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Abstract

Values have been recognized as critical leverage points for sustainability transformations. However, there is limited evidence unpacking which types of values are associated with specific types of sustainable and unsustainable futures, as described by future scenarios and other types of futures-related works. This paper builds on a review of 460 future scenarios, visions and other types of futures-related works in the IPBES Values Assessment, synthesising evidence from academia, private sector, governmental and non-governmental strategies, science-policy reports and arts-based

evidence, to identify the types of values of nature that underlie different archetypes of the future. The results demonstrate that futures related to dystopian scenario archetypes such as Regional Competition, Inequality and Breakdown are mostly underpinned by deeply individualistic and materialistic values. In contrast, futures with more sustainable and just outcomes, such as Global Sustainable Development and Regional Sustainability, tend to be underpinned by a more balanced combination of plural values of nature, with a dominant focus on nature's contribution to societal (as opposed to individual) aspects of wellbeing. Furthermore, the paper identifies research gaps and illustrates the key importance of acknowledging not only people's specific values directly related to nature, such as instrumental, intrinsic and relational human-nature values and relationships, but also broad values and worldviews that affect the interactions between nature and society, with resulting impacts on NCPs and opportunities for a good quality of life.

Keywords

future scenarios and visions, sustainability and transformation pathways, multiple and plural values of nature, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), equity, human-nature relationships

Introduction

With pressing social and environmental challenges across local to global scales, there is a need to urgently shift human development towards more sustainable and just trajectories [1]. In this context, achieving social-ecological transformations (i.e. fundamental shifts in human-environmental relationships [2]) relies on people's decisions and actions, which in turn depend on their different motivations, including values¹ [3–5].

Assessments by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) indicate that different types of futures, spanning from just and sustainable ones to those burdened by social and environmental challenges and inequalities, may be underpinned by different combinations of values motivating the decisions and actions of the imaginary actors included in the scenarios² and other types of futures-related works [6,7]. In spite of previous research interest in the role of values in scenario-development processes within the field of futures studies [8–11], the exploration of related findings in the context of current sustainability science has been only fragmentary, and the role of values in shaping different futures remains understudied (cf. e.g. [6]). Furthermore, there is increasing interest in understanding the role that values can play in transformations to sustainability [12]. To address these issues, the IPBES Values Assessment conducted a comprehensive structured review of the role of values in over 460 scenarios and other types of futures-related works ([13–15]; Supplementary Material). Since IPBES focuses primarily on socioecological dynamics related to the state of nature (including ecosystems and biodiversity) and nature's contributions to people (including ecosystem services) [16], the focus of this review was on people's values that are generally related to nature.

This work builds on the IPBES structured review and presents a synthesis of the combinations of values that underlie different types of scenarios, based on evidence from academia, private sector, governmental and non-governmental strategies, science-policy reports and arts-based evidence. With

¹ In this study, we understand values as a general term to describe “what is important to people and why” [74], incl. life “goals, beliefs and general guiding principles” as well as “judgements or measurements of the importance of specific things in particular situations and contexts” [23,24]. ² For the purpose of this study, we define scenarios broadly as qualitative or quantitative descriptions of potential future development, including both its environmental and social dimensions [88,89]. Hereafter, the manuscript refers to scenarios in this broad sense, including multiple types of futuresrelated works such as future visions and pathways [90].

implications for both policy and research, we highlight which types of values co-occur in futures that are normatively described as desirable or undesirable by their authors, while also reflecting on gaps for future exploration.

What role do values play in future scenarios?

Values of nature, held by the envisioned people, groups and societies acting within co-developed futures and scenarios, play a crucial role, as they shape the dynamics of the imagined futures in several ways [17]. Importantly, in this review we focus on the values held by imaginary actors within future scenarios; reflecting on the values implicitly imprinted into scenarios by people taking part in their development (researchers, experts, public sector representatives, etc.) arguably requires a different set of methods and is thus beyond the scope of this study [18].

First, values held by different scenario actors underlie what aspects of the current world these actors find desirable or undesirable. Thus, values can impact decisions across scales, from individual decisions and behaviours to the functioning and goals of society and the larger social-ecological system [19].

This, in turn, influences the decisions and actions people take, driving the directions in which future pathways unfold [20]. For instance, actors who place high value on material abundance and comfort may prefer consumption-oriented lifestyles, potentially triggering future pathways with greater environmental sustainability- or justice-related challenges [21]. Second, actors in different contexts as well as across spatial, temporal and political scales, hold different values shaping their vision of what the world should look like in the future [22]. These values, with associated relational dynamics and inherent power asymmetries, can influence the type of future outcomes that they consider desirable and thus worth pursuing. For instance, some actors may value individual freedom and prioritise steering their world to a state where individuals do not feel responsible for others, while other actors may value collaboration and reciprocity, and seek to steer the world towards a state where people feel collective responsibility for each other, with implications for societal and environmental governance [23].

A number of frameworks have been developed to unpack different types of values, from more categorical to more holistic ones [23–29]. In this respect, to better understand the role of plural values in future scenarios, we adopted the value approach gradually developed within IPBES [24,30] and applied two perspectives: first, the perspective of *value foci*, which shows whether nature is valued for itself (e.g. in the case of species protection), for its role in the provision of nature's contributions to people (e.g. material, non-material and regulating), or for supporting different aspects of human good quality of life (understood in IPBES as a context-dependent, non-prescriptive set of qualities related to individual, societal or cultural well-being [16,30,31]; Figure 1). Second, we embraced the perspective of *value justification*, which elucidates whether actors value nature for its own inherent worth (intrinsic values of nature), for its function in achieving desired outcomes (instrumental values of nature) or for its unique human-nature interactions (relational values of nature) [30]. These two perspectives are related but distinct; for instance, value focus on nature itself may be justified by intrinsic, instrumental and relational values, or their combination. A complementary IPBES-related perspective on values distinguishes between *broad values* as held, first-order preferences transcending contexts and guiding people's evaluation of events (also referred to as core values [12,32]), and *specific values*, as assigned, second-order preferences relating to the worth or importance of a particular object, or state of the world (also referred to as contextual values [12,33]) [24,29,34,35]. In this study, we draw upon this perspective in the discussion part below.

Although numerous social-ecological scenarios exist at different scales and encompass various geographic contexts, they tend to adhere to a small number of general storylines and assumptions, often referred to as scenario families or *archetypes* [7,36,37]). The main purpose of scenario archetypes is to amalgamate the variety of available scenarios into a smaller number of scenario narratives that illustrate the most important differences in how future pathways may unfold [38]. IPBES science-policy assessments build on several seminal scenario archetype classifications and apply these deductively to categorize reviewed futures works [7,39]; for the purpose of this review, in order to comply with the IPBES context, we have used the scenario archetypes formulated by the IPBES Regional Assessment for Europe and Central Asia, namely the archetypes of Business as Usual, Economic Optimism, Regional

Competition, Inequality, Breakdown, Regional Sustainability and Global Sustainable Development (see the Supplementary Material and [6,36] for detailed characteristics of the archetypes). Categorizing reviewed scenarios into scenario archetypes has demonstrated benefits in terms of conciseness and synthetic power; however, it is important to note that this approach may partly conceal the nuance and level of detail incorporated in the original scenarios [7].

Which combinations of values underpin different futures?

Our structured review identified a pattern of value combinations in the evidence provided by available future scenarios (Figure 1), illustrating what combinations of value justifications and foci may underlie different pathways and lead to different futures [13] (see Supplementary Material section A – Review Methodology). The following summary highlights that the focus of most of the reviewed scenarios was primarily on specific values related to nature, their focus and justification, rather than broad values (of nature and beyond), which represents one of the key points further discussed below.

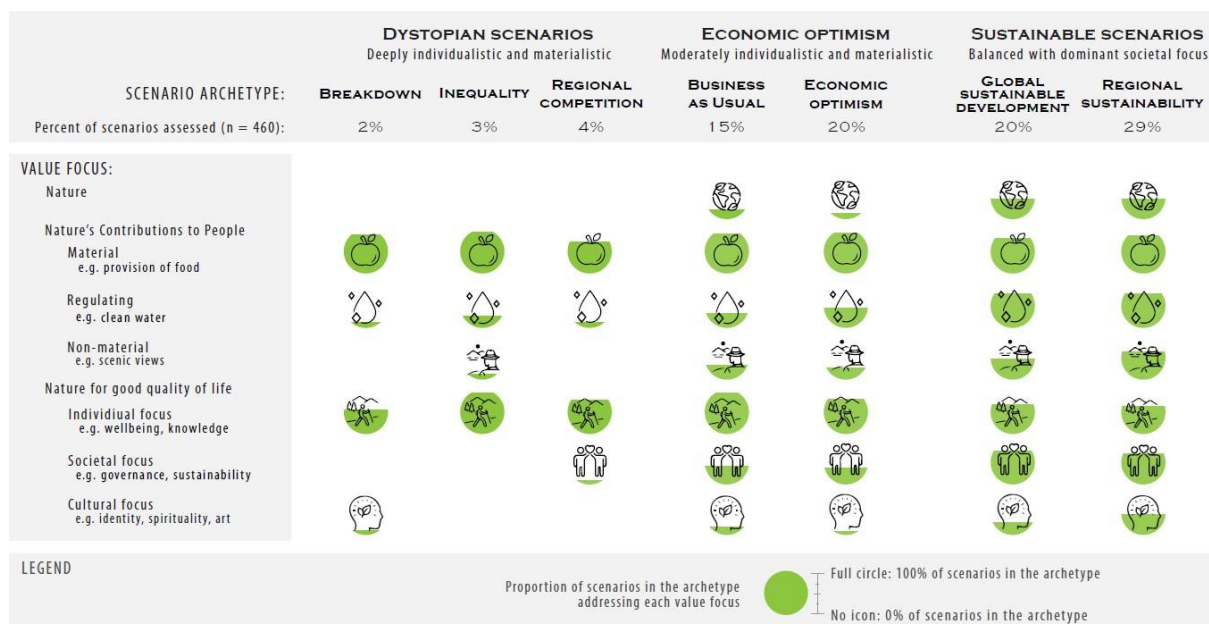


Figure 1: Value foci by scenario archetype. Each type of a value focus is rendered by a different icon. The proportions of reviewed future scenarios addressing different focal values related to nature, nature's contributions to people and good quality of life are symbolized by proportional shading of the circle underlying each icon (see legend). Global Sustainable Development and Regional Sustainability are characterized by a larger value plurality compared to the other scenario archetypes. (Figure based on the IPBES Values Assessment, [14]; see the Supplementary Material for the underlying data).

1. Values in dystopian scenario archetypes

The first group of scenarios characterised by similar value patterns are scenarios often normatively described as dystopian by their authors. These scenarios generally fall into three archetypes: "Regional Competition", "Inequality" and "Breakdown". In general, such scenarios depict a world in which inequalities in wealth, power, and knowledge increase both between and within countries. They assume a deterioration of societal bonds, whether between elites and the masses, within international bodies and countries, or communities and individuals. These scenarios typically suggest negative impacts on nature and the environment due to loosening regulation, dysfunctional governance or increasing exploitative use of natural resources stemming from people's full dependence on local resource base resulting from conflicts and growing barriers to trade [36,40,41].

The underlying values in the dystopian scenario archetypes tend to be a combination of deeply individualistic and materialistic instrumental values. The actors whose values are implemented in these scenarios are generally driven by the preference for individual aspects of good quality of life, including

individual wealth, individual access to healthcare and education and individual livelihood security, which may be interpreted as a reaction to the harsh conditions of the dystopian scenarios combined with the lack of societal structures supporting solidarity and collaboration [42]. It is crucial to note that actors and societies in these scenarios tend to strongly favour individual solutions over collective ones; at the same time, scenarios rarely provide insights into the envisioned power dynamics among scenario actors and their implications for whose values get to be enacted. From the perspective of a value focus, these scenarios assume a preference for material benefits from both nature (in the form of material nature's contributions to people) and anthropogenic assets, over non-material benefits [43].

2. Values in economic optimism archetypes

The second group of scenarios resemble the continuation of current trends in various ways, particularly with regards to relying on technological solutions to environmental challenges and reactive policies to tackle sustainability crises. These scenarios fall into the "Business as Usual" and "Economic Optimism" archetypes, where dominant assumptions are that economic growth will remain a strong driver of future development, and challenges resulting from the use of fossil fuels, environmental pollution and degradation, and public health deterioration will be tackled by rapid adoption of technological developments. Similarly to the previous group, these scenarios are rooted in individualistic and materialistic instrumental values [44]. However, an important difference to the previous group lies in the presence (be it weak) of additional types of value foci (e.g. appreciating regulating and nonmaterial contributions of nature such as clean water or scenic views), leading to a more diverse mix of underlying values compared to the first group of scenarios [45]. Still, available modelling studies highlight potential negative consequences of these scenarios particularly on the state of nature, including ecosystems and biodiversity [6,46].

3. Values in sustainability scenario archetypes

The final group of scenarios includes pathways leading to a future world that is more sustainable and just compared to current trajectories, according to the respective authors of the reviewed scenarios. These scenarios can be classified into two archetypes: "Global Sustainable Development" and "Regional Sustainability", both of which assume the achievement of sustainable and just futures but they differ in the pathways to reach associated sustainability and justice goals. The "Global Sustainable Development" archetype includes relying on international cooperation, strong governance and highlevel dedication to address global sustainability challenges, while "Regional Sustainability" scenarios assume a transformation towards sustainability through less material- and energy-intensive lifestyles, a shift in values towards non-material, convivial aspects of life such as good relationships, and a strong turn to more localised governance.

The "Global sustainable development" and "Regional sustainability" archetypes share a common feature with the previous scenario groups, which is a strong representation of values for material nature's contributions to people. However, unlike the previous scenario groups, these archetypes also strongly value regulating contributions (e.g. regulation of climate, erosion or water quality and quantity) and non-material contributions (e.g. nature-based recreation or inspiration).

One of the key characteristics of both of the sustainability archetypes is their emphasis on the contribution of nature to societal aspects of good quality of life, such as sustainability and resilience, cultural diversity, distributional justice and equity [30,47–50]. In addition, they highlight values for nature's contribution to cultural aspects of good quality of life, such as sense of place and community, historical values, stewardship, interactions between people and nature (in some cases seeing humans as inseparable to nature, or humans as nature), and artistic and spiritual inspiration, which sets this group of scenarios apart from the rest of the reviewed scenarios.

The scenarios in both of the sustainability archetypes reflect a greater plurality of values than the previous two scenario groups. This plurality occurs not only in terms of the focus of the values, but also in terms of higher representation of intrinsic and relational values, particularly in the case of the "Regional sustainability" scenarios. This highlights a significant difference between the scenarios

reaching sustainable and just outcomes, the dystopian scenarios and the business-as-usual and economic optimism scenarios.

Remaining gaps and directions for future research

The structured review points to several significant gaps that hinder our current understanding of the role of values in future development.

Developed futures-related works (including scenarios, visions, etc.) tend not to explicitly unpack the values motivating the decisions and actions of the imaginary people, groups and societies acting within the scenarios [6,14]. While futures-related works often include an economic, biophysical or sociocultural valuation of their outcomes (e.g. economic value of a potential future landscape resulting from a certain decision-making pathway, its biophysical function or aesthetic appreciation) [51], this type of analysis should not be confused with the underlying values that guide actors' behaviour in scenarios. Although initial work has developed frameworks facilitating the explicit articulation of values in scenarios (such as the Nature Futures Framework [52] or the Life Framework of Values [53]), further research needs to focus on both understanding the causal connection between actors' values and actions (e.g. the value-action gap) in future scenarios [54], and identifying methods that coherently connect actors' values, actions and their impacts on sustainability and justice outcomes [55]. To this end, there is the need for sustainability research to embrace the full potential of approaches facilitating these connections, e.g. by building on the long-term engagement of futures studies in issues related to values [10,18] through techniques such as causal layered analysis [56], artistic research methods and serious games [57–61], as well as futures studies' discussions on imaginaries and world views [11]. Further exploration and reflection of these approaches can help us better understand why top-down scenario assessments and processes tend to feed to decision-making processes more often than games-based and learning-based approaches despite the call for their more widespread use [57].

The available evidence indicates a clear skew towards designing scenarios assuming sustainable development, business-as-usual or economic optimism trajectories among the current research and practitioner communities. Scenarios depicting a dystopian future characterised by societal fragmentation along political, cultural, wealth or access axes have been notably underrepresented in the review, as the identified futures works tended to focus rather on business-as-usual types of futures, or futures closer to the Economic Optimism or sustainability archetypes. This limitation hinders the ability to reflect on the role of values that may underlie undesirable future development in which sustainability and justice goals are not met. Although some recent studies suggest a potential increase in the use of dystopian scenarios in research [62], they remain scarce in both peer-reviewed and grey literature, and remain more represented in other sources of future visions such as speculative fiction and science-fiction [63].

Most future scenarios tend to aggregate across different types of imaginary future societal actors featuring in the scenarios, without providing a nuanced understanding of whose values are prioritised and put into action, and whose values are neglected and how (i.e. via processes of the exertion of power and privilege) [64]. As a result, potential trade-offs between different interest groups or societal groups, and the implications for their types of livelihoods and opportunities remain unclear. This is further related to the general absence of explicit consideration of justice and equity issues in future scenarios across peer-reviewed and grey literature, including even implicit dimensions of distributional, procedural and recognitional aspects [65–67].

The reviewed scenarios generally explicitly or implicitly ascribe different value types and their combinations to actors, without reflecting on the role of institutions and governance systems in shaping values dominant in each of the futures, i.e. which values are favoured and supported by the institutions and societies and thus more likely to be displayed or expressed by actors in the imaginary future societies [68–70]. Consequently, typical scenario exercises commonly fail to identify the specific actors responsible for the actions assumed within the scenario and that decisions are not made within socio-political vacuums devoid of power asymmetries [71,72]. In this respect, futuring techniques such as future personas may present a suitable tool to tease out values of people, groups and societies acting within future scenarios [73]. In this respect, it is vital to acknowledge that the value portfolios of

different types of imaginary scenario actors, whether aggregated or nuanced across different actor groups, are shaped by the projections of value patterns dominant in scenario co-developing groups and the scenario field as such, including its internal power dynamics [72].

Finally, the review illustrated that if our societies aspire to achieving sustainable and just futures similar to those outlined in the Global Sustainable Development or Regional Sustainability archetypes, related decision pathways need to be nested in futures values grounded on societal and cultural aspects of good quality of life, potentially as opposed to individual ones. This highlights a significant concern that arises when scenarios prioritise solely the focus on specific values (e.g. those associated specifically with nature), rather than considering the deeper level of broad values [74,75]. Such scenarios may overlook the pivotal role of broad values that are not directly linked to our relationship with nature, but which may have a closer connection to the underlying motivations that shape our interactions with nature, both individually and collectively.

These gaps emphasise the need for greater attention to the plural engagement of actors and knowledge-holders in scenario co-development and other futuring processes [76] in order to leverage different types of experience and knowledge (including formal and informal knowledge, local and generalizable knowledge, novice and expert knowledge, traditional, experiential, scientific and indigenous knowledge) [77]. Scenario developers further need to consider whether the dominant representation of instrumental values is due to the prevailing methods used for scenario codevelopment processes, and find ways to shift the focus from instrumental values to a more nuanced representation of plural values [78–80]. This highlights the need to address the power dimensions of which and whose values shape the development of imagined futures, as these futures have the potential to become socially performative through guiding policy-making, or occupying places in social imaginations [81]. As such, the continued representation of the dominance of instrumental values as opposed to more pluralistic representation of values in future scenarios may prevent our collective abilities to design and choose pathways towards more sustainable and just futures, including failing to identify the need to disrupt the dominance of sustainability non-aligned types of values [82–84].

This review finds that those who construct future scenarios and other types of futures-related works tend to agree that values need to be diversified and balanced to achieve transformations to sustainability. However, research into how to intervene to shift the balance of values remains in its infancy [83,85]. Whilst the primary proposal of the IPBES Values Assessment is to incorporate greater diversity of values, there is an important complementary question about how people balance this diversity: which values do we want more of and which we need less of? [83]

Conclusions

Collectively building a sustainable future that is just for all human and non-human actors requires a concerted and transformative effort. Values play a fundamental role in determining the general direction of our collective pathways, and understanding their role is crucial for developing policies and strategies for promoting a shift towards more just and sustainable trajectories. The gaps identified by this review highlight that even scenarios primarily focusing on sustaining nature and its contributions to people urgently need to pay attention, not only to specific values of nature, but also to the broad values of different actors [86]. Such broad values influence actors' preferences towards different modes of societal functioning. These include responsibility for others versus responsibility for self, or level of individualism versus preference for collective solutions, which may have deeper influence on sustainability- and justice-related outcomes than values related to nature itself. Co-developing such knowledge requires plural ways of engagement between scientists and stakeholders and paying higher attention to causal links between actors' values, decisions, actions and outcomes in scenarios and futures-related works in general [87].

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Title

The role of values in future scenarios: What types of values underpin (un)sustainable and (un)just futures?

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Abstract

Values have been recognized as critical leverage points for sustainability transformations. However, there is limited evidence unpacking which types of values are associated with specific types of sustainable and unsustainable futures, as described by future scenarios and other types of futures-related works. This paper builds on a review of 460 future scenarios, visions and other types of futures-related works in the IPBES Values Assessment, synthesising evidence from academia, private sector, governmental and non-governmental strategies, science-policy reports and arts-based evidence, to identify the types of values of nature that underlie different archetypes of the future. The results demonstrate that futures related to dystopian scenario archetypes such as Regional Competition, Inequality and Breakdown are mostly underpinned by deeply individualistic and materialistic values. In contrast, futures with more sustainable and just outcomes, such as Global Sustainable Development and Regional Sustainability, tend to be underpinned by a more balanced combination of plural values of nature, with a dominant focus on nature's contribution to societal (as opposed to individual) aspects of wellbeing. Furthermore, the paper identifies research gaps and illustrates the key importance of acknowledging not only people's specific values directly related to nature, such as instrumental, intrinsic and relational human-nature values and relationships, but also broad values and worldviews that affect the interactions between nature and society, with resulting impacts on NCPs and opportunities for a good quality of life.

Keywords

future scenarios and visions, sustainability and transformation pathways, multiple and plural values of nature, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), equity, human-nature relationships

Introduction

With pressing social and environmental challenges across local to global scales, there is a need to urgently shift human development towards more sustainable and just trajectories [1]. In this context, achieving social-ecological transformations (i.e. fundamental shifts in human-environmental relationships [2]) relies on people's decisions and actions, which in turn depend on their different motivations, including values¹ [3–5].

Assessments by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) indicate that different types of futures, spanning from just and sustainable ones to those burdened by social and environmental challenges and inequalities, may be underpinned by different combinations of values motivating the decisions and actions of the imaginary actors included in the scenarios² and other types of futures-related works [6,7]. In spite of previous research interest in the role of values in scenario-development processes within the field of futures studies [8–11], the exploration of related findings in the context of current sustainability science has been only fragmentary, and the role of values in shaping different futures remains understudied (cf. e.g. [6]). Furthermore, there is increasing interest in understanding the role that values can play in transformations to sustainability [12]. To address these issues, the IPBES Values Assessment conducted a comprehensive structured review of the role of values in over 460 scenarios and other types of futures-related works ([13–15]; Supplementary Material). Since IPBES focuses primarily on

¹ In this study, we understand values as a general term to describe “what is important to people and why” [74], incl. life “goals, beliefs and general guiding principles” as well as “judgements or measurements of the importance of specific things in particular situations and contexts” [23,24]. ² For the purpose of this study, we define scenarios broadly as qualitative or quantitative descriptions of potential future development, including both its environmental and social dimensions [88,89]. Hereafter, the manuscript refers to scenarios in this broad sense, including multiple types of futures-related works such as future visions and pathways [90].

socioecological dynamics related to the state of nature (including ecosystems and biodiversity) and nature's contributions to people (including ecosystem services) [16], the focus of this review was on people's values that are generally related to nature.

This work builds on the IPBES structured review and presents a synthesis of the combinations of values that underlie different types of scenarios, based on evidence from academia, private sector, governmental and non-governmental strategies, science-policy reports and arts-based evidence. With implications for both policy and research, we highlight which types of values co-occur in futures that are normatively described as desirable or undesirable by their authors, while also reflecting on gaps for future exploration.

What role do values play in future scenarios?

Values of nature, held by the envisioned people, groups and societies acting within co-developed futures and scenarios, play a crucial role, as they shape the dynamics of the imagined futures in several ways [17].

Importantly, in this review we focus on the values held by imaginary actors within future scenarios; reflecting on the values implicitly imprinted into scenarios by people taking part in their development (researchers, experts, public sector representatives, etc.) arguably requires a different set of methods and is thus beyond the scope of this study [18].

First, values held by different scenario actors underlie what aspects of the current world these actors find desirable or undesirable. Thus, values can impact decisions across scales, from individual decisions and behaviours to the functioning and goals of society and the larger social-ecological system [19].

This, in turn, influences the decisions and actions people take, driving the directions in which future pathways unfold [20]. For instance, actors who place high value on material abundance and comfort may prefer consumption-oriented lifestyles, potentially triggering future pathways with greater environmental sustainability- or justice-related challenges [21]. Second, actors in different contexts as well as across spatial, temporal and political scales, hold different values shaping their vision of what the world should look like in the future [22]. These values, with associated relational dynamics and inherent power asymmetries, can influence the type of future outcomes that they consider desirable and thus worth pursuing. For instance, some actors may value individual freedom and prioritise steering their world to a state where individuals do not feel responsible for others, while other actors may value collaboration and reciprocity, and seek to steer the world towards a state where people feel collective responsibility for each other, with implications for societal and environmental governance [23].

A number of frameworks have been developed to unpack different types of values, from more categorical to more holistic ones [23–29]. In this respect, to better understand the role of plural values in future scenarios, we adopted the value approach gradually developed within IPBES [24,30] and applied two perspectives: first, the perspective of *value foci*, which shows whether nature is valued for itself (e.g. in the case of species protection), for its role in the provision of nature's contributions to people (e.g. material, non-material and regulating), or for supporting different aspects of human good quality of life (understood in IPBES as a context-dependent, non-prescriptive set of qualities related to e.g. individual, societal or cultural well-being [16,30,31]; Figure 1). Second, we embraced the perspective of *value justification*, which elucidates whether actors value nature for its own inherent worth (intrinsic values of nature), for its function in achieving desired outcomes (instrumental values of nature) or for its unique human-nature interactions (relational values of nature) [30]. These two perspectives are related but distinct; for instance, value focus on nature itself may be justified by intrinsic, instrumental and relational values, or their combination. A complementary IPBES-related perspective on values distinguishes between *broad values* as held, first-order preferences transcending contexts and guiding people's evaluation of events (also referred to as core values [12,32]), and *specific values*, as assigned, second-order preferences relating to the worth or importance of a particular object, or state of the world (also referred to as contextual values [12,33]) [24,29,34,35]. In this study, we draw upon this perspective in the discussion part below.

Although numerous social-ecological scenarios exist at different scales and encompass various geographic contexts, they tend to adhere to a small number of general storylines and assumptions, often referred to as scenario families or *archetypes* [7,36,37]). The main purpose of scenario archetypes is to amalgamate the variety of available scenarios into a smaller number of scenario narratives that illustrate the most important differences in how future pathways may unfold [38]. IPBES science-policy assessments build on several seminal scenario archetype classifications and apply these deductively to categorize reviewed futures works [7,39]; for the purpose of this review, in order to comply with the IPBES context, we have used the scenario archetypes formulated by the IPBES Regional Assessment for Europe and Central Asia, namely the archetypes of Business as Usual, Economic Optimism, Regional Competition, Inequality, Breakdown, Regional Sustainability and Global Sustainable Development (see the Supplementary Material and [6,36] for detailed characteristics of the archetypes). Categorizing reviewed scenarios into scenario archetypes has demonstrated benefits in terms of conciseness and synthetic power; however, it is important to note that this approach may partly conceal the nuance and level of detail incorporated in the original scenarios [7].

Which combinations of values underpin different futures?

Our structured review identified a pattern of value combinations in the evidence provided by available future scenarios (Figure 1), illustrating what combinations of value justifications and foci may underlie different pathways and lead to different futures [13] (see Supplementary Material section A – Review Methodology). The following summary highlights that the focus of most of the reviewed scenarios was primarily on specific values related to nature, their focus and justification, rather than broad values (of nature and beyond), which represents one of the key points further discussed below.

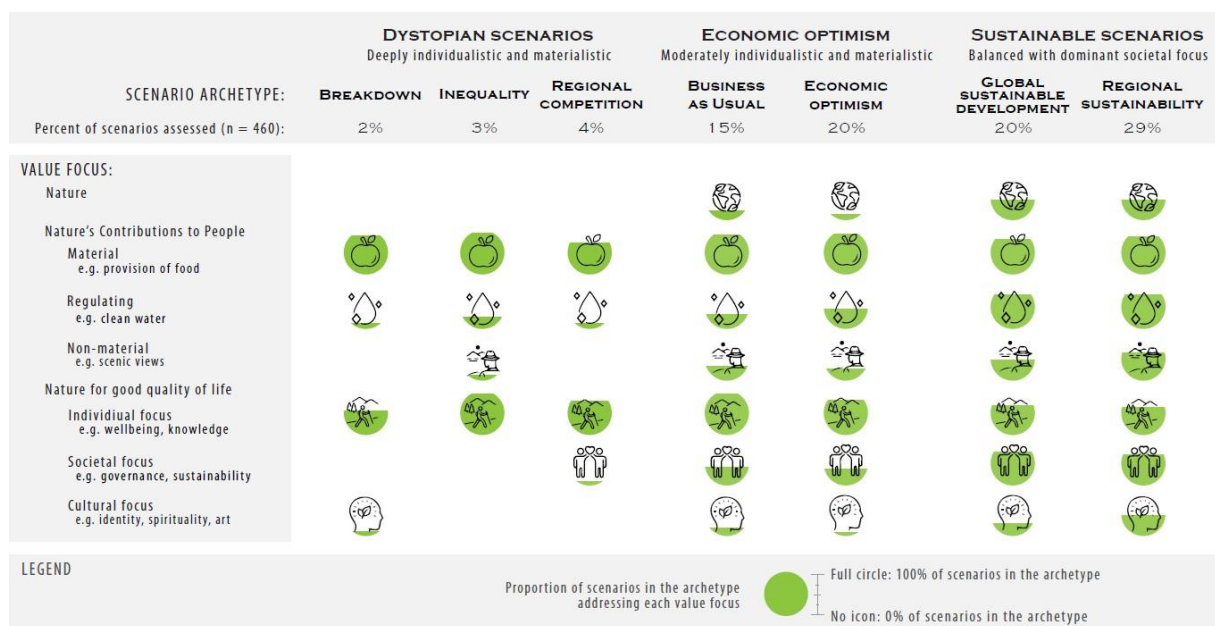


Figure 1: Value foci by scenario archetype. Each type of a value focus is rendered by a different icon. The proportions of reviewed future scenarios addressing different focal values related to nature, nature's contributions to people and good quality of life are symbolized by proportional shading of the circle underlying each icon (see legend). Global Sustainable Development and Regional Sustainability are characterized by a larger value plurality compared to the other scenario archetypes. (Figure based on the IPBES Values Assessment, [14]; see the Supplementary Material for the underlying data).

1. Values in dystopian scenario archetypes

The first group of scenarios characterised by similar value patterns are scenarios often normatively described as dystopian by their authors. These scenarios generally fall into three archetypes: "Regional Competition", "Inequality" and "Breakdown". In general, such scenarios depict a world in which

inequalities in wealth, power, and knowledge increase both between and within countries. They assume a deterioration of societal bonds, whether between elites and the masses, within international bodies and countries, or communities and individuals. These scenarios typically suggest negative impacts on nature and the environment due to loosening regulation, dysfunctional governance or increasing exploitative use of natural resources stemming from people's full dependence on local resource base resulting from conflicts and growing barriers to trade [36,40,41].

The underlying values in the dystopian scenario archetypes tend to be a combination of deeply individualistic and materialistic instrumental values. The actors whose values are implemented in these scenarios are generally driven by the preference for individual aspects of good quality of life, including individual wealth, individual access to healthcare and education and individual livelihood security, which may be interpreted as a reaction to the harsh conditions of the dystopian scenarios combined with the lack of societal structures supporting solidarity and collaboration [42]. It is crucial to note that actors and societies in these scenarios tend to strongly favour individual solutions over collective ones; at the same time, scenarios rarely provide insights into the envisioned power dynamics among scenario actors and their implications for whose values get to be enacted. From the perspective of a value focus, these scenarios assume a preference for material benefits from both nature (in the form of material nature's contributions to people) and anthropogenic assets, over non-material benefits [43].

2. Values in economic optimism archetypes

The second group of scenarios resemble the continuation of current trends in various ways, particularly with regards to relying on technological solutions to environmental challenges and reactive policies to tackle sustainability crises. These scenarios fall into the "Business as Usual" and "Economic Optimism" archetypes, where dominant assumptions are that economic growth will remain a strong driver of future development, and challenges resulting from the use of fossil fuels, environmental pollution and degradation, and public health deterioration will be tackled by rapid adoption of technological developments. Similarly to the previous group, these scenarios are rooted in individualistic and materialistic instrumental values [44]. However, an important difference to the previous group lies in the presence (be it weak) of additional types of value foci (e.g. appreciating regulating and nonmaterial contributions of nature such as clean water or scenic views), leading to a more diverse mix of underlying values compared to the first group of scenarios [45]. Still, available modelling studies highlight potential negative consequences of these scenarios particularly on the state of nature, including ecosystems and biodiversity [6,46].

3. Values in sustainability scenario archetypes

The final group of scenarios includes pathways leading to a future world that is more sustainable and just compared to current trajectories, according to the respective authors of the reviewed scenarios. These scenarios can be classified into two archetypes: "Global Sustainable Development" and "Regional Sustainability", both of which assume the achievement of sustainable and just futures but they differ in the pathways to reach associated sustainability and justice goals. The "Global Sustainable Development" archetype includes relying on international cooperation, strong governance and highlevel dedication to address global sustainability challenges, while "Regional Sustainability" scenarios assume a transformation towards sustainability through less material- and energy-intensive lifestyles, a shift in values towards non-material, convivial aspects of life such as good relationships, and a strong turn to more localised governance.

The "Global sustainable development" and "Regional sustainability" archetypes share a common feature with the previous scenario groups, which is a strong representation of values for material nature's contributions to people. However, unlike the previous scenario groups, these archetypes also strongly value regulating contributions (e.g. regulation of climate, erosion or water quality and quantity) and non-material contributions (e.g. nature-based recreation or inspiration).

One of the key characteristics of both of the sustainability archetypes is their emphasis on the contribution of nature to societal aspects of good quality of life, such as sustainability and resilience, cultural diversity, distributional justice and equity [30,47–50]. In addition, they highlight values for nature's contribution

to cultural aspects of good quality of life, such as sense of place and community, historical values, stewardship, interactions between people and nature (in some cases seeing humans as inseparable to nature, or humans as nature), and artistic and spiritual inspiration, which sets this group of scenarios apart from the rest of the reviewed scenarios.

The scenarios in both of the sustainability archetypes reflect a greater plurality of values than the previous two scenario groups. This plurality occurs not only in terms of the focus of the values, but also in terms of higher representation of intrinsic and relational values, particularly in the case of the “Regional sustainability” scenarios. This highlights a significant difference between the scenarios reaching sustainable and just outcomes, the dystopian scenarios and the business-as-usual and economic optimism scenarios.

Remaining gaps and directions for future research

The structured review points to several significant gaps that hinder our current understanding of the role of values in future development.

Developed futures-related works (including scenarios, visions, etc.) tend not to explicitly unpack the values motivating the decisions and actions of [the imaginary](#) people, groups and societies acting within the scenarios [6,14]. While futures-related works often include an economic, biophysical or sociocultural valuation of their outcomes (e.g. economic value of a potential future landscape resulting from a certain decision-making pathway, its biophysical function or aesthetic appreciation) [51], this type of analysis should not be confused with the underlying values that guide actors' behaviour in scenarios. Although initial work has developed frameworks facilitating the explicit articulation of values in scenarios (such as the Nature Futures Framework [52] or the Life Framework of Values [53]), [further research](#) needs to focus on both understanding the causal connection between actors' values and actions (e.g. the value-action gap) in future scenarios [54], and identifying methods that coherently connect actors' values, actions and their impacts on sustainability and justice outcomes [55]. To this end, [there is the need for sustainability research to embrace the full potential of approaches facilitating these connections, e.g. by building on the long-term engagement of futures studies in issues related to values \[10,18\] through techniques such as causal layered analysis \[56\], artistic research methods and serious games \[57–61\], as well as futures studies' discussions on imaginaries and world views \[11\]. Further exploration and reflection of these approaches can help us better understand why top-down scenario assessments and processes tend to feed to decision-making processes more often than games-based and learning-based approaches despite the call for their more widespread use \[57\].](#)

The available evidence indicates a clear [skew towards designing](#) scenarios assuming sustainable development, business-as-usual or economic optimism trajectories among the [current](#) research and practitioner communities. Scenarios depicting a dystopian future characterised by societal fragmentation along political, cultural, wealth or access axes have been notably underrepresented in the review, as the identified futures works tended to focus rather on business-as-usual types of futures, or futures closer to the Economic Optimism or sustainability archetypes. This limitation hinders the ability to reflect on the role of values that may underlie undesirable future development in which sustainability and justice goals are not met. Although some recent studies suggest a potential increase in the use of dystopian scenarios in research [62], they remain scarce in both peer-reviewed and grey literature, and remain more represented in other sources of future visions such as speculative fiction and science-fiction [63].

Most future scenarios tend to aggregate across different types of [imaginary future](#) societal actors [featuring in the scenarios](#), without providing a nuanced understanding of whose values are prioritised and put into action, and whose values are neglected and how (i.e. via processes of the exertion of power and privilege) [64]. As a result, potential trade-offs between different interest groups or societal groups, and the implications for their types of livelihoods and opportunities remain unclear. This is further related to the general absence of explicit consideration of justice and equity issues in future scenarios across peer-reviewed and grey literature, including even implicit dimensions of distributional, procedural and recognitional aspects [65–67].

The reviewed scenarios generally explicitly or implicitly ascribe different value types and their combinations to actors, without reflecting on the role of institutions and governance systems in shaping values dominant in each of the futures, i.e. which values are favoured and supported by the institutions and societies and thus more likely to be displayed or expressed by actors in the imaginary future societies [68–70]. Consequently, typical scenario exercises commonly fail to identify the specific actors responsible for the actions assumed within the scenario and that decisions are not made within socio-political vacuums devoid of power asymmetries [71,72]. In this respect, futuring techniques such as future personas may present a suitable tool to tease out values of people, groups and societies acting within future scenarios [73]. In this respect, it is vital to acknowledge that the value portfolios of different types of imaginary scenario actors, whether aggregated or nuanced across different actor groups, are shaped by the projections of value patterns dominant in scenario co-developing groups and the scenario field as such, including its internal power dynamics [72].

Finally, the review illustrated that if our societies aspire to achieving sustainable and just futures similar to those outlined in the Global Sustainable Development or Regional Sustainability archetypes, related decision pathways need to be nested in futures values grounded on societal and cultural aspects of good quality of life, potentially as opposed to individual ones. This highlights a significant concern that arises when scenarios prioritise solely the focus on specific values (e.g. those associated specifically with nature), rather than considering the deeper level of broad values [74,75]. Such scenarios may overlook the pivotal role of broad values that are not directly linked to our relationship with nature, but which may have a closer connection to the underlying motivations that shape our interactions with nature, both individually and collectively.

These gaps emphasise the need for greater attention to the plural engagement of actors and knowledge-holders in scenario co-development and other futuring processes [76] in order to leverage different types of experience and knowledge (including formal and informal knowledge, local and generalizable knowledge, novice and expert knowledge, traditional, experiential, scientific and indigenous knowledge) [77]. Scenario developers further need to consider whether the dominant representation of instrumental values is due to the prevailing methods used for scenario codevelopment processes, and find ways to shift the focus from instrumental values to a more nuanced representation of plural values [78–80]. This highlights the need to address the power dimensions of which and whose values shape the development of imagined futures, as these futures have the potential to become socially performative through guiding policy-making, or occupying places in social imaginations [81]. As such, the continued representation of the dominance of instrumental values as opposed to more pluralistic representation of values in future scenarios may prevent our collective abilities to design and choose pathways towards more sustainable and just futures, including failing to identify the need to disrupt the dominance of sustainability non-aligned types of values [82–84].

This review finds that those who construct future scenarios and other types of futures-related works tend to agree that values need to be diversified and balanced to achieve transformations to sustainability. However, research into how to intervene to shift the balance of values remains in its infancy [83,85]. Whilst the primary proposal of the IPBES Values Assessment is to incorporate greater diversity of values, there is an important complementary question about how people balance this diversity: which values do we want more of and which we need less of? [83]

Conclusions

Collectively building a sustainable future that is just for all human and non-human actors requires a concerted and transformative effort. Values play a fundamental role in determining the general direction of our collective pathways, and understanding their role is crucial for developing policies and strategies for promoting a shift towards more just and sustainable trajectories. The gaps identified by this review highlight that even scenarios primarily focusing on sustaining nature and its contributions to people urgently need to pay attention, not only to specific values of nature, but also to the broad values of different actors [86]. Such broad values influence actors' preferences towards different modes of societal functioning. These include responsibility for others versus responsibility for self, or level of

individualism versus preference for collective solutions, which may have deeper influence on sustainability- and justice-related outcomes than values related to nature itself. Co-developing such knowledge requires plural ways of engagement between scientists and stakeholders and paying higher attention to causal links between actors' values, decisions, actions and outcomes in scenarios and futures-related works in general [87].

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The study proposes connecting actors and scales, supporting network communities, innovating and fostering co-production processes as key fields of actions for sustainability-oriented research networks in order to leverage their role in enabling transformations towards sustainable and just futures. The study provides a heuristic for self-reflection, knowledge exchange and learning within and between the networks.

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The paper synthesizes literature to explore challenges for researchers involved in transdisciplinary knowledge co-production. It distinguishes researchers' role in generating knowledge, facilitating change and serving as intermediaries, and addresses challenges emerging in situations of combining these roles. The study provides a reflexive framework (including values) to assist researchers in transdisciplinary processes.

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DYSTOPIAN SCENARIOS
Deeply individualistic and materialistic

ECONOMIC OPTIMISM
Moderately individualistic and materialistic

SUSTAINABLE SCENARIOS
Balanced with dominant societal focus

SCENARIO ARCHETYPE:

BREAKDOWN

INEQUALITY

**REGIONAL
COMPETITION**

**BUSINESS
AS USUAL**

**ECONOMIC
OPTIMISM**

**GLOBAL
SUSTAINABLE
DEVELOPMENT**

**REGIONAL
SUSTAINABILITY**

Percent of scenarios assessed (n = 460):

2%

3%

4%

15%

20%

20%

29%

VALUE FOCUS:

Nature

Nature's Contributions to People

Material
e.g. provision of food

Regulating
e.g. clean water

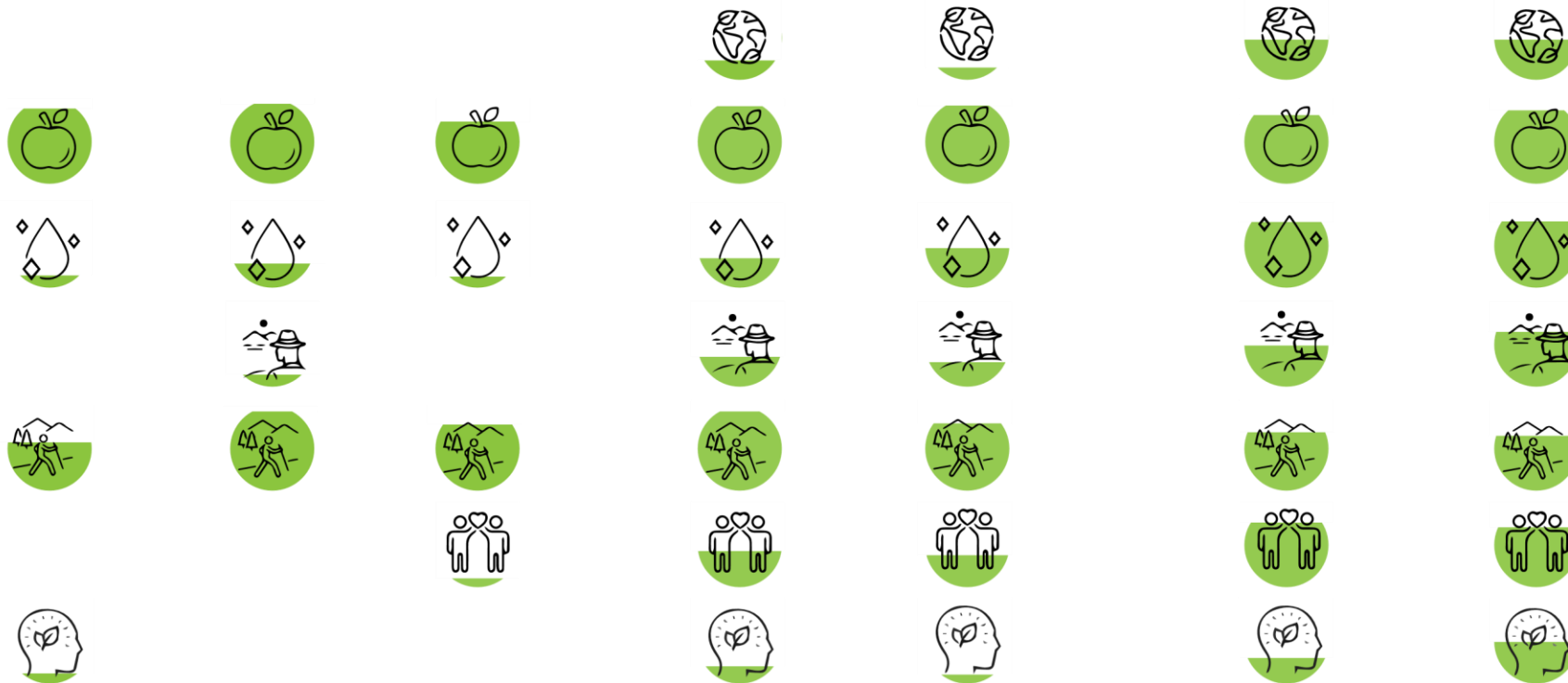
Non-material
e.g. scenic views

Nature for good quality of life

Individual focus
e.g. wellbeing, knowledge

Societal focus
e.g. governance, sustainability

Cultural focus
e.g. identity, spirituality, art



LEGEND

Proportion of scenarios in the archetype addressing each value focus



Full circle: 100% of scenarios in the archetype

No icon: 0% of scenarios in the archetype

Responses to reviewer comments

Reviewer 1:

This is an excellent synthesis of the extensive research into the complex and wide-ranging future scenarios through which sustainability transformations are being explored. The authors do a great job in making the point as to why they are looking at what types of values are at play in these in these scenarios.

[Many thanks for an extremely helpful review! We hope that addressing the comments helped us improve the manuscript.](#)

For me one of the key takeaways of the manuscript is that considering values in future scenarios like this, means we need to pay closer attention to how values are included and excluded in decision-making today, as this (unquestionably political) process may lead to more or less desirable futures. I was especially interested in the important messages around needing to build pathways that focus on the collective rather than then individual. There are a few suggestions here that might contribute to strengthening the key themes of the manuscript as I understood them.

[Thanks for the advice on how to strengthen these themes further in the manuscript!](#)

1. Emphasising role of power dynamics and institutions in shaping values in each scenariogrouping.

My main concern with the paper currently is that there could be further explanation of what it means for values to be at play in each of these groups of scenarios.

The assumption, thanks to the helpful footnote, no.1, on page 7 of the manuscript, is that these are values simply held by 'imaginary actors' in these future scenarios. However this feels quite vague and seems to treat people as a homogenous groups, leading to sentences in each section such as 'actors and societies in these scenarios tend to favour individual solutions over collective ones'. 'Actors and societies' here seems too broad a statement and too homogenising of people. The authors do address this concern in the next line, stating how 'at the same time, scenarios rarely provide insights into the envisioned power dynamics among scenario actors and their implications for whose values get to be enacted' (Line 44-7, pg. 9). I recognise that the authors also make this point more clearly in the discussions, stating 'Most future scenarios tend to aggregate across different types of societal actors, without providing a nuanced understanding of whose values are prioritised and put into action, and whose values are neglected and how (i.e. via processes of the exertion of power and privilege) [50]. As a result, potential trade-offs between different interest groups or societal groups, and the implications for their types of livelihoods and opportunities remain unclear'. While I think these are really important points and are central to the manuscript, it does lead me to question the worth of the approach of simply imagining 'actors and societies' values in future scenarios at all; it's as though these values simply exist in these scenarios and we are describing them as opposed to reflecting to some extent on how these values would likely have been shaped by power dynamics to arrive at this scenario.

[Many thanks for these reflections. We fully agree that such a treatment of values in most current scenarios is suboptimal and does not provide a nuanced enough insight into the](#)

disaggregated picture of value distribution across different types of imaginary future actors within the scenarios. At the same time, these are unfortunately exactly the types of scenarios that are available, and our paper aims to draw attention to the fact that such a disaggregation should pose a much needed next step in scenario formulation.

As our review has not directly studied the link between scenario co-developers' values and the values of "imaginary actors" within the scenarios, we are cautious about stepping a bit too far beyond the scope of the analysis that was done; however, we have elaborated on this point in the discussion, highlighting that the values within the scenarios reflect more general patterns of dominance within scenario co-development groups and the field, including related power dynamics.

Therefore in addition to the focus of the paper being only focused on imaginary future actors, as though a homogenous group in each future world/scenario, there could also be reference to the role of institutions and governance systems in shaping the dominant values that are envisioned in each of these futures. So for example, in the 'business as usual' or 'economic optimism' scenarios, based on these sections, rather than simply stating that 'materialistic' and 'individualistic values' are simply present, the framing would be that these are the values that are favoured and supported by the institutions and societies; thus these are the values that people would be likely to display, or express in society.

Thanks for highlighting this key point. In the first part of the paper, we would like to stay faithful to the way in which "imaginary actors" values were conceptualised in the reviewed scenarios; however, we have included this point in the discussion to highlight that the shaping of "imaginary actors" values in the scenarios would not happen in an institutional vacuum.

In that case there would be recognition of the power that institutions and governance systems have in shaping which values become more dominant in society thus leading towards these different groupings of future scenarios. So for instance a line such as, 'what combinations of value justifications and foci may underlie different pathways and lead to different futures' might include a focus on what combination of value justifications and foci both underlie but are also 'supported' and 'emphasised' in each of the different pathways. This additional framing and perspective through the manuscript might also add strength to the discussions, where there is a very welcome reference to the lack of explicit attention to justice and equity issues across the future-scenario research as well as the lack of focus on people bearing differentiated levels of responsibilities and power asymmetries.

Many thanks for highlighting these points. As mentioned above, we do acknowledge the importance of this issue and have strengthened the point in the discussion. At the same time, the reviewed scenarios do not generally describe the envisioned links between institutional context and the mechanisms of supporting or emphasising specific types of values. For that reason, we would like to highlight potential benefits of keeping the phrasing reflecting this in the first part of the manuscript, while recognizing this gap on the reflexive level in the later part of the manuscript.

On a related note, I wonder if in the discussion there could be reference to literature from Science and Technology Studies around the performativity of scenario-building work, again emphasising the need to focus on the power dynamics through political processes of understanding whose values are included and excluded in decision-making. For instance, the following paragraph beginning at line 52, pg. 11: 'These gaps emphasise the need for greater attention to the plural engagement of actors and knowledge-holders in scenario codevelopment and other futuring processes ... and find ways to shift the focus from instrumental values to a more nuanced representation of plural values [61-63].' I think these are very important points made here by the authors. So much so that I wonder if there could also be reference to the performativity of scenario-building research (for example - Oomen et

al., 2022). This would build on the points the authors seem to make in that scenario-building as a tool/method plays a key role in shaping the futures we may end up creating in society, especially if they are so influential in guiding policy, or in occupying places in our social imaginations (referring to the comment made by authors around fictional work focusing on dystopian scenarios). If so then a continued representation of the dominance of instrumental values as opposed to more pluralistic representation of values in future scenarios may prevent our collective abilities to design and choose pathways towards more sustainable and just futures. This line of thought also made me think of the notion of 'glass ceilings' that Hammond (2020) talks of in her work in identifying the role of deliberative democracy in facilitating cultural transformations in sustainability. This may also link the paper in well with themes from across other papers in the Special Issue too.

Many thanks for the guidance on how to emphasise this dimension - we have strengthened this point using the suggested references in this paragraph.

2. Making the different core and contextual values more explicit

Another point to add here is that while the clarifications on which types of values this manuscript focuses on is helpful (i.e. distinctions between 'value focus', and 'value justification') the use of core values and contextual values, feels slightly confused during the manuscript. While the distinction in lines 20-25 on page 8 is helpful, these points then seem to be a bit lost in the rest of the manuscript with there only being a fairly general line indicating towards what these values might be in each of the scenario groupings. More explicit attention to what the core and contextual values might be in each of the scenarios as well as perhaps examples of both core values and contextual values might help add depth to each of these sections.

The general skew of the reviewed scenarios towards focusing on specific values (of nature) rather than broad values is indeed one of the points the paper aims to highlight. We have now highlighted in the earlier part of the paper that the available scenarios generally focus on specific values rather than broad values and their pivotal role. In order to streamline the value terminology in the paper and clarify this point, as well as to keep the coherence with the Values Assessment, we have opted for keeping the terminology of specific and broad values, and adjusted the text accordingly.

Further to this, the core and contextual values could help make differences between sections a bit stronger. As a manuscript that builds on the structured review within IPBES' Values Assessment, the article does a good job of synthesising the important differences in combinations of values that emerge in each of the clusters of future scenarios. However at times these could be made clearer.

Many thanks for the comment and apologies for the confusion - we have now updated the text to highlight that the reviewed scenarios generally focused on specific values of nature, and the related focus and justification of these specific values. Broad values were generally beyond the scope of the scenarios, which we consider a key gap. The revised manuscript states this in the beginning of the results section and builds on this point in the discussion. In addition, as stated previously, we have opted for the Values Assessment terminology, referring to broad values (considered equivalent to core values) and specific values (considered equivalent to contextual values).

For instance, the distinction between the values in 'Dystopian scenarios' and the 'Economic optimism scenarios' feels slightly confusing at present and are hard to separate in the main body of the text. For instance, I am wondering why there seems to be a relatively high value focus on regulatory NCP in the 'Inequality' scenario, higher than say 'Business as Usual',

especially given that in the main body of the text, line 35-37, the authors state 'These scenarios typically suggest negative impacts on nature and the environment due to loosening regulation'. This left me wondering if there is something specific to the 'Inequality' scenario that is worth commenting on, i.e. there is a degree of importance conveyed around improving environmental quality and NCP yet only in certain places and with restricted, private access for certain groups within society? Outlining core and contextual values differences in each of these scenario groupings could be one way to make these differences more explicit.

Thanks for pointing this out - we have fixed an issue with rendering the proportions in the figure and provided the respective percentages of scenarios in which the different value foci featured in the Supplementary Material. This makes it more explicit that the proportion of scenarios in the "Inequality" archetype incorporating values of regulating NCPs is lower than the proportion of such scenarios in the "Business as Usual" archetype, which in turn explains potential negative impacts on nature and the environment in the Inequality archetype. Although the paper is constrained by its maximum length unfortunately, we have also included additional detail to the description of the value combinations under both of these groups of scenarios to highlight their differences.

Further minor comments:

Figure 1 - I wonder if the figure could be clearer if there are symbols in every box of the table even if that scenario does not support/address those value foci.

Thanks for the suggestions! We have strived for the figure to be able to quickly convey that some types of values were not represented at all in some of the scenario archetypes, and hope that the blanks are visually helpful to this end. We have tried to make this more understandable by adjusting the Legend of the figure and updating the caption.

Pg. 11 Line 4 - Hard to read and unclear what is meant in this line, perhaps needs revision - 'Although initial work has been focused on developing frameworks facilitating the explicit articulation of values in scenarios (such as the Nature Futures Framework [40] or the Life Framework of Values [41], both in terms of the values of more extensive research is needed.'

Corrected

Overall, I think this is a really important contribution to the Special Issue and to work coming out of the IPBES Values assessment. My comments here are simply to suggest that the article not only pays special attention to how values shape pathways towards different sustainability futures but to how they may also be shaped by these same pathways in turn.

Many thanks once again for the detailed guidance on how to improve the manuscript, it has been extremely helpful indeed!

References mentioned:

Hammond, M. (2020). Sustainability as a cultural transformation: The role of deliberative democracy. *Environmental Politics*, 29(1), 173-192.

Oomen, J., Hoffman, J., & Hajer, M. A. (2022). Techniques of futuring: On how imagined futures become socially performative. *European Journal of Social Theory*, 25(2), 252-270

Reviewer 2:

I found this a very nice synthesis, and have only minor comments on how to make it clearer.

Many thanks for the helpful comments - we hope that their addressing increased the clarity of the manuscript.

Abstract

-it would be nice if there was a specific reference to well known value types, namely instrumental, intrinsic and relational values of nature

Absolutely, we have added the reference to the abstract.

- a "dominant societal focus" is not clear in this context. Does it mean little care for nature? Only after reading the conclusion did I understand what you meant here.

Thanks, we have rephrased the sentence to more clearly refer to nature's contribution to the aspects of well-being concerning the society as a whole, as opposed to strictly individual wellbeing.

-the last 4 lines of the Abstract do not really have much content. Of course you identify research gaps, I would hope so! :) But what are they? It would be more useful if you could instead say something more tangible, in a simpler 1-2 concluding sentence.

We have rephrased the ending of the Abstract. We would like to ask whether the content of the last sentence could be retained, as it refers to a part of the conclusions that we deem key for the paper (the need for scenarios to pay more attention to broad values as opposed to strictly specific values of nature).

page 2 of main text (page numbers would have helped ...)

Apologies - we expected that the online submission system would provide page numbering, which we did not want to confuse with our own numbering. Sorry for the inconveniences!

... on whether people feel collective responsibility for each other. Yes that would be nice, but how is this example related to values of NATURE? It seems not such a good example because we may all care about each other, but not at all about the state of nature.

Thanks for highlighting this issue. In this section, we refer to the conceptualization of values in Chapter 2 of the Values Assessment, which relates broad values incl. responsibility and stewardship to how we relate to nature and govern it. We have clarified the phrasing and added the reference to the chapter to make the connection more explicit.

page 2: should this introduce the key concept "good quality of life", which is central to Fig 1 but does not really show up in the text?

Thanks - we have added a brief explanation and a reference to the IPBES conceptualization of good quality of life, which is in detail elaborated in Diaz et al. 2015, in the IPBES Preliminary guide on values and in the appendix to the Values Assessment Chapter 1, as the space that is available for the manuscript does not allow to go into an in-depth description of the concept.

bottom of page 2: you need to refer to fig 1 here Added

in fig 1 (I call this page 3 of the paper) you speak of nature for good quality of life and various sub-components. But those were not defined earlier.

Thanks! These are now cross-referenced with the sources listed above. in

fig 1, the legend is too small -- it is not legible when printed.

Thanks for pointing this out, we have enlarged the font.

on page 3, you speak of "barriers to trade and dependence on local resources" -- why would trade barriers necessarily be bad for sustainability? Why would reliance on local resources be bad? This seems not a good example.

Thanks - in this example, we are referring to the typical narratives of the "Regional Competition" type of scenarios, which assume that the quick regionalization resulting from the emergence of conflicts and cease in international trade would result in a sudden pressure on local natural resources. In combination with weak regulation in these scenarios, such dynamics often results in natural resource exploitation. We have updated the phrasing to clarify this point and added relevant references to the Regional Competition archetype and related scenarios.

top of page 4, on economic optimism: motivated by other types of values ... yes but which? spell out, like this it's not a very meaningful statement.

We have brought in additional examples of these value foci to illustrate the statement.

Note here that economic optimism basically sounds like a pretty good story!

We have highlighted the negative impacts of this group of scenarios particularly for nature, incl. ecosystems and biodiversity and included relevant IPBES citations. section 3, sustainability archetypes:

emphasis on the contribution of nature to societal aspects such as ... diversity, justice and equity. -- How would nature contribute to justice? This is conceptually a bit difficult to grasp for me. Again, it seems not entirely tidy in terms of its logic.

We follow here the IPBES conceptualization of nature's contribution to multiple aspects of good quality of life, in this particular case e.g. the contribution of nature to cultural diversity (e.g. in terms of nature-related cultural practices), and distributional justice and equity (e.g. in terms of access to nature's contributions). We have updated the phrasing accordingly and added reference to IPBES conceptualization.

top of page 5, starting with "should not be confused with the underlying ..." there's something wrong with the second sentence on this page, including its grammar and its brackets ("Although initial work has ...") **Corrected**

the point on whose values are implicated embodied in the scenarios on the middle of page 5 is good and very important

Thanks, we have elaborated the paragraph further to emphasise the point.

should there not be a link to universal human values somewhere, i.e Schwartz values? It is vital, I think, to recognise that individuals in different societies (i) do hold plural values, and (ii) some are oriented very directly towards sustainability (universalist values) **Included**

just before conclusion: which do we need more of and which less? Well - actually you already answered this, by implying we need less individualism. You may as well more boldly highlight what we need more of and what we need less of. Similarly, the notion of "plural values" is a bit empty -- it satisfies everyone but actually says nothing. We absolutely want less of some types of values, namely those opposed in Schwartz's wheel to universalism (power, individualism, etc). It would be worth highlighting this and being clear about it. Pluralism is a bit empty and a political cop-out.

Thanks for pointing this out, we totally resonate with potential tensions related to pluralism. While this tension between simple pluralism and a more selective rebalancing of values has never really been resolved in the VA process, there are additional planned papers trying to tackle this issue. Given the original scope of the analysis leading to the present paper and the space that we are allowed to take, we might not be able to go into a more nuanced discussion; however, we have updated the paragraph to recognise this tension and clarify that pluralism requires less (dominance) of some values.

Conclusion: I do not like the term "contextual values", you use it here and a couple of times before. It is not a self-explanatory term. I suggest you reword those instances.

Thanks! We have updated the terminology to "broad" and "specific" values to reflect the terminology of the Values Assessment.

These few minor, but hopefully not trivial, comments aside, I very much liked this paper!!

Thanks again for the extremely helpful comments!

Reviewer 3:

This paper reports on an interesting analysis of environmental scenarios that was done for an IPBES assessment. I think that this work merits publication, but it needs to be revised to better explain the analysis and results, as well as place the results in the larger context of work on scenarios and futures (particularly in the introduction and discussion of "gaps...").

Below I present three broad and related major issues that should be addressed as well as a series of specific minor issues.

I expect the authors will be able to easily address these points to create a clear and strong contribution to this special issue.

Many thanks for the kind reflection and for the helpful comments!

Major Issues

1) Figure 1 + explanation

Figure 1 is the key result of the paper, but it is not clearly presented nor well integrated with the text.

Right now the figure has two captions.

Thanks! Additional caption omitted.

If the figure is from an IPBES assessment it should be cited. The icons and shading should be explained. The caption should clearly explain the figure, including the icons and shading. How figure one was produced and where it comes from should be explained in the text and caption. The text should explain why the rows were selected should be clear in the text. I assume this is from the structure of the IPBES report but this is not clearly explained in the text or caption.

Figure 1 was developed specifically for this paper to make the assessment results more accessible to our readers (The same data is portrayed in Figure 5.10 in the IPBES Assessment).

The rows portray the seven value foci for which we evaluated future scenarios. For example, a scenario would be coded as having an individual focus regarding Nature's value for good quality of life if it valued the importance of nature for people's wellbeing. The columns stand for each of the scenario archetypes. The icons and coloured shading indicates the proportion of scenarios under the archetype that addressed each given value focus. For example, practically all Breakdown scenarios were underpinned by a focus on nature's material contributions to people. Blank spaces indicate that no scenario under the archetype addressed the value focus.

While the figure only portrays aggregate values under each archetype (and not e.g. how many value foci were addressed by each scenario), it gives some visual tangibility to the value plurality of each archetype (e.g. it is readily visible that the Sustainable Scenarios have more evenly shaded icons, while the Dystopian Scenarios have more blanks).

The dimensions in the rows are now clarified in the text, particularly with respect to good quality of life (incl. relevant citations of IPBES conceptual works).

Importantly, the text states that both types of sustainability scenarios emphasis contribution of nature to societal aspects of good quality of life, and cultural aspects. This is not evident in Figure 1. Only Regional sustainability looks substantial different for cultural, and societal also looks quite similar. Either the text should be revised or the figure should be redrawn to make these differences clearer.

We have now added Table S3 with the data underlying the Figure in the Supplementary Material, to clarify the differences between the proportions under each scenario archetype.

The text discusses value plurality, but the figure does not. Adding that to the figure would further align the figure and the text.

Thanks - reference to value plurality added.

The paper describes the mean values within archetypes, but it would also be good to know or have some reflection on the standard deviation around these means. Also, it would be useful to mention if the authors are aware of any particular assumptions of the scenario processes or the archetype analysis method that are producing these patterns? And in the paper's "Gaps .." section discuss how the analytical approach reported in this paper could be built upon.

We have now clarified the caption of the figure to highlight that the symbols render what proportion of the scenarios within each scenario archetype included a specific value focus, which was our reason to use frequencies expressed as percentages. We have also included a data table to the Supplementary Material to clarify the proportions of scenarios within each archetype.

Regarding the actual scenario archetype analysis, we absolutely agree that there is much to discuss, however, primarily for space constraints, we believe that this is beyond the scope of the manuscript, given that in this particular review, pre-existing scenario archetypes were used as a heuristic tool to categorise reviewed scenarios. However, we have included a citation of a study (Sitas et al.) discussing the pros and cons of scenario archetype approaches.

2) The paper needs to better link to the history and discussions in futures studies particularly in the introduction and the section "remaining issues". Values in scenarios and futures has been a long-term issue in discussions of the futures and futures practice, especially in terms of professional practice. However, most of the citations in the paper are very recent making it appear that awareness of these issues is very recent, when they have been discussed for decades. E.g.

Fowles, J. (1977). The problem of values in futures research. *Futures*, 9(4), 303-314.

Slaughter, Richard A. "Futures studies: From individual to social capacity." *Futures* 28, no. 8 (1996): 751-762.

Slaughter, R. A. (1999). Professional standards in futures work. *Futures*, 31(8), 835-851.

Masini, E. (2006). Rethinking futures studies. *Futures*, 38(10), 1158-1168.

Social scientists, and futurists, have also discussed values through discussions of imaginaries and world-views, and these discussions have strongly interacted with a lot of futures work. This has recently been complemented by discussions of decolonizing the future that have featured in a lot of work around Indigenous people and nature in countries such as Canada, Australia, and New Zealand. As well as much longer histories of global south futurism that have been on-going since at least the 1970s. (For a reflection on its impact see: Gallop, G. C. (2001). The Latin American world model (aka the Bariloche model): three decades ago. *Futures*, 33(1), 77-89.). This paper does not even mention these discussions or suggest why despite researchers arguing for more attention to diverse values, values remain relatively unexamined in scenarios. Furthermore, there are even fairly widely known, commonly taught, futures methods and frameworks to focus on values in scenarios, such as causal layered analysis, which are not mentioned or discussed. This is a short paper, but the introduction and discussion of the paper should briefly situate the work within broader discussions about values and the future, and recognize that these discussions have been occurring for a long while with many different voices and practices.

Many thanks for these valuable suggestions! The reason for not including some of these works in the original version of the manuscript was that the special issue author teams had been advised to focus primarily on current references from the past five years. However, we fully acknowledge that it is important to link to the fundamental literature from earlier on and have added the relevant references to the introduction and the discussion.

3) Introduction

The introduction should not just explain what the authors did but provide the reasons or justifications for why they did it that way. The paragraph on "what are values of nature" should explain and justify the definition used and place it in the context of other work. E.g. Why were the particular archetypes used, why were the particular values selected (rather than other ones). These explanations should be short, but help the reader interpret and understand the paper as part of a broader body of science. Many key terms (values, scenario, transformation, etc) are not defined. They should either be defined, or other papers that define the terms in the special feature.

Thanks for the guidance - we have expanded the definitions of these key terms in the introduction and the section "What role do values play in future scenarios" and provided references to other related papers defining these terms in the special feature.

Footnote 2 should be included in the main text as a key point, and it should be justified why this approach was taken.

Thanks for the recommendation - we have lifted the footnote to the main text. The reason for our focus on the values held by imaginary actors within future scenarios in this review stemmed from the scope of the study due to the division of work within the IPBES Values Assessment, in which the present author team was tasked with analysing the content of available scenarios (as opposed to the process through which values are implicitly imprinted into the scenarios by people taking part in their development, e.g. researchers, experts, public sector representatives).

Minor points

Page 7

Introduction:

On page 3, lines 35-36, it would be useful to have some more general references that discuss social support from nature. A review article on these would be good. It is not clear why these two specific references were chosen. For example, the Millennium Ecosystem Assessment had this in its conceptual framework, and its work on scenarios.

Apologies - due to the online submission system not providing page number, we are struggling to find which specific place in the manuscript this refers to (there seem to be more than one logical option) - we would be grateful for further guidance.

"role of values in shaping futures is understudied" this statement should be a bit more nuanced. Give a reference for this claim and make it more specific. There is a lot of work on values and futures, but not exactly what was done in this paper. (see major issues above)

Thanks, we have specified the statement and added additional nuance in the introduction and the discussion using the guidance above.

line 36: ref [11] - Why this reference. Seems a huge point should be expanded a bit and get some more influential references.

In the case of this special issue, we have been instructed to limit the number of less recent references - in this particular case, we have attempted to find a balance between recent yet seminal contributions. We would be grateful for further guidance in this direction.

page 8

line 4; I suggest make 3rd sentence first sentence of this paragraph, and then remove first sentence as trivial, and list frameworks in second sentence. Explain why these two perspectives were used vs. alternatives.

Thanks - we have omitted the first sentence and clarified the motivation to select these two perspectives (alignment with the gradual development of value perspectives within IPBES, to which this study relates).

lines 20-24 integrate paragraph this with the two points in the previous paragraph. This sentence does not explain that you used core and contextual values as part of your analysis. This should be made clear.

Done and addressed.

lines 26-32: Suggest start paragraph with explanation - that "the authors used scenarios archetypes to organize... diverse scenario". It would be good to mention in discussion of analysis what was lost (if anything) by organizing scenarios into archetypes.

Thanks - we have elaborated here on potential drawbacks of using scenario archetypes as an organising principle.

page 10

line 35; 36 - "highlight values for nature's contributions to cultural aspects..." would be good to have some more general references here - e.g. these values are broadly discussed in Millennium Ecosystem Assessment and its scenarios 20 years ago; review article on these would be good not clear why these two specific references are used here

Thanks, more general references added.

page 11

line 10 - link between decision making and games is old; goes back to 1950s cybernetics....; and even early environment modelling - e.g. Dennis Meadows spent lot of time after 'limits to growth' in 70s developing games (i.e. Systems Thinking Playbook & Fishbanks). It would be great if the authors include a bit more critical reflection here. Ie why despite decades of argumentation that games and learning approaches should be used more - assessments and top-down processes dominate.

Another recent synthesis paper on value of games for sustainability is:

Garcia, C. A. et al (2022). Strategy games to improve environmental policymaking. *Nature Sustainability*, 5(6), 464-471.

Thanks - we have elaborated on this point, incl. the need for deeper understanding of the skew towards opting for top-down scenario assessments and processes as opposed to game-based approaches, building on the references suggested.

line 12 - Please explain the argument here (or rewrite). Your analysis shows these scenarios exist, but doesn't show that this is the preference of the people who made them. If people are funded to do certain types of work, that is what they will do. That work is not necessarily their preference.

Thanks for pointing this out - rephrased to capture that this indeed may not be a matter of a preference.

line 27 - "Most future scenarios...." this is not analysed in paper. The point that scenarios or futures work privileges some perspectives (usually funders) is an old point in futures research - not something that was discovered by ref [50]. Please cite some of the older sources; and discuss what could be done to address this problem (e.g. explicit requirements to considering multiple value perspectives, having auditors to ensure that diverse perspectives are considered, or other approaches).

We have rephrased the point to clarify that what we mean here is the aggregation across different types of imaginary future societal actors featuring in the scenarios (as discussed earlier, we distinguish between this issue and the issue of aggregating across different actors *co-developing* the scenarios). Regarding the references, we would like to refer to our explanation above regarding the limits posed by the guidance on referencing in this special issue.


line 43 - "the review illustrated" - this is not clear from the text. How was this conclusion achieved? Please explain in more detail.

Thanks - we have rephrased the sentence to highlight that we refer back to the value representation within the sustainability archetypes (Global Sustainable Development, Regional Sustainability).


Page 12 line 9:

It would be good to use specific words, such as "the authors", "researchers", "IPBES," or "people" to be clear about who is being referred to. E.g., page 12 line 9.

Thanks - clarified by referring to people in general.



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Declaration of interests

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.

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