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Designing bio-based value chains for social justice: The potential of Capability Sensitive Design

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ABSTRACT

Bio-based value chains (BBVCs) have often been criticized for their detrimental social and environmental effects. Existing methods such as social impact assessment do not sufficiently address these negative effects because of their limited focus and lack of attention to social justice. This paper explores the contribution of Capability Sensitive Design (CSD) to designing BBVCs for social justice. CSD is a combination of Value Sensitive Design (VSD), an approach to account for human values in a design process, and the Capability Approach (CA), a normative framework that incorporates multiple dimensions of human well-being.

Three case studies demonstrate how CSD can be used to make design choices in the early stages of developing new BBVCs from waste biomass. The cases explore olive oil residues in Spain, coffee and cocoa residues in Colombia, and encroacher bush in Namibia. CSD is a relatively new approach and its contribution to social justice in BBVCs remained unexplored. We show that CSD can contribute to distributive, recognition, and procedural justice by allowing the identification of local vulnerable stakeholders and providing tools to connect their needs, knowledge, and capabilities to concrete design choices.

1. Introduction

There is an urgent need for a sustainable transition to move away from fossil-based materials and fuels. The bioeconomy is a concept proposed to promote sustainable transitions and generate local socio-economic and environmental benefits [1]. In the bioeconomy, biomass such as agricultural residues are used to make products previously made from oil, like biofuels. Through bio-based value chains (BBVCs), biomass producers are connected to new actors and markets. This could create opportunities but also impose new risks such as monoculture expansion, uncertain investments, and unequal wealth distribution [2,3]. For new BBVCs to deliver their potential, we need to understand how they can be developed in a sustainable *and* socially just way.

While sustainability and a sustainable transition are high on the research agenda, the social aspect of sustainability receives less attention than the environmental and economic dimensions [4]. Even less attention is paid to issues of social justice [5]. In addition, research on social aspects of sustainability and social justice in global value chains (VCs) is often backward-looking to evaluate the performance of existing structures and processes through methods such as social impact assessment. While this helps to formulate lessons learned we need to understand better how to create truly sustainable or socially just VCs [6].

One proposed pathway is to include diversified voices with different knowledge, concerns, and objectives to co-design a VC [7]. We present Capability Sensitive Design (CSD) as a relevant approach to engage local vulnerable stakeholders in the design of new BBVCs. With local vulnerable stakeholders, we refer to stakeholders at the beginning of the VC, such as small-scale farmers, indigenous communities, and workers, who hold less power than buying firms at the VC's end. While these stakeholders play a crucial role in a VC, their perspectives and needs have seldom been included in decision-making [8].

CSD is a combination of Value Sensitive Design (VSD), an approach to account for human values in a design process [9], and the Capability Approach (CA), a normative framework that incorporates multiple dimensions of human well-being [10]. The CA evaluates the real opportunities (capabilities) that people have to lead the lives they value. The advantage is the recognition of human diversity in what capabilities are valued and in our ability to achieve them [11]. Instead of taking moral values as the central goal of a design, as is done in a VSD approach, CSD

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concentrates on enhancing human capabilities. It provides a framework to normatively assess a design based on whether the design expands capabilities identified as valuable [12]. CSD is a relatively new approach and its contribution to designing for social justice in BBVCs remains unexplored. Moreover, there is a need for empirical research focusing on the meaning and interpretation of specific capabilities and how design might enhance those [13]. That leads to the main question of this paper: *How can the identification of local stakeholders' skills, needs, and capabilities be used to design scenarios of bio-based value chains for social justice?*

We argue that CSD can contribute to social justice because it allows identifying local vulnerable stakeholders and provides tools to connect their needs, knowledge, and capabilities to concrete design choices. We present a process of CSD for the context of BBVCs and apply this to three potential VCs for producing marine biofuels from waste biomass in Spain, Colombia, and Namibia. Our work makes academic and practical contributions to social justice and BBVCs debates. We do that by applying CSD prospectively in the methodology and analysis of the cases. This approach is relevant for scholars and practitioners who are involved in the development and design of new VCs.

First, we will outline our theoretical framework where we define social justice and explain its relevance in the context of the bioeconomy. Then, the concept of CSD is further explained, followed by a description of the methodology. In the results section, design scenarios are presented for the three cases. We then analyze how the process of CSD contributes to distributive, recognition, and procedural justice, the three dimensions of social justice used in this paper. Finally, limitations and trade-offs are discussed.

2. Social justice in bio-based value chains

We define social justice using the three dimensions of distributive, recognition, and procedural justice that are often used in the literature on environmental justice [14,15] and energy justice [16,17]. As these fields both relate to the bioeconomy, these justice dimensions also emerge here. We will briefly explain the dimensions and their relevance to the bioeconomy.

Distributive justice concerns the spatial and temporal allocation of benefits and burdens across society [18]. Studies have shown that so far, economic incentives to stimulate the bioeconomy accrue mainly to well-established agribusiness or urban consumers. The burdens, such as monoculture expansion and environmental risks, are disproportionally carried by resource-poor rural populations [19]. Additionally, it remains a challenge for smallholders to integrate into and benefit from BBVCs [2,20]. In the context of the bioeconomy, distributive justice requires prioritizing the needs of local vulnerable stakeholders and a fair allocation of environmental, economic, and social risks [21]. While distributive justice is central to social justice, it does not address the root causes of unfair distribution. It needs to be complemented by concepts like recognition and procedural justice. [22].

Whereas distributive justice considers how positive and negative impacts are distributed, recognition justice considers the additional needs and potential harms towards vulnerable groups [18]. It calls to acknowledge the differences rooted in social, cultural, and economic structures that underlie unfair distribution [22]. Questions relevant to recognition justice are related to who may be affected and which section of society is under- or misrepresented. Failing to identify and acknowledge the concerns, views, and needs of vulnerable stakeholders has implications for both distributive and procedural justice, as vulnerable rural communities are often left out of VC governance and the benefits of expanded bio-based production [19].

Apart from distributive and recognition justice, it is crucial to consider the processes leading to fair or unfair distribution [22]. Procedural justice has to do with participation in the design process and decisions about what kind of future is envisioned [19]. When designing new BBVCs, we need to carefully reflect on who is involved in the decision-making process and how decisions are made. By incorporating local stakeholders in the decision-making process, local knowledge is mobilized which can lead to alternative design choices and views that better represent particular needs and circumstances. In addition to justice claims, the participation of local stakeholders in decision-making processes can also lead to more effective VCs as producers have valuable knowledge of land management and cultivation practices [8]. Moreover, participation can enhance social acceptance of new technologies and VCs [22].

Whereas these concepts are useful for evaluating social justice, there is no concrete approach that actively accounts for social justice in the design of BBVCs. We propose CSD as a relevant approach to designing new BBVCs for social justice.

3. Design for social justice

VC design concerns making decisions about elements such as suppliers, locations, scale, technologies, and contractual arrangements [23]. These choices influence the distribution of burdens and benefits along the chain. Therefore it is relevant to proactively engage with social justice when making those choices. Approaches to inclusive VC development, such as inclusive business models or social impact assessment, often focus on the inclusion of smallholders into existing global VCs and improving economic and labor conditions [24,25]. BBVCs are more complex since they are new, often combine various VCs, and involve new and quickly evolving technologies. Therefore, we need an approach that can proactively engage with social justice in the design. Additionally, existing approaches lack a more holistic understanding of the multiple challenges and opportunities for resource-poor farmers in VCs [8,26].

The capability approach (CA) is a useful framework that is relevant in the context of social justice and (VC) design [13]. The CA evaluates the real or effective opportunities that people have to lead the life they have reason to value. Capabilities are defined as what people can effectively be and do, for example being healthy or forming meaningful relationships. The central focus of the CA is on increasing the opportunities for people to live a meaningful life. People can exercise their agency and make choices to turn capabilities into so-called 'functionings', realized capabilities [11]. Instead of focusing on expanding utility or resources, the CA looks at how these resources can enable people to fulfill meaningful activities [13].

Even though the CA is concerned with inequality and justice, it is not a theory of justice. Social justice concerns the distribution of benefits and burdens and the underlying processes and factors that lead to that distribution. The CA allows to identify capabilities, however it does not answer questions regarding which capabilities matter more, or what constitutes an equal distribution of capabilities [11]. The CA should be considered an 'open framework' [11] that can be used for several purposes such as the study of social justice issues. The CA offers a promising lens to study distributive, procedural, and recognition justice in BBVCs, as we will show in this paper.

The CA accounts for diversity in what we value and in our ability to fulfill those meaningful activities. A relevant concept to identify this diversity is the concept of conversion factors. Conversion factors are internal or external to a person and determine whether a person can transform resources into capabilities. They are classified into three categories. First, personal factors are internal, like physical conditions, skills, or intelligence. Second, social factors come from society, such as norms, policies, and power relations related to gender or ethnicity. Third, environmental factors arise from the physical environment, like climate, infrastructure stability, or transportation. Additionally, structural constraints like laws and institutions impact people's conversion factors and capabilities [11]. Conversion factors highlight the differences in access to resources and provide a lens to address these [8]. Fig. 1 shows the relation between the core concepts of the CA.

The CA can be useful in design through CSD, an approach developed by Oosterlaken [13]. CSD is an approach to account for human

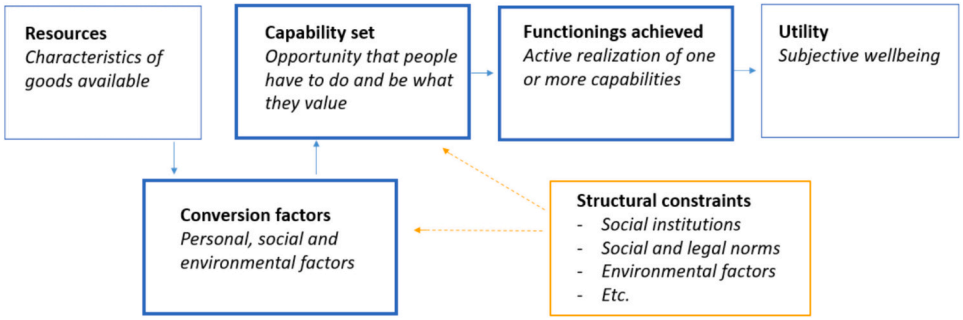

Fig. 1. Visualization of CA concepts, based on Robeyns [11].

capabilities in the design of new technologies. It is the combination of value-sensitive design (VSD) and the CA. VSD integrates moral values into technology design, recognizing that engineering is not neutral. Technologies can realize values like privacy, autonomy, and safety, or the opposite, they can embed injustice and insecurity [9]. VSD consists of three phases: 1) Conceptual investigations where stakeholders and their values concerning a certain technology are identified, 2) Empirical investigations in the social context in which the technology is situated, and 3) Technical investigations to translate the investigated values into design outcomes [9]. Iterations between these investigations can provide better insight into how the technology can support stakeholders' values [4].While VSD is a valuable approach to addressing the ethics of design, it also faces challenges.

Even though VSD uses ethical theories to identify relevant values, there is no explicit commitment to them and hence no normative guidance to distinguish between values. The CA provides normative guidance by evaluating whether a design enhances stakeholders' capabilities [12].

CSD thus combines the method of VSD with the core elements of the CA, namely capabilities and conversion factors. Instead of taking moral values as the central goal of a design, CSD concentrates on enhancing human capabilities. CSD is a promising approach but still relatively unexplored.

4. Methods

We applied CSD to three cases of early-stage design of marine biofuel VCs out of waste biomass. The choice of a case study approach allows gaining in-depth knowledge of the complex relationship of real-life dynamics [27]. Cases in different contexts are used to illustrate what design choices would be made when the capabilities of local vulnerable stakeholders are central to the design. We furthermore analyze what this means for social justice in BBVCs.

4.1. Case selection

This research is part of a multi-stakeholder and multi-disciplinary research project to design inclusive and sustainable biofuels for the marine industry, an industry that is actively looking to source more sustainable fuels [28]. The cases are selected in an iterative process with project partners who represent stakeholders in a biofuel VC (shipping company, (bio)fuel producers, renewable energy platform, and an NGO).

Based on input from these partners, potential feedstocks and countries were identified, and a list of criteria was created to filter the options (biomass availability, utilization potential, political stability, impact on small-scale farmers, infrastructure, enabling policies, and local connections). Moreover, a list of features was created to compare the potential cases (source of feedstock, geographical location, Human Development Index, the scale of farming, and current utilization of feedstock). The partners selected the final three cases: 1) Olive oil residues in Spain, 2) Coffee and cocoa residues in Colombia, and 3) Encroacher bush in Namibia. These cases all match the criteria, explore novel feedstocks, and represent a diversity of contexts. Due to COVID-19, we had to conduct our first case study in Europe.

In the selected cases, VCs for marine biofuels do not exist yet. This allows for a broad space for decision-making. The field research focused on learnings from existing VCs and perspectives on a conceptual design of a VC for marine biofuels. As such we offer a roadmap to parties who are interested in developing a socially just VC, such as our consortium partners. Whether they will follow up is still undecided at the time of writing. The partners contributed in cash and in-kind to the consortium but did not directly pay the researchers for any services.

4.2. Case study approach

The case studies are conducted following a CSD approach based on previous studies and adapted to the context of BBVCs [8,13,29,30]. We build on research done by Asveld et al. [8], who explore the potential of CSD for inclusive BBVCs by applying CSD as an analytical lens in retrospect to existing cases. We contribute to this research by applying CSD from the beginning in the methodology and analysis of the cases. Additionally, we explicitly connect CSD to social justice. The case study protocol can be found in Appendix A.

In the conceptual phase, stakeholders for both the existing VC and potential BBVC were identified (farmers, logistical companies, technology providers, academia, and governments). Vulnerable stakeholders were identified using power-interest grids based on their position towards the new BBVC. Based on the capabilities list developed by Nussbaum [31] and methodologies developed by Mink [29] and Steen [30], 17 capability cards were prepared and tailored to the context, covering capabilities such as social relationships and care for the environment. These cards were used to guide discussions in the empirical phase. The capabilities were still broadly defined, which allowed for the interpretation of the interviewees.

In the empirical investigation, fieldwork is carried out in the three countries (Spain: 18-10-2021 – 27-11-2021, Colombia: 20-06-2022 – 29-07-2022, Namibia: 16-01-2023 – 17-02-2023). First, interviews were conducted with the identified stakeholders about the current system, challenges, potential role in a new BBVC, as well as opportunities, hurdles, potential harms, and positions on the power-interest grid. In addition, in-depth interviews were conducted with small-scale farmers about the current use of biomass and their challenges. The capability cards were used to identify important capabilities and limiting and enabling conversion factors. Language barriers restricted the possibilities for in-depth interviews with communal farmers in Namibia, therefore we relied more on interviews with representatives of the different farmer groups.

Next, we organized multi-stakeholder workshops (Spain: 25-04-2022, Colombia: 28-07-2022, Namibia: 16-02-2023) to discuss different design choices (type of feedstock, feedstock processing and transport, contracts, biomass conversion, biorefinery products,

biorefinery ownership, location, and set-up) and necessary policies and local development needs. Participants were asked to choose options for these design choices and come up with an ideal scenario for the BBVC. Participants were then asked to co-create a roadmap to identify necessary steps to achieve the preferred scenario and allocate roles and responsibilities. The workshop protocol can be found in Appendix A.

In the technical investigation, information from the conceptual and empirical phases was used to formulate design propositions and develop context-specific VC design scenarios. Table I shows an overview of interview and workshop participants.

4.3. Data analysis

Interviews and workshop discussions were recorded with participants' consent, transcribed verbatim, and coded using MAXQDA 2012 software. The thematic analysis combined deductive and inductive coding, with the theoretical framework guiding the main codes (capabilities and conversion factors) and sub-codes emerging from the data. For example, "reluctance to change" was identified and interpreted as a social conversion factor. CSD was then used to create design propositions (DPs) linking capabilities and conversion factors to key design choices. Appendix B provides an overview of the main codes with illustrative quotes and sources.

This paper utilizes qualitative analysis to deeply explore real-life contexts and complex relationships. However, qualitative research has its limitations due to subjective input from stakeholders and interpretation by researchers. To enhance credibility and trustworthiness, several criteria were employed [32]. Data is triangulated, using documented in-depth interviews, semi-structured interviews, observations, and a workshop. Staying five to six weeks in the field allowed for prolonged engagement with the research context and participants. Interview and overall project findings were discussed with local partners, such as research institutes and multi-stakeholder platforms. The workshops at the end of the field visit served as a validation of the research findings. The transferability is facilitated by sharing case study protocols for potential replication in similar or different contexts. Detailed case study protocols and transcripts are available upon request.

5. Three cases

5.1. Spain

In the province of Jaén, Spain, the cultivation of olives is the most important economic activity and is dominated by small-scale farmers who cultivate olives in traditional ways. About 30–40 % of olive producers depend on olive cultivation for their livelihood. Each year, millions of tons of field and processing residues are either mismanaged or underutilized. Field residues consist of pruning rests, that are chipped and left on the soil or burned in the field. For both methods, farmers are making costs, and burning causes fire risks and environmental damage [33]. The main processing residue generated at the cooperative-owned olive mills is Crude Olive Pomace (COP) consisting of pulp, pit, peel, and water. This COP is brought to a private secondary mill where it is stored in large open ponds and processed to extract the remaining oil, dry it, and produce Exhausted Olive Pomace (EOP). EOP is used in the same facility as a source of energy and sold to other industries. In the current scenario, farmers don't receive economic benefits from the production of EOP. Cooperatives are responsible for transporting COP and sometimes need to pay to treat the COP in the secondary mill. So, farmers are making costs to process both field and processing residues [33]. The large quantities of available residues, coupled with stimulating bioenergy policies and rural development opportunities, make this an interesting case to explore a potential BBVC.

5.2. Colombia

In the coffee axis of Colombia, residues from coffee and cocoa production are identified as potential sources for new BBVCs. Similar to Spain, coffee and cocoa are produced by small-scale farmers who own less than five hectares. Residues such as coffee pulp and cocoa pod husks are generated in the field and are underutilized or mismanaged. They are left on piles on the field, or applied to the soil as a type of compost. Current practices pose environmental risks due to leakages of the residues into water streams. In comparison to the farmers in Spain, most of the farmers in Colombia depend on agriculture for their livelihood. This makes them more vulnerable to price fluctuations, productivity losses, and climate change. These factors currently influence their capability of having economic stability. Farmers diversify their income to cope with that insecurity. Coffee and cocoa are mainly grown in agroforestry systems, where alongside these crops, bananas and other fruits are cultivated, producing residues like stems, leaves, and pruning. Selling the residues that they generate on their plots can be an additional diversification strategy.

5.3. Namibia

Different from Spain and Colombia, the potential biomass source for a new BBVC is not an agricultural residue but an encroacher bush. In Namibia, about 45 million hectares are bush encroached. This involves the expansion of indigenous bushes, like blackthorn (*Senegalia mellifera*), at the expense of grass vegetation in the Savannah areas. This harms the ecological balance as it causes soil infertility and groundwater depletion [34]. Compared to Spain and Colombia, there is a larger diversity of biomass suppliers due to the land ownership structures and historical processes. Firstly, large commercial cattle farmers own on average 7000 ha. Secondly, communal farmers use land that belongs to the government and share the resources. Finally, resettlement farmers are previously disadvantaged farmers who are placed on land sold by commercial farmers. Each type of farmer has different capabilities, skills, and needs. In addition to negative environmental impact, bush encroachment threatens the livelihoods of people due to the reduced grazing capacity of cattle. More than 70 % of the Namibian population depends directly or indirectly on agriculture for their livelihoods as most of them are cattle farmers. Developing new VCs based on encroacher bush can offer opportunities to solve local issues and add value to the bush.

6. Capability sensitive design for social justice

In this section, we show how context-specific design scenarios can be formulated based on the identified capabilities and conversion factors, and what that means for distributive, recognition, and procedural justice. For each case, design propositions are formulated (DPs). Fig. 2 shows how those DPs were derived from the data. Appendix C shows a more extensive explanation of the DPs and how they were derived from the identified capabilities and conversion factors.

6.1. Design propositions

Table II shows the main DPs derived from the analysis and how those propositions relate to the desired capabilities and existing social (s), environmental (e), personal (p), and structural (str) conversion factors. In addition, we show how the DPs relate to the dimensions of social justice.

Looking at the three cases, we observe clear differences in conversion factors and capabilities of different stakeholders to participate in and benefit from a new BBVC. In comparison, the farmers in Spain are already in a good position and DPs are mainly related to maintaining the current system and improving economic stability. In Colombia and Namibia, the position of the farmers is more vulnerable, which has consequences for social justice and the interventions needed to achieve

Table I
Overview of interviews and workshop participants.

Type of stakeholder	Spain (S)		Colombia (C)		Namibia (N)	
	Interviews	*Workshop*	*Interviews*	*Workshop*	*Interviews*	*Workshop*
Farmers (F)	27	2	24	–	8	–
Farmer cooperative/association(C)	8	8	8	4	1	3
(Farm) workers (W)	–	–	4	–	8	–
Farmer union/federation (FU)	2	1	5	2	3	2
(Secondary) industry (I)	1	1	1	1	3	1
Entrepreneurs (E)	–	–	2	1	1	1
Logistics (L)	1	–	3	3	1	–
Government (G)	1	4	4	3	5	5
Technology developers (T)	2	2	–	–	–	–
Academia/knowledge institute (A)	3	3	10	7	2	1
NGO (N)	–	–	2	1	3	3
Bioenergy association (B)	1	4	–	–	1	4
Total	*44*	*25*	*63*	*21*	*36*	*20*

We use abbreviations to refer to interview participants. For example, the code S-F3 refers to farmer #3 in Spain.

social justice via VC design. In Colombia, limiting factors are environmental factors such as a lack of infrastructure or poor tertiary roads, social factors such as reluctance to change, distrust and agricultural practices, and personal factors like low education levels and learning practices. While these factors also play a role in Namibia, structural factors like land ownership are limiting the capabilities of especially communal and resettlement farmers. These issues can partially be addressed by adapting the VC design, such as allowing for both low-tech and high-tech options in Namibia or offering different options to supply biomass in Colombia. Some issues cannot be addressed by adapting the technical design and require investments and interventions in the institutional context, such as knowledge building, developing sustainable harvesting plans, and conducting pilots in communal areas, which requires a multi-stakeholder approach. Below we discuss in more detail how to design for social justice in a BBVC.

6.2. Distributive justice

Distributive justice concerns the distribution of opportunities and resources as well as imposed risks and harms from a BBVC. CSD contributes to distributive justice by first identifying which capabilities are important to local stakeholders and should be enhanced, or not harmed, by a new BBVC. An added value of CSD is that it allows to identify capabilities apart from economic benefits that are otherwise overlooked, such as the capability to care for one's environment and the capability for self-determination. As such CSD provides a more holistic perspective on distributive justice compared to traditional methods, such as social impact assessment or inclusive business.

In all three cases, the capabilities of enhancing economic stability and care for the environment are identified as relevant to distributive justice, which are also the most obvious capabilities that could be enhanced by a new BBVC. In the two cases focusing on agricultural residues, self-determination emerged as an important capability that should not be harmed. This was less of an issue in Namibia. Here, there are many inequalities in the distribution of land ownership. This implies that the capability to be included in the new BBVC was important because such inclusion also increases opportunities for stakeholders who do not own land.

In Spain, a motivation for olive farmers to engage in a new BBVC is to improve the capability of economic stability. If this BBVC is designed well, it would contribute to distributive justice because it foresees this need. Currently, a stable income for farmers is threatened due to volatile olive oil prices and fluctuating input prices (structural factors). In addition, few plots are irrigated, which makes them vulnerable to climate change (environmental factor). Engaging in a new BBVC could offer them a more stable income.

Moreover, the desire to enhance the capability to care for the environment was identified by farmers. Currently, COP is stored in open ponds and water is evaporated in a water-scarce area (environmental factor). The burdens associated with the new technology can be minimized by choosing a technology that minimizes water usage (DP 1.4). At the same time, this design choice can make sure that additional benefits for farmers arise since the technology will help them realize the capability to care for the environment.

In Colombia, selling the residues that coffee and cocoa farmers produce in their fields can be an additional strategy to diversify their income and contribute to economic stability. According to a local researcher, this can have economic value as well as cultural: "*We need to think about the uses of those residues for the quality of life of the families that produce cocoa. We need to visualize their production system as more diverse so that they can receive more income, but also more ecosystem services like tourism. Services that sometimes are the last ones that are seen.*" (C-A6). In addition, selling residues can enhance the capability to care for the environment, because currently, the residues pose environmental risks of leaking into water sources.

In Colombia, a new BBVC should offer opportunities to younger farmers specifically (DP 2.8). This is desirable because young generations are migrating out of rural areas due to a lack of stable job opportunities. This has a major impact on families and the sustainability of the coffee and cocoa sectors, integral to the local culture. According to an NGO representative: "*Coffee is part of their culture. There is a family history and their children don't leave their plots because they don't love coffee. They go because they look for more opportunities. But if there are opportunities, they want to stay. Also for family reasons, they want to continue with what their parents do*" (C-N3). However, this younger generation does not desire to continue with the traditional practices of the older generations and has a more entrepreneurial mindset.

Beyond the economic, environmental, and social benefits of a new BBVC, participants preferred end-products that can be used locally, like energy, which remains a challenge in some rural areas. A technical advisor of a coffee association says: "*If you can produce gas from the residues and the woman that is cooking doesn't inhale smoke from wood, those are things that improve the quality of life.*" (C-C1). Biofuel for the marine industry might not be the best-suited choice for a biorefinery in this region. From a social justice point of view, at least part of the (by-) products generated in the biorefinery should be distributed and used in the region where biomass is supplied (DP 2.7).

In Namibia, the main motivation for farmers is to restore the rangeland to increase grazing capacity for their cattle. One commercial farmer explains: "*Well, the bush in our eyes is the enemy because he's stealing the water from the grass and the grass is our precious food for the cattle.*" (N-F2). In addition, rangeland restoration can improve conditions for wildlife and also provide more economic stability for farmers.

A concern in Namibia is sustainable harvesting. There is a monitoring system in place, but monitoring and implementation are lacking due to a lack of resources (structural factor). A government

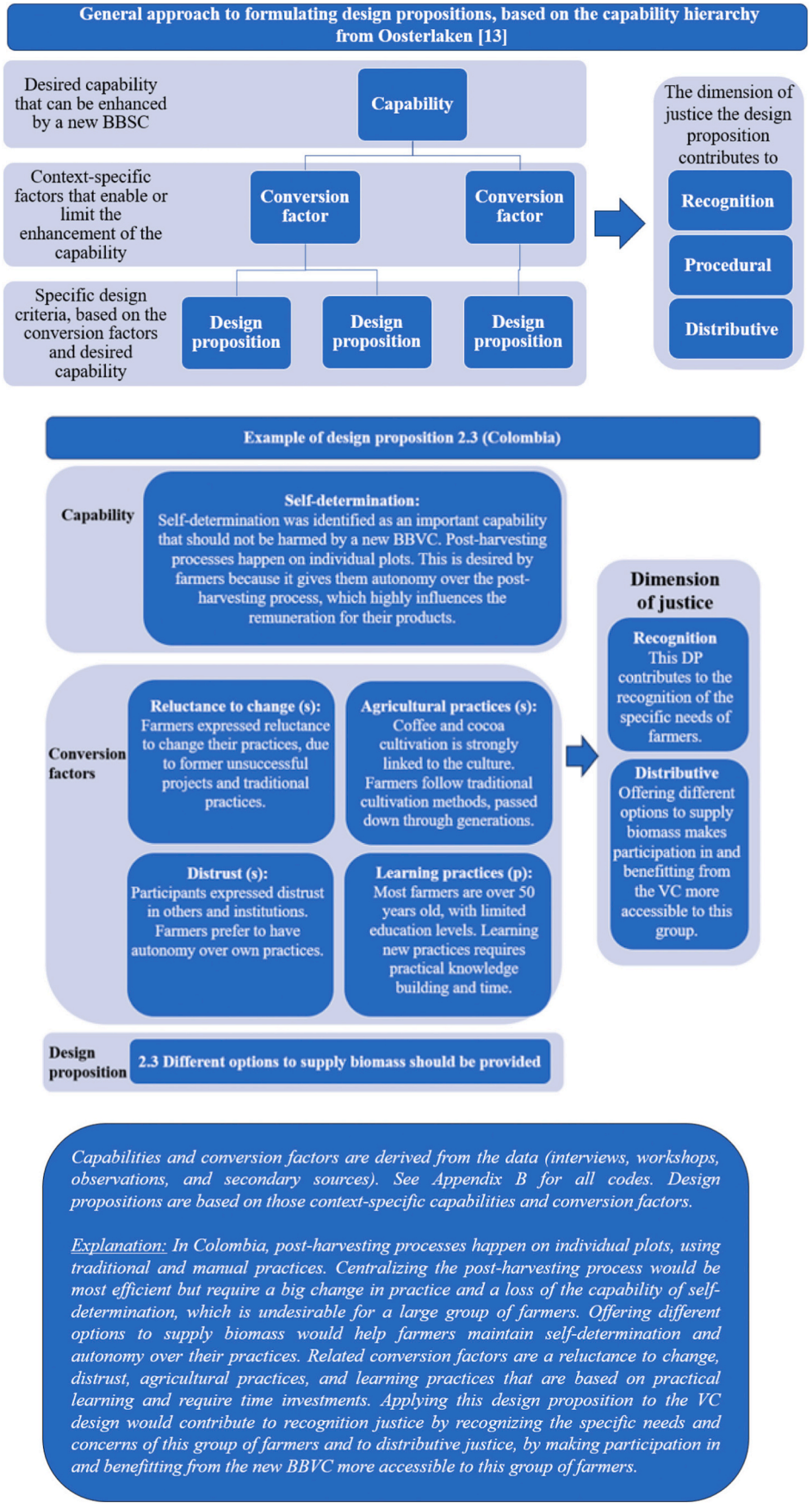

Fig. 2. Analysis process, based on the capability hierarchy [13].

Table II
Design propositions for Spain, Colombia, and Namibia.

1. Design propositions (DPs) Spain	Related design variable	Related capability	Related conversion factor	Related dimension of social justice
1.1 Use COP as the main feedstock.	Feedstock	Economic stability, Maintaining traditional system, Self-determination	Reluctance to change (s), Existing infrastructure (e)	Recognition justice, distributive justice
1.2 Use the existing infrastructure of primary and secondary mills.	Feedstock process, biomass conversion	Economic stability	Existing infrastructure (e)	Distributive justice
1.3 Use the existing cooperative structure to organize feedstock collection and benefit sharing.	Feedstock processing	Economic stability, Self-determination	Strong cooperatives (s)	Procedural justice; distributive justice
1.4 The technology should minimize water use.	Conversion technology	Care for the environment	Water scarcity (e)	Distributive justice
1.5 The by-product biochar should be distributed to farmers, to use as soil amendment.	Biorefinery products	Care for the environment	Poor soil quality (e)	Distributive justice, recognition justice
2. Design propositions (DPs) Colombia	**Related design variable**	**Related capability**	**Related conversion factor**	**Related dimension of social justice**
2.1 The biorefinery should be able to use multiple types of residues.	Feedstock; Biomass conversion	Economic stability, care for the environment	Agroforestry system (e), small volumes (e)	Recognition justice, Distributive justice
2.2 A centralized collection system should be set up, with a standardized post-harvest process.	Feedstock processing	Economic stability	Agricultural practices (s), lacking infrastructure (e)	Distributive justice
2.3 Different options to supply biomass should be provided.	Feedstock processing	Self-determination	Reluctance to change (s), trust (s), learning practices (p), agricultural practices (s)	Recognition justice, distributive justice
2.4 Farmers' associations need to play a central role in collecting biomass.	Feedstock processing	Self-determination	Distrust (s)	Procedural justice
2.5 Biomass should be converted into a decentralized system.	Biomass conversion	Economic stability	Mountainous landscape (e), small volumes (e)	Distributive justice
2. 6 An already proven technology is preferred.	Biomass conversion	Economic stability	Lacking knowledge/ experience (str), Reluctance to change (s)	Recognition justice
2.7 The biorefinery should produce products that can be used in the region.	Biorefinery products	Access to energy	Limited electricity access rural areas (e)	Distributive justice, recognition justice
2.8 The new value chain should offer stable job opportunities to youth.	Value chain	Satisfactory work, Meaningful social relations	Entrepreneurial mindset youth (s),	Recognition justice, distributive justice
2.9 Farmers' associations need to be strengthened.	Institutional context	Self-determination	Limited capacity and resources associations (s)	Procedural justice
2.10 Investments are needed in education and knowledge building.	Institutional context		Learning practices (p), reluctance to change (s)	Recognition justice
2.11 A long-term commitment is necessary.	Institutional context		Distrust (s)	Procedural justice
3. Design propositions (DPs) Namibia	**Related design variable**	**Related capability**	**Related conversion factor**	**Related dimension of social justice**
3.1 The biorefinery should be able to process multiple, problematic species.	Feedstock, biomass conversion	Care for the environment	Multiple problematic species (e)	Distributive justice
3.2 Biomass harvesting and supply methods should be adapted to the capacities of biomass suppliers.	Feedstock, Feedstock processing	Inclusion	Learning practices (p), land ownership (str)	Recognition justice, distributive justice
3.3 Encroacher bush should be harvested according to sustainable harvesting management plans.	Feedstock	Care for the environment	Forest regulation (str), lack of monitoring and implementation (str)	Distributive justice, procedural justice
3.4 Proper harvesting equipment needs to be developed.	Feedstock, Feedstock processing	Economic stability, care for the environment	Hard and thorny bush (e)	Distributive justice
3.5 A pilot needs to be conducted that includes communal areas in the commercial value chain.	Feedstock, feedstock processing	Inclusion	Land ownership (str), communal organization structures (s)	Recognition justice, distributive justice, procedural justice
3.6 Biomass should be converted using a combination of large-scale, high-tech, and small-scale, low-tech hubs.	Biomass conversion	Economic stability, Inclusion	Learning practices (p), lack of access to energy (str), land ownership (str)	Recognition justice, distributive justice
3.7 Biomass conversion and value-adding activities should take place in Namibia.	Biomass conversion	Economic stability, satisfactory work	High unemployment (str)	Distributive justice
3.8 End-products from the biorefinery should first satisfy local demand.	End-product	Access to energy	Dependence on imports (str),	Distributive justice
3.9 Investments are needed in sustainable harvest management and implementation	Institutional context	Care for the environment	Lack of monitoring and implementation (str)	Distributive justice
3.10 Investments are needed in resource management and equitable benefit-sharing structures in communal areas.	Institutional context	Inclusion	Land ownership structure (str), communal organization structures (s)	Procedural justice, distributive justice, recognition justice

representative states: "*The biggest challenge for monitoring by Forestry is the equipment, the vehicles, internet, computers' that stuff. They hardly have such stuff and it's easy for me to sit here and say they should have been doing this and that. But I mean you come to an office where there's only one person. And even the internet to check on Google Earth sometimes lacks.*" (N-G1). Monitoring and implementation should be strengthened to ensure sustainable harvesting of the bush and prevent environmental harm (DP 3.9).

Another motivation is to enhance inclusion. In Otjozondjupa's communal areas, bush encroachment is worse due to farmers' lack of resources for control. Concerns about overexploitation and unequal benefit sharing have led to strict regulations. Workshop stakeholders

emphasized that a new BBVC should include all farmers, especially those on communal lands, who seek new commercial opportunities for bush valorization. A representative of communal farmers explains: "*We are eager for any change and we are ready for any cooperation. We don't want to sit and be fed. Our people are so eager. There is always progress if there is change. There's no progress now*." (N-F5-communal).

In addition, workshop participants stressed the importance of conducting all value-adding activities in Namibia itself, thereby maximizing value addition and job opportunities (DP 3.7). Because the majority of Namibia's fuel demand is imported, biofuel should first satisfy the local demand before being exported (DP 3.8). Additionally, using biomass for electricity in rural areas with limited access could enhance distributive justice.

6.3. Recognition justice

Recognition justice concerns acknowledging the needs and potential harms towards vulnerable and underrepresented groups. CSD offers a relevant lens for identifying those structures and needs using the concepts of capabilities and conversion factors. Social justice can only be achieved when these context-specific factors are identified and recognized in the design.

Local vulnerable stakeholders were identified to align CSD with recognition justice. In Spain, these include small-scale olive farmers with fragmented plots inherited over generations. Despite their small size, farmers can negotiate and participate in decision-making through cooperatives that own the primary mills (social factor). The lens of conversion factors helped to identify and contextualize the concerns of the farmers. For example, farmers in Jaén showed reluctance to change (social factor). Olive cultivation is integral to Jaén's culture, and farmers wish to preserve their traditional system. Due to fragmented production (environmental factor), mobilizing pruning rests would only be economically viable with more concentrated land management. This conflicts with farmers' conservative attitude, valuing control over their plots and traditional methods.

Building on the desired capability of more economic stability and preserving control and the traditional cultivation system, the design for a new BBVC in Spain should be close to the current system. This is also confirmed by participants in the workshop. This contributes to recognition justice because it acknowledges the specific needs of these local stakeholders. Choosing crude olive pomace (COP) as a main feedstock instead of pruning residues also contributes to maintaining traditional farming practices because many farmers value the current practice of chipping the pruning residues and applying them to the soil (DP 1.1). An olive farmer illustrates: "*I am interested that it stays in the field. Because soil degradation is a problem here, and now my pruning rests are used as compost, it provides benefits to the soil now.*" (S-F7).

In addition, bringing by-products from the biorefinery such as biochar back to the plots to enhance the soil quality can also support recognition justice because it makes the bioeconomy more relatable to farmers (DP 1.5). A cooperative representative explains: "*Another thing is that we don't know the technology and the market. If it will generate compost, we can use it so that is familiar to us.*" (S-C2).

Unlike in Spain, many conversion factors need to be created or strengthened before small-scale farmers in Colombia can participate in and benefit from a new BBVC. The country lacks experience with biorefineries (structural factor) and biomass transport from plots is challenging due to unpaved tertiary roads in mountainous areas (environmental factors). In Spain, many conversion factors necessary for a new BBVC, such as the existing infrastructure and quality roads are already present. This differs from the context in Colombia, where coffee and cocoa farmers are identified as vulnerable local stakeholders due to their small scale and dependency on agriculture.

The most efficient way would be to centralize the collection of the whole fruit, instead of the green beans or residues (DP 2.2). However, it is important to recognize the current practices and concerns of farmers. In Colombia, post-harvesting processes happen on individual plots, meaning that the coffee pulp and cocoa pod husks are produced and collected in the field (social factor). Current practices are seen as ways to dispose of the residues and are not as highly valued as in Spain with the pruning rests. A centralized system requires big changes in practices and raises concerns about the remuneration process. Farmers receive prices based on the quality of their products. One farmer and association leader says: "*If I am handing over what belongs to my property, then how do I access and get what I gave from my property? How do I fertilize? What compensation do I have?*" (C-C8). For this system to work, trust needs to be built. In addition, due to the low education levels of especially the older generation farmers, changes require time and practical knowledge building (personal conversion factor).

Building on the identified needs and conversion factors, a design where multiple, smaller-scale hubs supply a larger biorefinery would be best suited for this context (DP 2.5). Farmers should be offered different options to supply biomass (DP 2.3). A representative of an NGO stated in the workshop: "*Not every farmer will be able or willing to change their practices. It is important that they can supply in their preferred way.*" Farmers that are more willing to make changes could supply to a centralized location and showcase how this could work. Alternative options should be offered to farmers who are less open to changing their practices. This approach supports recognition justice by allowing farmers autonomy over residue use. A technology that can handle multiple biomass types is also desirable, recognizing the practice of cultivating multiple crops (DP 2.1).

In Namibia, many conversion factors limit farmers' ability to participate in new BBVCs despite large bush availability and stakeholders' interest in its use. Compared to Spain and Colombia, there is a larger diversity of biomass suppliers due to structural factors where certain groups have been disadvantaged.

From the point of view of commercial farmers, an issue that needs to be recognized is the manual labor that is necessary to harvest the bush, often performed by migrant workers. The bush's hardness makes mechanical harvesting difficult, and providing housing and food for workers is costly and poses challenges like illegal poaching and language barriers. From their point of view, mechanized harvesting is preferred. Because of their large plots, commercial farms could provide a more steady biorefinery supply but require investments in machinery and skills development (DP 3.4).

The capabilities of farmers in communal areas differ from commercial farmers. The land is owned by the government and shared by people living on the land (structural factor), which makes the bush a common pool resource. This prevents communal farmers currently from taking part in commercial VCs. A condition for participation in commercial VCs from the bush is the establishment of a resource management plan to guarantee a sustainable harvest and equitable benefit sharing (DP 3.3). Several pilots have been carried out but so far have been unsuccessful. According to a civil society representative involved in this pilot: "*We've been struggling to get that structure in place also with the communal areas because it is, you know, millions of hectares belonging to hundreds of thousands of people equally. Getting a structure in place where one guy does not have a bigger benefit than the other. Other than just the time that he's putting in, it's very difficult.*" (N-N2).

Another limiting conversion factor is the education system which is especially problematic in communal areas (structural factor). Learning new skills requires time (personal factor). Resettlement farmers face similar challenges, as they often have a background as communal farmers and do not have the necessary skills and resources to manage a commercial farm. A representative of resettlement farmers explains: "*The government takes a person from wherever and puts him on a piece of land wherever, expecting him to produce. No orientation, no nothing, at least, they need to be mentored to be productive.*" (N-FU2). From the point of view of communal and resettlement farmers, more low-tech and manual harvesting techniques are preferred.

If a BBVC is to benefit all, different farmers need to be involved in

diverse ways. Workshop participants proposed a more flexible design that responds to the recognition of the different conversion factors and capabilities of farmers. A central hub with more advanced technologies supplied by larger scale, commercial farmers can be combined with smaller-scale suppliers using more low-tech harvesting techniques in communal and resettlement areas (DP 3.2).

6.4. Procedural justice

Procedural justice involves participation in VC design and decision-making on future visions. When designing a new BBVC, it's crucial to consider who participates in decision-making and how decisions are reached. The CSD process enhances procedural justice by involving local stakeholders in decisions from the early stages on. In addition, we identified important conversion factors that influence the capability for involvement in decision-making, namely the existence of strong co-operatives, trust, and commitment.

An important conversion factor related to procedural justice is farmers' organizations (social factor). Farmers in Spain have a good negotiation position because most of them are organized in co-operatives. Since the cooperatives own the primary mills, where value is added to the olives and the main residue is produced, farmers can influence decision-making in the current and a potential new BBVC. This is different in Colombia, where farmers are organized through the national federation or a smaller-scale association. The position of individual farmers in this system is less powerful than in Spain. The national federation, especially in the coffee sector, has a hierarchical system where decisions are made top-down. One farmer explains: "*Many times, they want to put things on the properties that we don't agree with, like a coffee seed, and we don't want to plant it, and they say, 'Well, you should plant that.' So, I, who manages it and works the property, know what seed I like and what is good for me. They have an idea that they impose on you.*" (C-F22). Although this structure provides coffee farmers with important benefits such as guaranteed outlets for their products and capacity building, it limits their negotiation position. Smaller scale associations are experienced differently. However, associations reported a lack of resources or capacity and would require strengthening to play an important role in the bioeconomy (DP 2.9).

In addition, in Colombia, the issue of trust was raised. Farmers have faced many projects that promised changes but were discontinued or never materialized, making them reluctant to invest time in new initiatives (social factor). One technical advisor of a coffee association explains: "*People are always sensitive to organizations and to the loss of time and money. Farmers are tired that they come to them and promise a lot of things. That is why some members don't participate in projects like this.*" (C-C1). Therefore, for a new project to work, a longer-term commitment is necessary (DP 2.11).

In Namibia, the position of farmers is more complex and very much dependent on other factors such as land ownership and available resources. Commercial farmers are well-organized in labor unions, while communal farmers face more complex and area-specific organizational structures. As one civil society representative states: "*We don't put enough effort into reaching the people that are not organized and something that we see very little in Namibia are cooperatives. The farmers in the commercial areas got their farmers associations, but you don't have a lot of that in communal areas.*" (N-N1). In communal areas, further investments need to be made in pilot projects to include communal areas in commercial VCs to prevent the reproduction of existing inequalities (DP 3.5). These pilots should build as much as possible on structures that already exist in some areas such as conservancies and community forests, that manage natural resources.

6.5. Opportunities and challenges

By applying CSD to three cases, we showed that it has added value to social justice. CSD offers a useful approach to identifying the concerns, views, and needs of local vulnerable stakeholders. The CA provides a more holistic view compared to other approaches to develop inclusive and socially just VCs. It allows the identification of capabilities that would otherwise be overlooked, such as care for the environment and self-determination, and the concept of conversion factors helps to identify the context-specific factors that cause differences in access to resources and opportunities. This is highly relevant for recognition and procedural justice. We showed the differences in conversion factors and the investments needed for smaller-scale actors to participate in a new BBVC. These investments and interventions are higher in areas where conversion factors are limiting the capabilities of local stakeholders such as in Colombia and Namibia. Building on the recognition of the needs and capabilities of local vulnerable stakeholders, and their participation in decision-making, CSD enables making concrete recommendations for the design of the VCs. That is important since choices in the early stage such as feedstock type, scale of production, and technology determine to a large extent the capability of smaller-scale actors to participate in a VC. This influences the distribution of opportunities and resources as well as risks and harms. In parallel to the engagement of local stakeholders in technical VC design choices, investments and developments in necessary conversion factors are needed, especially in contexts where these conversion factors are lacking. CSD helps in identifying those needs.

While CSD is a promising approach, some challenges are identified. One dilemma involves choosing which stakeholders' capabilities to prioritize and dealing with potential conflicts. In the Spanish context, we encountered a dilemma between preserving the traditional practices preferred by the older generation that dominates the sector or adopting innovations desired by the younger generation. In addition, conflicting needs could arise between stakeholders at different positions in the VC. The needs and capabilities of stakeholders at the downstream part of the VC, such as fuel producers or investors, might conflict with the DPs at the local level. An example is contractual arrangements. Downstream actors prioritize supply security and favor longer-term contracts, while farmers, as revealed in workshop discussions, lean towards shorter, more adaptable contract terms. These conflicts cannot entirely be solved by CSD. Similar to the process of VSD, the DPs in this paper are normative, but not prescriptive [4]. They are meant to bring forward the perspectives of local stakeholders and include them in decision-making since these are often overlooked.

Second, studies show that firms are generally less interested in including marginalized stakeholders as co-creators of economic activities [35]. In the bioeconomy, fossil-dependent companies already face challenges transitioning to sustainability, and engaging local stakeholders could add complexity. However, identifying local capabilities and needs does not only help in creating social justice outcomes, but it can also increase the security of supply. If a VC design does not match local skills and knowledge, the project could fail. So CSD could also contribute to the success of the VC. Moreover, the bioeconomy presents a unique case due to limited availability and competitive demand for bio-resources. This gives biomass suppliers a stronger position than in industries where suppliers are more abundant, for example in the garment industry.

Third, the defined DPs raise the question of responsibilities. Who is or should be the main responsible party to realize a socially just VC design? We formulated some DPs that can be adapted by companies, such as choosing a type of technology, method of biomass collection, or contractual arrangements. But there are also DPs related to the institutional context that are outside the sphere of influence of a company but vital for social justice. Here, collaborations are needed with governmental and civil society organizations to realize a socially just VC design.

7. Discussion

This paper explored how CSD could enhance social justice in new BBVCs. The insights from this study contribute to the emerging attention

for social justice in debates on sustainability and sustainable transition. Given the role of the bioeconomy in this transition, it is crucial to ask where bio-resources come from, under what conditions they are sourced, and who determines those conditions [19]. While many studies concentrate on evaluating social justice outcomes in existing VCs, it remains a challenge how to proactively consider social justice issues in the development of new BBVCs. This is particularly relevant since choices made in the early stages determine to a large extent the outcomes in a later stage. CSD offers an approach to proactively engage with social justice issues in the design phase of the VC. Moreover, we build on research done in the emerging field of CSD [8,12,13]. We specifically contribute to this field by applying CSD to three real-life cases of new BBVCs in the methodology and analysis. This has not been done before. In addition, we make an explicit connection between CSD and social justice.

Our work has practical implications by showing how context-specific capabilities and conversion factors can be linked to important VC design decisions. This can help companies in reaching social justice outcomes and better acceptance and performance of the VC. Furthermore, our study can contribute to policy decisions. The three cases show that the institutional context is important in achieving more social justice in BBVCs. This is especially true for contexts in the Global South where necessary institutions or conversion factors are lacking. Policymakers can provide support in strengthening these necessary conversion factors. In addition, this research has social implications by including the voices of stakeholders at the beginning of the VC who are seldom included in decision-making. We show an approach that connects research and practice and show three cases in underrepresented contexts. Furthermore, we demonstrate the potential for BBVCs to benefit local vulnerable stakeholders, addressing concerns about adverse social impact of the bioeconomy [19].

Besides the contributions, this research has several limitations. The first limitation is the absence of operational BBVCs in the three contexts. This prevents evaluating their performance or social impact. The scope of this paper is limited to presenting a process that can be followed to reach a more equitable decision-making process and impact of the VC. Correspondingly, the DPs in this paper are limited to early-stage design choices. Factors vital to social justice issues, like governance and power dynamics among stakeholders, are excluded from the method due to the challenge of assessing these in prospective VCs. In addition, this paper shows the potential of CSD by using three qualitative case studies. This limits the possibilities of generalization. However, we do show the complex realities in which stakeholders are creating or transforming VCs and present a process that can be replicated in multiple contexts. Last, this paper focuses on the stakeholders at the beginning of the VC. Including stakeholders in the downstream part of the VC could have revealed more trade-offs and conflicts.

Future research could build on this approach by applying CSD to other sectors to further explore its potential. In addition, more research can be done on the practical implications of CSD for companies and dealing with conflicting needs and interests. Last, we found that VC design should be done in parallel with institutional development. Further research is needed on how institutions can be developed and strengthened and who is responsible, especially when operating in contexts in the Global South.

8. Conclusion

This paper explored the potential of CSD for designing new BBVCs for social justice. We argued that CSD is a relevant framework to guide important early-stage design choices. We show that design choices made via the CSD process can contribute to more distributive, recognition, and procedural justice because it allows the identification of local vulnerable stakeholders and provides tools to connect their needs, knowledge, and capabilities to these choices. We illustrated this by applying CSD to the design of three potential VCs for producing marine biofuels from waste biomass in Spain, Colombia, and Namibia. The CSD process connects with distributive and recognition justice, as it enables the identification of the current distribution of opportunities and resources, as well as the recognition of differences rooted in processes that underlie this distribution. Particularly relevant is the identification of conversion factors, that cause differences in access to resources and opportunities, which links with procedural and recognition justice, and underlies the distribution of opportunities and resources. We have also shown that, besides adapting processes and technical design, investments are needed in the institutional context, especially in contexts where necessary conversion factors are lacking.

CRediT authorship contribution statement

Susan van der Veen: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Lotte Asveld:** Writing – review & editing, Supervision, Funding acquisition, Formal analysis, Conceptualization. **Patricia Osseweijer:** Writing – review & editing, Supervision, Funding acquisition.

Declaration of competing interest

The authors 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. Supplementary data

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References

[1] I. Lewandowski, N. Gaudet, J. Lask, J. Maier, B. Tchouga, R. Vargas-Carpintero, Context, in: Bioeconomy, Springer International Publishing, 2017, pp. 5–16, https://doi.org/10.1007/978-3-319-68152-8_2.
[2] A. Balkema, A. Pols, Biofuels: sustainable innovation or gold rush? Identifying responsibilities for biofuel innovations, in: Responsible Innovation 2, Springer International Publishing, 2015, pp. 283–303, https://doi.org/10.1007/978-3-319-17308-5_15.
[3] J. Hoffman, M. Davies, T. Bauwens, P. Späth, M.A. Hajer, B. Arifi, A. Bazaz, M. Swilling, Working to align energy transitions and social equity: an integrative framework linking institutional work, imaginaries and energy justice, in: Energy Research & Social Science Vol. 82, Elsevier BV, 2021 102317, https://doi.org/10.1016/j.erss.2021.102317.
[4] M. Palmeros Parada, L. Asveld, P. Osseweijer, J.A. Posada, Integrating value considerations in the decision making for the design of biorefineries, in: Science and Engineering Ethics Vol. 26, Issue 6, Springer Science and Business Media LLC, 2020, pp. 2927–2955, https://doi.org/10.1007/s11948-020-00251-z.
[5] C.J.C. Jabbour, R.C. Janeiro, A.B.L. de Sousa Jabbour, J.A.G. Junior, M.H. Salgado, D. Jugend, Social aspects of sustainable supply chains: unveiling potential relationships in the Brazilian context, in: Annals of Operations Research Vol. 290, Issues 1–2, Springer Science and Business, Media LLC, 2017, pp. 327–341, https://doi.org/10.1007/s10479-017-2660-7.
[6] M. Pagell, A. Shevchenko, Why research in sustainable supply chain management should have no future, in: Journal of Supply Chain Management Vol. 50, Issue 1, Wiley, 2014, pp. 44–55, https://doi.org/10.1111/jscm.12037.

[7] A. Touboulic, L. McCarthy, L. Matthews, Re-imagining supply chain challenges through critical engaged research, in: Journal of Supply Chain Management Vol. 56, Issue 2, Wiley, 2020, pp. 36–51, https://doi.org/10.1111/jscm.12226.
[8] L. Asveld, Z.H. Robaey, S. Francke, P. Osseweijer, Capability approach and inclusion: developing a context sensitive design for biobased value chains, in: Journal of Agricultural and Environmental Ethics Vol. 36, Issue 1, Springer Science and Business Media LLC, 2023, https://doi.org/10.1007/s10806-023-09901-1.
[9] B. Friedman, Value-sensitive design. interactions 3 (6) (1996) 16–23.
[10] A. Sen, Development as Freedom (1999). The Globalization and Development Reader: Perspectives on Development and Global Change, 2014, p. 525.
[11] I. Robeyns, Wellbeing, Freedom and Social Justice: The Capability Approach Re-examined, Open Book Publishers, 2017, p. 266.
[12] N. Jacobs, Capability sensitive design for health and wellbeing technologies, in: Science and Engineering Ethics Vol. 26, Issue 6, Springer Science and Business Media LLC, 2020, pp. 3363–3391, https://doi.org/10.1007/s11948-020-00275-5.
[13] E.T. Oosterlaken, Taking a Capability Approach to Technology and its Design: A Philosophical Exploration, 2013.
[14] D. Schlosberg, Defining Environmental Justice: Theories, Movements, and Nature, OUP Oxford, 2007.
[15] P. Newell, S. Srivastava, L.O. Naess, G.A. Torres Contreras, R. Price, Toward transformative climate justice: An emerging research agenda, in: WIREs Climate Change Vol. 12, Issue 6, Wiley, 2021, https://doi.org/10.1002/wcc.733.
[16] K. Jenkins, D. McCauley, R. Heffron, H. Stephan, R. Rehner, Energy justice: a conceptual review, in: Energy Research & Social Science Vol. 11, Elsevier BV, 2016, pp. 174–182, https://doi.org/10.1016/j.erss.2015.10.004.
[17] B.K. Sovacool, M. Burke, L. Baker, C.K. Kotikalapudi, H. Wlokas, New frontiers and conceptual frameworks for energy justice, in: Energy Policy Vol. 105, Elsevier BV, 2017, pp. 677–691, https://doi.org/10.1016/j.enpol.2017.03.005.
[18] K.J. Dillman, J. Heinonen, A 'just' hydrogen economy: a normative energy justice assessment of the hydrogen economy, in: Renewable and Sustainable Energy Reviews Vol. 167, Elsevier BV, 2022 112648, https://doi.org/10.1016/j.rser.2022.112648.
[19] M.G. Bastos Lima, Just transition towards a bioeconomy: four dimensions in Brazil, India and Indonesia, in: Forest Policy and Economics Vol. 136, Elsevier BV, 2022 102684, https://doi.org/10.1016/j.forpol.2021.102684.
[20] Z. Robaey, L. Asveld, K.M. Sinha, E. Wubben, P. Osseweijer, Identifying practices of inclusive biobased value chains: lessons from corn stover in Iowa, sugar cane in Jamaica, and sugar beet in the Netherlands, in: Cleaner and Circular Bioeconomy Vol. 3, Elsevier BV, 2022 100032, https://doi.org/10.1016/j.clcb.2022.100032.
[21] J. Gupta, L. Lebel, Access and allocation in earth system governance: Lessons learnt in the context of the sustainable development goals, in: International Environmental Agreements: Politics, Law and Economics Vol. 20, Issue 2, Springer Science and Business Media LLC, 2020, pp. 393–410, https://doi.org/10.1007/s10784-020-09486-4.
[22] P. Velasco-Herrejon, T. Bauwens, Energy justice from the bottom up: a capability approach to community acceptance of wind energy in Mexico, in: Energy Research & Social Science Vol. 70, Elsevier BV, 2020 101711, https://doi.org/10.1016/j.erss.2020.101711.
[23] O. Battaïa, R. Guillaume, Z. Krug, R. Oloruntoba, Environmental and social equity in network design of sustainable closed-loop supply chains, in: International Journal of Production Economics Vol. 264, Elsevier BV, 2023 108981, https://doi.org/10.1016/j.ijpe.2023.108981.
[24] M.A. Ros-Tonen, V. Bitzer, A. Laven, D. Ollivier de Leth, Y. Van Leynseele, A. Vos, Conceptualizing inclusiveness of smallholder value chain integration, in: Current Opinion in Environmental Sustainability Vol. 41, Elsevier BV, 2019, pp. 10–17, https://doi.org/10.1016/j.cosust.2019.08.006.
[25] M.M. Lundy, A. Amrein, J.J. Hurtado Bermudez, G. Becx, N. Zamierowski, F. Rodríguez, E.E. Mosquera Echeverry, LINK Methodology: A Participatory Guide to Business Models that Link Smallholders to Markets. Version 2.0, 2014.
[26] A. Devaux, M. Torero, J. Donovan, D. Horton, Agricultural innovation and inclusive value-chain development: a review, in: Journal of Agribusiness in Developing and Emerging Economies Vol. 8, Issue 1, Emerald, 2018, pp. 99–123, https://doi.org/10.1108/jadee-06-2017-0065.
[27] M. Backhouse, K. Lorenzen, Knowledge production and land relations in the bioeconomy. a case study on the Brazilian sugar-bioenergy sector, in: Sustainability Vol. 13, Issue 8, MDPI AG, 2021, p. 4525, https://doi.org/10.3390/su13084525.
[28] IMO (International Maritime Organization), Low carbon shipping and air pollution control, Retrieved from: http://www.imo.org/en/MediaCentre/HotTopics/GHG/Pages/default.aspx, 2018.
[29] A. Mink, Design for 'Well-being: An Approach for Understanding Users' Lives in Design for Development, 2016.
[30] M. Steen, Organizing design-for-wellbeing projects: using the capability approach, in: Design–Issues Vol. 32, Issue 4, MIT Press - Journals, 2016, pp. 4–15, https://doi.org/10.1162/desi_a_00412.
[31] M.C. Nussbaum, Capabilities, entitlements, rights: Supplementation and critique, Journal of Human Development and Capabilities 12 (1) (2011) 23–37.
[32] E.G. Guba, Y.S. Lincoln, Competing paradigms in qualitative research, Handbook of qualitative research 2 (163–194) (1994) 105.
[33] J.A. La Cal Herrera, Estrategias para la transformacion de las industrias del sector oleicola. Almazaras y extractoreas de aceite de orujo en bioindustrias, 2020.
[34] DAS, State and Trends of the Namibian Bush Biomass Sector 2019, 2019 (Based on an inclusive survey in line with the DAS indicator framework. De-bushing advisory service).
[35] R. Chowdhury, S.D. Sarasvathy, R.E. Freeman, Toward a theory of marginalized stakeholder-centric entrepreneurship, in: Business Ethics Quarterly Vol. 34, Issue 1, Cambridge University Press (CUP), 2023, pp. 1–34, https://doi.org/10.1017/beq.2022.29.