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An integrated conflict analysis approach for the sustainable supply of Forest Ecosystem Services in Germany - the case of forest-based biofuel production

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ABSTRACT

The increased harvesting of forest biomass for biofuel production in Germany could lead to trade-offs in the provision of forest ecosystem services (FES). The potential conflicts between already existing forest users and proponents of biofuels from forest biomass are insufficiently investigated. In this paper, we propose an innovative step-wise methodology for analysing the conflicts that could arise due to a foreseen increase in scarcity of various forest goods and services, as well as formulating sustainable conflict management strategies. Based on a mixed study design for triangulation, we carried out twelve expert interviews, two workshops and three focus group discussions in order to assess potential conflicts and to deepen strategies to deal with them. We found that most of our participants were against the prospect of using forest biomass for biofuel production partially due to possible negative consequences for biodiversity, climate regulation, and other FES. Study participants also asserted that there is a lack of information regarding the claimed benefits from biofuels from forest biomass. Participative processes, market-based instruments, and policy harmonization are strategies proposed to alleviate conflicts among forest users. Our insights could help the forest policy decision-making process by increasing transparency regarding possible trade-offs and strategies, which could improve sustainability in forest management.

1. Introduction

Forests provide a range of (forest) ecosystem services (FES) that are essential for human well-being (Millennium Ecosystem Assessment (Program), 2005). They regulate the climate, water and air, while also acting as a biodiversity repository. In addition to providing a plethora of raw materials such as wood, food and fodder, they also offer a range of cultural services such as spaces for spiritual and cultural interaction with nature, recreation and sports. The provision of these forest functions and associated goods and services have become so essential in forest policy and management that harnessing forests is seen as a modern solution for tackling climate change (Sedjo and Sohngen, 2012), biodiversity loss (Lippe et al., 2021), and fostering cultural development (Agnoletti and Santoro, 2015; Marini Govigli and Bruzzese, 2023).

Germany has a total national area of 35.7 million hectares of which 11.4 million, or 32 %, are officially recognized as forested areas (BMEL, 2016). These forests offer a wide range of FES. For example, they contribute significantly to regulating the climate through carbon storage. About 2.6 billion tons of carbon are being stored in German forests as living biomass, dead wood or within the ground (BMEL, 2021). Each year it is estimated that the living biomass carbon stocks in Germany's forests increase about 1.0 t C ha^{-1} yr^{-1} (Wellbrock et al., 2017), which forms an integral part of the country's federal climate change mitigation strategy (Federal Climate Change Act, 2019). Forests in Germany are also recognized as the most important ecosystem for biodiversity conservation. One can find 76 tree species, over 100 shrub species, around 1000 herbaceous plant species (BMEL, 2017), with an estimated 7000 species of fauna residing in local deciduous forests alone (NABU, 2023). Over 40 % of all protected water areas in Germany are found in forests (BMEL, 2021).

Forests in Germany also offer several social benefits. For example, they significantly contribute to the economy of the country. About 39,000 people are directly employed in the forestry sector, which added € 1.2 billion in gross value to the Germany economy in 2020 (Eurostat, 2022). In 2022, the wood industry accounted for the employment of around 135,000 people which generated € 8.25 billion in gross value to the German economy (Statista, 2023). Forests further offer recreational opportunities for locals and vacationers as a place for leisure activities,

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such as mountain biking (Wilkes-Allemann et al., 2020), or to relax after work or for social gatherings (Bösch et al., 2018). It is estimated that 70 % of the German population visit a forest at least once a year for recreational purposes (BMEL, 2021). The importance of forests was highlighted during the covid-19 pandemic as visitor numbers increased for forest recreation in the country (Derks et al., 2020). Elsasser and Weller (2013) estimate the German public is willing to pay around 36.06 €/P/yr. to visit forests, which gives an aggregated value of around 1.9 bill. €/yr. for the whole population of Germany.

In the past decades, however, forest degradation has severely accelerated, affecting the sustainable provision of forest ecosystem services at a global scale (IPBES, 2019), as well as in Germany (BMEL, 2021; UBA, 2021). According to Germany's latest forest health survey ("Bundeswaldinventur"), several indicators show a rapid decline of forest health across the country, e.g. only 21 % of all trees show no crown thinning and the death rate of trees above 60 years of age has drastically increased (BMEL, 2022). The report highlights increased occurrences of drought, storms and pests as the main reasons behind this decline (BMEL, 2022). In line with this, it was found that more than 1200 forest fires occurred between 2018 and 2020 throughout the country (European Commission. Joint Research Centre, 2022), and bark beetle damage currently accounts for 81.4 % of all felling (Statistisches Bundesamt, 2022).

At the same time, Germany has been promoting a bioeconomy transition, i.e. using biological resources to provide products, processes, and services across diverse sectors of its economy. That forests have a vital role in the national bioeconomy strategy through its provision of biomass is readily acknowledged (The Federal Government, 2020). Partly as a reaction to the energy crisis, one of the emerging fields in Germany's bioeconomy strategy is the use of forest biomass for biofuel production for the transport sector. The argument has been made that biofuels generated from forest biomass could emit less greenhouse gases in comparison to fossil fuels, and would therefore be a viable fossil fuel substitute for the country's energy transition (Cowie et al., 2021). There are, however, established streams of forest goods and services uses with a range of interdependent stakeholders in Germany's forests. The assessment of the relationship between established and newly emerging demands for forest goods and services, in this case for biofuel production, might help forest policy and management to become aware of potential conflicts and trade-offs between FES uses and users (Gutsch et al., 2018a; Simons et al., 2021; Tiemann and Ring, 2018; Wang and Fu, 2013).

The number of conflict analysis approaches for forest resource uses is still limited. Typical conflicts that are found in forestry are between timber production and other ecosystem services (Blattert et al., 2023; Gamfeldt et al., 2013; Pohjanmies et al., 2017), in particular with biodiversity conservation (Edwards and Kleinschmit, 2013; Winkel and Sotirov, 2016), or timber production and recreation (e.g. Gundersen et al., 2019; Wilkes-Allemann et al., 2015). Moreover, few studies have examined the occurrence of conflicts among non-timber benefits from managed forests (Pohjanmies et al., 2017). In line with the concept of multi-functional forestry, we position three conflict lines between the ecological, economic and social forest functions at the outset of this research for further investigation: production vs. conservation, production vs. recreation, and conflict between different kinds of production.

First, the production function of forests can conflict with forest conservation efforts (Krumm et al., 2020). Services like timber production and harvesting eventually lead to a certain extent of forest degradation, which compromise forest conservation efforts. At the same time, society is dependent on forest provision services as the industries that need them provide significant economic gains and employment.

Second, the conflict between forest production and forest recreation stems from the significant increase in popularity of recreational use of forests in Germany (Mann and Absher, 2008). This encompasses activities such as hiking, mountain biking, dog walking and horse riding in the forest, among others. Recreational users of forests depend on the atmosphere that trees provide and so certain forest production activities that somewhat compromise the forest aesthetic, e.g. felling, the use of chainsaws, heavy machinery and infrastructural damages, are seen critically by recreational users (Nousiainen and Mola-Yudego, 2022). At the same time, forest managers may also see the drawbacks in allowing certain recreational uses in their areas for safety concerns as forestry activities can be hazardous (Bayne et al., 2022).

Third, there are various conflicts between different types of goods that emerge from forest production. Several industries within the forest production umbrella depend on the provision of raw materials from forests. Forest-based industries and the energy production sector, for example, have certain parallels but are also competing with each other for raw materials (Cazzaniga et al., 2019). Meanwhile, the conflict between forestry and the wood processing industry, in certain contexts, could be dictated by a mismatch between demand and supply of timber assortments and varying prices, among others (Marić et al., 2012). Further, wood pellets and wood chips are in competition with certain wood-based products e.g., wood panels and paper, the intensity of which is dependent upon market conditions (Jonsson and Rinaldi, 2017).

It remains largely unknown how the introduction of forest biomass harvesting for biofuel production might affect stakeholders dependent on pre-existing forest functions or derived ecosystem goods and services. This paper seeks to address this knowledge gap by developing a stepwise methodology for conflict analysis in relation to FES provision and then applying it to the case of forest biomass for biofuel production. We designed and tested our methodology in the framework of the BIO-KRAFT[1] project, which investigated the possible effects of increasing extraction of biomass from forests for biofuel production in Germany. We specifically aim to analyze:

1. What conflicts, synergies and potential innovations arising from stakeholder competition caused by changes in forest management and/or forest biomass use can be identified?
2. How can the potential, limits and challenges of a possible change in forest biomass use for biofuel production be assessed?
3. What strategies can be developed in order to alleviate competing demands for forest biomass?

This paper is structured as follows: after this introduction, the theoretical orientation, which is comprised of natural resource conflict theory and the concept of forest multi-functionality, is discussed as a starting point for our analysis in chapter 2. Methodologically, this study builds on an integrated study design, which is detailed in methods chapter 3. Our study design consists of expert interviews, workshops and focus group discussions to elaborate on potential conflicts and respective management strategies. Potential conflicts between stakeholder groups, the evaluation of how the topic of biofuels could affect forest ecosystems, management and policy, and strategies proposed by stakeholders for dealing with the identified potential conflicts are detailed in chapter 4. The chances and challenges of our proposed methodology for the analysis of potential conflicts are then discussed (chapter 5) and conclusions are drawn for its further refinement and use in the final chapter.

2. Theoretical orientation

We build our theoretical orientation on two concepts that guide our analyses. First, we refer to Buckles and International Development Research Centre, & World Bank, 1999 in order to understand how conflicts for natural resources manifest between stakeholders. Second, we refer to the concept of forest multi-functionality, acknowledging the

[1] The project "Woody biomass availability for biofuel production in DE and EU until 2040" ran from 2021 until the 1st quarter of 2023. It was financed by the German Federal Ministry for Digital and Transport (BMDV)

various societal demands for different forest uses that help us in determining where conflicts occur.

Natural resource conflicts largely emerge due to the multiple and competing demands on natural resources. According to Matiru et al. (2000), they can arise if user groups are excluded from participating in natural resource management decisions. They also occur due to contradictions between local users and new institutions and management systems or lack of information about policy and management objectives. Contradictions or a lack of clarity in laws and policies also functions as a source of conflict, similar to a real or perceived inequity in resource distribution or poor policy implementation. For a structured conflict analysis, the work of Buckles and International Development Research Centre, & World Bank, 1999 outlines four main reasons why conflicts for natural resources arise between stakeholders. First, they describe how the interconnectedness of stakeholders' actions could have far-reaching repercussions for others. Forest stakeholders are competing for a limited supply of FES. As such, the manner in which forest each stakeholder utilizes resources could affect the supply for others, which could cause competition over scarce resource supply, for example, conflicts between timber production and the provision of other FES. In addition, behind competition over varying uses, conflicts can also be due to fundamentally different actor perceptions, values or worldviews regarding forests and forest management and hence may be difficult (or even impossible) to resolve (Winkel and Sotirov 2016). This underlines the need for transparent decision-making over tradeoffs as well as working towards integrated solutions. Second, the complex and unequal relationships and power imbalances between stakeholders could lead to conflicts. Research suggests that not all stakeholders receive equal political support, which therefore hinders each one's capacity to influence forest management. For example, stakeholder demands for cultural FES and particular infrastructures are often less well considered in forest management decisions (Torralba et al., 2020). This leads to their under-provision and/or under-valuation in forest management regimes (e.g. Dwyer et al., 2015). Third, the scarcity of natural resources due to environmental change, increasing demand and unequal distribution is also a significant source of conflict. For example, the intensified climate change mitigation needs (Gutsch et al., 2018b; Naumov et al., 2018), or market and policy trends related to advancing the bioeconomy might further exacerbate scarcity and require decisions over trade-offs with biodiversity conservation and cultural FES (Bauhus et al., 2017; Tyräinen et al., 2017). This is supported by Maxwell and Reuveny (2000) and is closely related to the aforementioned interconnectedness perspective. Finally, stakeholders' identities could also be a source of conflict as they are symbolically defined by their use of natural resources (e.g., as forest owner or forest worker). When traditional stakeholder practices that lead to negative consequences for others (again, interconnectedness) are threatened with change, such as new stakeholder demands and requests for change in forest management, this can lead to conflict. As most forest owners and managers still rely on biomass production for profit generation (Lindahl et al., 2017), this may reinforce the identity of foresters to traditionally provide timber as the main product, even though forest management objectives have evolved integrating new objectives and forestry approaches, such as for biodiversity conservation or carbon sequestration (Bauhus et al., 2017).

As a complement to Buckles and International Development Research Centre, & World Bank, 1999 work, the authors use the concept of forest multi-functionality, namely the idea that forests that fulfill the various ecological, social and economic functions ensure the provision of multiple ecosystem services (Mina et al., 2018). The concept of (forest) ecosystem services (FES) (e.g. Costanza et al., 1996), meanwhile, helped to establish the idea of multi-functional forestry, and the identification of trade-off relationships among conflicting management objectives (Lexer and Brooks, 2005). In Germany, multi-functional forest management became institutionalized in forest planning about half a century ago Gesetz zur Erhaltung des Waldes und zur Förderung der Forstwirtschaft, 1975, but it was criticized for tending to neglect the potential conflicts between different forest functions (Winkel et al., 2011), e.g., production (economic), ecological (protection) and social (Bončina et al., 2019; Führer, 2000). These conflicts stem from user competition for forest functions and services or perceptions of ambiguity for their use and provision in policy and management (Maxwell and Reuveny, 2000; Primmer et al., 2021; Ranacher et al., 2020; Schramm and Litschel, 2017). The tendency to increase provisioning services can reduce regulating and cultural FES, which might lead to conflicts over forest uses, in particular between production and conservation functions, goods and services (Angelstam et al., 2018; Kleinschmit et al., 2017).

With these two main concepts together, we seek to understand how stakeholders who are dependent on various FES could be affected by the possible onset of biofuels from forest biomass, and why conflicts arise.

3. Methodological proceeding for conflict analysis

Study results were cross-validated using various qualitative methods in a triangulation design. In order to generate insights about the potential conflicts an increase in demand for forest biomass for biofuel production could induce for other forest stakeholders, as well as to elaborate about possible conflict management strategies, various qualitative methods have been employed and combined. First, a literature research was undertaken to establish the state of the art of conflicts in forestry in Germany. From there, a stakeholder analysis was carried out with the objective of identifying relevant actors who have an interest or are involved in particular forest uses. Subsequently, expert interviews were conducted with representatives of each stakeholder group. Then, two workshops were carried out for this study. The first workshop focused on the prioritization of the conflicts identified during the expert interviews and the formulation of initial strategies to manage them. The second workshop further elaborated on the types of strategies formulated and the conditions for their implementation. As a final step, three Focus Group Discussions were carried out to further elaborate on particular, contrasting conflict management strategies and the possibilities of their implementation in Germany. Each methodological step incrementally contributed to elaborating the findings and triangulation of the generated results. Fig. 1 shows an overview of the proceedings.

3.1. Stakeholder analysis

The grouping of stakeholders was done using an inclusive (Agnoletti and Santoro, 2015; Torralba et al., 2020), top-down categorization approach, which means that the stakeholder categories were set by the authors (Reed et al., 2009). Three criteria determined a stakeholder group's inclusion into the study: (1) the functioning/existence of their practice is dependent on one type or bundles of provisioning, regulatory, or cultural forest ecosystem services, (2) they have some influence on forest policies, and (3) they are affected by changes in the forest socio-economic landscape.

Based on these criteria, we identify seven major stakeholder groups within the forestry arena in Germany (Table 1). Actors in the group “Forestry” are stakeholders who are directly responsible for the administrative management of forests, including the setting of forest management objectives. Nature conservationists are those groups that prioritize the protection of forests and aim to preserve the ecosystem for future generations. The group “Politics” includes stakeholders who work in public policy or administration. “Industry” are stakeholders who process forest biomass for the production of a wide range of timber-based goods and services, such as the timber processing or biofuel industry. “Science/academia” includes stakeholders affiliated with research organizations. The “Tourism” group refers to stakeholders who are proponents of forest-based outdoor recreation or leisure activities. Finally, the “Health and recreation” group refers to actors who promote the use of forests for health and therapeutic purposes.

Fig. 1. Methodology overview. (Template provided by powerpointschool.com).

Table 1
Identified stakeholder groups with various interests in the forestry arena in Germany.

Stakeholder Group	Description
1. Forestry	• Groups that are responsible for the administration and management of forests • This includes private and public sectors
2. Nature Conservation	• Groups that seek to protect forests and biodiversity and by extension the ecosystem services that they provide • This is generally through the promotion of decreased anthropogenic activities in forests
3. Politics	• Political actors who have an influence on public policy or its implementation that directly or indirectly affect the management of forests
4. Industry	• Covers all groups that receive and process forest biomass for the production of a wide range of products
5. Science/Academia	• Includes scientists, researchers, groups that are affiliated with education and research institutions
6. Tourism	• Encompasses groups that use forests for leisure activities, e.g. biking, hiking, yoga. • These can be profit or non-profit oriented
7. Health and Recreation	• Are using the forest for health purposes or for enjoyment and pastime, spiritual uses

Table 2
List of interviewed experts representing one of the seven stakeholder groups.

Code	Position	Stakeholder Group
TM	Manager at a State Forest	Forestry
LR	Manager at a State Forestry Institution	Forestry
OZ	Coordinator at a Non-Government Organization on Environment	Nature Conservation
ZR	Adviser on Forestry at a Non-Government Organization	Nature Conservation
NM	Adviser on Forest Protection at a National Institution	Politics
NE	Adviser on Sustainable Forest Management at a National Institution	Politics
LH	Director at a Private Biorefinery	Industry
RD	Forest Scientist at a University	Science/Academia
ER	Manager at a National Park	Tourism and Recreation
EH	State Advisor on Forest Politics and Nature Conservation	Tourism and Recreation
EE	Chief Executive at a Health Association	Health
EN	Chief Executive at a Learning Institution for Forest Bathing	Health

3.2. Identifying potential conflicts through expert interviews

Problem-centered, semi-structured interviews (Atteslander et al., 2008; Gläser and Laudel, 2010) were conducted with a total of twelve experts to identify potential conflicts related to increased forest biomass uses for biofuel production. The interviewees represent each of the seven stakeholder groups at least once. The aim of the interviews was to identify: (1) each interviewee's fundamental position on the prospect of increasing forest biomass harvesting for biofuel production in Germany, (2) potential conflicts that could arise between the various stakeholder groups, and (3) potential innovations and synergies between stakeholders regarding prospects for change in forest management.

Table 2 shows the anonymized list of experts, their position in their respective organizations and primary stakeholder group association. Due to the corona pandemic, all interviews were conducted online. The interviews lasted between 45 and 75 min.

Experts were first asked to state their opinion concerning forest biomass harvesting for biofuel production and describe previous experiences with the topic. Next they were asked to assess whether conflicts could arise if harvesting forest biomass for biofuels were to increase, decrease, or remain constant in Germany, specifically with regard to the provision of other FES. This was done in order to establish a connection between societal demand for limited forest goods and services (including FES) and conflict between stakeholders.

They were then asked if any positive developments could arise in connection to an increase in forest biomass use, and whether any strategies and innovations could mitigate potential conflicts. Finally, the experts were asked to assess future demands for forest biomass, specifically whether societal demand would increase or decrease in the coming years. This resulted in the formulation of the nine conflict lines as perceived by the interviewed stakeholders (see Appendix A).

3.3. Workshops for in-depth conflict analysis and strategy development

As a next methodological step, two workshops were organized. The workshops aimed at identifying the conflicts that could arise from potential changes in forest management focusing on the harvesting of forest biomass for biofuels, the limits and challenges of a change in forest biomass use, and to develop strategies for managing competing demands for forest biomass. Both workshops were held online due to corona pandemic, lasting 3 and 3.5 h respectively.

3.3.1. First workshop: Understanding conflicts

The first workshop took place in July 2021. It was attended by 23 participants with each of the seven stakeholder groups represented. The workshop was divided into two phases (see Fig. 2): First, the prioritization of identified conflicts between stakeholder groups, which were based on the findings of the expert interviews, and second the initial formulation of potential strategies for alleviating these conflicts. In the first phase of the workshop, the participants formed four homogenous groups, i.e. each group was comprised of participants who shared

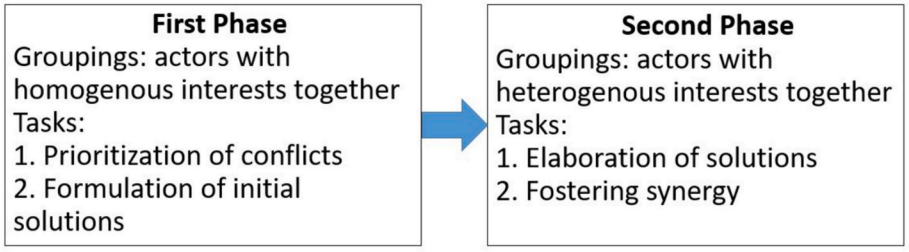

Fig. 2. Overview of Proceeding for the First Workshop.

common views and interests. As an example, the views that cultural FES are crucial for society was shared by members of the "Tourism, Recreation & Health" group members. The additional three groups were: Forestry & Industry, Forestry & Nature Conservation, and Politics & Science/Academia. The groups were asked to rank the conflicts according to which ones, in their opinion, are most pressing and should be prioritized. This was done by presenting the nine conflict lines to each group and the participants ranking each conflict from one to nine (1 being the most crucial and 9 being the least). After this prioritization, participants were asked to formulate initial strategies as to how these conflicts could be tackled, including the identification of the main actors that should be involved in the process.

The top ranked conflicts were as follows: "Wood use vs. Carbon Storage", "Wood Utilization vs. Biodiversity", "New Products (including biofuels) vs. Already Established Products", "Cultural FES vs. Conservation vs. Wood Industry". They were used as a basis for the discussions in the second phase of the workshop.

In the second phase, the participants were re-grouped into heterogeneous groups. Each group was now comprised of stakeholders that had varying, and at times directly conflicting, views on forest management and politics. The groups were asked to comment on the top ranked conflicts from the previous session and to suggest a path forward as to how these could be implemented. Each group presented their strategies to the plenary at the end of the workshop. The workshop was recorded by video for the sole purpose of easing the documentation process. The documentation of the proceedings and results were then shared with participants for validation.

3.3.2. *Second workshop: Debating conflict management strategies*

The second workshop was conducted online in November 2021 and was attended by 14 participants. Similar to the first workshop, each of the seven stakeholder groups was represented. The aim of the second workshop was to concretize the possible strategies to conflicts arising from biofuel production among stakeholders that were suggested in the first workshop. In order to do this, scenario narratives were used as a communication tool to invoke out-of-the-box thinking and to orchestrate a constructive debate (Aukes, 2021).

Three scenario narratives were formulated with each expressing a unique, overstated vision of the future of forest management in Germany. Each of the narratives demonstrates alternating future developments regarding the use of forest biomass from playing a minimal role in society only (i.e. no use) to being a priority in forest policy. Together with this, all identified stakeholder groups also have varying roles, positions, and levels of influence on the development of forest management in the future. Embedded within the scenarios are the strategies and results from the first workshop integrated as best practices for future forest management and dealing with biofuel production. These strategies include (1) payment schemes for ecosystem services, (2) strong public political and financial support for the development of wood products, and (3) a broad implementation of participatory processes in forest decision-making. As such, each of the three scenarios represents a dominating perspective of stakeholders for a particular forest function (ecological, economic and social). Attached to the functions emerge previously identified conflict lines together with particular strategies as a basis for further debate. As a result, there was one scenario focusing on forest conservation, which was named Nature Conservation Scenario, and one scenario that is timber production centric (Economic Scenario). A third scenario, the Society Scenario emphasizes the multi-functionality of forests and its particular role for society. Table 3 summarizes the three scenarios, including the conflicts addressed and strategies promoted to stimulate debate (see Appendix B for the full display of scenarios).

During the workshop, three heterogeneous groups of participants were formed and assigned one scenario each. The group had three tasks. First, they had to assess the opportunities and limitations of the forest management strategies outlined in each scenario for FES provision. Next, the participants had to gauge the strategies' chances of being implemented in real-world situations. For this, potential barriers were discussed. Finally, required context conditions to the strategies were formulated, which would give each the best chance of success. The workshop was recorded by video. The documentation of the proceedings and results were shared with participants for validation and correction.

3.4. *Focus group discussions for deepening conflict management strategies*

As a final methodological step, a series of three focus group discussions (FGDs) was organized between April and May 2022 (see e.g. Morgan, 1996; Nyumba et al., 2018; Slovák et al., 2023). In contrast to the workshops, the objective of FGDs was to focus on particular aspects of strategies based on a small set of experts, to elaborate on various aspects of one particular strategy. The FGDs also had less participants (maximum of four), each of whom were experts on the particular strategy of discussion. Finally, the FGDs provided a means to triangulate the findings of the authors about each strategy up to this point. This was done by giving the FGD experts an overview of the preliminary findings for discussion.

Each FGD focused on one of the three strategies identified in the workshops: (1) "Strengthening participatory processes in forest management through the formation of forest committees", (2) "More systematic use of market-based instruments and compensation systems", and (3) "Harmonization of government regulation for the provision of FES". The groups were a mix of two to four representatives of civil service, academia, NGO and private practice each of them being an expert in the FGD topic they were assigned to such as in participatory governance or the design of payments for ecosystem services.

Each FGD had a duration of 90 min. Due to the corona pandemic, all of them took place online. The FGDs were recorded for the sole purpose of easing the documentation process. The documentation of the proceedings and results were then sent to all the participants for validation and feedback.

4. Results

The following section presents the outcomes and results of each methodological step employed. We highlight the potential of the research design to generate insights on conflict lines, stakeholder

Table 3
The three scenarios used for the second workshop.

Scenario	Description	Conflicts Addressed	Strategies
Nature Conservation Scenario	Aspects of nature conservation take precedence over all other forms of forest use	• Forest Production vs. Conservation	• Payment for Forest Ecosystem Services • No bioeconomy • Use of only local timber • Use of only native trees
Economic Scenario	Timber utilization is prioritized and other types of forest use must be subordinated to it	• Forest Production vs. Conservation • Competition on forest biomass between different kinds of production	• Support for bioeconomy • Subsidy program for carbon storage in wood products • Wood and wood products gain political support as being sustainable • Research into innovative wood use
Society Scenario	Future forest use is decisively shaped by participatory processes and thus by a broad public	• Forest Production vs. Recreation • Forest Production vs. Conservation • Competition on forest biomass between different kinds of production.	• Emphasis on multi-functionality of forests • Participative processes integrated in decision-making • Support for bioeconomy • Use of non-native tree species better adapted to climate change

Table 3
Prioritized list of identified stakeholder conflicts from the expert interviews.

Conflict	Description
Energetic vs. Material Use	This refers to the choice that needs to be made between using wood for energy as a substitute for fossil fuels and storing carbon in material use, where carbon is stored for longer and a higher overall economic value is created.
New Products (including biofuels) vs. Already Established Products	Numerous wood products compete for shared sources of raw materials. Biofuels, for example, would be a new product, increasing the demand for forest biomass that is already highly demanded.
Wood Use vs. Biodiversity	An increasing demand for forest biomass is associated with an incentive to harvest more biomass in the forest. This can result in a reduction of the proportion of deadwood in the forest or in the stock of older, larger-sized trees.
Forest Biomass Use vs. Recreation	Increased harvesting of forest biomass could affect the recreational value of forests by limiting access to forest areas or by a decrease of forest area in general.

interests, and possible strategies to deal with conflicting demands. Although the focus is on the case of forest biomass for biofuel production, our investigation also brought to light a wide range of conflicts between several forest uses.

4.1. The identified conflicts from forest biomass use for biofuel production

The expert interviews showed that majority of the interviewees (10 out of 12) were against a potential increase of harvesting volumes of forest biomass for biofuel production. These experts were from forestry, nature conservation, politics, industry, and science/academia. They foresaw that such an increase would lead to increased conflicts and competition with stakeholders using forest biomass for engineered wood products, pulp and paper production or energy production, among others. Furthermore, restricting use to wood residues in order to minimize the aforementioned conflict raised doubts whether a sufficient amount of biofuels could be produced. The experts posit that increasing negative effects of climate change, such as forest fires and bark beetle infestations in recent years, have led and will lead to (further) instabilities in terms of forest biomass availability, which would then also affect an incoming biofuel industry.

During the interviews, the experts provided further background information on the conflicts at stake, which allowed for gaining a deeper understanding of the different stakeholders' perceptions. One example is the idea of using forest biomass for biofuel production being closely connected to general concerns regarding supply chains. Here, the potential effect of utilizing wood for energy production on material supply for wood products, or on biodiversity conservation, should be considered, especially on regional level. Multi-faceted layers of conflict identified through interviews were used as input for the workshops to deepen conflict understanding. Table 3 shows the prioritized list of identified conflict lines.

4.2. Delving deeper into Conflicts from Forest biomass for biofuel and management strategies

The design of the workshop and the composition of participants allowed a deeper understanding of the conflicts at stake, especially regarding their perception of urgency to handle them. For example, the Forestry & Nature Conservation group prioritized the conflict "Wood Use vs. Biodiversity" noting that the demand for forest biomass would lead to unfavorable conditions for Germany's forest biodiversity such as less dead wood or old growth/older trees. In contrast, the Politics & Science/Academia group assigned the topic of "Wood Use vs. Carbon Storage" as their conflict priority. Here, competing interests of carbon storage via the use of forest biomass for timber production, versus storage within intact forests, were addressed. The Forestry & Industry group decided that "New Products (including biofuels) vs. Already Established Products" should be prioritized as various wood products compete for the same raw material source (forest biomass) and an increase in demand due to biofuel production would lead to increased conflicts. Finally, the Tourism, Recreation & Health group defined a new conflict line "Cultural FES vs. Conservation vs. Wood industry", which describes how some conservation measures, through its restrictions regarding access to forests, and how the wood industry's harvesting of forest biomass both can limit the provision of cultural FES. Table 4 shows an overview of the four prioritized conflicts and the respective groups that named them.

The second part of the workshop was dedicated to formulating and elaborating on potential strategies for the identified and prioritized

Table 4
Conflict prioritization by the homogeneous groups during the first workshop.

Stakeholder Group	Prioritized Conflict
Politics & Science/ Academia	Wood Use vs. Carbon Storage
Forestry & Nature Conservation	Wood Use vs. Biodiversity
Forestry & Industry	New Products (including biofuels) vs. Already Established Products
Tourism, Recreation & Health	Cultural FES vs. Conservation vs. Wood Industry

conflicts from the now heterogeneous groups. Here, the need to debate trade-offs and to work towards compromises is higher than within homogenous groups. For example, regarding the conflict "Wood Use vs. Carbon Storage", the groups recognized the need for a common standard for the establishment of nature reserves, which would support carbon sequestration by forests. A policy to set aside 10 % of the forest area for nature conservation is seen as helpful. In addition, the establishment of a cascade policy for the use of forest product is needed to maximize resource use efficiency. This comes along with the decision whether carbon storage in wood materials should be prioritized over using forest biomass for energy use. Further, discussions regarding the conflict "Cultural FES vs. Conservation vs. Wood Industry", it was stated that communication with stakeholders is key, specifically the mediation between them. In addition, the regional context must first be understood in defining which conflicts for FES are relevant. Table 5 shows two of the prioritized conflicts and a selection of the initial strategies developed by the groups.

The prioritized forest conflicts and the initial strategies formulated from the first workshop were integrated into the three theoretical scenario narratives for the second workshop for further debate. For example, in acknowledgement of the various societal demands for FES, a call for strengthening participatory processes in forest management is particular helpful on communal level. A promising idea that emerged is the formation of forest committees, which shall comprise of the local stakeholders who are depending on the supply of FES. It is envisioned that strategies for alleviating conflicts, including those foreseen by harvesting forest biomass for biofuel production, can be found through dialogue, negotiation and mediation. Another strategy pathway targets Germany's forest policies, including those that indirectly influence forest management, that are found to be conflicting one another when it comes to the provision of FES. Thus, it is recommended that a harmonized or integrated strategy for the provision of FES should be established, which could contribute to a clearer cascade use policy. This would then bring clarity as to how biofuels are prioritized, if at all, in light of other demands for various FES. Finally, establishing compensation systems for regulating or even cultural FES, is seen as a way to address the market failure for their lack of provision compared to timber production. This would offer alternative income streams for forest owners, which in turn could lead to an enlarged set of forestry products and service portfolio. Table 6 shows the three strategies and their descriptions.

4.3. Future strategies for conflict management

Focus Group Discussions (FGD) were carried out to elaborate on previously identified strategies from the workshops and to expound on their effects and the required conditions for implementation. At this point in the study, it became apparent that conflict arising from biofuels from forest biomass is only one of many issues that need to be addressed in terms of competing FES demand. Accordingly, the strategies were developed to contextualize the issue of using forest biomass for biofuel production as being a part of a broader spectrum of FES needs that should be accounted for in forest governance.

Table 5
Examples for initial strategies from the heterogeneous groups during the first workshop.

Prioritized Conflict	Selection of Initial Strategies
Wood Use vs. Carbon Storage	• Development of indicator set for establishing nature reserves • 10 % set-aside of forest area • Further research on how much energy can be provided by biofuels from forest biomass • Establishment of a cascade use for forest products
Cultural FES vs. Conservation vs. Wood Industry	• More communication and mediation between user groups. • Consideration of regional context when defining existing conflicts • Determination which FES are in demand (where do biofuels stand) • Move away from classic economic perspective/ do not let economic pressure solely dictate forest management

Table 6
Strategies for managing conflicts and the provision of FES derived from the second workshop.

Strategy	Description
1. Strengthening participatory processes in forest management through the formation of forest committees	The forest committee acts mainly through participatory processes and decides how to manage the forest in a particular area with the inclusion of heterogeneous interests and in consultation with all stakeholders
2. More systematic use of market-based instruments and compensation systems	Alternative approaches for generating income from FES beyond timber provision should be supported. This calls for accounting for and valuing natural capital and is especially important for small private forest owners to show management alternatives.
3. Harmonizing government regulation for the provision of FES	A strategy for FES provision is needed. This could begin with identifying which forest policies conflict with each other and addressing them through prioritization or innovation. This could mean the designation of more protected areas with less forest production area being made available in total, which should be managed more intensively.

One future pathway that crystallized as a promising strategy was the formation of forest committees, which is further explained here in order to demonstrate the potential of the designed FGD. As it was elaborated, a forest committee can serve as an exchange platform for citizens, forest owners and managers who are dependent upon the FES provided by, for example, a communal forest. It offers its members the opportunity to co-design forest management strategies and planning approaches. Such structures already exist e.g., in Italy where forest management is done by a "Waldkomitee" or forest committee (Gemeinde, 2023). According to the FGD participants, this strategy offers the opportunity to embed a debate on biofuel production from forest biomass into the context of stakeholder consultation on a local level. Here, societal demands can be raised and trade-offs identified which can be considered in forest management decision-making. One of the experts highlighted that there is dissatisfaction in how little societal concerns are taken into account into public decision-making. In particular, there are general communication problems when it comes to the inclusion of alternative knowledge sources for forest management. Experts felt there is a need to further develop science communication by breaking the barrier between "information bubbles", where scientific information is unable to reach society.

In terms of chances, the establishment of forest committees would mean involving a wider range of stakeholders, which would ideally lead to the inclusion of more diversified opinions on which FES (including biofuels) should be prioritized and ultimately, on how forest management is done. This could result in management decisions that offer more opportunities to account for the conflicts between competing stakeholder interests. Digitalization also offers the chance to reach more stakeholders and facilitates their inclusion into forest management processes. As a prerequisite for forest committees to succeed, the experts expressed the need to work towards a culture of participation that has to be established first in existing governance structures. This would entail forest managers to redefine their roles and to act as mediators that manage the various societal demands for FES. Apart from that, the legitimacy of the forest committee needs to be ensured by its institutionalization. Ideally, this would also entail that the forest management

process is transparent and that outcomes of participatory processes are made to be binding. Table 7 shows a summary of the expert findings focusing on that pathway.

5. Discussion

For this study on potential conflicts that could arise from harvesting forest biomass for biofuel production, a methodology that consists of four interlinked steps was developed and tested. By synergizing the findings of each methodological step and its iterative proceeding, the identification of already existing as well as potential future conflicts between forest stakeholders was possible. The analytical capability of the methodology and its potential chances and limitations are discussed.

5.1. Increasing competition requires transparent decisions over trade-offs

As a foundation for conflict analysis, expert interviews were utilized as a means to identify which conflicts exist between the aforementioned stakeholders. The interviewed stakeholders commonly highlighted that the competition for limited forest biomass and forest ecosystem services in Germany's forest arena is high and that new demand for the production of biofuels would exacerbate already existing conflicts. This perception was also largely confirmed during the workshops. It supports Buckles and International Development Research Centre, & World Bank, 1999 theory on conflict due to interconnectedness as the decisions of each forest stakeholder affect the others and thus leads to increased conflict. It also became apparent that resource scarcity (here forest biomass and other FES) leads to additional conflict among stakeholders (Maxwell and Reuveny (2000). Increasing the use of forest biomass for biofuel production, especially the forest-based industries and the energy sector to which biofuels belong, would increase competition for the same resources, accelerating the perception of scarcity (Cazzaniga et al., 2019). This atmosphere (and fear) of scarcity and competition was observed throughout the duration of this study especially in light of the various other societal demands on FES, such as to mitigate the climate change effects in Germany. The interactions with the study participants echo the findings of the latest forest health survey (BMEL, 2022) and the climate risk prognosis of the UBA (2021), that Germany's forests are degrading at an alarming rate and are further at risk due to the effects of climate change. The participants of this study recognize that their respective industries or sectors are very much at risk as well.

Stakeholder selection is crucial to ensure a representative picture of the forestry arena in Germany. Considering the wide variety of opinions and perspectives not only across but also within each stakeholder group (Rosenkranz et al., 2017), the nuances of perception heterogeneity are likely not completely captured in this study. The same can be said regarding the potential conflicts identified. However, the methodology for conflict analysis allowed us to confirm the diversity of interests and perceptions between heterogeneous stakeholders, and underline the need to make trade-offs transparent in the debate regarding biofuels production from forest biomass in light of further FES provision. The need for such a debate was observed specifically during the prioritization of conflicts during the workshops. The homogeneous groups identified their most pressing conflicts, while the formation of the heterogeneous groups initiated more debate between the participants - mostly regarding which FES should be prioritized. Cowie et al. (2021) have argued for the climate benefits of using biofuels from forest biomass as a substitute for fossil fuels. It was found during the first workshop, however, that stakeholders were calling for further quantification of the climate benefits of using this technology in order to have a clearer understanding, which would improve their decision-making. Furthermore, the environmental cost, e.g., the loss of FES such as provisioning of construction timber, water regulation or cultural services, could lead to social conflicts between forest stakeholders if this policy route is taken in Germany.

The designed methodology also demonstrated the diversity of interests between heterogeneous stakeholders. The prospect of using biofuels from forest biomass was not outright dismissed. During the expert interviews, two experts from the stakeholder groups “tourism” and “health & recreation” saw the potential to provide enough forest biomass for biofuel production if done in a regional context, acknowledging how this would benefit the further development of the bioeconomy. Following the development of this stakeholder group further, during the first workshop they defined a conflict, “Cultural FES vs. Conservation vs. Wood industry”, which depicts how cultural FES stakeholders often need to negotiate both with conservation efforts, due to restrictive access, and wood industry activities, due to safety concerns in forest management and impacts on landscape picture. Studies have demonstrated that cultural FES are less prioritized in most circumstances in forest management (Agnoletti and Santoro, 2015; Torralba et al., 2020). This likely describes a characteristic within cultural FES stakeholders that supports negotiation and mediation as being standard strategies for pushing for their forest use goals, as they usually have less political influence in forest management (Torralba et al., 2020). This complex and unequal relationship between cultural FES stakeholders and others are described by Buckles and International Development Research Centre, & World Bank, 1999 as a source of conflict. Further investigation on the topic of influence among stakeholders e.g., Marques et al. (2020), is recommended for a better understanding of this relationship and to develop more profound approaches to minimize such conflicts.

5.2. Scenario-workshops as means to debate alternative futures

In contrast to the work of Pérez-Soba et al. (2015), who have shown how scenarios can be used to capture ideal visions of the future for land use planning (including forestry), scenarios in this study were used as a mean for communication. Their intention was to provoke workshop participants by framing forest management in overstated situations in which the role of utilization of forest biomass for the production of

Table 7
FGD results on strengthening participatory processes in forest management through the formation of forest committees.

Barriers	Chances	Framework Conditions
Hardly any participation processes available in public structures (internal as well as external)	Great project-related diversity of opinion	Creation of a general culture of participation in existing governance structures
Concerns/concerns from the population regarding forestry measures are often not taken seriously	Digitization of participation processes	New understanding of the roles of decision-makers; they must allow themselves to be questioned
"Information bubbles" (forestry/science vs. Internet)	Integration into participation processes that have already been successfully conducted	Legitimacy/binding nature of decisions must be ensured

biofuels varies, leading to differing conflicts and pledging for various strategies. The use of scenarios in this study is in line with the methodology outlined by Aukes (2021), which states that one can also use extreme scenarios to induce out-of-the-box thinking among participants. Specifically, the Economic Scenario and the Nature Conservation Scenario which maximize either timber production or biodiversity conservation in forest management, helped participants to reflect on the possible implications of each strategy, the trade-offs these incorporate, and on their particular role. This methodological step resulted in the identification of the three potential strategies for the future.

The strategies were then deepened with help of the focus groups, as a complement to the second workshop, to ground them in reality by identifying the chances, barriers and conditions so they can have an effective chance to minimize the conflicts identified. Though the FGDs were effective in gathering information, the results are however, as Slovák et al. (2023) have pointed out, rooted in and therefore limited to each expert's knowledge and experience. In practical terms, the results from the FGDs are non-exhaustive and should be considered a starting point for more in-depth research on each of the three strategies and their applicability. As an example, the establishment of forest committees aims for the inclusion of a broader range of stakeholders into forest management decisions. In terms of barriers, the FGD showed that the practices and traditions associated with forestry are very much intertwined with the identities of the forest practitioners and that conflicts arise when these identities are being threatened. Krumm et al. (2020) note that this can be observed not just in forestry but in hunting as well. As such, obtaining political support for establishing a Forest Committee would be a significant challenge. This phenomenon is also described by Buckles and International Development Research Centre, & World Bank, 1999 where they state that stakeholders' identities are at times defined by their use of natural resources and are indeed a source of natural resource conflict. Overcoming this barrier by establishing a general culture of participation is then identified as a crucial framework condition for this strategy's success. This supports the work of Beckley et al. (2006) who stated that participatory processes can be designed to enhance forest management by providing a platform for sharing information, expressing one's interests and possibly influence the forest management process. Other.

5.3. Limitations of the study

Overall, the design proposed in this study relies heavily on the variety of stakeholders included in each methodological step. From the expert interviews, workshops and FGDs, the represented perspectives are crucial in ascertaining which FES are to be prioritized, and for identification of potential use conflicts and mitigation strategies. That said, the relatively small participant sample size for the interviews, workshops, and FGDs is therefore a limitation as it is prone to bias. Workshops and FGDs are methodologies that are vulnerable to groupthink and this was observed in more than one occasion where stronger personalities tend to dominate discussions. Furthermore, the workshops and FGDs were moderated by the authors and moderator bias comes into play.

In order to improve the methodology outlined in this study, it is important to increase the range of experts involved in the study, add more perspectives, change group compositions and triangulate results even further. One possibility could be to include the hunting community, wildlife conservationists, and economists among others. The inclusion of new views and the findings would better reflect the more heterogeneous perceptions present in society and would then have marked implications on the overall sustainability of the management of particular forests. Further multi-sectoral investigations into the possible forest user conflicts with biofuels from forest biomass should be undertaken particularly on a local and communal scale. In addition, although there were study participants who support the idea of utilizing forest biomass for biofuel production, no explicit biofuel experts took part in the study. As such, the discussions on its advantages (and disadvantages) for the economy and even the environment were limited. Furthermore, an external moderator could be employed in order to improve the objectivity of the discussions.

The authors encountered significant hurdles during this study due to the corona pandemic as the data gathering was done from June 2021 until May 2022. Most of the activities were originally planned to be in-person events, which had to be adapted online. The authors therefore decided to plan for the workshops to last no longer than three hours each, in order to alleviate as much strain as possible from the participants. This time limit, however, restricted the overall amount of exchange that was possible between the participants during the two workshops. At the same time, shifting to an online format eased the logistical burdens for all parties involved, for example by eliminating travel time and costs for participants.

6. Conclusion

Utilizing forest biomass for the production of biofuels in Germany is a highly debated topic, as many stakeholders are dependent upon the country's forests to provide an array of ecosystem services, which could be affected. This study contributes to the debate as an innovative ex-ante conflict assessment methodology that outlines how the utilization of forest biomass for the production of biofuels could affect already existing types of utilization and related stakeholders, as well as how to co-create management strategies to aid in conflict resolution and inform decision-making. Beyond biofuels, forests are recognized as a key sector to the general progress of the bioeconomy, the development of which could lead to more diversified demand for forest ecosystem services with new stakeholders becoming more active in time. Considering the already crowded forest arena and the current demands for forests, it would also follow that the potential for conflict could also increase. Considering this, further research involving a more heterogeneous range of forest stakeholders would enrich this methodology. This approach could be used as part of a sustainability assessment that engages in critical debate on the provision of forest ecosystem services with concerned stakeholders as part of a participatory process.

CRediT authorship contribution statement

Gino Garcia: Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Carsten Mann:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Tobias Cremer:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Gino Garcia, Carsten Mann, and Tobias Cremer report that financial support was provided by the German Federal Ministry of Transport and Digital Infrastructure (BMDV). Gino Garcia reports financial support was provided by Ministry of Science, Research and Culture of the federal state of Brandenburg, Germany. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A

The nine identified stakeholder conflicts from the expert interviews.

Conflict	Description
Energetic vs. Material Use	This refers to the choice that needs to be made between using wood for energy as a substitute for fossil fuels and storing carbon in material use, where carbon is stored for longer and a higher overall economic value is created.
Wood Use vs. Carbon Storage	The conflict asks: which is the better strategy against climate change – storing carbon in wood products or in trees?
Reforestation vs. Agricultural Use	A growing demand for wood can increase the demand for additional areas for afforestation. These areas are often used for agriculture.
New Products vs. Already Established Products	Many wood products are made from similar ranges, so they compete with each other for a common raw material base. Biofuels, for example, would be a new product, increasing the demand for forest biomass that is already highly demanded.
Wood Use vs. Biodiversity	An increasing demand for forest biomass is associated with an incentive to harvest more biomass in the forest. This can result in a reduction of the proportion of deadwood in the forest or in the stock of older, larger-sized trees.
Forest Biomass Use vs. Recreation	Increased harvesting of forest biomass could affect the recreational value of forests by limiting access to forest areas or by a decrease of forest area in general.
Use of Wood vs. Remuneration for Public Services	Remuneration for public services (e.g. regulatory and cultural FES) could reduce the willingness of forest owners to use wood. This could result in a wood shortage.
Rising Commodity Prices vs. Other Types of Forest Use	If commodity prices rise, other types of forest use could be deprioritized.
Value Creation vs. Non-Utilization	Different targets are being set for the proportion of forests being set aside for non-utilization or conservation. These would further promote the scarcity of raw materials.

Appendix B

The three scenarios used for the second workshop.

The Society Scenario was presented as a press release from the fictitious federal state of “Brandenberg”. It emphasizes qualities that call for multi-functionality in forest management and the provision of a diverse set of FES.

Brandenberg

Menschen, Leben, Natur

Pressemitteilung

25.10.2040 | Pressestelle der Stadt Brandenberg

Multifunktionale Wälder sind zukunftsfähig

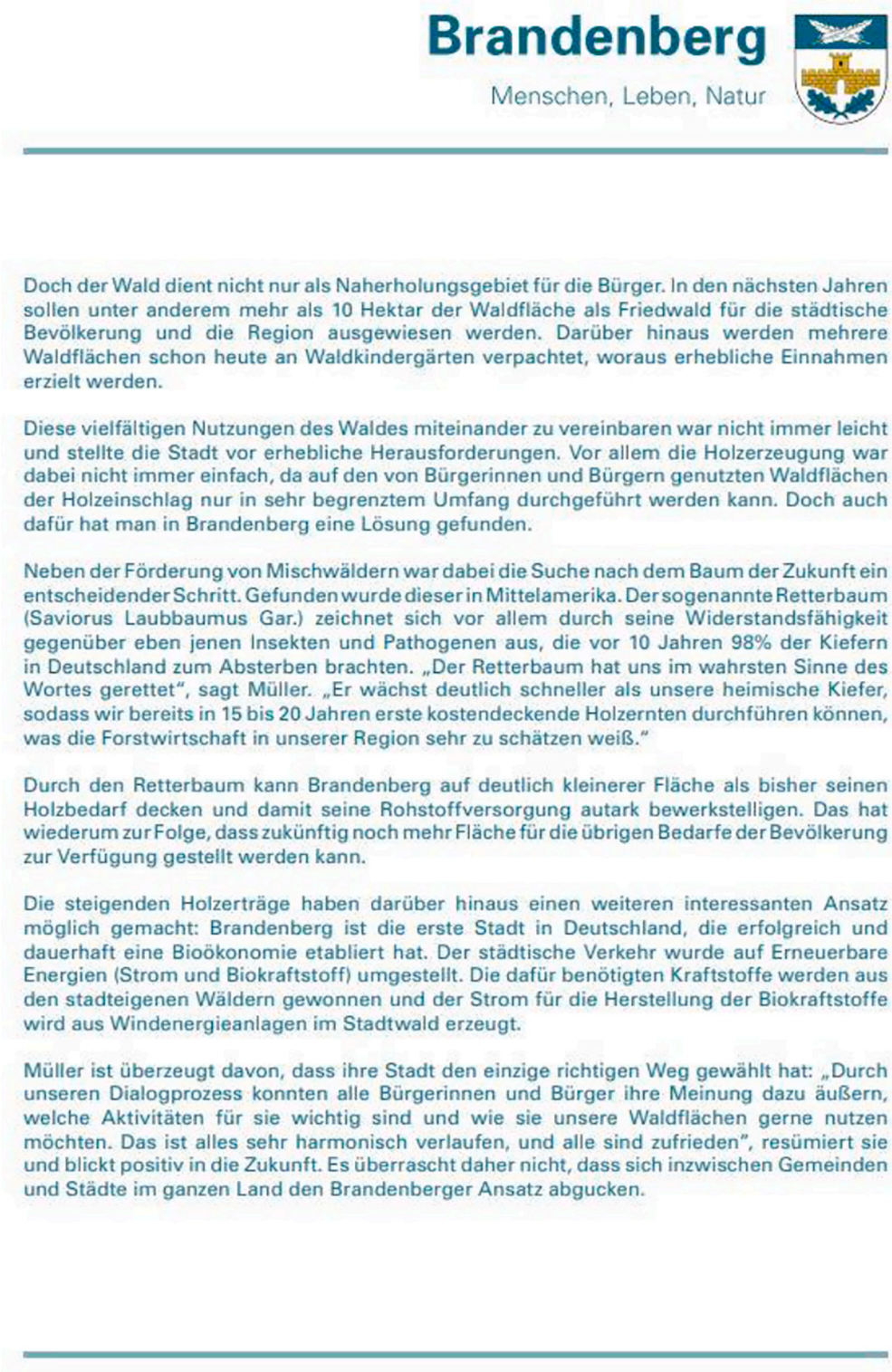
Die Stadt Brandenberg präsentiert die Fortschritte ihrer "Alles für alle"-Philosophie bei der Umsetzung ihrer Waldbewirtschaftungsstrategie

Multifunktionalität – das ist Brandenbergs Geheimnis für den Einklang von wirtschaftlicher Prosperität und Umweltschutz. Während der Klimawandel im Rest des Landes und in der ganzen Welt verheerende Folgen für Mensch und Umwelt hat, ist es Brandenberg gelungen, seiner Bevölkerung unter dem Motto „Alles für alle" sowohl wirtschaftlichen Wohlstand als auch eine intakte Natur zu bieten und dadurch ganz nebenbei das soziale Wohlbefinden zu steigern.

„Unser Ansatz, die Forderungen unserer Bürgerinnen und Bürger zu berücksichtigen und unsere Waldbewirtschaftungsstrategien an diese anzupassen, war ein Erfolg", sagt Jasmine Müller, Oberbürgermeisterin von Brandenberg. Hauptaufgabe der Revierleitung ist inzwischen weniger die Bewirtschaftung des Waldes, sondern vor allem die Moderation von Konflikten zwischen den beteiligten Parteien und der Flächenverwaltung im Sinne der Erholungssuchenden.

„Unser mehrstufiger, partizipativer Ansatz und die Bildung eines sogenannten Waldkomitees haben allen das Gefühl gegeben, einbezogen zu werden. Das hat dazu geführt, dass alle ein Interesse an dem haben, was wir tun", fasst Müller zusammen. Wichtig dabei ist, dass die Beschlüsse des Waldkomitees bindend für die Arbeit der Gemeinde sind.

Heute sind rund 80% der städtischen Waldfläche langfristig, über mehrere Generationen als Erholungswald ausgewiesen und gesichert. Dies hat zu einer überwältigenden Zufriedenheit der Brandenbergerinnen und Brandenberger geführt, die ihre gesellschaftlichen Ansprüche an den Wald klar erfüllt sehen und dadurch gerne zu seinem Erhalt beitragen. So zahlen die Waldnutzenden auch gerne das von der Gemeinde angesetzte Eintrittsgeld, das unter anderem für den Bau und die Instandhaltung von erstklassigen Wander- und Radwegen verwendet wird. Damit ist beispielsweise auch der lokale Mountainbike Verein sehr zufrieden. Darüber hinaus hat sich eine Walderlebnisgenossenschaft gegründet, deren Mitglieder die Infrastruktur des Waldes mitgestalten und sich um deren Pflege kümmern.



Brandenberg

Menschen, Leben, Natur

Doch der Wald dient nicht nur als Naherholungsgebiet für die Bürger. In den nächsten Jahren sollen unter anderem mehr als 10 Hektar der Waldfläche als Friedwald für die städtische Bevölkerung und die Region ausgewiesen werden. Darüber hinaus werden mehrere Waldflächen schon heute an Waldkindergärten verpachtet, woraus erhebliche Einnahmen erzielt werden.

Diese vielfältigen Nutzungen des Waldes miteinander zu vereinbaren war nicht immer leicht und stellte die Stadt vor erhebliche Herausforderungen. Vor allem die Holzerzeugung war dabei nicht immer einfach, da auf den von Bürgerinnen und Bürgern genutzten Waldflächen der Holzeinschlag nur in sehr begrenztem Umfang durchgeführt werden kann. Doch auch dafür hat man in Brandenberg eine Lösung gefunden.

Neben der Förderung von Mischwäldern war dabei die Suche nach dem Baum der Zukunft ein entscheidender Schritt. Gefunden wurde dieser in Mittelamerika. Der sogenannte Retterbaum (Saviorus Laubbaumus Gar.) zeichnet sich vor allem durch seine Widerstandsfähigkeit gegenüber eben jenen Insekten und Pathogenen aus, die vor 10 Jahren 98% der Kiefern in Deutschland zum Absterben brachten. „Der Retterbaum hat uns im wahrsten Sinne des Wortes gerettet", sagt Müller. „Er wächst deutlich schneller als unsere heimische Kiefer, sodass wir bereits in 15 bis 20 Jahren erste kostendeckende Holzernten durchführen können, was die Forstwirtschaft in unserer Region sehr zu schätzen weiß."

Durch den Retterbaum kann Brandenberg auf deutlich kleinerer Fläche als bisher seinen Holzbedarf decken und damit seine Rohstoffversorgung autark bewerkstelligen. Das hat wiederum zur Folge, dass zukünftig noch mehr Fläche für die übrigen Bedarfe der Bevölkerung zur Verfügung gestellt werden kann.

Die steigenden Holzerträge haben darüber hinaus einen weiteren interessanten Ansatz möglich gemacht: Brandenberg ist die erste Stadt in Deutschland, die erfolgreich und dauerhaft eine Bioökonomie etabliert hat. Der städtische Verkehr wurde auf Erneuerbare Energien (Strom und Biokraftstoff) umgestellt. Die dafür benötigten Kraftstoffe werden aus den stadteigenen Wäldern gewonnen und der Strom für die Herstellung der Biokraftstoffe wird aus Windenergieanlagen im Stadtwald erzeugt.

Müller ist überzeugt davon, dass ihre Stadt den einzige richtigen Weg gewählt hat: „Durch unseren Dialogprozess konnten alle Bürgerinnen und Bürger ihre Meinung dazu äußern, welche Aktivitäten für sie wichtig sind und wie sie unsere Waldflächen gerne nutzen möchten. Das ist alles sehr harmonisch verlaufen, und alle sind zufrieden", resümiert sie und blickt positiv in die Zukunft. Es überrascht daher nicht, dass sich inzwischen Gemeinden und Städte im ganzen Land den Brandenberger Ansatz abgucken.

The Nature Conservation Scenario was written as a press release from the fictitious "Ministry for Forest and Nature Conservation". It depicts a society that supports the protection of biodiversity and nature.

Bundesministerium
für Wald
und Naturschutz

Pressemitteilung

19.03.2040, Pressestelle des BMWN

Wir müssen auf den Fortschritten der letzten zehn Jahre aufbauen

Zum Internationalen Tag der Wälder fordert der Bundesminister die Naturschutzanstrengungen zur Bekämpfung des Klimawandels fortzusetzen

Bundesministerium
für Wald
und Naturschutz

Gutleben: Wir müssen auf den Fortschritten der letzten zehn Jahre aufbauen

Zum Internationalen Tag der Wälder fordert der Bundesminister die Naturschutzanstrengungen zur Bekämpfung des Klimawandels fortzusetzen

„Wir dürfen uns nicht auf dem Erreichten ausruhen", sagt Peter Gutleben, der als Bundesminister im Ministerium für Wald und Naturschutz (BMWN) die Umsetzung der bundesweiten Naturschutzpolitik in den letzten zehn Jahren federführend begleitet hat. Angesichts der sechsten sommerlichen Hitzewelle in Folge und der damit verbundenen Waldbrände sowie angesichts des nahezu vollständigen Verlustes der Fichte in Deutschland war der Kampf um die Rettung der deutschen Wälder nicht einfach.
„Es war nur mit Hilfe aller Bereiche der Gesellschaft und vor allem der Gemeinden, die um die Wälder herum leben, möglich, mit den von uns eingeleiteten Maßnahmen den Grundstein für eine stärkere Resilienz der Wälder unseres Landes zu legen", erklärt Gutleben.
Die bisherigen Anstrengungen – verstärkte Aufforstungsmaßnahmen kombiniert mit der Stilllegung von 20% der deutschen Waldfläche – haben bis heute bereits zu einer Vorratszunahme in unseren Wäldern von 28,5 %, zu einer Zunahme der einheimischen Laubbäume um 30 % und insgesamt zu einer Zunahme der Kohlenstoffspeicherung im Wald in Form von lebender Biomasse, Totholz und Boden um 45 % geführt.

Auf seinem Weg ist Gutleben jedoch auf einigen Widerstand gestoßen. In der Tourismusbranche musste beispielsweise viel Überzeugungsarbeit geleistet werden. Die Ausdehnung der Waldschutzgebiete und die Nutzung strengerer Qualitätskriterien für Waldwildnisgebiete haben den Zugang der Besucherinnen und Besucher zum Wald eingeschränkt und die Möglichkeiten der touristischen Nutzung von Wäldern deutlich verringert.
Auch im Kleinprivatwald gab es zunächst erhebliche Bedenken. Doch Steuerfinanzierte Systeme zur Honorierung von Ökosystemleistungen, einschließlich der Kohlenstoffbindung, der Wasserfilterung und des Bodenschutzes und weitere ähnliche Initiativen haben sich am Ende als mehr als ausreichend erwiesen, um die Einkommensverluste durch die geringere Holzernte und den Verzicht auf die Nutzung von invasiven Baumarten wie Roteiche oder Douglasie auszugleichen.

Vor allem aus der Holzwirtschaft gibt es jedoch immer noch Gegenwind für Gutlebens Kurs.
„Wir befinden uns in einer Übergangsphase und wir hören die Bedenken laut und deutlich", sagt er. „Es ist wichtig festzuhalten, dass wir hart daran arbeiten, unsere Wirtschaft umzubauen, und wir sollten das Gesamtziel im Auge behalten. Es lässt sich jedoch nicht bestreiten, dass die Qualität der Waldökosysteme Deutschlands noch nie so gut war wie heute und sie wird sich in den kommenden Jahrzehnten erfreulicherweise durch unsere Maßnahmen sogar weiter verbessern."

Darüber hinaus konnten die negativen gesamtwirtschaftlichen Effekte durch den Abbau von signifikanten Einschnittkapazitäten und Arbeitsplätzen mangels Rohstoff in der Holzindustrie und die politische Vorgabe der ausschließlichen Nutzung regionalen Holzes, die immer wieder befürchtet wurden, durch die eingeleiteten Maßnahmen bisher mehr als ausgeglichen werden. Dies wird durch eine Studie des BfN unterstützt, die zu dem Schluss kommt, dass die Klimawirksamkeit ungenutzter Wälder die Wirksamkeit genutzter Wälder um ein Vielfaches übertrifft.
Bislang verfolgte Ansätze der Bioökonomie wie z.B. die Biokraftstoffproduktion aus Holz haben sich damit als wirkungslos erwiesen.

The Economic Scenario was depicted as a newsletter from a fictitious timber company. Forests here are used mainly for timber production.

Gerrer
Das Magazin

Jubiläumsausgabe
zum 80-jährigen Bestehen

05.03.2040

Seit mehr als 20 Jahren auf dem Holzweg – und das mit Erfolg!

Produktionsleiterin
Sylvia Schlegl

Auch 80 Jahre nach Firmengründung ist bei der Gerrer Gruppe, einem der größten Konzerne der europäischen Holzindustrie, kein Stillstand in Sicht. Vor allem die letzten 20 Jahre sahen das größte Wachstum der Firmengeschichte.
Auf diese fulminante Zeit und jüngst getroffene richtungsweisende Entscheidungen blicken wir gemeinsam mit unserer **Produktionsleiterin Sylvia Schlegl zurück.**

GM: Frau Schlegl, worin sehen Sie den Impulsgeber für den Erfolg der Gerrer Gruppe in den vergangenen 20 Jahren?

Schlegl: In den frühen 20er Jahren gab es da zum einen richtungsweisende Entscheidungen der öffentlichen Hand zur Förderung von Holz als nachhaltigem Werk- und Rohstoff. Hierzu gehörte vor allem die EU-Bioökonomiestrategie und ihre ausgesprochen kluge Umsetzung auf nationaler Ebene in attraktiven Förderprogrammen. Nicht nur die klassischen Bereiche, wie zum Beispiel der Holzbau, wurden hierbei gefördert, sondern auch die Fertigung innovativer Holzprodukte, die gerade durch die Gerrer Gruppe entwickelt und zur Marktreife geführt wurden. Sehr geholfen hat hierbei die Aufstockung der zur Verfügung stehenden Mittel zur Erforschung von Holzprodukten als CO2-Speicher im Rahmen des Waldklimafonds.
Die Substitution von herkömmlichen Rohstoffen durch Holz wurde dabei am stärksten honoriert. Das ließ die Forderungen nach Vergütung von Ökosystemleistungen vollständig verhallen. Wenn ich mich recht erinnere, konnte das Fördervolumen für unsere Branche in nur fünf Jahren beinahe um den Faktor 6 vervielfacht, also auf insgesamt 60 Millionen Euro erhöht werden.

Gerrer

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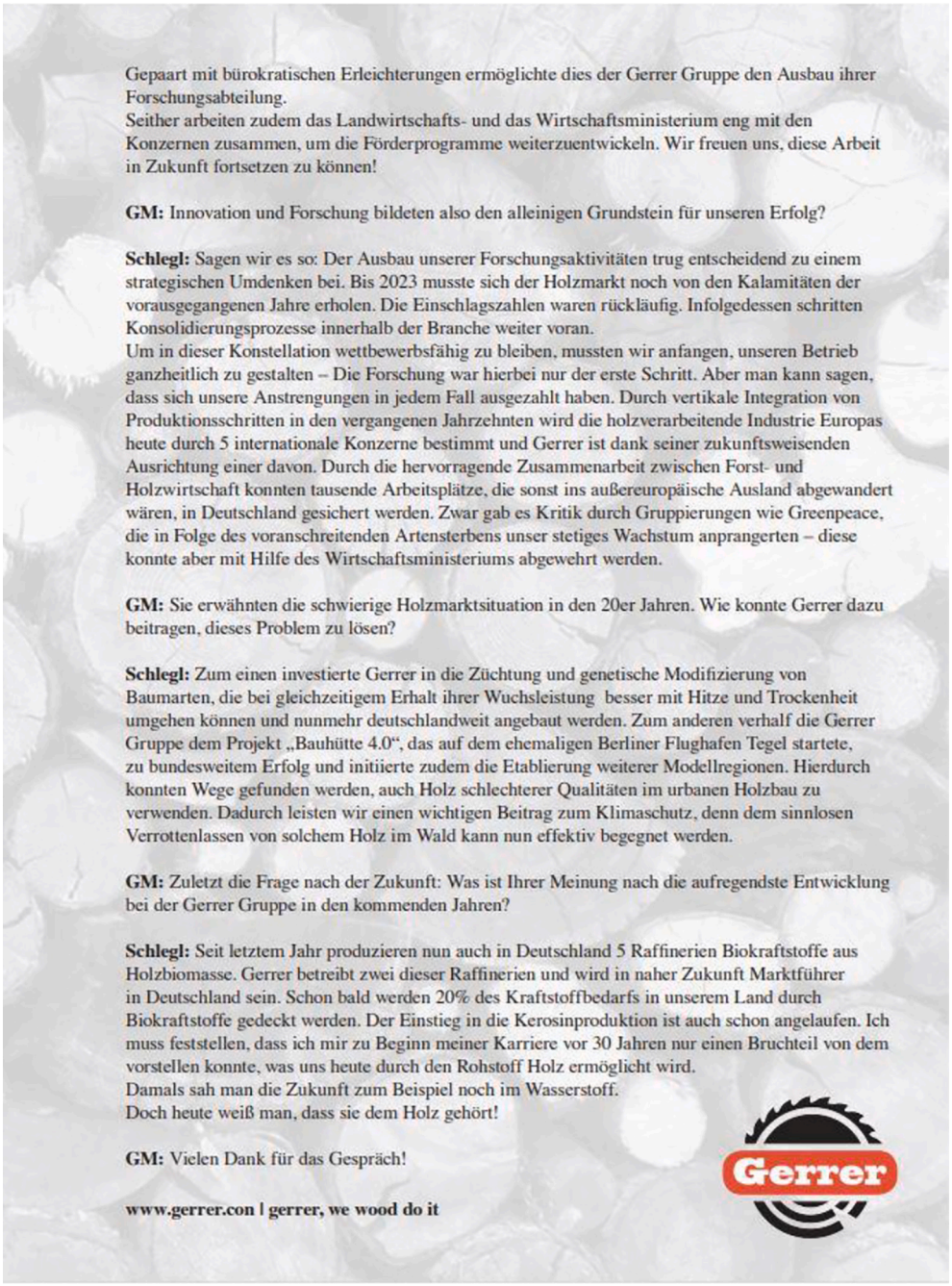

Gepaart mit bürokratischen Erleichterungen ermöglichte dies der Gerrer Gruppe den Ausbau ihrer Forschungsabteilung.
Seither arbeiten zudem das Landwirtschafts- und das Wirtschaftsministerium eng mit den Konzernen zusammen, um die Förderprogramme weiterzuentwickeln. Wir freuen uns, diese Arbeit in Zukunft fortsetzen zu können!

GM: Innovation und Forschung bildeten also den alleinigen Grundstein für unseren Erfolg?

Schlegl: Sagen wir es so: Der Ausbau unserer Forschungsaktivitäten trug entscheidend zu einem strategischen Umdenken bei. Bis 2023 musste sich der Holzmarkt noch von den Kalamitäten der vorausgegangenen Jahre erholen. Die Einschlagszahlen waren rückläufig. Infolgedessen schritten Konsolidierungsprozesse innerhalb der Branche weiter voran.
Um in dieser Konstellation wettbewerbsfähig zu bleiben, mussten wir anfangen, unseren Betrieb ganzheitlich zu gestalten – Die Forschung war hierbei nur der erste Schritt. Aber man kann sagen, dass sich unsere Anstrengungen in jedem Fall ausgezahlt haben. Durch vertikale Integration von Produktionsschritten in den vergangenen Jahrzehnten wird die holzverarbeitende Industrie Europas heute durch 5 internationale Konzerne bestimmt und Gerrer ist dank seiner zukunftsweisenden Ausrichtung einer davon. Durch die hervorragende Zusammenarbeit zwischen Forst- und Holzwirtschaft konnten tausende Arbeitsplätze, die sonst ins außereuropäische Ausland abgewandert wären, in Deutschland gesichert werden. Zwar gab es Kritik durch Gruppierungen wie Greenpeace, die in Folge des voranschreitenden Artensterbens unser stetiges Wachstum anprangerten – diese konnte aber mit Hilfe des Wirtschaftsministeriums abgewehrt werden.

GM: Sie erwähnten die schwierige Holzmarktsituation in den 20er Jahren. Wie konnte Gerrer dazu beitragen, dieses Problem zu lösen?

Schlegl: Zum einen investierte Gerrer in die Züchtung und genetische Modifizierung von Baumarten, die bei gleichzeitigem Erhalt ihrer Wuchsleistung besser mit Hitze und Trockenheit umgehen können und nunmehr deutschlandweit angebaut werden. Zum anderen verhalf die Gerrer Gruppe dem Projekt „Bauhütte 4.0“, das auf dem ehemaligen Berliner Flughafen Tegel startete, zu bundesweitem Erfolg und initiierte zudem die Etablierung weiterer Modellregionen. Hierdurch konnten Wege gefunden werden, auch Holz schlechterer Qualitäten im urbanen Holzbau zu verwenden. Dadurch leisten wir einen wichtigen Beitrag zum Klimaschutz, denn dem sinnlosen Verrottenlassen von solchem Holz im Wald kann nun effektiv begegnet werden.

GM: Zuletzt die Frage nach der Zukunft: Was ist Ihrer Meinung nach die aufregendste Entwicklung bei der Gerrer Gruppe in den kommenden Jahren?

Schlegl: Seit letztem Jahr produzieren nun auch in Deutschland 5 Raffinerien Biokraftstoffe aus Holzbiomasse. Gerrer betreibt zwei dieser Raffinerien und wird in naher Zukunft Marktführer in Deutschland sein. Schon bald werden 20% des Kraftstoffbedarfs in unserem Land durch Biokraftstoffe gedeckt werden. Der Einstieg in die Kerosinproduktion ist auch schon angelaufen. Ich muss feststellen, dass ich mir zu Beginn meiner Karriere vor 30 Jahren nur einen Bruchteil von dem vorstellen konnte, was uns heute durch den Rohstoff Holz ermöglicht wird.
Damals sah man die Zukunft zum Beispiel noch im Wasserstoff.
Doch heute weiß man, dass sie dem Holz gehört!

GM: Vielen Dank für das Gespräch!

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