt am Main.
García-Frapolli, E., Ayala-Orozco, B., Oliva, M., Smith, R., 2018. Different approaches towards the understanding of socio-environmental conflicts in protected areas. Sustainability 10, 2240. https://doi.org/10.3390/su10072240.
Garms, M., Leiz, M., Mayer, M., 2023. Perception of climate change-related forest dieback in mountain forests among the local population. Eur. J. For. Res. 143, 1–22.
Glaser, M., Krause, G., Ratter, B.M., Welp, M., 2012. Human-Nature Interactions in the Anthropocene. Routledge.
Glasl, F., 1999. Confronting Conflict: A First-Aid Kit for Handling Conflict. Hawthorn Press, Stroud.
Grêt-Regamey, A., Huber, S.H., Huber, R., 2019. Actors' diversity and the resilience of social-ecological systems to global change. Nature Sustainability 2, 290–297. https://doi.org/10.1038/s41893-019-0236-z.
Halla, T., Laine, J., 2022. To cut or not to cut – emotions and forest conflicts in digital media. J. Rural. Stud. 94, 439–453. https://doi.org/10.1016/j.jrurstud.2022.07.019.
Halla, T., Holz, J., Karhunkorva, R., Laine, J., 2023. The concept of the human-forest relationship (HFR) – definition and potentials for forest policy research. Forest Policy Econ. 153, 102995. https://doi.org/10.1016/j.forpol.2023.102995.
Harrison, H.L., Loring, P.A., 2020. Seeing beneath disputes: a transdisciplinary framework for diagnosing complex conservation conflicts. Biol. Conserv. 248, 108670. https://doi.org/10.1016/j.biocon.2020.108670.
Hazarika, R., Bolte, A., Bednarova, D., Chakraborty, D., Gaviria, J., Kanzian, M., Kowalczyk, J., Lackner, M., Lstibůrek, M., Longauer, R., Nagy, L., Tomášková, I., Schueler, S., 2021. Multi-actor perspectives on afforestation and reforestation strategies in Central Europe under climate change. Annals of Forest Science 78. https://doi.org/10.1007/s13595-021-01044-5.
Hebermehl, W., Kohler, B., 2022. Waldeslust statt Waldesfrust!. In: Astrein – Jahresmagazin der Forstlichen Versuchs- und Forschungsanstalt Baden-Württemberg, pp. 52–57.
Hebermehl, W., Kohler, B., Wirth, K., 2024. Waldeslust statt Waldesfrust!: Anregungen zur Einbindung der Materialien aus dem Projekt "Waldeslust statt Waldesfrust! Grundlagen für einen konstruktiven Dialog in waldbezogenen Konflikten!" in Seminare, Dialogveranstaltungen und Beteiligungsprozesse. Stabsstelle Gesellschaftlicher Wandel, FVA Baden-Württemberg.
Hengst-Ehrhart, Y., 2019. Knowing is not enough: exploring the missing link between climate change knowledge and action of German forest owners and managers. Ann. For. Sci. 76. https://doi.org/10.1007/s13595-019-0878-z.
Ingalls, M.L., 2017. Not just another variable: untangling the spatialities of power in social-ecological systems. Ecol. Soc. 22. https://doi.org/10.5751/ES-09543-220320.
Jahn, T., Hummel, D., Drees, L., Liehr, S., Lux, A., Mehring, M., Stieß, I., Völker, C., Winker, M., Zimmermann, M., 2020. Shaping social-ecological transformations in the Anthropocene. ISOE-Diskussionspapiere 45, Frankfurt am Main. (originally published in German in GAIA 29/2 (2020): 93–97).
Juerges, N., Viedma, A., Leahy, J., Newig, J., 2017. The role of trust in natural resource management conflicts: a forestry case study from Germany. For. Sci. https://doi.org/10.5849/FS-2016-050.
Juerges, N., Arts, B., Masiero, M., Hoogstra-Klein, M., Borges, J.G., Brodrechtova, Y., Brukas, V., Canadas, M.J., Carvalho, P.O., Corradini, G., Corrigan, E., Felton, A., Karahalil, U., Karakoc, U., Krott, M., van Laar, J., Lodin, I., Lundholm, A., Makrickienė, E., Marques, M., Mendes, A., Mozgeris, G., Novais, A., Pettenella, D., Pivoriūnas, N., Sarı, B., 2021. Power analysis as a tool to analyse trade-offs between ecosystem services in forest management: a case study from nine European countries. Ecosyst. Serv. 49, 101290. https://doi.org/10.1016/j.ecoser.2021.101290.
Knutzen, F., Averbeck, P., Barrasso, C., Bouwer, L.M., Gardiner, B., Grünzweig, J.M., Hänel, S., Haustein, K., Johannessen, M.R., Kollet, S., Müller, M.M., Pietikäinen, J.-P., Pietras-Couffignal, K., Pinto, J.G., Rechid, D., Rousi, E., Russo, A., Suarez-Gutierrez, L., Veit, S., Wendler, J., Xoplaki, E., Gliksman, D., 2025. Impacts on and damage to European forests from the 2018–2022 heat and drought events. Nat. Hazards Earth Syst. Sci. 25, 77–117. https://doi.org/10.5194/nhess-25-77-2025.
Konczal, A.A., Derks, J., Koning, J.H.C., Winkel, G., 2023. Integrating nature conservation measures in European forest management - an exploratory study of barriers and drivers in 9 European countries. J. Environ. Manage. 325, 116619. https://doi.org/10.1016/j.jenvman.2022.116619.
Lawrence, A., 2017. Adapting through practice: Silviculture, innovation and forest governance for the age of extreme uncertainty. Forest Policy Econ. 79, 50–60. https://doi.org/10.1016/j.forpol.2016.07.011.
Lederach, J., 2015. Little Book of Conflict Transformation: Clear Articulation of the Guiding Principles by a Pioneer in the Field. Skyhorse Publishing, New York.
Liehr, S., Röhrig, J., Mehring, M., Kluge, T., 2017. How the social-ecological systems concept can guide transdisciplinary research and implementation: addressing water challenges in central northern Namibia. Sustainability 9, 1109. https://doi.org/10.3390/su9071109.
Mack, P., Kremer, J., Kleinschmit, D., 2023. Forest dieback reframed and revisited? Forests (re)negotiated in the German media between forestry and nature conservation. Forest Policy Econ. 147, 102883. https://doi.org/10.1016/j.forpol.2022.102883.
Marques, M., Juerges, N., Borges, J.G., 2020. Appraisal framework for actor interest and power analysis in forest management - insights from northern Portugal. Forest Policy Econ. 111, 102049. https://doi.org/10.1016/j.forpol.2019.102049.
Mehring, M., Bernard, B., Hummel, D., Liehr, S., Lux, A., 2017. Halting biodiversity loss: how social-ecological biodiversity research makes a difference. International Journal of Biodiversity Science, Ecosystem Services & Management 13, 172–180. https://doi.org/10.1080/21513732.2017.1289246.
Miall, H., 2004. Conflict transformation: A multi-dimensional task. In: Austin, A., Fischer, M., Ropers, N. (Eds.), Transforming Ethnopolitical Conflict. VS Verlag für Sozialwissenschaften, Wiesbaden, pp. 67–89.
Millar, C.I., Stephenson, N.L., Stephens, S.L., 2007. Climate change and forests of the future: managing in the face of uncertainty. Ecol. Appl. 17, 2145–2151. https://doi.org/10.1890/06-1715.1.
Mina, M., Messier, C., Duveneck, M.J., Fortin, M.-J., Aquilué, N., 2022. Managing for the unexpected: building resilient forest landscapes to cope with global change. Glob. Chang. Biol. 28, 4323–4341. https://doi.org/10.1111/gcb.16197.
Niemelä, J., Young, J., Alard, D., Askasibar, M., Henle, K., Johnson, R., Kurttila, M., Larsson, T.-B., Matouch, S., Nowicki, P., Paiva, R., Portoghesi, L., Smulders, R., Stevenson, A., Tartes, U., Watt, A., 2005. Identifying, managing and monitoring conflicts between forest biodiversity conservation and other human interests in Europe. Forest Policy Econ. 7, 877–890. https://doi.org/10.1016/j.forpol.2004.04.005.
Nikinmaa, L., Koning, J.H., Derks, J., Grabska-Szwagrzyk, E., Konczal, A.A., Lindner, M., Socha, J., Muys, B., 2024. The priorities in managing forest disturbances to enhance forest resilience: a comparison of a literature analysis and perceptions of forest professionals. Forest Policy Econ. 158, 103119. https://doi.org/10.1016/j.forpol.2023.103119.
Norström, A.V., Cvitanovic, C., Löf, M.F., West, S., Wyborn, C., Balvanera, P., Bednarek, A.T., Bennett, E.M., Biggs, R., Bremond, A., Campbell, B.M., Canadell, J.G., Carpenter, S.R., Folke, C., Fulton, E.A., Gaffney, O., Gelcich, S., Jouffray, J.-B., Leach, M., Le Tissier, M., Martín-López, B., Louder, E., Loutre, M.-F., Meadow, A.M., Nagendra, H., Payne, D., Peterson, G.D., Reyers, B., Scholes, R., Speranza, C.I., Spierenburg, M., Stafford-Smith, M., Tengö, M., van der Hel, S., van Putten, I., Österblom, H., 2020. Principles for knowledge co-production in sustainability research. Nat. Sustainability 3, 182–190. https://doi.org/10.1038/s41893-019-0448-2.

Paletto, A., Hamunen, K., Meo, I., 2015. Social network analysis to support stakeholder analysis in participatory forest planning. Soc. Nat. Resour. 28, 1108–1125. https://doi.org/10.1080/08941920.2015.1014592.

Pelyukh, O., Lavnyy, V., Paletto, A., Troxler, D., 2021. Stakeholder analysis in sustainable forest management: an application in the Yavoriv region (Ukraine). Forest Policy Econ. 131, 102561. https://doi.org/10.1016/j.forpol.2021.102561.

Pohl, C., Thompson Klein, J., Hoffmann, S., Mitchell, C., Fam, D., 2021. Conceptualising transdisciplinary integration as a multidimensional interactive process. Environ. Sci. Policy 118, 18–26. https://doi.org/10.1016/j.envsci.2020.12.005.

Popkin, G., 2021. Forest fight. Science 374, 1184–1189.

Reif, A., Brucker, U., Kratzer, R., Schmiedinger, A., Bauhus, J., 2010. Waldbau und Baumartenwahl in Zeiten des Klimawandels aus Sicht des Naturschutzes: Abschlussbericht eines F+E-Vorhabens im Auftrag des Bundesamtes für Naturschutz. Bundesamt für Naturschutz, Bonn.

Robson, M., Rosenthal, J., 2014. Evaluating the effectiveness of stakeholder advisory committee participation in forest management planning in Ontario, Canada. For. Chron. 90, 361–370. https://doi.org/10.5558/tfc2014-070.

Rosenkranz, L., von Arnim, G., Englert, H., Husmann, K., 2023. Alternative forest management strategies to adapt to climate change: an economic evaluation for Germany. In: Thünen Working Paper 219, Braunschweig.

Sandström, C., Eckerberg, K., Raitio, K., 2013. Studying conflicts, proposing solutions - towards multi-level approaches to the analyses of forest conflicts. Forest Policy Econ. 33, 123–127. https://doi.org/10.1016/j.forpol.2013.05.002.

Sarkki, S., 2008. Forest dispute and change in Muonio, northern Finland. Journal of Northern Studies 2, 7–27. https://doi.org/10.36368/jns.v2i2.559.

Satterfield, T., 2007. Anatomy of a Conflict: Identity, Knowledge, and Emotion in Old-Growth Forests. UBC Press, Vancouver.

Schramm, E., 2013. Klimaanpassung in der Forstwirtschaft. Ökologisches Wirtschaften 28, 42–45. https://doi.org/10.14512/oew.v28i1.1260.

Schramm, E., Stockmann, M., Wenzel, L., 2020a. Jagd & Waldbau - Ergebnisse einer empirischen Erhebung in Hessen. AFZ - Der Wald 14/2020 27–31.

Schramm, E., Hummel, D., Mehring, M., 2020b. Die Soziale Ökologie und ihr Beitrag zu einer Gestaltung des Naturschutzes. Natur und Landschaft 95, 397–406.

Schusser, C., Krott, M., Movuh, M.C.Y., Logmani, J., Devkota, R.R., Maryudi, A., Salla, M., 2016. Comparing community forestry actors in Cameroon, Indonesia, Namibia, Nepal and Germany. Forest Policy Econ. 68, 81–87. https://doi.org/10.1016/j.forpol.2016.03.001.

Shackleton, R.T., Walters, G., Bluwstein, J., Djoudi, H., Fritz, L., Lafaye de Micheaux, F., Loloum, T., Nguyen, V.T.H., Rann Andriamahefazafy, M., Sithole, S.S., Kull, C.A., 2023. Navigating power in conservation. Conserv. Sci. Pract. 5 (3), e12877. https://doi.org/10.1111/csp2.12877.

Sheppard, S.R., Meitner, M., 2005. Using multi-criteria analysis and visualisation for sustainable forest management planning with stakeholder groups. For. Ecol. Manage. 207, 171–187. https://doi.org/10.1016/j.foreco.2004.10.032.

Sotirov, M., Blum, M., Storch, S., Selter, A., Schraml, U., 2017. Do forest policy actors learn through forward-thinking? Conflict and cooperation relating to the past, present and futures of sustainable forest management in Germany. Forest Policy Econ. 85, 256–268. https://doi.org/10.1016/j.forpol.2016.11.011.

Väyrynen, R., 1991. To settle or to transform? Perspectives on the resolution of national and international conflicts. In: Väyrynen, R. (Ed.), New Directions in Conflict Theory: Conflict Resolution and Conflict Transformation. Sage Publications, London, pp. 1–25.

Weber, M., 1968. Economy and Society: An Outline of Interpretive Sociology. University of California Press, Berkeley, Los Angeles, London.

Weinbrenner, H., Palm, T., Schraml, U., 2021. Die Krise ist noch nicht in allen Köpfen angekommen. AFZ - Der Wald 2/2021, 12–16.

Winkel, G., Gleißner, J., Pistorius, T., Sotirov, M., Storch, S., 2011. The sustainably managed forest heats up: discursive struggles over forest management and climate change in Germany. Critical Policy Studies 5, 361–390. https://doi.org/10.1080/19460171.2011.628002.